

IBM i  
7.2

*Programming  
IBM Toolbox for Java*

**IBM**

**Note**

Before using this information and the product it supports, read the information in [“Notices” on page 537.](#)

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# IBM Toolbox for Java

IBM® Toolbox for Java™ is a set of Java classes that allow you to use Java programs to access data on your system. You can use these classes to write client/server applications, applets, and servlets that work with data on your system. You can also run Java applications that use the IBM Toolbox for Java classes on the IBM i Java virtual machine (JVM).

IBM Toolbox for Java uses the IBM i [Host Servers](#) as access points to the system. Because IBM Toolbox for Java uses communication functions built into Java, you do not need to use IBM i Access for Windows to use IBM Toolbox for Java. Each server runs in a separate job on the server, and each server job sends and receives data streams on a socket connection.

**Note:** By using the code examples, you agree to the terms of the [“Code license and disclaimer information”](#) on page 534.


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## What's new for IBM Toolbox for Java

Read about new or significantly changed information for the IBM Toolbox for Java topic collection.



### Obtaining IBM Toolbox for Java

IBM Toolbox for Java is available in the following forms:

- The IBM Toolbox for Java [JAR files](#) are installed in the integrated file system of IBM i, under directory /QIBM/ProdData/OS400/jt400/.
- IBM Toolbox for Java is also available in an open source version. You can download the code and get more information from the [JTOpen](#)  Web site.

### How to see what's new or changed

To help you see where technical changes have been made, the information center uses:

- The  image to mark where new or changed information begins.
- The  image to mark where new or changed information ends.

In PDF files, you might see revision bars (|) in the left margin of new and changed information.

To find other information about what's new or changed this release, see the [Memo to users](#).

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## PDF file for IBM Toolbox for Java

You can view and print a PDF file of this information.

To view or download the PDF version of this document, select [IBM Toolbox for Java](#).

You can view or download these related topic PDFs:

- [IBM Developer Kit for Java](#)
- [IBM i Debugger](#)

### Other information

You can also download a zipped package of the IBM Toolbox for Java topic that includes the Javadocs at the [IBM Toolbox for Java and JTOpen Web site](#) .


**Note:** The information in the zipped package has links to documents that are not included in the zipped package, so these links do not work.

## Saving PDF files

To save a PDF on your workstation for viewing or printing:

1. Right-click the PDF link in your browser.
2. Click the option that saves the PDF locally.
3. Navigate to the directory in which you want to save the PDF.
4. Click **Save**.

## Downloading Adobe Reader

You need Adobe Reader installed on your system to view or print these PDFs. You can download a free copy from the [Adobe Web site \(www.adobe.com/products/acrobat/readstep.html\)](http://www.adobe.com/products/acrobat/readstep.html) .

## Installing and managing IBM Toolbox for Java

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Using IBM Toolbox for Java makes it easier to write client Java applets, servlets, and applications that access system resources, data, and programs.

### Managing your IBM Toolbox for Java installation

You need to install IBM Toolbox for Java only on client systems that use it, or in a location on your network where your clients can access it. Your clients can be personal computers, dedicated workstations, or IBM i systems. It is important to remember that you can configure an IBM i server or a partition of the server to be a client. In the latter case, you need to install IBM Toolbox for Java on the client partition of the server.

You can use any of the following methods (alone or in combination) to install and manage IBM Toolbox for Java:

- Individual management to install and individually manage IBM Toolbox for Java on each client
- Network management of a single installation by using your network to install and manage a single, shared installation of IBM Toolbox for Java on a server

The following sections briefly explain how each method affects both performance and manageability. How you choose to develop your Java applications and manage your resources determines which of the methods (or which combination of methods) you use.

#### Individual management

You can choose to individually manage your IBM Toolbox for Java installations on individual clients. The main advantage of installing IBM Toolbox for Java on individual clients is that it reduces the time that a client takes to start an application that uses IBM Toolbox for Java classes.

The main disadvantage is managing those installations individually. Either a user or an application that you create must track and manage which version of IBM Toolbox for Java is installed on each workstation.

#### Network management of a single installation

You can also use your network to install and manage a single copy of IBM Toolbox for Java on a server that all your clients can access. This kind of network installation provides the following advantages:

- All clients use the same version of IBM Toolbox for Java
- Updating the single installation of IBM Toolbox for Java benefits all clients
- Individual clients have no maintenance issues, other than setting the same initial CLASSPATH

This kind of installation also has the disadvantage of increasing the time that a client takes to start a IBM Toolbox for Java application. You must also enable your client CLASSPATH to point to your server. You can use [NetServer](#), which is integrated into IBM i, or a different method that enables you to access files on the system, such as [IBM i Access for Windows](#).

# Installing IBM Toolbox for Java

How you install IBM Toolbox for Java depends on how you want to manage your installation. Use these topics to install IBM Toolbox for Java.

## IBM i requirements for IBM Toolbox for Java

This topic details the requirements that your environment must meet in order use IBM Toolbox for Java.

**Note:** Before you use IBM Toolbox for Java, make sure to address the [workstation requirements](#) that pertain to your environment.

### **Required IBM i options**

To run IBM Toolbox for Java in a client/server environment, you must enable the QUSER user profile, start the host servers, and have TCP/IP running.

- The QUSER user profile must be enabled in order to start the host servers.
- Host servers listen for and accept connection requests from clients. IBM i Host Servers option is included with the base option of IBM i. For more information, see [Host server administration](#).
- TCP/IP support, which is integrated into IBM i, allows you to connect your server to a network. For more information, see [TCP/IP](#).

### **Starting required IBM i options**

From a command line, start the required IBM i options by completing the following steps:

1. [Ensure that the QUSER profile is enabled](#).
2. To start the IBM i host servers, use the CL Start Host Server command. Type **STRHOSTSVR \*ALL** and press **ENTER**.
3. To start the TCP/IP distributed data management (DDM) server, use the CL Start TCP/IP Server command. Type **STRTCPSVR SERVER(\*DDM)** and press **ENTER**.

### **Determining if IBM Toolbox for Java is installed on your system**

To see if IBM Toolbox for Java is already installed on your IBM i server, complete the steps in this topic.

1. In System i® Navigator, select and sign on to the system that you want to use.
2. In the **Function Tree** (the left pane), expand the system, then expand **Configuration and Service**.
3. Expand **Software**, then expand **Installed Products**.
4. In the **Details** pane (the right pane), see if product 5770-SS1 option 3 is installed. If you see this product and option combination, the IBM Toolbox for Java is installed on the selected server.

**Note:** You can also find out if IBM Toolbox for Java is installed by using the CL Go to Menu command (**GO MENU(LICPGM)**), Option 11.

If IBM Toolbox for Java is not installed, you can install the IBM Toolbox for Java by installing option 3 of product 5770-SS1.

### **Checking the QUSER profile**

The IBM i Host Servers start under the QUSER user profile, so you first need to ensure that the QUSER profile is enabled in order to run IBM Toolbox for Java in a client/server environment.

#### **Check the QUSER profile**

To use the command line to check the QUSER profile, complete the following steps:

1. On a command line, type **DSPUSRPRF USRPRF (QUSER)** and press **Enter**.
2. Make sure that the **Status** is **\*ENABLED**. If the profile status is not **\*ENABLED**, [change the QUSER profile](#).

## ***Changing the QUSER user profile***

If the QUSER profile is not \*ENABLED, you must enable it to start the IBM i Host Servers. Also, the QUSER profile password cannot be \*NONE. If this is true, you must reset it.

To use the command line to enable the QUSER profile, complete the following steps:

1. Type `CHGUSRPRF USRPRF(QUSER)` and press **ENTER**.
2. Change the **Status** field to \*ENABLED and press **ENTER**.

The QUSER user profile is now ready to start the IBM i Host Servers.

## ***Dependencies on other licensed programs***

Depending on how you want to use IBM Toolbox for Java, you may need to install other licensed programs.

## **Spoiled file viewer**

When you want to use the spoiled file viewer functions (SpoiledFileViewer class) of IBM Toolbox for Java, ensure that you have installed host option 8 (AFP Compatibility Fonts) on your server.

**Note:** SpoiledFileViewer, PrintObjectPageInputStream, and PrintObjectTransformedInputStream classes work only when connecting to V4R4 or later systems.


## **Secure Sockets Layer**

When you want to use Secure Sockets Layer (SSL), ensure that you have installed the following:

- [IBM HTTP Server for i](#) licensed program, 5770-DG1
- IBM i Option 34 (Digital Certificate Manager)

For more information about SSL, see [“Secure Sockets Layer and Java Secure Socket Extension”](#) on page 273.

## **HTTP server for using applets, servlets, or SSL**

If you want to use applets, servlets, or SSL on the IBM i server, you must set up an HTTP server and install the class files on the system. For more information about the IBM HTTP Server for i, see the [HTTP Server](#)  Web site.

For information about the Digital Certificate Manager and how to create and work with digital certificates using the IBM HTTP Server, see [Digital Certificate Management](#).

## ***Compatibility with different levels of IBM i***

Because you can use IBM Toolbox for Java both on your server and your client, the compatibility issues affect both running on a server and connecting from a client back to a server.

## **Using IBM Toolbox for Java to connect from a client back to the server**

You can use different versions of IBM Toolbox for Java on a client and on the server to which you are connecting. To use IBM Toolbox for Java to access data and resources on an IBM i server, the **server to which you are connecting** must be running one of the following:

- IBM i 7.2
- IBM i 7.1
- IBM i 6.1

The following table shows the compatibility requirements for connecting back to different versions of IBM i.

**Note:** IBM Toolbox for Java does not support forward compatibility. You cannot install IBM Toolbox for Java on or use it to connect to a server that runs a more recent version of IBM i. For example, if you are using the version of IBM Toolbox for Java that ships with IBM i 6.1, you cannot connect to a server that runs IBM i 7.2.

LPP	Ships with IBM i	Connects back to IBM i
5761-JC1	6.1	5.3 and later
5770-SS1	7.1	5.4 and later
5770-SS1	7.2	6.1 and later

### ***Native optimizations when running on the IBM i JVM***

Native optimizations are a set of functions that make the IBM Toolbox for Java classes work the way a user would expect them to work when running on IBM i. The optimizations affect operation of IBM Toolbox for Java only when running on the IBM i JVM.

The IBM Toolbox for Java optimizations when running on IBM i are:

- Signon: When no userid or password is specified in the AS400 object, the userid and password of the current job are used
- Directly calling IBM i APIs instead of making socket calls to host servers:
  - Record-level database access, data queues and user space when security requirements are met.
  - Program call and command call when security requirements and thread safety requirements are met.

**Note:** For best performance, set your JDBC driver property to use the native driver when the Java program and database file are on the same server.

No change to the Java application is needed to get the optimizations. IBM Toolbox for Java automatically enables the optimizations when appropriate.

In order to gain the performance improvements, you need to make sure to use the JAR file that includes IBM i native optimizations. For more information, see [Note 1 in JAR files](#).

When you do not use the JAR file that includes IBM i native optimizations, IBM Toolbox for Java works as if it is running on a client.

## **Workstation requirements for IBM Toolbox for Java**

Ensure that your workstation meets the following requirements.

**Note:** Before you use IBM Toolbox for Java, make sure to address the [IBM i requirements](#) that pertain to your environment.

### ***Workstation requirements for running IBM Toolbox for Java applications***

To develop and run IBM Toolbox for Java applications, ensure that your workstation meets the following requirements.

- We recommend using a supported Java 2 Standard Edition (J2SE) Java virtual machine. Many new IBM Toolbox for Java functions require using version 1.4 or higher of the JVM.
- TCP/IP installed and configured

### ***Workstation requirements for running IBM Toolbox for Java applets***

To develop and run IBM Toolbox for Java applications, ensure that your workstation meets the following requirements.

- A browser that has a compatible Java virtual machine (JVM).
- TCP/IP installed and configured
- The workstation must connect to a server that is running IBM i 6.1 or newer release.

## Installing IBM Toolbox for Java on your system

You need to install IBM Toolbox for Java on your IBM i server only when you have configured the system or a partition of the system as a client.

Before installing IBM Toolbox for Java, you need to ensure that your version of IBM i meets the requirements for running IBM Toolbox for Java. You may want to [determine whether the IBM Toolbox for Java is already installed on your server](#).

### Installing IBM Toolbox for Java

You can install the IBM Toolbox for Java by installing 5770-SS1 option 3. You can use either System i Navigator or the command line.

#### Using System i Navigator to install IBM Toolbox for Java

To install IBM Toolbox for Java using System i Navigator, complete the following steps:

1. In System i Navigator, sign on to the system that you want to use.
2. In the Function Tree (the left pane), expand **My Connections**.
3. Under **My Connections**, right click the system where you want to install IBM Toolbox for Java.
4. Select **Run command**.
5. In the **Restore Licensed Program (RSTLICPGM)** dialog, type the following information, then click **OK**:
  - Product: 5770-SS1
  - Device: The name of the device or save file
  - Optional part to be restored: 3

**Note:** For more information, click **Help** in the **Restore Licensed Program (RSTLICPGM)** dialog,

You can use System i Navigator to view the status of the resulting Management Central Command task by completing the following steps:

1. Expand **Management Central**.
2. Expand **Task Activity**.
3. Under **Task Activity**, select **Commands**.
4. In the Detail pane, click on the appropriate **Run Command** task.

#### Using the command line to install IBM Toolbox for Java

To install IBM Toolbox for Java from a command line, complete the following steps:

1. On a command line, use the CL Go to Menu command. Type **GO MENU(LICPGM)** and press **ENTER**.
2. Select **11. Install licensed program**.
3. Select **5770-SS1 3 Extended Base Directory Support**.


For more information about installing licensed programs, see [Managing software and licensed programs](#).

## Installing IBM Toolbox for Java on your workstation

Before you install IBM Toolbox for Java, make sure to address the workstation requirements that pertain to your environment.

How you install IBM Toolbox for Java on your workstation depends on how you want to [manage your installation](#):

- To install IBM Toolbox for Java on individual clients, copy the JAR files to your workstation and configure your workstation CLASSPATH.
- To use IBM Toolbox for Java that is installed on a server, you only have to configure your workstation CLASSPATH to point to the server installation. To point your workstation CLASSPATH to the server, your server must have IBM i NetServer installed.

This documentation explains how to copy the class files to your workstation. For more information about setting the CLASSPATH on your workstation, refer to the operating system documentation for your workstation or information available at the [Sun Java Web site](#) .

**Note:** Using the IBM Toolbox for Java classes in your application also requires that your system meets the requirements for [IBM i](#).

The IBM Toolbox for Java class files are packaged in several JAR files, consequently you need to copy one or more of these JAR files to your workstation. For more information about which JAR files are required for specific IBM Toolbox for Java functions, see [JAR files](#).


### Example: Copying jt400.jar

The following example assumes you want to copy jt400.jar, which contains the core IBM Toolbox for Java classes.

To manually copy the JAR file, complete the following steps:

1. Find the jt400.jar file in the following directory: /QIBM/ProdData/HTTP/Public/jt400/lib
2. Copy jt400.jar from the server to your workstation. You can do this in a variety of ways:
  - Use IBM i Access for Windows to map a network drive on your workstation to the server, then copy the file.
  - Use file transfer protocol (FTP) to send the file (in binary mode) to your workstation.
3. Update the CLASSPATH environment variable of your workstation.
  - For example, if you are using Windows NT and you copied jt400.jar to C:\jt400\lib, add the following string to the end of your CLASSPATH:

```
;C:\jt400\lib\jt400.jar
```

You also have the option of using the open source version of IBM Toolbox for Java, called JTOpen. For more information about JTOpen, see the [IBM Toolbox for Java and JTOpen Web site](#) .

### JAR files

The IBM Toolbox for Java is shipped as a set of JAR files. Each JAR file contains Java packages that provide specific functions. You can reduce the amount of required storage space by using only the JAR files required to enable the specific functions that you want.

To use a JAR file, make sure that you include an entry for it in your CLASSPATH.

The following chart indicates which JAR files you must add to your CLASSPATH to use the associated function or package.

IBM Toolbox for Java package or function	JAR files required to be in your CLASSPATH
<a href="#">Access classes</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , or jt400Proxy.jar in a proxy environment
<a href="#">“CommandHelpRetriever class” on page 235</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> and an XML parser and XSLT processor <a href="#">Note 3</a>
<a href="#">CommandPrompter</a> <a href="#">Note 3</a>	jt400.jar, jui400.jar, util400.jar <a href="#">Note 4</a> , and an XML parser <a href="#">Note 3</a>
Commtrace classes	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a>
<a href="#">HTML classes</a>	jt400.jar <a href="#">Note 1</a> plus jt400Servlet.jar (client), or jt400Native.jar (server) <a href="#">Note 1</a>
<a href="#">HTMLDocument class</a>	The same JAR files required for HTML classes, plus an XML parser and XSLT processor <a href="#">Note 3</a>
JCA classes	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a>

IBM Toolbox for Java package or function	JAR files required to be in your CLASSPATH
JDBC Data Source GUI	jt400.jar (client) <a href="#">Note 1</a> and jui400.jar <a href="#">Note 5</a>
NLS system and error messages	jt400Mri_lang_cntry.jar <a href="#">Note 6</a>
PCML (development and run-time, parsed) <a href="#">Note 7</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , <a href="#">Note 8</a> , and an XML parser <a href="#">Note 3</a>
PCML (run-time, serialized)	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , <a href="#">Note 8</a>
<a href="#">ReportWriter classes</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , reportwriter JAR files <a href="#">Note 9</a> , and an XML parser and XSLT processor <a href="#">Note 3</a>
<a href="#">RFML</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , and an XML parser <a href="#">Note 3</a>
<a href="#">Security classes</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , or jt400Proxy.jar in a proxy environment
<a href="#">Servlet classes</a>	jt400.jar <a href="#">Note 1</a> plus jt400Servlet.jar (client), or jt400Native.jar (server) <a href="#">Note 1</a>
IBM i Debugger <a href="#">Note 4</a>	jt400.jar (client) <a href="#">Note 1</a> and tes.jar
<a href="#">XPCML</a>	jt400.jar (client) or jt400Native.jar (server) <a href="#">Note 1</a> , and an XML parser and XSLT processor <a href="#">Note 3</a>


**Note 1:** Do not put both jt400.jar and jt400Native.jar in your CLASSPATH. Choose the JAR file most appropriate for your environment and use only that JAR in your CLASSPATH.

**Note 2:** Some of the IBM Toolbox for Java classes are in more than one JAR file:

- **jt400.jar** - Access, commtrace, JCA, JDBC support, PCML, RFML, security, utilities, and XPCML.
- **jt400.zip** - Use jt400.jar instead of jt400.zip. jt400.zip is shipped to retain compatibility with previous releases of IBM Toolbox for Java.
- **jt400Access.zip** - The same classes that are in jt400.jar. jtAccess400.zip is shipped to retain compatibility with previous releases of IBM Toolbox for Java. Use jt400.jar or jt400Native.jar instead of jt400Access.zip.
- **jt400Native.jar** - Access, HTML, PCML, RFML, security, XPCML, and [native optimizations](#). Native optimizations is a set of classes (fewer than 20) that take advantage of IBM i function when running on the IBM i JVM. Because jt400Native.jar contains the native optimizations, when running on the IBM i JVM, use jt400Native.jar instead of jt400.jar. jt400Native.jar ships with IBM i and resides in directory / QIBM/ProdData/OS400/jt400/lib.
- **jt400Native11x.jar** - Use jt400Native.jar instead of jt400Native11x.jar. jt400Native11x.jar is shipped to retain compatibility with previous releases of IBM Toolbox for Java.

**Note 3:** When you must use an XML parser or XSLT processor, make sure that they are JAXP-compliant. For more information, see the following page:

[“XML parser and XSLT processor” on page 311](#)

**Note 4:** Using CommandPrompter or the IBM i Debugger also requires one additional JAR file that is not part of IBM Toolbox for Java: jhall.jar. For more information about downloading jhall.jar, see the [Sun JavaHelp Web site](#) .

**Note 5:** util400.jar contains IBM i-specific classes for formatting input and for using the command line prompter. Using the CommandPrompter class requires util400.jar.

**Note 6:** jui400.jar contains the classes necessary to use the JDBC DataSource GUI interface. jt400.jar ([Note 1](#)) contains the classes necessary for all other JDBC functions.



**Note 7:** jt400Mri\_xx\_yy.jar contains translated messages, including strings contained in exception messages, dialogs, and output from other normal processing. In jt400Mri\_lang\_cntry.jar, lang = the ISO Language Code and cntry = the ISO Country or Region Code used to translate the contained text. In some cases, the ISO Country or Region Code is not used. Installing a particular national language version of the IBM Toolbox for Java licensed program on the system installs the appropriate jt400Mri\_lang\_cntry.jar file. If the language is not supported, the install defaults to the English version, which is included in the IBM Toolbox for Java JAR files.

- For example, installing the German language version of licensed program 5770-SS1 installs the German language JAR file, jt400Mri\_de.jar.

You can add support for other languages by adding more than one of these JAR files to the classpath. Java loads the correct string based on the current locale.

**Note 8:** Serializing your PCML file during development has two benefits:

1. You need to parse the PCML file only during development and not during run-time
2. Users need fewer JAR files in their CLASSPATH to run the application

To parse the PCML file during development, you need both the PCML run-time in data.jar or jt400.jar and the PCML parser in x4j400.jar. To run the serialized application, users need only jt400.jar. For more information, see [“Building IBM i program calls with PCML” on page 274](#).

**Note 9:** Use jt400.jar and jt400Native.jar instead of data400.jar. data400.jar contains the PCML runtime classes, which are now also in jt400.jar and jt400Native.jar ([Note 1](#)). data400.jar is shipped to retain compatibility with previous releases of IBM Toolbox for Java.

**Note 10:** Copies of the ReportWriter classes are in more than one JAR file:

- composer.jar
- outputwriter.jar
- reportwriters.jar

If your application streams PCL data to an IBM i spooled file, you must make the access classes available by using the appropriate JAR file ([Note 1](#)). Creating a spooled file to hold PCL data requires the AS400, OutputQueue, PrintParameterList, and SpooledFileOutputStream classes. For more information, see the [ReportWriter classes](#).

## System properties

You can specify system properties to configure various aspects of the IBM Toolbox for Java.

For example, you can use system properties to define a proxy server or a level of tracing. System properties are useful for convenient runtime configuration without needing to recompile code. System properties work like environment variables in that when you change a system property during runtime, the change is generally not reflected until the next time you run the application.

There are several ways that you can set system properties:

- **Using the `java.lang.System.setProperties()` method**

You can set system properties programmatically by using the `java.lang.System.setProperties()` method.

For example, the following code sets the `com.ibm.as400.access.AS400.proxyServer` property to `hqoffice`:

```
Properties systemProperties = System.getProperties();
systemProperties.put ("com.ibm.as400.access.AS400.proxyServer", "hqoffice");
System.setProperties (systemProperties);
```

- **Using the `-D` option of the `java` command**

Many environments allow you to set system properties when running applications from a command line by using the `-D` option of the `java` command.

For example, the following program runs the application called Inventory with the `com.ibm.as400.access.AS400.proxyServer` property set to `hqoffice`:

```
java -Dcom.ibm.as400.access.AS400.proxyServer=hqoffice Inventory
```

- **Using a `jt400.properties` file**

In some environments, it may be inconvenient to instruct all users to set their own system properties. As an alternative, you can specify IBM Toolbox for Java system properties in a file called `jt400.properties` that is searched for as if it is part of the `com.ibm.as400.access` package. In other words, place the `jt400.properties` file in a `com/ibm/as400/access` directory pointed to by the classpath.

For example, set the `com.ibm.as400.access.AS400.proxyServer` property to `hqoffice` by inserting the following line into the `jt400.properties` file:

```
com.ibm.as400.access.AS400.proxyServer=hqoffice
```

The backslash character (`\`) functions as an escape character in properties files. Specify a literal backslash character by using two backslashes (`\\`).

Modify this [sample](#) of a `jt400.properties` file for your environment.

- **Using a `Properties` class**

Some browsers do not load properties files without explicitly changing security settings. However, most browsers do allow properties in `.class` files, so IBM Toolbox for Java system properties can also be specified by a class called `com.ibm.as400.access.Properties` which extends `java.util.Properties`.

For example, to set the `com.ibm.as400.access.AS400.proxyServer` property to `hqoffice`, use the following Java code:

```
package com.ibm.as400.access;

public class Properties
extends java.util.Properties
{
    public Properties ()
    {
        put ("com.ibm.as400.access.AS400.proxyServer", "hqoffice");
    }
}
```

Modify and compile this [sample](#) of a `Properties.java` source file for your environment.

If an IBM Toolbox for Java system property is set using more than one of the mechanisms described above, then the precedence is as follows (in order of decreasing precedence):

1. The system property set programmatically using `java.lang.System.setProperties()`
2. The system property set using the `-D` option of the `java` command
3. The system property set using a `Properties` class
4. The system property set using a `jt400.properties` file

IBM Toolbox for Java supports the following system properties:

- [“Proxy server properties” on page 11](#)
- [“Trace properties” on page 11](#)
- [“CommandCall/ProgramCall properties” on page 11](#)
- [“FTP properties” on page 12](#)
- [“Connection properties” on page 12](#)

## Proxy server properties

Proxy server property	Description
com.ibm.as400.access.AS400.proxyServer	<p>Specifies the proxy server host name and port number, using the format:</p> <pre>hostName:portNumber</pre> <p>The port number is optional.</p>
com.ibm.as400.access.TunnelProxyServer.clientCleanupInterval	<p>Specifies how often, in seconds, the proxy server looks for idle connections. The proxy server starts a thread to look for clients that are no longer communicating. Use this property to set how often the thread looks for idle connections.</p>
com.ibm.as400.access.TunnelProxyServer.clientLifetime	<p>Specifies how long, in seconds, a client can be idle before the proxy server removes references to the objects so the JVM can garbage collect them. The proxy server starts a thread to look for clients that are no longer communicating. Use this property to set how long a client can be idle before performing garbage collection on it.</p>

## Trace properties

Trace property	Description
com.ibm.as400.access.Trace.category	<p>Specifies which trace categories to enable. This is a comma-delimited list containing any combination of trace categories. The complete list of trace categories is defined in the Trace class.</p>
com.ibm.as400.access.Trace.file	<p>Specifies the file to which trace output is written. The default is to write trace output to System.out.</p>
com.ibm.as400.access.ServerTrace.JDBC	<p>Specifies which trace categories to start on the JDBC server job. For information about supported values, see the <a href="#">JDBC server trace property</a>.</p>

## CommandCall/ProgramCall properties

CommandCall/ProgramCall property	Description
com.ibm.as400.access.CommandCall.threadSafe	<p>Specifies whether CommandCalls might be assumed to be thread-safe. If true, all CommandCalls are assumed to be thread-safe. If false, all CommandCalls are assumed to be non-thread-safe. This property is ignored for a given CommandCall object if either <code>CommandCall.setThreadSafe()</code> or <code>AS400.setMustUseSockets(true)</code> has been performed on the object.</p>

CommandCall/ProgramCall property	Description
com.ibm.as400.access.ProgramCall.threadSafe	Specifies whether ProgramCalls might be assumed to be thread-safe. If <code>true</code> , all ProgramCalls are assumed to be thread-safe. If <code>false</code> , all ProgramCalls are assumed to be non-thread-safe. This property is ignored for a given ProgramCall object if either <code>ProgramCall.setThreadSafe()</code> or <code>AS400.setMustUseSockets(true)</code> has been performed on the object.

### FTP properties

FTP property	Description
com.ibm.as400.access.FTP.reuseSocket	Specifies whether the socket is reused for multiple file transfers (through a single FTP instance), when in "active" mode. If <code>true</code> , the socket is reused. If <code>false</code> , a new socket is created for each file transfer. This property is ignored for a given FTP object if <code>FTP.setReuseSocket()</code> has been performed on the object.

### Connection properties

Connection property	Description
com.ibm.as400.access.AS400.guiAvailable	Indicates whether the current environment has GUI capability. If <code>true</code> , prompting may occur during signon to display error conditions, to prompt for additional information, or to prompt for change password. If <code>false</code> , error conditions or missing information will result in exceptions. Applications that are running as IBM i applications or want to control the signon user interface may want to run with prompting mode set to <code>false</code> . The default is <code>true</code> .
com.ibm.as400.access.AS400.mustAddLanguageLibrary	Indicates whether AS400 objects should attempt to add the appropriate secondary language library to the library list when running on the system. Setting the language library will ensure that any system error messages that are returned, will be returned in the appropriate national language for the client locale. If <code>true</code> , AS400 objects will attempt to add the secondary language library to the library list when running on the system. If <code>false</code> , no attempt is made by AS400 objects to add the secondary language library to the library list. The default is <code>false</code> .
com.ibm.as400.access.AS400.mustUseNetSockets	Specifies whether AS400 objects should use Internet domain sockets only. When your Java program runs on the system, some IBM Toolbox for Java classes create UNIX domain socket connections. If <code>true</code> , only Internet domain sockets will be used by AS400 objects. If <code>false</code> , AS400 objects may use UNIX domain socket connections in addition to Internet domain sockets. The default is <code>false</code> .

Connection property	Description
com.ibm.as400.access.AS400.mustUseSockets	Specifies whether AS400 objects should use sockets. When your Java program runs on the system, some IBM Toolbox for Java classes access data by calling an API instead of making a socket call to the system. There are minor differences in the behavior of the classes when API calls are used instead of socket calls. If your program is affected by these differences you can force the classes to use socket calls instead of API calls by setting this property to true. The default is false.
com.ibm.as400.access.AS400.mustUseSuppliedProfile	Specifies whether AS400 objects should use a supplied profile only. When your Java program runs on the system, the information from the currently signed-on user profile (*CURRENT) can be used. If true, a user profile must be supplied. If false, AS400 objects retrieves the current user profile information if a user profile is not supplied. . The default is false.
com.ibm.as400.access.AS400.signonHandler	Specifies the default signon handler. This property is ignored for a given AS400 object if AS400.setSignonHandler() has been performed on the object, or if AS400.setDefaultSignonHandler() has been called.
com.ibm.as400.access.AS400.threadUsed	Specifies whether AS400 objects use threads in communication with the host servers. Letting the IBM Toolbox for Java use threads may be beneficial to performance; turning threads off may be necessary if your application needs to be compliant with the Enterprise Java Beans specification. The default is true.

## Example: Properties File

This example shows properties for the proxy server, trace categories, command calls, program calls, file transfers, and connections.

```

#=====#
# IBM Toolbox for Java                               #
#-----#
# Sample properties file                             #
#                                                    #
# Name this file jt400.properties and store it in a  #
# com/ibm/as400/access directory that is pointed to by #
# the classpath.                                     #
#=====#

#-----#
# Proxy server system properties                       #
#-----#

# This system property specifies the proxy server host name
# and port number, specified in the format: hostName:portNumber
# The port number is optional.
com.ibm.as400.access.AS400.proxyServer=hqoffice

# This system property specifies how often, in seconds,
# the proxy server will look for idle connections. The
# proxy server starts a thread to look for clients that are
# no longer communicating. Use this property to set how
# often the thread looks for idle connections.
com.ibm.as400.access.TunnelProxyServer.clientCleanupInterval=7200

```

```

# This system property specifies how long, in seconds, a
# client can be idle before it is cleaned up. The proxy server
# starts a thread to look for clients that are no longer
# communicating. Use this property to set long a client can
# be idle before it is cleaned up.
com.ibm.as400.access.TunnelProxyServer.clientLifetime=2700

#-----#
# Trace system properties                                     #
#-----#

# This system property specifies which trace categories to enable.
# This is a comma-delimited list containing any combination of trace
# categories. The complete list of trace categories is defined in
# the Trace class.
com.ibm.as400.access.Trace.category=error,warning,information

# This system property specifies the file to which trace output
# is written. The default is to write trace output to System.out.
com.ibm.as400.access.Trace.file=c:\\temp\\trace.out

#-----#
# Command Call system properties                             #
#-----#

# This system property specifies whether CommandCalls should
# be assumed to be thread-safe. If true, all CommandCalls are
# assumed to be thread-safe. If false, all CommandCalls are
# assumed to be non-thread-safe. This property is ignored
# for a given CommandCall object if either
# CommandCall.setThreadSafe(true/false) or
# AS400.setMustUseSockets(true) has been performed on the object.
com.ibm.as400.access.CommandCall.threadSafe=true

#-----#
# Program Call system properties                             #
#-----#

# This system property specifies whether ProgramCalls should
# be assumed to be thread-safe. If true, all ProgramCalls are
# assumed to be thread-safe. If false, all ProgramCalls are
# assumed to be non-thread-safe. This property is ignored
# for a given ProgramCall object if either
# ProgramCall.setThreadSafe(true/false) or
# AS400.setMustUseSockets(true) has been performed on the object.
com.ibm.as400.access.ProgramCall.threadSafe=true

#-----#
# FTP system properties                                     #
#-----#

# This system property specifies whether the socket is reused
# for multiple file transfers (through a single FTP instance),
# when in "active" mode.
# If true, the socket is reused. If false, a new socket is
# created for each file transfer.
# This property is ignored for a given FTP object if
# FTP.setReuseSocket(true/false) has been performed on the object.
com.ibm.as400.access.FTP.reuseSocket=true

#-----#
# Connection system properties                             #
#-----#

# This system property specifies the default signon handler.
# This property is ignored for a given AS400 object if
# AS400.setSignonHandler() has been performed on
# the object, or if AS400.setDefaultSignonHandler()
# has been called.
com.ibm.as400.access.AS400.signonHandler=mypackage.MyHandler

# This system property specifies whether the Toolbox should
# assume that the current environment has GUI capability.

```

```

# This property is ignored for a given AS400 object if
# AS400.setGuiAvailable() has been performed on the object.
com.ibm.as400.access.AS400.guiAvailable=true

# This system property specifies whether the appropriate
# secondary language library must be added to the library list,
# when running on the system. By default the library is not added.
# This property is ignored for a given AS400 object if
# AS400.setMustAddLanguageLibrary() has been performed
# on the object.
com.ibm.as400.access.AS400.mustAddLanguageLibrary=true

# This system property specifies whether sockets
# must be used when communicating with the system.
# Setting this property to true directs the Toolbox to refrain
# from exploiting native optimizations, when running directly on
# the system.
# By default, when running directly on the system the Toolbox
# will exploit native optimizations if they are available,
# and bypass sockets.
# This property is ignored for a given AS400 object if
# AS400.setMustUseSockets() has been performed on the object.
com.ibm.as400.access.AS400.mustUseSockets=true

# This system property specifies whether Internet domain sockets
# must be used when communicating with the system.
# Setting this property to true directs the Toolbox to refrain
# from exploiting Unix sockets, when running directly on
# the system.
# By default, when running directly on the system the Toolbox
# will exploit Unix sockets if they are available,
# rather than Internet domain sockets.
# This property is ignored for a given AS400 object if
# AS400.setMustUseNetSockets() has been performed on the object.
com.ibm.as400.access.AS400.mustUseNetSockets=true

# This system property specifies whether the explicitly supplied
# profile must be used when communicating with the system.
# Setting this property to true directs the Toolbox to
# refrain from exploiting the currently signed-on profile
# by default, when running directly on the system.
# This property is ignored for a given AS400 object if
# AS400.setMustUseSuppliedProfile() has been performed on the object.
com.ibm.as400.access.AS400.mustUseSuppliedProfile=true

# This system property specifies whether threads are used
# when communicating with the host servers.
# By default, the AS400 object creates separate threads
# to listen on communication sockets to the host servers.
# Setting this property to false directs the Toolbox to refrain
# from creating separate threads for host server communications.
# This property is ignored for a given AS400 object if
# AS400.setThreadUsed() has been performed on the object.
com.ibm.as400.access.AS400.threadUsed=true
# End

```

## Example: System Properties Class Source File

```

//=====
// IBM Toolbox for Java
//-----
// Sample properties class source file
//
// Compile this source file and store the class file in
// the classpath.
//=====
package com.ibm.as400.access;

public class Properties
extends java.util.Properties
{
    public Properties ()
    {
        /*-----*/
        /* Proxy server system properties          */
        /*-----*/

        // This system property specifies the proxy server host name

```

```

// and port number, specified in the format: hostName:portNumber
// The port number is optional.
put ("com.ibm.as400.access.AS400.proxyServer", "hqoffice");

// This system property specifies how often, in seconds,
// the proxy server will look for idle connections. The
// proxy server starts a thread to look for clients that are
// no longer communicating. Use this property to set how
// often the thread looks for idle connections.
put("com.ibm.as400.access.TunnelProxyServer.clientCleanupInterval", "7200");

// This system property specifies how long, in seconds, a
// client can be idle before it is cleaned up. The proxy server
// starts a thread to look for clients that are no longer
// communicating. Use this property to set long a client can
// be idle before it is cleaned up.
put("com.ibm.as400.access.TunnelProxyServer.clientLifetime", "2700");

/*-----*/
/* Trace system properties */
/*-----*/

// This system property specifies which trace categories to enable.
// This is a comma-delimited list containing any combination of trace
// categories. The complete list of trace categories is defined in
// the Trace class.
put ("com.ibm.as400.access.Trace.category", "error,warning,information");

// This system property specifies the file to which trace output
// is written. The default is to write trace output to System.out.
put ("com.ibm.as400.access.Trace.file", "c:\temp\trace.out");

/*-----*/
/* Command Call system properties */
/*-----*/

// This system property specifies whether CommandCalls should
// be assumed to be thread-safe. If true, all CommandCalls are
// assumed to be thread-safe. If false, all CommandCalls are
// assumed to be non-thread-safe. This property is ignored
// for a given CommandCall object if either
// CommandCall.setThreadSafe(true/false) or
// AS400.setMustUseSockets(true) has been performed on the object.
put ("com.ibm.as400.access.CommandCall.threadSafe", "true");

/*-----*/
/* Program Call system properties */
/*-----*/

// This system property specifies whether ProgramCalls should
// be assumed to be thread-safe. If true, all ProgramCalls are
// assumed to be thread-safe. If false, all ProgramCalls are
// assumed to be non-thread-safe. This property is ignored
// for a given ProgramCall object if either
// ProgramCall.setThreadSafe(true/false) or
// AS400.setMustUseSockets(true) has been performed on the object.
put ("com.ibm.as400.access.ProgramCall.threadSafe", "true");

/*-----*/
/* FTP system properties */
/*-----*/

// This system property specifies whether the socket is reused
// for multiple file transfers (through a single FTP instance),
// when in "active" mode. If true, the socket is reused.
// If false, a new socket is created for each file transfer.
// This property is ignored for a given FTP object if
// FTP.setReuseSocket(true/false) has been performed on the object.
put ("com.ibm.as400.access.FTP.reuseSocket", "true");

/*-----*/
/* Connection system properties */
/*-----*/

// This system property specifies the default signon handler.
// This property is ignored for a given AS400 object if
// AS400.setSignonHandler() has been performed on

```



```

// the object, or if AS400.setDefaultSignonHandler()
// has been called.
put ("com.ibm.as400.access.AS400.signonHandler", "mypackage.MyHandler");

// This system property specifies whether the Toolbox should
// assume that the current environment has GUI capability.
// This property is ignored for a given AS400 object if
// AS400.setGuiAvailable() has been performed on the object.
put ("com.ibm.as400.access.AS400.guiAvailable", "true");

// This system property specifies whether the appropriate
// secondary language library must be added to the library list,
// when running on the system. By default the library is not added.
// This property is ignored for a given AS400 object if
// AS400.setMustAddLanguageLibrary() has been performed
// on the object.
put ("com.ibm.as400.access.AS400.mustAddLanguageLibrary", "true");

// This system property specifies whether sockets
// must be used when communicating with the system.
// By default, when running directly on the system the Toolbox
// will exploit native optimizations if they are available,
// and bypass sockets.
// This property is ignored for a given AS400 object if
// AS400.setMustUseSockets() has been performed on the object.
put ("com.ibm.as400.access.AS400.mustUseSockets", "true");

// This system property specifies whether Internet domain sockets
// must be used when communicating with the system.
// Setting this property to true directs the Toolbox to refrain
// from exploiting Unix sockets, when running directly on
// the system.
// By default, when running directly on the system the Toolbox
// will exploit Unix sockets if they are available,
// rather than Internet domain sockets.
// This property is ignored for a given AS400 object if
// AS400.setMustUseNetSockets() has been performed on the object.
put ("com.ibm.as400.access.AS400.mustUseNetSockets", "true");

// This system property specifies whether the explicitly supplied
// profile must be used when communicating with the system.
// Setting this property to true directs the Toolbox to
// refrain from exploiting the currently signed-on profile
// by default, when running directly on the system.
// This property is ignored for a given AS400 object if
// AS400.setMustUseSuppliedProfile() has been performed on the object.
put ("com.ibm.as400.access.AS400.mustUseSuppliedProfile", "true");

// This system property specifies whether threads are used
// when communicating with the host servers.
// By default, the AS400 object creates separate threads
// to listen on communication sockets to the host servers.
// Setting this property to false directs the Toolbox to refrain
// from creating separate threads for host server communications.
// This property is ignored for a given AS400 object if
// AS400.setThreadUsed() has been performed on the object.
put ("com.ibm.as400.access.AS400.threadUsed", "true");

}
}
}

```

## JTOpenLite

The JTOpenLite package (com.ibm.jtopenlite) enables you to write Java programs that allow a variety of mobile devices to directly access IBM i data and resources. Although JTOpenLite is considered a part of IBM Toolbox for Java, it is not included in the licensed product. The JTOpenLite jar file (jtopenlite.jar) is included in the open source version of IBM Toolbox for Java, called JTOpen. You must separately download and set up JTOpenLite, which is contained in JTOpen.

## Getting started with JTOpenLite

You can download JTOpenLite from the IBM Toolbox for Java/JTOpen web site. The web site also offers additional information about setting up JTOpenLite.

### Related information

[IBM Toolbox for Java/JTOpen web site](#)

## IBM Toolbox for Java classes

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The IBM Toolbox for Java classes are categorized, like all Java classes, into packages. Each package provides a certain kind of functionality.

For convenience, this documentation usually refers to each package with a short name. For example, the com.ibm.as400.access package is called the access package.

## Access classes

The IBM Toolbox for Java access classes represent IBM i data and resources.

### Related information

[EventLog classes Javadoc](#)

[Access package summary](#)

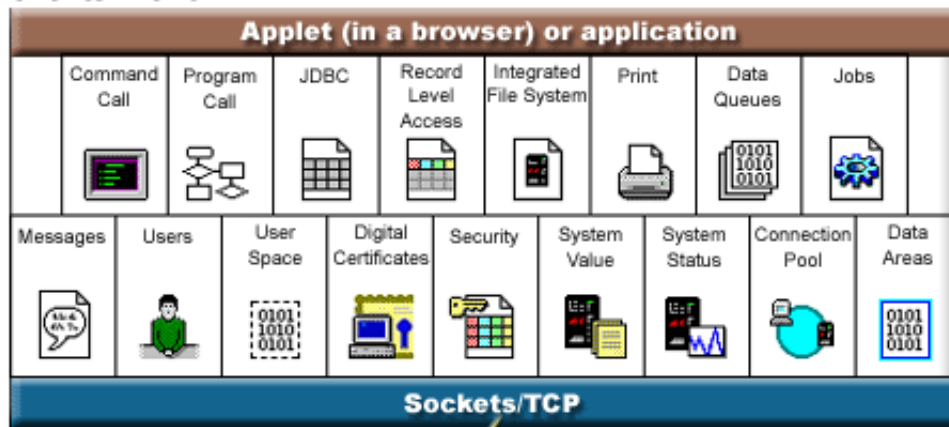
## Server access points

The IBM Toolbox for Java access classes provide functionality that is similar to using IBM i Access for Windows APIs. However, installing IBM i Access for Windows is not a requirement for using these classes.

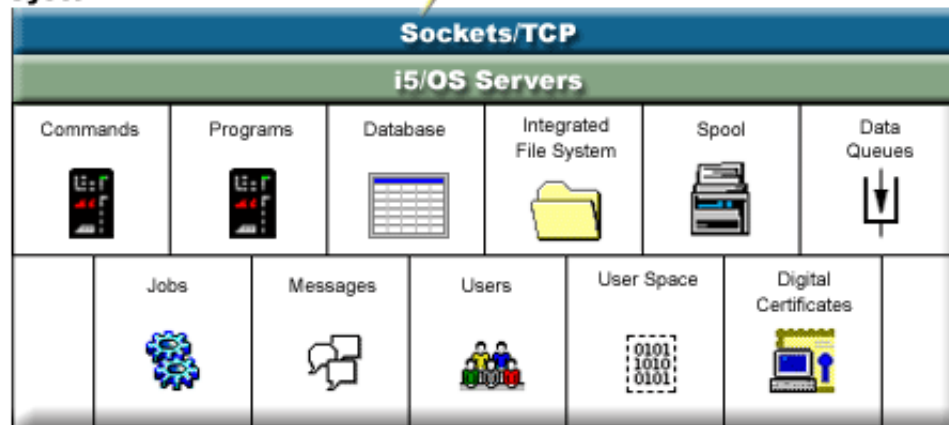
The access classes use the existing systems as the access points. Each server runs in a separate job on the system and sends and receives data streams on a socket connection.

### Figure 1: Server access points

## Clients with JVM



## System i




## AS400 class

The IBM Toolbox for Java AS400 class manages a set of socket connections to the server jobs on server and sign-on behavior for the server, including prompting the user for sign-on information, password caching, and default user management.

The Java program must provide an AS400 object when the Java program uses an instance of a class that accesses the IBM i system. For example, the CommandCall object requires an AS400 object before it can send commands to the system.

The AS400 object handles connections, user IDs, and passwords differently when it is running in the IBM i Java virtual machine. For more information, see ["IBM i Java virtual machine"](#) on page 344.

AS400 objects now support Kerberos authentication, using the Java Generic Security Service Application Programming Interface (JGSS API) to authenticate to the server, instead of using a user ID and password.

**Note:** Using Kerberos tickets requires that you to configure the Java Generic Security Services (JGSS) Application Programming Interface. For more information about JGSS, see the [Java Security Documentation](#) .

See [managing connections](#) for information about managing connections to the server through the AS400 object. See the AS400ConnectionPool Javadoc for information about reducing initial connect time by requesting connections from a connection pool.

The AS400 class provides the following sign-on functions:

- Authenticate the user profile

- Get a profile token credential and authenticate the associated user profile
- Set a profile token credential
- [Manage default user IDs](#)
- [Cache passwords](#)
- [Prompt for user ID](#)
- Change a password
- Get the version and release of the operating system

For information about using an AS400 object when sending or receiving encrypted data, see the [SecureAS400](#) class.

### **Related information**

[AS400ConnectionPool Javadoc](#)

[AS400 Javadoc](#)

### ***Managing default user IDs***

To minimize the number of times a user has to sign on, use a default user ID. The Java program uses the default user ID when a the program does not provide a user ID. The default user ID can be set either by the Java program or through the user interface. If the default user ID has not been established, the Sign-On dialog allows the user to set the default user ID.

Once the default user ID is established for a given server, the Sign-On dialog does not allow the default user ID to be changed. When an AS400 object is [constructed](#), the Java program can supply the user ID and password. When a program supplies the user ID to the AS400 object, the default user ID is not affected. The program must explicitly set the default user ID [setUseDefaultUser\(\)](#) if the program wants to set or change the default user ID. See [Prompting, default user ID, and password caching summary](#) for more information.

The AS400 object has methods to [get](#), [set](#), and [remove](#) the default user ID. The Java program can also disable default user ID processing through the [setUseDefaultUser\(\)](#) method. If default user ID processing is disabled and the Java application does not supply a user ID, the AS400 object prompts for user ID every time a connection is made to the server.

All AS400 objects that represent the same IBM i system within a Java virtual machine use the same default user ID.

In the following example, two connections to the server are created by using two AS400 objects. If the user checked the Default User ID box when signing on, the user is not prompted for a user ID when the second connection is made.

```
// Create two AS400 objects to the same system.
AS400 sys1 = new AS400("mySystem.myCompany.com");
AS400 sys2 = new AS400("mySystem.myCompany.com");

// Start a connection to the command call service.
// The user is prompted for user ID and password.
sys1.connectService(AS400.COMMAND);

// Start another connection to the command call service.
// The user is not prompted.
sys2.connectService(AS400.COMMAND);
```

The default user ID information is discarded when the last AS400 object for the server is garbage collected.

### ***Using a password cache***

The password cache allows the IBM Toolbox for Java to save password and user ID information so that it does not prompt the user for that information every time a connection is made.

Use the methods provided by the AS400 object to do the following:

- Clear the password cache and disable the password cache

- Minimize the number of times a user must type sign-on information

The password cache applies to all AS400 objects that represent an IBM i system within a Java virtual machine. Java does not allow sharing information between virtual machines, so a cached password in one Java virtual machine is not visible to another virtual machine. The cache is discarded when the last AS400 object is garbage collected. The Sign-on dialog has a checkbox that gives the user the option to cache the password. When an AS400 object is constructed, the Java program has the option to supply the user ID and password. Passwords supplied on constructors are not cached.

The AS400 object provides methods to [clear the password cache](#) and [disable the password cache](#) . See [Prompting, default user ID, and password caching summary](#) for more information.

### ***Prompting for user IDs and passwords***

When you are using the AS400 class, prompting for user ID and password may occur when connecting to the server. Prompting can be turned off by your Java program.

Java programs can turn off user ID and password prompting and message windows displayed by the AS400 object. An example of when this may be needed is when an application is running on a gateway on behalf of many clients. If prompts and messages are displayed on the gateway machine, the user has no way of interacting with the prompts. These types of applications can turn off all prompting by using the [setGuiAvailable\(\)](#) method on the AS400 object.

See [Prompting, default user ID, and password caching summary](#) for more information.

### ***Prompting, default user ID, and password caching summary***

Java programs can control when prompting for user ID and password caching occurs. The information from the Sign-On dialog can be used to set the default user ID and cache the password. The following table summarizes when prompting takes place, what information is retrieved, and what information is set.

This table assumes that the Java program allows default user ID processing and password caching, and that you checked the **Default User ID** box and the **Save Password** box on the Sign-On dialog.

Use this table for client connections, not for running Java on your server.

<b>System supplied on constructor</b>	<b>User ID supplied on constructor</b>	<b>Password supplied on constructor</b>	<b>Default user is established</b>	<b>Password in cache for user ID</b>	<b>Result of using marked settings</b>
					User is prompted for system name, user ID, and password. Default user ID is established and password is cached.
<b>Yes</b>					User is prompted for user ID and password. System name is displayed but cannot be changed. Default user ID is established and password is cached.

<b>System supplied on constructor</b>	<b>User ID supplied on constructor</b>	<b>Password supplied on constructor</b>	<b>Default user is established</b>	<b>Password in cache for user ID</b>	<b>Result of using marked settings</b>
<b>Yes</b>	<b>Yes</b>				User is prompted for password. User ID is displayed and can be changed. System name is displayed but cannot be changed. Default user ID is not changed. Password is cached.
<b>Yes</b>	<b>Yes</b>	<b>Yes</b>			No prompt. Default user ID is not changed. Password is not cached.
			<b>Yes</b>		User is prompted for system name and password. User ID is displayed and can be changed. Changing the user ID will not change the default user ID. Password is cached.
<b>Yes</b>			<b>Yes</b>		Prompt for password for the default user ID. User ID is displayed and can be changed. System name is displayed but cannot be changed. Password is cached.
<b>Yes</b>			<b>Yes</b>	<b>Yes</b>	No prompt. Connect using default user ID and password from cache.

System supplied on constructor	User ID supplied on constructor	Password supplied on constructor	Default user is established	Password in cache for user ID	Result of using marked settings
Yes	Yes			Yes	No prompt. Connect as specified user using password from cache.
Yes	Yes		Yes	Yes	No prompt. Connect as specified user using password from cache.
Yes	Yes	Yes	Yes		No prompt. Connect as specified user.

## SecureAS400 class

The SecureAS400 class enables you to use an AS400 object when sending or receiving encrypted data. When an AS400 object communicates with the server, user data (except the user password) is sent unencrypted to the server. So, IBM Toolbox for Java objects associated with an AS400 object exchange data with the server over a normal connection.

When you want to use IBM Toolbox for Java to exchange sensitive data with the server, you can encrypt data by using Secure Sockets Layer (SSL). Use the SecureAS400 object to designate which data you want to encrypt. IBM Toolbox for Java objects associated with a SecureAS400 object exchange data with the server over a secure connection.

For more information, see [Secure Sockets Layer and Java Secure Socket Extension](#).

The SecureAS400 class is a subclass of the AS400 class.

You can set up a secure server connection by creating an instance of a SecureAS400 object in the following ways:

- SecureAS400(String systemName, String userID) prompts you for sign-on information
- SecureAS400(String systemName, String userID, String password) does not prompt you for sign-on information

The following example shows you how to use CommandCall to send commands to the server using a secure connection:

```
// Create a secure AS400 object. This is the only statement that changes
// from the non-SSL case.
SecureAS400 sys = new SecureAS400("mySystem.myCompany.com");

// Create a command call object
CommandCall cmd = new CommandCall(sys, "myCommand");

// Run the commands. A secure connection is made when the
// command is run. All the information that passes between the
// client and server is encrypted.
cmd.run();
```

## Related information

[SecureAS400 Javadoc](#)

[AS400 Javadoc](#)

## AS400JPing class

The IBM Toolbox for Java AS400JPing class allows your Java program to query the host servers to see which services are running and which ports are in service.

To query the servers from a command line, use the [JPing class](#).

The AS400JPing class provides several methods:

- Ping the server
- Ping a specific service on the server
- Set a PrintWriter object to which you want to log ping information
- Set the time out for the ping operation

### Example: Using AS400JPing

The following example shows how you can use AS400JPing within a Java program to ping the Remote Command Service:

```
AS400JPing pingObj = new AS400JPing("myAS400", AS400.COMMAND, false);
if (pingObj.ping())
    System.out.println("SUCCESS");
else
    System.out.println("FAILED");
```

#### Related information

[AS400JPing class](#)

## BidiTransform class

The IBM Toolbox for Java BidiTransform class provides layout transformations that enable you to convert bidirectional text in IBM i format (after first converting it to Unicode) to bidirectional text in Java format, or from Java format to IBM i format.

[AS400BidiTransform class](#)

The AS400BidiTransform class allows you to:

- Get and set the system CCSID
- Get and set the string type of IBM i data
- Get and set the string type of Java data
- Convert data from a Java layout to IBM i
- Convert data from an IBM i layout to Java

### Example: Using AS400BidiTransform

The following example shows how you can use the AS400BidiTransform class to transform bidirectional text:

```
// Java data to system layout:
AS400BidiTransform abt;
abt = new AS400BidiTransform(424);
String dst = abt.toAS400Layout("some bidirectional string");
```

**Note:** Read the [Code example disclaimer](#) for important legal information.

## BidiConversionProperties class

The BidiConversionProperties class provides a set of properties that can be used to control the conversion of character set data.

#### Related information

[BidiConversionProperties Javadoc](#)



## CallStackEntry class

The CallStackEntry class represents an entry in the call stack of a specific thread of a server job.

Objects of this type are generated by calling `Job.getCallStack()`.

### Related information

[CallStackEntry Javadoc](#)

## ClusteredHashTable classes

The IBM Toolbox for Java ClusteredHashTable classes enable your Java programs to use highly available clustered hash tables to share and replicate data to nonpersistent storage among the nodes in a cluster.

To use the ClusteredHashTable classes, ensure that you can use nonpersistent storage for the data. Replicated data is not encrypted.

**Note:** The following information assumes that you understand the concepts and terminology common to IBM i cluster technology. See [IBM i cluster technology](#) for details.

Using the ClusteredHashTable class requires that you have defined and activated a cluster on the systems. You must also start a clustered hash table server. For more information, see [Configure clusters and Clustered Hash Table APIs](#).

Required parameters are the name of the clustered hash table server and the AS400 object, which represents the system that contains the clustered hash table server.

In order to store data in a clustered hash table server, you need a connection handle and a key:

- When you open a connection, the clustered hash table server assigns the connection handle that you must specify on subsequent requests to the clustered hash table server. This connection handle is good only for the instantiated AS400 object, so you must open another connection if you use a different AS400 object.
- You must specify the key to access and change data in the clustered hash table. Duplicate keys are not supported.

The [ClusteredHashTable](#) class provides methods that enable you to perform the following actions:

- [Open a connection](#) to the clustered hash table server job
- [Generate a unique key](#) to store data into the clustered hash table
- [Close the active connection](#) to the clustered hash table server job

Some methods in the ClusteredHashTable class use the [ClusteredHashTableEntry](#) class to perform the following actions:

- [Get an entry](#) from the clustered hash table
- [Store an entry](#) in the clustered hash table
- [Get a list of entries](#) from the clustered hash table for all user profiles

## Example: Using ClusteredHashTable

The following example operates on clustered hash table server named CHTSVR01. It assumes a cluster and a clustered hash table server is already active. It opens a connection, generates a key, puts an entry using the new key in the clustered hash table, gets an entry from the clustered hash table, and closes the connection.

```
ClusteredHashTableEntry myEntry = null;

String myData = new String("This is my data.");
System.out.println("Data to be stored: " + myData);

AS400 system = new AS400();

ClusteredHashTable cht = new ClusteredHashTable(system, "CHTSVR01");
```

```

// Open a connection.
cht.open();

// Get a key to the hash table.
byte[] key = null;
key = cht.generateKey();

// Prepare some data that you want to store into the hash table.
// ENTRY_AUTHORITY_ANY_USER means that any user can access the
// entry in the clustered hash table.
// DUPLICATE_KEY_FAIL means that if the specified key already exists,
// the ClusteredHashTable.put() request will not succeed.
int timeToLive = 500;
myEntry = new ClusteredHashTableEntry(key,myData.getBytes(),timeToLive,
    ClusteredHashTableEntry.ENTRY_AUTHORITY_ANY_USER,
    ClusteredHashTableEntry.DUPLICATE_KEY_FAIL);

// Store (or put) the entry into the hash table.
cht.put(myEntry);

// Get an entry from the hash table.
ClusteredHashTableEntry output = cht.get(key);

// Close the connection.
cht.close();

```

Using the ClusteredHashTable class causes the AS400 object to connect to the server. For more information, see [Managing connections](#).

## CommandCall class

The CommandCall class allows a Java program to call a non-interactive IBM i command.

Results of the command are available in a list of AS400Message objects.

Input to CommandCall is as follows:

- The command string to run
- The AS400 object that represents the system that will run the command

The command string can be set on the constructor, through the CommandCall setCommand() method, or on the run() method. After the command is run, the Java program can use the getMessageList() method to retrieve any IBM i messages resulting from the command.

Using the CommandCall class causes the AS400 object to connect to the system. See [managing connections](#) for information about managing connections.

When the Java program and the IBM i command are on the same server, the default IBM Toolbox for Java behavior is to look up the thread safety for the command on the system. If threadsafe, the command is run on-thread. You can suppress the run-time lookup by explicitly specifying thread-safety for the command by using the setThreadSafe() method.

## Examples

The following examples show ways you can use the CommandCall class to run different kinds of commands.

**Note:** Read the [Code example disclaimer](#) for important legal information.

### Example: Running a command

The following example shows how to use the CommandCall class to run a command on the system:

```

// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a command call object. This
// program sets the command to run later.
// It could set it here on the constructor.
CommandCall cmd = new CommandCall(sys);

// Run the CRTLIB command

```

```
cmd.run("CRTLIB MYLIB");

// Get the message list which
// contains the result of the command.
AS400Message[] messageList = cmd.getMessageList();

// ... process the message list.

// Disconnect since I am done sending
// commands to the server
sys.disconnectService(AS400.COMMAND);
```

### Example: Running a user-specified command

“[Example: Using CommandCall](#)” on page 361 shows how to run a command that is specified by the user.

#### Related information

[CommandCall Javadoc](#)

[AS400Message Javadoc](#)

[AS400 Javadoc](#)

## Connection pooling

Use connection pools to share connections and manage sets (pools) of connections to an IBM i system. For example, an application can retrieve a connection from a pool, use it, then return it to the pool for reuse.

The `AS400ConnectionPool` class manages a pool of `AS400` objects. The `AS400JDBCConnectionPool` class represents a pool of `AS400JDBCConnections` that are available for use by a Java program as part of IBM Toolbox for Java support for the JDBC 2.0 Optional Package API. The JDBC `ConnectionPool` interface is also supported in the JDBC 3.0 API, which is bundled with the Java 2 Platform, Standard Edition, version 1.4.

A connection pool of either type keeps track of the number of connections it creates. Using methods inherited from `ConnectionPool`, you can set several connection pool properties, including:

- the maximum number of connections that can be given out by a pool
- the maximum lifetime of a connection
- the maximum inactivity time of a connection

In terms of performance, connecting to the server is an expensive operation. Using connection pools can improve performance by avoiding repeated connection times. For example, create connections when you create the connection pool by filling the pool with active (preconnected) connections using the `AS400ConnectionPool` class. Instead of creating new connections, you can use a connection pool to easily retrieve, use, return, and reuse the connection objects.

Retrieve a connection using an `AS400ConnectionPool` by specifying the system name, user id, the password, and (optionally) the service. To specify the service to which you want to connect, use constants from the `AS400` class (`FILE`, `PRINT`, `COMMAND`, and so on).

After retrieving and using the connection, applications return connections to the pool. It is the responsibility of each application to return connections to the pool for reuse. When connections are not returned to the pool, the connection pool continues to grow in size and connections are not reused.

See [managing connections](#) for more information about managing when a connection to the system is opened when using the `AS400ConnectionPool` classes.

### Example: Using AS400ConnectionPool

“[Example: Using AS400ConnectionPool](#)” on page 362 shows how to reuse `AS400` objects.

#### Related information

[AS400ConnectionPool Javadoc](#)

[AS400 Javadoc](#)

## Data area

The IBM Toolbox for Java DataArea class is an abstract base class that represents an IBM i data area object.

This base class has four subclasses that support the following: character data, decimal data, logical data, and local data areas that contain character data.

Using the DataArea class, you can do the following:

- Get the size of the data area
- Get the name of the data area
- Return the AS400 system object for the data area
- Refresh the attributes of the data area
- Set the system where the data area exists

Using the DataArea class causes the AS400 object to connect to the server. See [managing connections](#) for information about managing connections.

## CharacterDataArea

The CharacterDataArea class represents a data area on the server that contains character data. Character data areas do not have a facility for tagging the data with the proper CCSID; therefore, the data area object assumes that the data is in the user's CCSID. When writing, the data area object converts from a string (Unicode) to the user's CCSID before writing the data to the server. When reading, the data area object assumes that the data is the CCSID of the user and converts from that CCSID to Unicode before returning the string to the program. When reading data from the data area, the amount of data read is by number of characters, not by the number of bytes.

Using the CharacterDataArea class, you can do the following:

- Clear the data area so that it contains all blanks.
- Create a character data area on the system using default property values
- Create a character data area with specific attributes
- Delete the data area from the system where the data area exists
- Return the IFS path name of the object represented by the data area.
- Read all of the data that is contained in the data area
- Read a specified amount of data from the data area starting at offset 0 or the offset that you specified
- Set the fully qualified integrated file system path name of the data area
- Write data to the beginning of the data area
- Write a specified amount of data to the data area starting at offset 0 or the offset that you specified

## DecimalDataArea

The DecimalDataArea class represents a data area on the server that contains decimal data.

Using the DecimalDataArea class, you can do the following:

- Clear the data area so that it contains 0.0
- Create a decimal data area on the system using default property values
- Create a decimal data area with specified attributes
- Delete the data area from the server where the data area exists
- Return the number of digits to the right of the decimal point in the data area
- Return the IFS path name of the object represented by the data area.
- Read all of the data that is contained in the data area

- Set the fully qualified integrated file system path name of the data area
- Write data to the beginning of the data area

**Example: Using DecimalDataArea** The following example shows how to create and to write to a decimal data area:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Establish a connection to the server "MyServer".
AS400 system = new AS400("MyServer");
// Create a DecimalDataArea object.
QSYSObjectPathName path = new QSYSObjectPathName("MYLIB", "MYDATA", "DTAARA");
DecimalDataArea dataArea = new DecimalDataArea(system, path.getPath());
// Create the decimal data area on the server using default values.
dataArea.create();
// Clear the data area.
dataArea.clear();
// Write to the data area.
dataArea.write(new BigDecimal("1.2"));
// Read from the data area.
BigDecimal data = dataArea.read();
// Delete the data area from the server.
dataArea.delete();
```

## LocalDataArea

The LocalDataArea class represents a local data area on the server. A local data area exists as a character data area on the server, but the local data area does have some restrictions of which you should be aware.

The local data area is associated with a server job and cannot be accessed from another job. Therefore, you cannot create or delete the local data area. When the server job ends, the local data area associated with that server job is automatically deleted, and the LocalDataArea object that is referring to the job is no longer valid. You should also note that local data areas are a fixed size of 1024 characters on the server.

Using the LocalDataArea class, you can do the following:

- Clear the data area so that it contains all blanks
- Read all of the data that is contained in the data area
- Read a specified amount of data from the data area starting at offset that you specified
- Write data to the beginning of the data area
- Write a specified amount of data to the data area where the first character is written to offset

## LogicalDataArea

The LogicalDataArea class represents a data area on the server that contains logical data.

Using the LogicalDataArea class, you can do the following:

- Clear the data area so that it contains false
- Create a character data area on the server using default property values
- Create a character data area with specified attributes
- Delete the data area from the server where the data area exists
- Return the IFS path name of the object represented by the data area.
- Read all of the data that is contained in the data area
- Set the fully qualified integrated file system path name of the data area
- Write data to the beginning of the data area

## DataAreaEvent

The DataAreaEvent class represents a data area event.

You can use the `DataAreaEvent` class with any of the `DataArea` classes. Using the `DataAreaEvent` class, you can do the following:

- Get the identifier for the event

## DataAreaListener

The `DataAreaListener` class provides an interface for receiving data area events.

You can use the `DataAreaListener` class with any of the `DataArea` classes. You can invoke the `DataAreaListener` class when any of the following are performed:

- Clear
- Create
- Delete
- Read
- Write

[DataArea Javadoc](#)

[CharacterDataArea Javadoc](#)

[DecimalDataArea Javadoc](#)

[LocalDataArea Javadoc](#)

[LogicalDataArea Javadoc](#)

[DataAreaEvent Javadoc](#)

[DataAreaListener Javadoc](#)

## Data conversion and description

The data conversion classes provide the capability to convert numeric and character data between IBM i and Java formats. Conversion may be needed when accessing IBM i data from a Java program. The data conversion classes support conversion of various numeric formats and between various EBCDIC code pages and Unicode.

The **data description** classes build on the data conversion classes to convert all fields in a record with a single method call. The `RecordFormat` class allows the program to describe data that makes up a `DataQueueEntry`, `ProgramCall` parameter, a record in a database file accessed through record-level access classes, or any buffer of system data. The `Record` class allows the program to convert the contents of the record and access the data by field name or index.

The **converter** classes provide fast and efficient conversion between Java and your system. `BinaryConverter` converts between Java byte arrays and Java simple types. `CharConverter` converts between Java String objects and IBM i code pages. For more information, see the [Converters](#) topic.

## Data types

The `AS400DataType` is an interface that defines the methods required for data conversion. A Java program uses data types when individual pieces of data need to be converted. Conversion classes exist for the following types of data:

- [Numeric](#)
- [Text \(character\)](#)
- [Composite \(numeric and text\)](#)

### Example: Using AS400DataType classes

The following example illustrates using `AS400DataType` classes with `ProgramCall` to supply data for program parameters and to interpret the data returned in program parameters.

[Example: Using AS400DataType classes with ProgramCall](#)

## Conversion specifying a record format

The IBM Toolbox for Java provides classes for building on the data types classes to handle converting data one record at a time instead of one field at a time. For example, suppose a Java program reads data off a data queue. The data queue object returns a byte array of IBM i data to the Java program. This array can potentially contain many types of IBM i data. The application can convert one field at a time out of the byte array by using the data types classes, or the program can create a record format that describes the fields in the byte array. That record then does the conversion.

Record format conversion can be useful when you are working with data from the program call, data queue, and record-level access classes. The input and output from these classes are byte arrays that can contain many fields of various types. Record format converters can make it easier to convert this data between IBM i format and Java format.

Conversion through record format uses three classes:

- [FieldDescription](#) classes identify a field or parameter with a data type and a name.
- A [RecordFormat](#) class describes a group of fields.
- A [Record](#) class joins the description of a record (in the RecordFormat class) with the actual data.
- A [LineDataRecordWriter](#) class writes a record to an OutputStream in line data format

### Examples: Using record format conversion classes

The following examples illustrate using the record format conversion classes with data queues:

[Using the Record and RecordFormat classes to put data on a queue](#)

[Using the FieldDescription, RecordFormat, and Record classes](#)

[AS400DataType Javadoc](#)

## Conversion classes for numeric data

Conversion classes for numeric data convert numeric data from the format used on the IBM i (called **system format** in the following table) to the Java format.

Supported types are shown in the following table:

Numeric Type	Description
<a href="#">AS400Bin2</a>	Converts between a signed two-byte number in the system format to a Java Short object.
<a href="#">AS400Bin4</a>	Converts between a signed four-byte number in the system format and a Java Integer object.
<a href="#">AS400ByteArray</a>	Converts between two byte arrays. This is useful because the converter correctly zero-fills and pads the target buffer.
<a href="#">AS400Float4</a>	Converts between a signed four-byte floating point number in the system format and a Java Float object.
<a href="#">AS400Float8</a>	Converts between a signed eight-byte floating point number in the system format and a Java Double object.
<a href="#">AS400PackedDecimal</a>	Converts between a packed-decimal number in the system format and a Java BigDecimal object.
<a href="#">AS400UnsignedBin2</a>	Converts between an unsigned two-byte number in the system format and a Java Integer object.
<a href="#">AS400UnsignedBin4</a>	Converts between an unsigned four-byte number in the system format and a Java Long object.

Numeric Type	Description
<a href="#">AS400ZonedDecimal</a>	Converts between a zoned-decimal number in the system format and a Java BigDecimal object.

## Examples

The following examples show data conversions that use a numeric type in the system format and a Java int:

### Example: Converting from the system format to a Java int

```
// Create a buffer to hold the system data type. Assume the buffer is
// filled with numeric data in the system format by data queues,
// program call, and so on.
byte[] data = new byte[100];

// Create a converter for this system data type.
AS400Bin4 bin4Converter = new AS400Bin4();

// Convert from system type to Java object. The number starts at the
// beginning of the buffer.
Integer intObject = (Integer) bin4Converter.toObject(data,0);

// Extract the simple Java type from the Java object.
int i = intObject.intValue();
```

### Example: Converting from a Java int to the system format

```
// Create a Java object that contains the value to convert.
Integer intObject = new Integer(22);

// Create a converter for the system data type.
AS400Bin4 bin4Converter = new AS400Bin4();

// Convert from Java object to system data type.
byte[] data = bin4Converter.toBytes(intObject);

// Find out how many bytes of the buffer were filled with the
// system value.
int length = bin4Converter.getBytesLength();
```

## Text conversion

Character data is converted through the IBM Toolbox for Java AS400Text class. This class converts character data between an EBCDIC code page and character set (CCSID), and Unicode.

When the AS400Text object is constructed, the Java program specifies the length of the string to be converted and the server CCSID or encoding. The CCSID of the Java program is assumed to be 13488 Unicode. The toBytes() method converts from Java form to byte array in IBM i format. The toObject() method converts from a byte array in IBM i format to Java format.

The AS400BidiTransform class provides layout transformations that allow the conversion of bidirectional text in IBM i format (after its conversion to Unicode) to bidirectional text in Java format, or from Java format to IBM i format. The default conversion is based on the CCSID of the job. To alter the direction and shaping of the text, specify a BidiStringType. Note that where IBM Toolbox for Java objects perform the conversion internally, as in the DataArea class, the objects have a method to override the string type. For example, the DataArea class has addVetoableChangeListener() method that you can specify to listen for a veto changes to certain properties, including string type.

### Example: Converting text data

The following example assumes that a DataQueueEntry object returns text in EBCDIC. The example converts the EBCDIC data to Unicode, so that the Java program can use data:

```
// Assume the data queue work has already been done to
// retrieve the text from the system and the data has been
// put in the following buffer.
```



```

int textLength = 100;
byte[] data = new byte[textLength];

// Create a converter for the system data type. Note a default
// converter is being built. This converter assumes the IBM i
// EBCDIC code page matches the client's locale. If this is not
// true the Java program can explicitly specify the EBCDIC
// CCSID to use. However, it is recommended that you specify a
// CCSID whenever possible (see the Notes: below).
AS400Text textConverter = new AS400Text(textLength)

// Note: Optionally, you can create a converter for a specific
// CCSID. Use an AS400 object in case the program is running
// as an IBM Toolbox for Java proxy client.
int ccsid = 37;
AS400 system = ...; // AS400 object
AS400Text textConverter = new AS400Text(textLength, ccsid, system);

// Note: You can also create a converter with just the AS400 object.
// This converter assumes the IBM i code page matches
// the CCSID returned by the AS400 object.
AS400Text textConverter = new AS400Text(textLength, system);

// Convert the data from EBCDIC to Unicode. If the length of
// the AS400Text object is longer than the number of
// converted characters, the resulting String will be
// blank-padded out to the specified length.
String javaText = (String) textConverter.toObject(data);

```

## Related information

[AS400Text Javadoc](#)

[AS400BidiTransform Javadoc](#)

[BidiStringType Javadoc](#)

## Conversion classes for composite types

This topic describes IBM Toolbox for Java conversion classes for composite types.

- AS400Array - Allows the Java program to work with an array of data types.
- AS400Structure - Allows the Java program to work with a structure whose elements are data types.

## Example: Converting composite data types

The following example shows conversion from a Java structure to a byte array and back again. The example assumes that the same data format is used for both sending and receiving data.

```

// Create a structure of data types that corresponds to a structure
// that contains: - a four-byte number
//               - four bytes of pad
//               - an eight-byte number
//               - 40 characters
AS400DataType[] myStruct =
{
    new AS400Bin4(),
    new AS400ByteArray(4),
    new AS400Float8(),
    new AS400Text(40)
};

// Create a conversion object using the structure.
AS400Structure myConverter = new AS400Structure(myStruct);

// Create the Java object that holds the data to send to the server.
Object[] myData =
{
    new Integer(88),           // the four-byte number
    new byte[0],              // the pad (let the conversion object 0 pad)
    new Double(23.45),        // the eight-byte floating point number
    "This is my structure"    // the character string
};

// Convert from Java object to byte array.
byte[] myAS400Data = myConverter.toBytes(myData);

```

```

// ... send the byte array to the server. Get data back from the
// server. The returned data will also be a byte array.

// Convert the returned data from IBM i to Java format.
Object[] myRoundTripData = (Object[])myConverter.toObject(myAS400Data,0);

// Pull the third object out of the structure. This is the double.
Double doubleObject = (Double) myRoundTripData[2];

// Extract the simple Java type from the Java object.
double d = doubleObject.doubleValue();

```

[AS400Array Javadoc](#)

[AS400Structure Javadoc](#)

### ***FieldDescription classes***

The field description classes allow the Java program to describe the contents of a field or parameter with a data type and a string containing the name of the field. If the program is working with data from record-level access, it can also specify any IBM i data definition specification (DDS) keywords that further describe the field.

[Field description classes](#)

The field description classes are as follows:

- [BinaryFieldDescription](#)
- [CharacterFieldDescription](#)
- [DateFieldDescription](#)
- [DBCSEitherFieldDescription](#)
- [DBCSTextGraphicFieldDescription](#)
- [DBCSTextOnlyFieldDescription](#)
- [DBCSTextOpenFieldDescription](#)
- [FloatFieldDescription](#)
- [HexFieldDescription](#)
- [PackedDecimalFieldDescription](#)
- [TimeFieldDescription](#)
- [TimestampFieldDescription](#)
- [ZonedDecimalFieldDescription](#)

### **Example: Creating field descriptions**

The following example assumes that the entries on a data queue have the same format. Each entry has a message number (AS400Bin4), a time stamp (8 characters), and message text (50 characters) that you can describe with field descriptions:

```

// Create a field description for the numeric data. Note it uses the
// AS400Bin4 data type. It also names the field so it can be accessed by
// name in the record class.
BinaryFieldDescription bfd = new BinaryFieldDescription(new AS400Bin4(), "msgNumber");

// Create a field description for the character data. Note it uses the
// AS400Text data type. It also names the field so it can be accessed by
// name by the record class.
CharacterFieldDescription cfd1 = new CharacterFieldDescription(new AS400Text(8),
"msgTime");

// Create a field description for the character data. Note it uses the
// AS400Text data type. It also names the field so it can be accessed by
// name by the record class.
CharacterFieldDescription cfd2 = new CharacterFieldDescription(new AS400Text(50),
"msgText");

```

You can now group the field descriptions in an instance of the RecordFormat class. To see how to add the field descriptions to a RecordFormat object, see the example on the following page:

[“RecordFormat class” on page 35](#)

### **RecordFormat class**

The IBM Toolbox for Java RecordFormat class allows the Java program to describe a group of fields or parameters. A record object contains data described by a RecordFormat object. If the program is using record-level access classes, the RecordFormat class also allows the program to specify descriptions for key fields.

A RecordFormat object contains a set of field descriptions. The field description can be accessed by index or by name. Methods exist on the RecordFormat class to do the following:

- Add field descriptions to the record format.
- Add key field descriptions to the record format.
- Retrieve field descriptions from the record format by index or by name.
- Retrieve key field descriptions from the record format by index or by name.
- Retrieve the names of the fields that make up the record format.
- Retrieve the names of the key fields that make up the record format.
- Retrieve the number of fields in the record format.
- Retrieve the number of key fields in the record format.
- Create a Record object based on this record format.

### **Example: Adding field descriptions to a record format**

The following example adds the field descriptions created in the [field description](#) example to a record format:

```
// Create a record format object, then fill it with field descriptions.
RecordFormat rf = new RecordFormat();
rf.addFieldDescription(bfd);
rf.addFieldDescription(cfd1);
rf.addFieldDescription(cfd2);
```

To see how to create a record from the record format, see the example on the following page:

[“Record class” on page 35](#)

[RecordFormat Javadoc](#)

### **Record class**

The IBM Toolbox for Java record class allows the Java program to process data described by the record format class.

Data is converted between byte arrays containing the server data and Java objects. Methods are provided in the record class to do the following:

- [Retrieve the contents](#) of a field, by index or by name, as a Java object.
- [Retrieve the number](#) of fields in the record.
- [Set the contents](#) of a field, by index or by name, with a Java object.
- Retrieve the contents of the record as server data [into a byte array or output stream](#).
- Set the contents of the record [from a byte array or an input stream](#).
- Convert the contents of the record [to a String](#).

## Example: Reading a record

The following example uses the record format created in the [record format example](#):

```
// Assume data queue setup work has already been done. Now read a
// record from the data queue.
DataQueueEntry dqe = dq.read();

// The data from the data queue is now in a data queue entry. Get
// the data out of the data queue entry and put it in the record.
// We obtain a default record from the record format object and
// initialize it with the data from the data queue entry.
Record dqRecord = rf.getNewRecord(dqe.getData());

// Now that the data is in the record, pull the data out one
// field at a time, converting the data as it is removed. The result
// is data in a Java object that the program can now process.
Integer msgNumber = (Integer) dqRecord.getField("msgNumber");
String msgTime = (String) dqRecord.getField("msgTime");
String msgText = (String) dqRecord.getField("msgText");
```

### Related information

[Record Javadoc](#)

### *Retrieving the contents of a field*

Retrieve the contents of a Record object by having your Java program either get one field at a time or get all the fields at once.

Use the `getField()` method of the Record class to retrieve a single field by name or by index. Use the `getFields()` method to retrieve all of the fields as an `Object[]`.

The Java program must cast the Object (or element of the `Object[]`) returned to the appropriate Java object for the retrieved field. The following table shows the appropriate Java object to cast based on the field type.

Field Type (DDS)	Field Type (FieldDescription)	Java Object
BINARY (B), length <= 4	BinaryFieldDescription	Short
BINARY (B), length >= 5	BinaryFieldDescription	Integer
CHARACTER (A)	CharacterFieldDescription	String
DBCS Either (E)	DBCSEitherFieldDescription	String
DBCS Graphic (G)	DBCSGlobalFieldDescription	String
DBCS Only (J)	DBCSEitherFieldDescription	String
DBCS Open (O)	DBCSEitherFieldDescription	String
DATE (L)	DateFieldDescription	String
FLOAT (F), single precision	FloatFieldDescription	Float
FLOAT (F), double precision	FloatFieldDescription	Double
HEXADECIMAL (H)	HexFieldDescription	byte[]
PACKED DECIMAL (P)	PackedDecimalFieldDescription	BigDecimal
TIME (T)	TimeDecimalFieldDescription	String
TIMESTAMP (Z)	TimestampDecimalFieldDescription	String
ZONED DECIMAL (P)	ZonedDecimalFieldDescription	BigDecimal

### Related information

[Record Javadoc](#)

## Setting the contents of a field

Set the contents of a Record object by using the `setField()` method in your Java program.

The Java program must specify the appropriate Java object for the field being set. The following table shows the appropriate Java object for each possible field type.

Field Type (DDS)	Field Type (FieldDescription)	Java Object
BINARY (B), length <= 4	BinaryFieldDescription	Short
BINARY (B), length >= 5	BinaryFieldDescription	Integer
CHARACTER (A)	CharacterFieldDescription	String
DBCS Either (E)	DBCSEitherFieldDescription	String
DBCS Graphic (G)	DBCSGraphicFieldDescription	String
DBCS Only (J)	DBCSEitherFieldDescription	String
DBCS Open (O)	DBCSEitherFieldDescription	String
DATE (L)	DateFieldDescription	String
FLOAT (F), single precision	FloatFieldDescription	Float
FLOAT (F), double precision	FloatFieldDescription	Double
HEXADECIMAL (H)	HexFieldDescription	byte[]
PACKED DECIMAL (P)	PackedDecimalFieldDescription	BigDecimal
TIME (T)	TimeDecimalFieldDescription	String
TIMESTAMP (Z)	TimestampDecimalFieldDescription	String
ZONED DECIMAL (P)	ZonedDecimalFieldDescription	BigDecimal

### Related information

[Record Javadoc](#)

### ***LineDataRecordWriter class***

The `LineDataRecordWriter` class writes the record data, in line data format, to an `OutputStream`. The class translates the data into bytes by using the specified CCSID. The record format associated with the record determines the format of the data.

[LineDataRecordWriter](#)

Using `LineDataRecordWriter` requires that the following record format attributes be set:

- Record format ID
- Record format type

In conjunction with the `Record` or the `RecordFormat` classes, the `LineDataRecordWriter` takes a record as input to the `writeRecord()` method. (`Record` takes a `RecordFormat` as input when you instantiate it.)

The `LineDataRecordWriter` class provides methods that allow you to:

- Get the CCSID
- Get the name of the encoding
- Write the record data, in line data format, to an `OutputStream`

### **Example: Using the LineDataRecordWriter class**

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows one way to use the LineDataRecordWriter class to write a record:

```
// Example using the LineDataRecordWriter class.
try
{
    // create a ccsid
    ccsid_ = system_.getCcsid();

    // create output queue and specify spooled file data to be *LINE
    OutputQueue outQ = new OutputQueue(system_, "/QSYS.LIB/RLPLIB.LIB/LDRW.OUTQ");
    PrintParameterList parms = new PrintParameterList();
    parms.setParameter(PrintObject.ATTR_PRTDEVTYPE, "*LINE");

    // initialize the record format for writing data
    RecordFormat recfmt = initializeRecordFormat();

    // create a record and assign data to be printed...
    Record record = new Record(recfmt);
    createRecord(record);

    SpooledFileOutputStream os = null;
    try {
        // create the output spooled file to hold the record data
        os = new SpooledFileOutputStream(system_, parms, null, outQ);
    }
    catch (Exception e) {
        System.out.println("Error occurred creating spooled file");
        e.printStackTrace();
    }

    // create the line data record writer
    LineDataRecordWriter ldw;
    ldw = new LineDataRecordWriter(os, ccsid_, system_);

    // write the record of data
    ldw.writeRecord(record);

    // close the outputstream
    os.close();
}

catch(Exception e)
{
    failed(e, "Exception occurred.");
}
```

[LineDataRecordWriter Javadoc](#)

[Record Javadoc](#)

[RecordFormat Javadoc](#)

## Data queues

The DataQueue classes allow the Java program to interact with server data queues.

IBM i data queues have the following characteristics:

- The data queue allows for fast communications between jobs. Therefore, it is an excellent way to synchronize and pass data between jobs.
- Many jobs can simultaneously access the data queues.
- Messages on a data queue are free format. Fields are not required as they are in database files.
- The data queue can be used for either synchronous or asynchronous processing.
- The messages on a data queue can be ordered in one the following ways:
  - Last-in first-out (LIFO). The last (newest) message that is placed on the data queue is the first message that is taken off the queue.
  - First-in first-out (FIFO). The first (oldest) message that is placed on the data queue is the first message that is taken off the queue.
  - Keyed. Each message on the data queue has a key associated with it. A message can be taken off the queue only by specifying the key that is associated with it.

The data queue classes provide a complete set of interfaces for accessing server data queues from your Java program. It is an excellent way to communicate between Java programs and programs on the server that are written in any programming language.

A required parameter of each data queue object is the AS400 object that represents the server that has the data queue or where the data queue is to be created.

Using the data queue classes causes the AS400 object to connect to the server. See [managing connections](#) for information about managing connections.

Each data queue object requires the integrated file system path name of the data queue. The type for the data queue is DTAQ. See [integrated file system path names](#) for more information.

## Sequential and keyed data queues

The data queue classes support sequential and keyed data queues.:

Methods common to both types of queues are in the BaseDataQueue class. The DataQueue class extends the BaseDataQueue class in order to complete the implementation of sequential data queues. The BaseDataQueue class is extended by the KeyedDataQueue class to complete the implementation of keyed data queues.

When data is read from a data queue, the data is placed in a DataQueueEntry object. This object holds the data for both keyed and sequential data queues. Additional data available when reading from a keyed data queue is placed in a KeyedDataQueueEntry object that extends the DataQueueEntry class.

The data queue classes do not alter data that is written to or is read from the server data queue. The Java program must correctly format the data. The [data conversion classes](#) provide methods for converting data.

## Example: Using DataQueue and DataQueueEntry

The following example creates a DataQueue object, reads data from the DataQueueEntry object, and then disconnects from the system.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Create an AS400 object
AS400 sys = new AS400("mySystem.myCompany.com");

// Create the DataQueue object
DataQueue dq = new DataQueue(sys, "/QSYS.LIB/MYLIB.LIB/MYQUEUE.DTAQ");

// read data from the queue
DataQueueEntry dqData = dq.read();

// get the data out of the DataQueueEntry object.
byte[] data = dqData.getData();

// ... process the data

// Disconnect since I am done using data queues
sys.disconnectService(AS400.DATAQUEUE);
```

### Related information

[BaseDataQueue Javadoc](#)

[DataQueue Javadoc](#)

[KeyedDataQueue Javadoc](#)

[DataQueueEntry Javadoc](#)

[KeyedDataQueueEntry Javadoc](#)

## ***Sequential data queues***

Entries on a sequential data queue on the server are removed in first-in first-out (FIFO) or last-in first-out (LIFO) sequence.

The BaseDataQueue and DataQueue classes provide the following methods for working with sequential data queues:

- Create a data queue on the server. The Java program must specify the maximum size of an entry on the data queue. The Java program can optionally specify additional data queue parameters (FIFO vs LIFO, save sender information, specify authority information, force to disk, and provide a queue description) when the queue is created.
- Peek at an entry on the data queue without removing it from the queue. The Java program can wait or return immediately if no entry is currently on the queue.
- Read an entry off the queue. The Java program can wait or return immediately if no entry is available on the queue.
- Write an entry to the queue.
- Clear all entries from the queue.
- Delete the queue.

The BaseDataQueue class provides additional methods for retrieving the attributes of the data queue.

## **Examples: Working with sequential data queues**

The following sequential data queue examples illustrate how a producer puts items on a data queue and how a consumer takes the items off the queue and processes them:

[“Example: Using DataQueue classes to put data on a queue” on page 375](#)

[“Example: Using DataQueue classes to read entries off a data queue” on page 378](#)

[BaseDataQueue Javadoc](#)

[DataQueue Javadoc](#)

## ***Keyed data queues***

The BaseDataQueue and KeyedDataQueue classes provide methods for working with keyed data queues.

- Create a keyed data queue on the system. The Java program must specify key length and maximum size of an entry on the queue. The Java program can optionally specify authority information, save sender information, force to disk, and provide a queue description.
- Peek at an entry based on the specified key without removing it from the queue. The Java program can wait or return immediately if no entry is currently on the queue that matches the key criteria.
- Read an entry off the queue based on the specified key. The Java program can wait or return immediately if no entry is available on the queue that matches the key criteria.
- Write a keyed entry to the queue.
- Clear all entries or all entries that match a specified key.
- Delete the queue.

The BaseDataQueue and KeyedDataQueue classes also provide additional methods for retrieving the attributes of the data queue.

## **Examples: Working with keyed data queues**

The following keyed data queue examples illustrate how a producer puts items on a data queue, and how a consumer takes the items off the queue and processes them:

[“Example: Using KeyedDataQueue” on page 382](#)

[“Example: Using KeyedDataQueue classes to read entries off a data queue” on page 385](#)



## Digital certificates

Digital certificates are digitally-signed statements used for secured transactions over the internet.


To make a secure connection using the Secure Sockets Layer (SSL), a digital certificate is required.

Digital certificates comprise the following:

- The public encryption key of the user
- The name and address of the user
- The digital signature of a third-party certification authority (CA). The authority's signature means that the user is a trusted entity.
- The issue date of the certificate
- The expiration date of the certificate

As an administrator of a secured server, you can add a certification authority's "trusted root key" to the server. This means that your server will trust anyone who is certified through that particular certification authority.

Digital certificates also offer encryption, ensuring a secure transfer of data through a private encryption key.

You can create digital certificates through the `javakey` tool. (For more information about `javakey` and Java security, see the [Sun Microsystems, Inc., Java Security page](#) ) The IBM Toolbox for Java has classes that administer digital certificates on the system.

The `AS400Certificate` classes provide methods to manage X.509 ASN.1 encoded certificates. Classes are provided to do the following:

- Get and set certificate data.
- List certificates by validation list or user profile.
- Manage certificates, for example, add a certificate to a user profile or delete a certificate from a validation list.

Using a certificate class causes the AS400 object to connect to the server. See [managing connections](#) for information about managing connections.

On the server, certificates belong to a validation list or to a user profile.

- The `AS400CertificateUserProfileUtil` class has methods for managing certificates on a user profile.
- The `AS400CertificateVldUtil` class has methods for managing certificates in a validation list.

Using `AS400CertificateUserProfileUtil` and `AS400CertificateVldUtil` requires that you install base operating system option 34 (Digital Certificate Manager). These two classes extend `AS400CertificateUtil`, which is an abstract base classes that defines methods common to both subclasses.

The `AS400Certificate` class provides methods to read and write certificate data. Data is accessed as an array of bytes. The `Java.Security` package in Java virtual machine 1.2 provides classes that can be used to get and set individual fields of the certificate.

## Listing certificates

To get a list of certificates, the Java program must do the following:

1. Create an AS400 object.
2. Construct the correct certificate object. Different objects are used for listing certificates on a user profile (`AS400CertificateUserProfileUtil`) versus listing certificates in a validation list (`AS400CertificateVldUtil`).

3. Create selection criteria based on certificate attributes. The AS400CertificateAttribute class contains attributes used as selection criteria. One or more attribute objects define the criteria that must be met before a certificate is added to the list. For example, a list might contain only certificates for a certain user or organization.
4. Create a user space on the server and put the certificate into the user space. Large amounts of data can be generated by a list operation. The data is put into a user space before it can be retrieved by the Java program. Use the listCertificates() method to put the certificates into the user space.
5. Use the AS400CertificateUtil.getCertificates() method to retrieve certificates from the user space.

### Example: Listing digital certificates

The following example lists certificates in a validation list. It lists only those certificates belonging to a certain person.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Create an AS400 object. The certificates are on this system.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create the certificate object.
AS400CertificateVldlUtil certificateList =
    new AS400CertificateVldlUtil(sys, "/QSYS.LIB/MYLIB.LIB/CERTLIST.VLDL");

// Create the certificate attribute list. We only want certificates
// for a single person so the list consists of only one element.
AS400CertificateAttribute[] attributeList = new AS400CertificateAttribute[1];
attributeList[0] =
    new AS400CertificateAttribute(AS400CertificateAttribute.SUBJECT_COMMON_NAME, "Jane
Doe");

// Retrieve the list that matches the criteria. User space "myspace"
// in library "mylib" will be used for storage of the certificates.
// The user space must exist before calling this API.
int count = certificateList.listCertificates(attributeList, "/QSYS.LIB/MYLIB.LIB/
MYSPACE.USRSPC");

// Retrieve the certificates from the user space.
AS400Certificates[] certificates =
    certificateList.getCertificates("/QSYS.LIB/MYLIB.LIB/MYSPACE.USRSPC", 0, 8);

// Process the certificates
```

[AS400CertificateUserProfileUtil Javadoc](#)

[AS400CertificateVldlUtil Javadoc](#)

[AS400CertificateAttribute Javadoc](#)

### EnvironmentVariable class

The IBM Toolbox for Java EnvironmentVariable class and the EnvironmentVariableList class enable you to access and set IBM i system-level environment variables.

Each variable has unique identifiers: the system name and the environment variable name. Each environment variable is associated with a CCSID, which is by default the CCSID of the current job, which describes where the contents of the variable are stored.

**Note:** Environment variables are different than system values, although they are often used for the same purpose. See [SystemValues](#) for more information on how to access system values.

Use an EnvironmentVariable object to perform the following actions on an environment variable:

- Get and set the name
- Get and set the system
- Get and set the value (which allows you to change the CCSID)
- Refresh the value

## Example: Creating, setting, and getting environment variables

The following example creates two EnvironmentVariables and sets and gets their values.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Create the system object.
AS400 system = new AS400("mySystem");

// Create the foreground color environment variable and set it to red.
EnvironmentVariable fg = new EnvironmentVariable(system, "FOREGROUND");
fg.setValue("RED");

// Create the background color environment variable and get its value.
EnvironmentVariable bg = new EnvironmentVariable(system, "BACKGROUND");
String background = bg.getValue();
```

[EnvironmentVariable Javadoc](#)

[EnvironmentVariableList Javadoc](#)

## Exceptions

The IBM Toolbox for Java access classes throw exceptions when device errors, physical limitations, programming errors, or user input errors occur. The exception classes are based upon the type of error that occurs instead of the location where the error originates.

Most exceptions contain the following information:

- **Error type:** The exception object that is thrown indicates the type of error that occurred. Errors of the same type are grouped together in an exception class.
- **Error details:** The exception contains a return code to further identify the cause of the error that occurred. The return code values are constants within the exception class.
- **Error text:** The exception contains a text string that describes the error that occurred. The string is translated in the locale of the client Java virtual machine.

## Example: Catching a thrown exception

The following example shows how to catch a thrown exception, retrieve the return code, and display the exception text:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// All the setup work to delete a file on the server through the
// IFSFile class is done. Now try deleting the file.
try
{
    aFile.delete();
}

// The delete failed.
catch (ExtendedIOException e)
{
    // Display the translated string containing the reason that the
    // delete failed.
    System.out.println(e);

    // Get the return code out of the exception and display additional
    // information based on the return code.
    int rc = e.getReturnCode()

    switch (rc)
    {
        case ExtendedIOException.FILE_IN_USE:
            System.out.println("Delete failed, file is in use ");
            break;

        case ExtendedIOException.PATH_NOT_FOUND:
            System.out.println("Delete failed, path not found ");
            break;
```

```

        // For every specific error that you want to track...
        default:
            System.out.println("Delete failed, rc = ");
            System.out.println(rc);
    }
}

```

## FileAttributes class

The IBM Toolbox for Java FileAttributes class represents the set of file attributes that can be retrieved and set through the Get Attributes (Qp0lGetAttr) and Set Attributes (Qp0lSetAttr) APIs.

To obtain the attributes of an object, the object must exist and the caller must have authority to it. Only attributes supported by the specific file system, object type, and system operating release can be retrieved or set.

You can find a complete list of the available attributes in the FileAttributes Javadoc.

### Related information

[FileAttributes Javadoc](#)

[Get Attributes \(Qp0lGetAttr\) API](#)

[Set Attributes \(Qp0lSetAttr\) API](#)

## FTP class

The IBM Toolbox for Java FTP class provides a programmable interface to FTP functions.

You are no longer required to use `java.runtime.exec()` or tell your users to run FTP commands in a separate application. That is, you can program FTP functions directly into your application. So, from within your program, you can do the following:

- Connect to an FTP server
- Send commands to the server
- List the files in a directory
- Get files from the server and put files to the server

### Example: Using FTP to copy files from a server

**Note:** Read the [Code example disclaimer](#) for important legal information.

For example, with the FTP class, you can copy a set of files from a directory on a server:

```

FTP client = new FTP("myServer", "myUID", "myPWD");
client.cd("/myDir");
client.setDataTransferType(FTP.BINARY);
String [] entries = client.ls();

for (int i = 0; i < entries.length; i++)
{
    System.out.println("Copying " + entries[i]);
    try
    {
        client.get(entries[i], "c:\\ftptest\\" + entries[i]);
    }
    catch (Exception e)
    {
        System.out.println("  copy failed, likely this is a directory");
    }
}

client.disconnect();

```

FTP is a generic interface that works with many different FTP servers. Therefore, it is up to the programmer to match the semantics of the server.

## AS400FTP subclass

While the FTP class is a generic FTP interface, the AS400FTP subclass is written specifically for the FTP server on the server. That is, it understands the semantics of the FTP server on the IBM i. For example, this class understands the various steps needed to transfer a save file to the server and performs these steps automatically. AS400FTP also ties into the security facilities of the IBM Toolbox for Java. As with other IBM Toolbox for Java classes, AS400FTP depends on the AS400 object for system name, user ID, and password.

### Example: Using AS400FTP to save a file to the server

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example puts a save file to the server. Note the application does not set data transfer type to binary or use CommandCall to create the save file. Since the extension is .savf, AS400FTP class detects the file to put is a save file so it does these steps automatically.

```
AS400 system = new AS400();
AS400FTP ftp = new AS400FTP(system);
ftp.put("myData.savf", "/QSYS.LIB/MYLIB.LIB/MYDATA.SAVF");
```

[FTP Javadoc](#)

[AS400FTP Javadoc](#)

## Integrated file system classes

The integrated file system classes allow a Java program to access files in the IBM i integrated file system as a stream of bytes or a stream of characters. The integrated file system classes were created because the java.io package does not provide file redirection and other IBM i functionality.

The function that is provided by the IFSFile classes is a superset of the function provided by the file IO classes in the java.io package. All methods in java.io FileInputStream, FileOutputStream, and RandomAccessFile are in the integrated file system classes.

In addition, the classes contain methods to do the following:

- Specify a file sharing mode to deny access to the file while it is in use
- Specify a file creation mode to open, create, or replace the file
- Lock a section of the file and deny access to that part of the file while it is in use
- List the contents of a directory more efficiently
- Cache the contents of a directory to improve performance by limiting calls to the server
- Determine the number of bytes available on the server file system
- Allow a Java applet to access files in the server file system
- Read and write data as text instead of as binary data
- Determine the type of the file object (logical, physical, save, and so on) when the object is in the QSYS.LIB file system

Through the integrated file system classes, the Java program can directly access stream files on the system. The Java program can still use the java.io package, but the client operating system must then provide a method of redirection. For example, if the Java program is running on a Windows 95 or Windows NT operating system, the Network Drives function of IBM i Access for Windows is required to redirect java.io calls to the system. With the integrated file system classes, you do not need IBM i Access for Windows.

A required parameter of the integrated file system classes is the [AS400](#) object that represents the system that contains the file. Using the integrated file system classes causes the AS400 object to connect to the system. See [managing connections](#) for information about managing connections.

The integrated file system classes require the hierarchical name of the object in the integrated file system. Use the forward slash as the path separator character. The following example shows how to access FILE1 in directory path DIR1/DIR2:

```
/DIR1/DIR2/FILE1
```

### Examples: Using integrated file system classes

[“Example: Using IFS classes to copy a file from one directory to another”](#) on page 391 shows how to use the integrated file system classes to copy a file from one directory to another on the system.

[“Example: Using the IFS classes to list the contents of a directory”](#) on page 393 shows how to use the integrated file system classes to list the contents of a directory on the system.

### **IFSFile class**

The IBM Toolbox for Java IFSFile class represents an object in the IBM i integrated file system.

The methods on IFSFile represent operations that are done on the object as a whole. You can use IFSFileInputStream, IFSFileOutputStream, and IFSRandomAccessFile to read and write to the file. The IFSFile class allows the Java program to do the following:

- Determine if the object exists and is a directory or a file
- Determine if the Java program can read from or write to a file
- Determine the length of a file
- Determine the permissions of an object and set the permissions of an object
- Create a directory
- Delete a file or directory
- Rename a file or directory
- Get or set the last modification date of a file
- List the contents of a directory
- List the contents of a directory and save the attribute information to a local cache
- Determine the amount of space available on the system
- Determine the type of the file object when it is in the QSYS.LIB file system

You can get the list of files in a directory by using either the list() method or the listFiles() method:

- The listFiles() method caches information for each file on the initial call. After calling listFiles(), using other methods to query file details results in better performance because the information is retrieved from the cache. For example, calling isDirectory() on an IFSFile object returned from listFiles() does not require a call to the server.
- The list() method retrieves information about each file in a separate request to the server, making it slower and more demanding of server resources.

**Note:** Using listFiles() means that the information in the cache may eventually become stale, so you may need to refresh the data by calling listFiles() again.

### Examples

The following examples show how to use the IFSFile class:

- [“Example: Creating a directory”](#) on page 388
- [“Example: Using IFSFile exceptions to track errors”](#) on page 388
- [“Example: Listing files with a .txt extension”](#) on page 389
- [“Example: Using the IFSFile listFiles\(\) method to list the contents of a directory”](#) on page 389

### Related information

[IFSFile Javadoc](#)

## ***IFSJavaFile class***

This IBM Toolbox for Java class represents a file in the IBM i integrated file system and extends the `java.io.File` class. `IFSJavaFile` allows you to write files for the `java.io.File` interface that access integrated file systems.

`IFSJavaFile` makes portable interfaces that are compatible with `java.io.File` and uses only the errors and exceptions that `java.io.File` uses. `IFSJavaFile` uses the security manager features from `java.io.File`, but unlike `java.io.File`, `IFSJavaFile` uses security features continuously.

You use `IFSJavaFile` with `IFSFileInputStream` and `IFSFileOutputStream`. It does not support `java.io.FileInputStream` and `java.io.FileOutputStream`.

`IFSJavaFile` is based on `IFSFile`; however, its interface is more like `java.io.File` than `IFSFile`. `IFSFile` is an alternative to the `IFSJavaFile` class.

You can get the list of files in a directory by using either the `list()` method or the `listFiles()` method:

- The `listFiles()` method performs better because it retrieves and caches information for each file on the initial call. After that, information about each file is retrieved from the cache.
- The `list()` method retrieves information about each file in a separate request, making it slower and more demanding of server resources.

**Note:** Using `listFiles()` means that the information in the cache eventually become stale, so you may need to refresh the data.

## **Example: Using IFSJavaFile**

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to use the `IFSJavaFile` class:

```
// Work with /Dir/File.txt on the system flash.
AS400 as400 = new AS400("flash");
IFSJavaFile file = new IFSJavaFile(as400, "/Dir/File.txt");

// Determine the parent directory of the file.
String directory = file.getParent();

// Determine the name of the file.
String name = file.getName();

// Determine the file size.
long length = file.length();

// Determine when the file was last modified.
Date date = new Date(file.lastModified());

// Delete the file.
if (file.delete() == false)
{
    // Display the error code.
    System.err.println("Unable to delete file.");
}

try
{
    IFSFileOutputStream os =
        new IFSFileOutputStream(file.getSystem(), file, IFSFileOutputStream.SHARE_ALL, false);
    byte[] data = new byte[256];
    int i = 0;
    for (; i < data.length; i++)
    {
        data[i] = (byte) i;
        os.write(data[i]);
    }
    os.close();
}
catch (Exception e)
{
    System.err.println ("Exception: " + e.getMessage());
}
```

## Related information

[IFSJavaFile Javadoc](#)

### ***IFSFileInputStream***

The IBM Toolbox for Java `IFSFileInputStream` class represents an input stream for reading data from a file on the server.

As in the `IFSFile` class, methods exist in `IFSFileInputStream` that duplicate the methods in `FileInputStream` from the `java.io` package. In addition to these methods, `IFSFileInputStream` has additional methods specific to the IBM i platform. The `IFSFileInputStream` class allows a Java program to do the following:

- Open a file for reading. The file must exist since this class does not create files on the server. You can use a constructor that allows you to specify the file sharing mode.
- Determine the number of bytes in the stream.
- Read bytes from the stream.
- Skip bytes in the stream.
- Lock or unlock bytes in the stream.
- Close the file.

As in `FileInputStream` in `java.io`, this class allows a Java program to read a stream of bytes from the file. The Java program reads the bytes sequentially with only the additional option of skipping bytes in the stream.

In addition to the methods in `FileInputStream`, `IFSFileInputStream` gives the Java program the following options:

- Locking and unlocking bytes in the stream. See [IFSKey](#) for more information.
- Specifying a sharing mode when the file is opened. See [sharing modes](#) for more information.

### **Example: Using IFSFileInputStream**

The following example shows how to use the `IFSFileInputStream` class.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Open a file object that represents the file.
IFSFileInputStream aFile = new IFSFileInputStream(sys, "/mydir1/mydir2/myfile");

// Determine the number of bytes in the file.
int available = aFile.available();

// Allocate a buffer to hold the data
byte[] data = new byte[10240];

// Read the entire file 10K at a time
for (int i = 0; i < available; i += 10240)
{
    aFile.read(data);
}

// Close the file.
aFile.close();
```

## Related information

[IFSFileInputStream Javadoc](#)

### ***IFSTextFileInputStream class***

`IFSTextFileInputStream` has been deprecated and replaced by class `IFSFileReader`.

The [IFSTextFileInputStream](#) class represents a stream of character data read from a file. The data read from the `IFSTextFileInputStream` object is supplied to the Java program in a Java String object, so it is always Unicode. When the file is opened, the `IFSTextFileInputStream` object determines the CCSID of the



data in the file. If the data is stored in an encoding other than Unicode, the `IFSTextFileInputStream` object converts the data from the file's encoding to Unicode before giving the data to the Java program. If the data cannot be converted, an `UnsupportedEncodingException` is thrown.

The following example shows how to use the `IFSTextFileInputStream`:

```
// Work with /File on the system mySystem.
AS400 as400 = new AS400("mySystem");
IFSTextFileInputStream file = new IFSTextFileInputStream(as400, "/File");

// Read the first four characters of the file.
String s = file.read(4);

// Display the characters read. Read the first four
// characters of the file. If necessary, the data is
// converted to Unicode by the IFSTextFileInputStream object.
System.out.println(s);

// Close the file.
file.close();
```

### Related reference

[“IFSFileReader” on page 49](#)

Use this class for reading character files in the integrated file system.

### ***IFSFileReader***

Use this class for reading character files in the integrated file system.

`IFSFileReader` is meant for reading streams of characters. `IFSFileReader` replaces `IFSTextFileOutputStream`.

### Example: Using `IFSFileReader`

The following example illustrates the use of `IFSFileReader`:

```
import java.io.BufferedReader;

// Work with /File1 on the system eniac.
AS400 system = new AS400("eniatic");
IFSFile file = new IFSFile(system, "/File1");
BufferedReader reader = new BufferedReader(new IFSFileReader(file));

// Read the first line of the file, converting characters.
String line1 = reader.readLine();

// Display the String that was read.
System.out.println(line1);

// Close the reader.
reader.close();
```

### Related information

[IFSFileReader Javadoc](#)

### ***IFSFileOutputStream class***

The `IFSFileOutputStream` class represents an output stream for writing data to a file on the server.

As in the `IFSFile` class, methods exist in `IFSFileOutputStream` that duplicate the methods in `FileOutputStream` from the `java.io` package. `IFSFileOutputStream` also has additional methods specific to the server. The `IFSFileOutputStream` class allows a Java program to do the following:

- Open a file for writing. If the file already exists, it is replaced. Constructors are available that specify the file sharing mode and whether the contents of an existing file have been appended.
- Write bytes to the stream.
- Commit to disk the bytes that are written to the stream.
- Lock or unlock bytes in the stream.
- Close the file.

As in `FileOutputStream` in `java.io`, this class allows a Java program to sequentially write a stream of bytes to the file.

In addition to the methods in `FileOutputStream`, `IFSFileOutputStream` gives the Java program the following options:

- Locking and unlocking bytes in the stream. See [IFSKey](#) for more information.
- Specifying a sharing mode when the file is opened. See [sharing modes](#) for more information.

## Example: Using `IFSFileOutputStream`

The following example shows how to use the `IFSFileOutputStream` class:

```
// Create an AS400 object
AS400 sys = new AS400("mySystem.myCompany.com");

// Open a file object that represents the file.
IFSFileOutputStream aFile =
    new IFSFileOutputStream(sys, "/mydir1/mydir2/myfile");

// Write to the file
byte i = 123;
aFile.write(i);

// Close the file.
aFile.close();
```

[IFSFileOutputStream Javadoc](#)

## ***IFSTextFileOutputStream class***

`IFSTextFileOutputStream` has been deprecated and replaced by class `IFSFileWriter`.

The [IFSTextFileOutputStream](#) class represents a stream of character data being written to a file. The data supplied to the `IFSTextFileOutputStream` object is in a Java String object so the input is always Unicode. The `IFSTextFileOutputStream` object can convert the data to another CCSID as it is written to the file, however. The default behavior is to write Unicode characters to the file, but the Java program can set the target CCSID before the file is opened. In this case, the `IFSTextFileOutputStream` object converts the characters from Unicode to the specified CCSID before writing them to the file. If the data cannot be converted, an `UnsupportedEncodingException` is thrown.

## Example: Using `IFSTextFileOutputStream`

The following example shows how to use `IFSTextFileOutputStream`:

```
// Work with /File on the system mySystem.
AS400 as400 = new AS400("mySystem");
IFSTextFileOutputStream file =
    new IFSTextFileOutputStream(as400, "/File");

// Write a String to the file. Because no CCSID was
// specified before writing to the file, Unicode
// characters will be written to the file. The file
// will be tagged as having Unicode data.
file.write("Hello world");

// Close the file.
file.close();
```

## Related reference

[“IFSFileWriter” on page 51](#)

Use `IFSFileWriter` for writing character files in the integrated file system. `IFSFileWriter` is meant for writing streams of characters.

### ***IFSFileWriter***

Use `IFSFileWriter` for writing character files in the integrated file system. `IFSFileWriter` is meant for writing streams of characters.

`IFSFileWriter` is the replacement of `IFSTextFileOutputStream`.

### **Example: Using IFSFileWriter**

The following example illustrates the use of `IFSFileWriter`:

```
import java.io.PrintWriter;
import java.io.BufferedWriter;

// Work with /File1 on the system mysystem.
AS400 as400 = new AS400("mysystem");
IFSFile file = new IFSFile(system, "/File1");
PrintWriter writer =
    new PrintWriter(new BufferedWriter(new IFSFileWriter(file)));

// Write a line of text to the file, converting characters.
writer.println(text);

// Close the file.
writer.close();
```

### **Related information**

[IFSFileWriter Javadoc](#)

### ***IFSRandomAccessFile***

The IBM Toolbox for Java `IFSRandomAccessFile` class represents a file on the server for reading and writing data.

The Java program can read and write data sequentially or randomly. As in `IFSFile`, methods exist in `IFSRandomAccessFile` that duplicate the methods in `RandomAccessFile` from the `java.io` package. In addition to these methods, `IFSRandomAccessFile` has additional methods specific to IBM i. Through `IFSRandomAccessFile`, a Java program can do the following:

- Open a file for read, write, or read/write access. The Java program can optionally specify the file sharing mode and the existence option.
- Read data at the current offset from the file.
- Write data at the current offset to the file.
- Get or set the current offset of the file.
- Close the file.

In addition to the methods in `java.io RandomAccessFile`, `IFSRandomAccessFile` gives the Java program the following options:

- Committing to disk bytes written.
- Locking or unlocking bytes in the file.
- Locking and unlocking bytes in the stream. See [IFSKey](#) for more information.
- Specifying a sharing mode when the file is opened. See [sharing modes](#) for more information.
- Specify the existence option when a file is opened. The Java program can choose one of the following:
  - Open the file if it exists; create the file if it does not.
  - Replace the file if it exists; create the file if it does not.
  - Fail the open if the file exists; create the file if it does not.
  - Open the file if it exists; fail the open if it does not.
  - Replace the file if it exists; fail the open if it does not.

## Example: Using IFSRandomAccessFile

The following example shows how to use the IFSRandomAccessFile class to write four bytes at 1K intervals to a file.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Open a file object that represents the file.
IFSRandomAccessFile aFile =
    new IFSRandomAccessFile(sys, "/mydir1/myfile", "rw");

// Establish the data to write.
byte i = 123;

// Write to the file 10 times at 1K intervals.
for (int j=0; j<10; j++)
{
    // Move the current offset.
    aFile.seek(j * 1024);

    // Write to the file. The current offset advances
    // by the size of the write.
    aFile.write(i);
}

// Close the file.
aFile.close();
```

### Related information

[IFSRandomAccessFile Javadoc](#)

### *IFSKey* class

If the Java program allows other programs access to a file at the same time, the Java program can lock bytes in the file for a period of time. During that time, the program has exclusive use of that section of the file. When a lock is successful, the integrated file system classes return an IFSKey object.

This object is supplied to the unlock() method to indicate which bytes to unlock. When the file is closed, the system unlocks all locks that are still on the file (the system does an unlock for every lock that the program did not unlock).

## Example: Using IFSKey

The following example shows how to use the IFSKey class.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Open an input stream. This constructor opens with
// share_all so other programs can open this file.
IFSFileInputStream aFile =
    new IFSFileInputStream(sys, "/mydir1/mydir2/myfile");

// Lock the first 1K bytes in the file. Now no other
// instance can read these bytes.
IFSKey key = aFile.lock(1024);

// Read the first 1K of the file.
byte data[] = new byte[1024];
aFile.read(data);

// Unlock the bytes of the file.
aFile.unlock(key);

// Close the file.
aFile.close();
```

### Related information

[IFSKey Javadoc](#)

## File sharing mode

The Java program can specify a sharing mode when a file is opened. The program either allows other programs to open the file at the same time or has exclusive access to the file.

The following example shows how to specify a file sharing mode.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Open a file object that represents the file. Since
// this program specifies share-none, all other open
// attempts fail until this instance is closed.
IFSFileOutputStream aFile =
    new IFSFileOutputStream(sys,
        "/mydir1/mydir2/myfile",
        IFSFileOutputStream.SHARE_NONE,
        false);

// Perform operations on the file.

// Close the file. Now other open requests succeed.
aFile.close();
```

## IFSSystemView

IFSSystemView provides a gateway to the IBM i integrated file system, for use when constructing javax.swing.JFileChooser objects.

JFileChooser is a standard Java way to build dialogs for navigating and choosing files.

### Example: Using IFSSystemView

The following example demonstrates the use of IFSSystemView:

```
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.IFSJavaFile;
import com.ibm.as400.access.IFSSystemView;
import javax.swing.JFileChooser;
import java.awt.Frame;

// Work with directory /Dir on the system myAS400.
AS400 system = new AS400("myAS400");
IFSJavaFile dir = new IFSJavaFile(system, "/Dir");

JFileChooser chooser = new JFileChooser(dir, new IFSSystemView(system));
Frame parent = new Frame();
int returnVal = chooser.showOpenDialog(parent);
if (returnVal == JFileChooser.APPROVE_OPTION)
{
    IFSJavaFile chosenFile = (IFSJavaFile)(chooser.getSelectedFile());
    System.out.println("You selected the file named " +
        chosenFile.getName());
}
}
```

### Related information

[IFSSystemView Javadoc](#)

## ISeriesNetServer class

The ISeriesNetServer class represents the NetServer service on a server. This class allows the user to query and modify the state and configuration of the NetServer.

ISeriesNetServer replaces the NetServer class.

### Related information

[ISeriesNetServer Javadoc](#)

## JavaApplicationCall class

The JavaApplicationCall class provides you with the ability to have your client use the server JVM to run a Java program that resides on the server.

After establishing a connection to the server from the client, the JavaApplicationCall class lets you configure the following:

1. Set the CLASSPATH environment variable on the server with the setClassPath() method
2. Define your program's parameters with the setParameters() method
3. Run the program with run()
4. Send input from the client to the Java program. The Java program reads the input via standard input which is set with the sendStandardInString() method. You can redirect standard output and standard error from the Java program to the client via the getStandardOutString() and getStandardErrorString().

JavaApplicationCall is a class you call from your Java program. However, the IBM Toolbox for Java also provides utilities to call Java programs that reside on the server. These utilities are complete Java programs you can run from your workstation. See [RunJavaApplication class](#) for more information.

## Example

The example in the JavaApplicationCall Javadoc reference documentation shows how to run a program on the server (that outputs "Hello World!") from the client:

[JavaApplicationCall](#)

## Related information

[JavaApplicationCall Javadoc](#)

## JDBC classes

JDBC is an application programming interface (API) included in the Java platform that enables Java programs to connect to a wide range of databases.

## Supported interfaces

The following table lists the supported JDBC interfaces and the API required to use them:

Supported JDBC interface	API required
Blob provides access to binary large objects (BLOBs).	JDBC 2.1 core, enhanced support in JDBC 4.0
CallableStatement runs SQL stored procedures.	JDK 1.1, enhanced support in JDBC 4.0
Clob provides access to character large objects (CLOBs).	JDBC 2.1 core, enhanced support in JDBC 4.0
Connection represents a connection to a specific database.	JDK 1.1, enhanced support in JDBC 4.0
ConnectionPool represents a pool of Connection objects.	JDBC 2.0 Optional Package
ConnectionPoolDataSource represents a factory for pooled AS400JDBCPooledConnection objects.	JDBC 2.0 Optional Package
DatabaseMetaData provides information about the database as a whole.	JDK 1.1, enhanced support in JDBC 4.0
DataSource represents a factory for database connections.	JDBC 2.0 Optional Package, enhanced support in JDBC 4.0

<b>Supported JDBC interface</b>	<b>API required</b>
Driver creates the connection and returns information about the driver version.	JDK 1.1
ParameterMetaData provides the ability to get information about the types and properties of the parameters in a PreparedStatement object.	JDBC 3.0 API, enhanced support in JDBC 4.0
PooledConnection provides hooks for connection pool management.	JDBC 2.0 Optional Package, enhanced support in JDBC 4.0
PreparedStatement runs compiled SQL statements.	JDK 1.1, enhanced support in JDBC 4.0
ResultSet provides access to a table of data that is generated by running a SQL query or DatabaseMetaData catalog method.	JDK 1.1, enhanced support in JDBC 4.0
ResultSetMetaData provides information about a specific ResultSet.	JDK 1.1, enhanced support in JDBC 4.0
RowId represents an SQL ROWID value.	JDBC 4.0
RowSet is a connected row set that encapsulates a ResultSet.	JDBC 2.0 Optional Package
Savepoint provides finer grained control within transactions	JDBC 3.0 API
SQLXML represents an SQL XML value.	JDBC 4.0
Statement runs SQL statements and obtains the results.	JDK 1.1, enhanced support in JDBC 4.0
StatementEvent is sent to all StatementEventListeners which were registered with a PooledConnection. This occurs when the driver determines that a PreparedStatement that is associated with the PooledConnection has been closed or is determined by the driver to be invalid.	
StatementEventListener registers to be notified of events that occur on PreparedStatements that are in the Statement pool.	JDBC 4.0
XAConnection is a database connection which participates in global XA transactions.	JDBC 2.0 Optional Package
XAResource is resource manager for use in XA transactions.	JDBC 2.0 Optional Package

### **Related reference**

[“JDBC” on page 238](#)

JDBC is an application programming interface (API) included in the Java platform that enables Java programs to connect to a wide range of databases.

[“Example: Using JDBCPopulate to create and populate a table” on page 396](#)

This program uses the IBM Toolbox for Java JDBC driver to create and populate a table.

[“Example: Using JDBCQuery to query a table” on page 406](#)

This program uses the IBM Toolbox for Java JDBC driver to query a table and output its contents.

### **Related information**

[JTOpen: The Open Source version of the IBM Toolbox for Java](#)

[AS400JDBCConnectionPoolDataSource Javadoc](#)

[AS400JDBCPooledConnection Javadoc](#)

[RowID](#)

### **AS400JDBCBlob class**

You can use a AS400JDBCBlob object to access binary large objects (BLOBs), such as sound byte (.wav) files or image (.gif) files.

The key difference between the AS400JDBCBlob class and the AS400JDBCBlobLocator class is where the blob is stored. With the AS400JDBCBlob class, the blob is stored in the database, which inflates the size of the database file. The AS400JDBCBlobLocator class stores a locator (think of it as a pointer) in the database file that points to where the blob is located.

With the AS400JDBCBlob class, the lob threshold property can be used. This property specifies the maximum large object (LOB) size (in kilobytes) that can be retrieved as part of a result set. LOBs that are larger than this threshold are retrieved in pieces using extra communication to the server. Larger LOB thresholds reduce the frequency of communication to the server, but they download more LOB data, even if it is not used. Smaller lob thresholds may increase frequency of communication to the server, but they only download LOB data as it is needed. See [JDBC properties](#) for information about additional properties that are available.

Using the AS400JDBCBlob class, you can do the following:

- Return the entire blob as a stream of uninterpreted bytes
- Return part of the contents of the blob
- Return the length of the blob
- Create a binary stream to write to the blob
- Write a byte array to the blob
- Write all or a portion of byte array to the blob
- Truncate the blob

### **Examples**

The following examples show how to use the AS400JDBCBlob class to read from a blob and update a blob:

#### **Example: Using the AS400JDBCBlob class to read from a blob**

```
Blob blob = resultSet.getBlob(1);
long length = blob.length();
byte[] bytes = blob.getBytes(1, (int) length);
```

#### **Example: Using the AS400JDBCBlob class to update a blob**

```
ResultSet rs = statement.executeQuery ("SELECT BLOB FROM MYTABLE");
rs.absolute(5);
Blob blob = rs.getBlob(1);

// Change the bytes in the blob, starting at the seventh byte
// of the blob
blob.setBytes (7, new byte[] { (byte) 57, (byte) 58, (byte) 98});

//Update the blob in the result set, changing the blob starting
// at the seventh byte of the blob (1-based) and truncating the
// blob at the end of the updated bytes (the blob now has 9 bytes).
rs.updateBlob(1, blob);

// Update the database with the change. This will change the blob
// in the database starting at the seventh byte of the blob, and
// truncating at the end of the updated bytes.
rs.updateRow();
rs.close();
```



## AS400JDBCBlobLocator class

You can use a AS400JDBCBlobLocator object to access a binary large objects.

Using the AS400JDBCBlobLocator class, you can do the following:

- Return the entire blob as a stream of uninterpreted bytes
- Return part of the contents of the blob
- Return the length of the blob
- Create a binary stream to write to the blob
- Write a byte array to the blob
- Write all or a portion of byte array to the blob
- Truncate the blob

[AS400JDBCBlob Javadoc](#)

[AS400JDBCBlobLocator Javadoc](#)

## CallableStatement interface

Use a CallableStatement object to run SQL stored procedures. The stored procedure being called must already be stored in the database. CallableStatement does not contain the stored procedure, it only calls the stored procedure.

A stored procedure can return one or more ResultSet objects and can use IN parameters, OUT parameters, and INOUT parameters. Use Connection.prepareCall() to create new CallableStatement objects.

The CallableStatement object allows you to submit multiple SQL commands as a single group to a database through the use of batch support. You may get better performance by using batch support because processing a group of operations is usually faster than processing them one at a time.

CallableStatement allows you to get and set parameters and columns by name, although using the column index results in better performance.

## Example: Using CallableStatement

The following example shows how to use the CallableStatement interface.

```
// Connect to the server.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem");

// Create the CallableStatement object. It precompiles the
// specified call to a stored procedure. The question marks
// indicate where input parameters must be set and where output
// parameters can be retrieved. The first two parameters are
// input parameters, and the third parameter is an output parameter.
CallableStatement cs = c.prepareCall("CALL MYLIBRARY.ADD (?, ?, ?)");

// Set input parameters.
cs.setInt (1, 123);
cs.setInt (2, 234);

// Register the type of the output parameter.
cs.registerOutParameter (3, Types.INTEGER);

// Run the stored procedure.
cs.execute ();

// Get the value of the output parameter.
int sum = cs.getInt (3);

// Close the CallableStatement and the Connection.
cs.close();
c.close();
```

[AS400JDBCCallableStatement Javadoc](#)

## AS400JDBClob class

You can use a AS400JDBClob object to access character large objects (CLOBs), such as large documents.

The key difference between the AS400JDBClob class and the AS400JDBClobLocator class is where the blob is stored. With the AS400JDBClob class, the clob is stored in the database, which inflates the size of the database file. The AS400JDBClobLocator class stores a locator (think of it as a pointer) in the database file that points to where the clob is located.

With the AS400JDBClob class, the lob threshold property can be used. This property specifies the maximum large object (LOB) size (in kilobytes) that can be retrieved as part of a result set. LOBs that are larger than this threshold are retrieved in pieces using extra communication to the server. Larger LOB thresholds reduce the frequency of communication to the server, but they download more LOB data, even if it is not used. Smaller lob thresholds may increase frequency of communication to the server, but they only download LOB data as it is needed. See [“IBM Toolbox for Java JDBC properties” on page 247](#) for information about additional properties that are available.

Using the AS400JDBClob class, you can do the following:

- Return the entire clob as a stream of ASCII characters
- Return the contents of the clob as a character stream
- Return a part of the contents of the clob
- Return the length of the clob
- Create a Unicode character stream or an ASCII character stream to write to the clob
- Write a String to the clob
- Truncate the clob

## Examples

The following examples show how to use the AS400JDBClob class to read from a clob and update a clob:

### Example: Using the AS400JDBClob class to read from a clob

```
Clob clob = rs.getClob(1);
int length = clob.length();
String s = clob.getSubString(1, (int) length);
```

### Example: Using the AS400JDBClob class to update a clob

```
ResultSet rs = statement.executeQuery ("SELECT CLOB FROM MYTABLE");
rs.absolute(4);
Clob clob = rs.getClob(1);

// Change the characters in the clob, starting at the
// third character of the clob
clob.setString (3, "Small");

// Update the clob in the result set, starting at the third
// character of the clob and truncating the clob at the end of
// the update string (the clob now has 7 characters).
rs.updateClob(1, clob);

// Update the database with the updated clob. This will change the
// clob in the database starting at the third character of the clob,
// and truncating at the end of the update string.
rs.updateRow();
rs.close();
```

## AS400JDBClobLocator class

You can use a AS400JDBClobLocator object to access character large objects (CLOBs).

Using the AS400JDBClobLocator class, you can do the following:

- Return the entire clob as a stream of ASCII characters
- Return the entire clob as a character stream
- Return a part of the contents of the clob
- Return the length of the clob
- Create a Unicode character stream or an ASCII character stream to write to the clob
- Write a String to the clob
- Truncate the clob

[AS400JDBCClob Javadoc](#)

[AS400JDBCClobLocator Javadoc](#)

### ***AS400JDBCConnection class***

The AS400JDBCConnection class provides a JDBC connection to a specific DB2® for IBM i database.

Use `DriverManager.getConnection()` to create new AS400JDBCConnection objects. For more information, see [“Registering the JDBC driver”](#) on page 71.

There are many optional properties that can be specified when the connection is created. Properties can be specified either as part of the URL or in a `java.util.Properties` object. See [“IBM Toolbox for Java JDBC properties”](#) on page 247 for a complete list of properties supported by the AS400JDBCDriver.

**Note:** A connection may contain at most 9999 open statements.

AS400JDBCConnection includes support for savepoints and statement-level holdability, and limited support for returning auto-generated keys.

To use Kerberos tickets, set only the system name (and not the password) on your JDBC URL object. The user identity is retrieved through the Java Generic Security Services (JGSS) framework, so you also do not need to specify a user on your JDBC URL. You can set only one means of authentication in an AS400JDBCConnection object at a time. Setting the password clears any Kerberos ticket or profile token. For more information, see the [“AS400 class”](#) on page 19.

Using the AS400JDBCConnection class, you can do the following:

- Create a statement (Statement, PreparedStatement, or CallableStatement objects)
- Create a statement that has a specific result set type and concurrency (Statement, PreparedStatement, or CallableStatement objects)
- Commit and rollback changes to the database and release database locks currently held
- Close the connection, closing server resources immediately instead of waiting for them to be automatically released
- Set holdability and get holdability for the Connection
- Set the transaction isolation and get the transaction isolation for the Connection
- Get the meta data for the Connection
- Set auto commit on or off
- Get the job identifier of the host server job that corresponds to the Connection

If you use JDBC 3.0 and connect to a server running IBM i 5.2 or later, you can use AS400JDBCConnection to perform the following actions:

- Create a statement with a specific result set holdability (Statement, PreparedStatement, or CallableStatement object)
- Create a prepared statement that returns any auto-generated keys (when `getGeneratedKeys()` is called on the Statement object)
- Use [savepoints](#), which offer more granular control over transactions:
  - Set savepoints
  - Rollback savepoints

- Release savepoints

[AS400JDBCConnection Javadoc](#)

### ***AS400JDBCConnectionPool***

The AS400JDBCConnectionPool class represents a pool of AS400JDBCConnection objects that are available for use by a Java program as part of IBM Toolbox for Java support for the JDBC 2.0 Optional Package API.

You can use an AS400JDBCConnectionPoolDataSource to specify properties for the connections that are created in the pool, as in the following [example](#).

You cannot change the connection pool data source after you have requested a connection and the pool is in use. To reset the connection pool data source, first call `close()` on the pool.

Return connections to an AS400JDBCConnectionPool by using `close()` on the AS400JDBCConnection object.

**Note:** When connections are not returned to the pool, the connection pool continues to grow in size and connections are not reused.

Set properties on the pool by using methods inherited from `ConnectionPool`. Some of the properties that you can set include:

- maximum number of connections to allow in the pool
- maximum lifetime of a connection
- maximum inactivity time of a connection.

You can also register AS400JDBCConnectionPoolDataSource objects by using a Java Naming and Directory Interface (JNDI) service provider. For more information about JNDI service providers, see [IBM Toolbox for Java reference links](#).

### **Example: Using connection pool**

The following example gets a connection pool data source from JNDI and uses it to create a connection pool with 10 connections:

```
// Obtain an AS400JDBCConnectionPoolDataSource object from JNDI
// (assumes JNDI environment is set).
Context context = new InitialContext(environment);
AS400JDBCConnectionPoolDataSource datasource =
    (AS400JDBCConnectionPoolDataSource)context.lookup("jdbc/myDatabase");

// Create an AS400JDBCConnectionPool object.
AS400JDBCConnectionPool pool = new AS400JDBCConnectionPool(datasource);

// Adds 10 connections to the pool that can be used by the
// application (creates the physical database connections based on
// the data source).
pool.fill(10);

// Get a handle to a database connection from the pool.
Connection connection = pool.getConnection();

// ... Perform miscellaneous queries/updates on the database.

// Close the connection handle to return it to the pool.
connection.close();

// ... Application works with some more connections from the pool.

// Close the pool to release all resources.
pool.close();
```

[AS400JDBCConnectionPool Javadoc](#)

[AS400JDBCConnectionPool Javadoc](#)

[AS400JDBCConnectionPoolDataSource Javadoc](#)

## **AS400JDBCManagedConnectionPoolDataSource class**

The JDBC connection pool is a managed connection pool that allows you to reuse connections.

The AS400JDBCManagedConnectionPoolDataSource class simplifies connection pool maintenance by eliminating the need for user applications to implement their own management code. The connection pool is used in combination with the JDBC DataSource interface mechanism. The class AS400JDBCManagedConnectionPoolDataSource contains an implementation of the `javax.sql.DataSource` interface. This class manages the functionality of the connection pooling mechanism and allows you to access it like a normal DataSource. Setting up and using self-managed JDBC connection pool manager involves the usage of Java Naming and Directory Interface (JNDI) to bind the connection pool managed datasource. In order for self-managed JDBC connection pooling to function, JNDI is necessary.

These properties allow you to configure the attributes of the connection pool:

- InitialPoolSize
- MinPoolSize
- MaxPoolSize
- MaxLifetime
- MaxIdleTime
- PropertyCycle
- ReuseConnections

For more information, see the Javadocs on `setX()` methods where X is the property.

### *Examples: Using AS400JDBCManagedConnectionPoolDataSource class*

These examples demonstrate the use of the AS400JDBCManagedConnectionPoolDataSource class. The AS400JDBCManagedConnectionPoolDataSource class simplifies connection pool maintenance by eliminating the need for user applications to implement their own management code.

**Note:** By using the code examples, you agree to the terms of the [“Code license and disclaimer information”](#) on page 534.

### **Example 1**

This brief example shows the basic use of the AS400JDBCManagedConnectionPoolDataSource class.

```
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.sql.DataSource;

import com.ibm.as400.access.AS400JDBCManagedConnectionPoolDataSource;
import com.ibm.as400.access.AS400JDBCManagedDataSource;

public class TestJDBCConnPoolSnippet
{
    void test()
    {
        AS400JDBCManagedConnectionPoolDataSource cpds0 = new AS400JDBCManagedConnectionPoolDataSource();

        // Set general datasource properties. Note that both connection pool datasource (CPDS) and
managed        // datasource (MDS) have these properties, and they might have different values.
        cpds0.setServerName(host);
        cpds0.setDatabaseName(host); //iasp can be here
        cpds0.setUser(userid);
        cpds0.setPassword(password);

        cpds0.setSavePasswordWhenSerialized(true);

        // Set connection pooling-specific properties.
        cpds0.setInitialPoolSize(initialPoolSize_);
        cpds0.setMinPoolSize(minPoolSize_);
        cpds0.setMaxPoolSize(maxPoolSize_);
        cpds0.setMaxLifetime((int)(maxLifetime_/1000)); // convert to seconds
        cpds0.setMaxIdleTime((int)(maxIdleTime_/1000)); // convert to seconds
        cpds0.setPropertyCycle((int)(propertyCycle_/1000)); // convert to seconds
    }
}
```

```

        //cpds0.setReuseConnections(false); // do not re-use connections

        // Set the initial context factory to use.
        System.setProperty(Context.INITIAL_CONTEXT_FACTORY,
"com.sun.jndi.fscontext.RefFSContextFactory");

        // Get the JNDI Initial Context.
        Context ctx = new InitialContext();

        // Note: The following is an alternative way to set context properties locally:
        // Properties env = new Properties();
        // env.put(Context.INITIAL_CONTEXT_FACTORY, "com.sun.jndi.fscontext.RefFSContextFactory");
        // Context ctx = new InitialContext(env);

        ctx.rebind("mydatasource", cpds0); // We can now do lookups on cpds, by the name "mydatasource".

        // Create a standard DataSource object that references it.

        AS400JDBCManagedDataSource mds0 = new AS400JDBCManagedDataSource();
        mds0.setDescription("DataSource supporting connection pooling");
        mds0.setDataSourceName("mydatasource");
        ctx.rebind("ConnectionPoolingDataSource", mds0);

        DataSource dataSource_ = (DataSource)ctx.lookup("ConnectionPoolingDataSource");

        AS400JDBCManagedDataSource mds_ = (AS400JDBCManagedDataSource)dataSource_;

        boolean isHealthy = mds_.checkPoolHealth(false); //check pool health

        Connection c = dataSource_.getConnection();
    }
}

```

## Example 2

This example shows more details about how to use the AS400JDBCManagedConnectionPoolDataSource class.

```

import java.awt.TextArea;
import java.io.BufferedReader;
import java.io.File;
import java.io.FileReader;
import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.io.OutputStream;
import java.io.PrintStream;
import java.util.Vector;
import java.util.Properties;

import java.sql.Connection;
import javax.sql.DataSource;
import java.sql.ResultSet;
import java.sql.Statement;
import javax.naming.*;
import java.util.Date;
import java.util.ArrayList;
import java.util.Random;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400JDBCManagedConnectionPoolDataSource;
import com.ibm.as400.access.AS400JDBCManagedDataSource;
import com.ibm.as400.access.Trace;

public class TestJDBConnPool
{
    private static final boolean DEBUG = false;

    // If you turn this flag on, be sure to also turn on the following flag:
    // AS400JDBCConnection.TESTING_THREAD_SAFETY.
    private static final boolean TESTING_THREAD_SAFETY = false;

    private static String userid;
    private static String password;
    private static String host;

    // Note: For consistency, all time values are stored units of milliseconds.

```

```

private int initialPoolSize_; // initial # of connections in pool
private int minPoolSize_; // max # of connections in pool
private int maxPoolSize_; // max # of connections in pool
private long maxLifetime_; // max lifetime (msecs) of connections in pool
private long maxIdleTime_; // max idle time (msecs) of available connections in pool
private long propertyCycle_; // pool maintenance frequency (msecs)

private int numDaemons_; // # of requester daemons to create
private static long timeToRunDaemons_; // total duration (msecs) to let the daemons run
private long daemonMaxSleepTime_; // max time (msecs) for requester daemons to sleep each cycle
private long daemonMinSleepTime_; // min time (msecs) for requester daemons to sleep each cycle
private long poolHealthCheckCycle_; // # of msecs between calls to checkPoolHealth()

private boolean keepDaemonsAlive_ = true; // When this is false, the daemons shut down.

private DataSource dataSource_;
private AS400JDBCManagedDataSource mds_;

private final Object daemonSleepLock_ = new Object();

private Random random_ = new Random();

static
{
    try {
        Class.forName("com.ibm.as400.access.AS400JDBCdriver");
    }
    catch(Exception e){
        System.out.println("Unable to register JDBC driver.");
        System.exit(0);
    }
}

public static void main(String[] args)
{
    host = args[0];
    userid = args[1];
    password = args[2];
    timeToRunDaemons_ = (new Integer(args[3])).intValue() * 1000; //milliseconds
    //args[3]=time to run in seconds
    TestJDBCConnPool cptest = new TestJDBCConnPool();

    cptest.setup();
    cptest.runTest();
}

public void setup()
{
    try
    {
        if (DEBUG)
            System.out.println("TESTING_THREAD_SAFETY flag is "
                + (TESTING_THREAD_SAFETY ? "true" : "false"));

        if (TESTING_THREAD_SAFETY)
        {
            // Adjust values for performing thread-intensive stress testing.
            // NOTE: This assumes that the AS400JDBCConnection class has also been modified to
            // not make actual connections to an actual server.
            // To do this, edit AS400JDBCConnection.java, changing its TESTING_THREAD_SAFETY
            // flag to 'false', and recompile.
            minPoolSize_ = 100;
            maxPoolSize_ = 190;
            initialPoolSize_ = 150; // this should get reset to maxPoolSize_
            numDaemons_ = 75;
            if (timeToRunDaemons_ == 0) {
                timeToRunDaemons_ = 180*1000; // 180 seconds == 3 minutes
            }
        }
        else
        {
            // Set more conservative values, as we'll be making actual connections to an
            // actual server, and we don't want to monopolize the server.
            minPoolSize_ = 5;
            maxPoolSize_ = 15;
            initialPoolSize_ = 9;
            numDaemons_ = 4;
            if (timeToRunDaemons_ == 0) {
                timeToRunDaemons_ = 15*1000; // 15 seconds
            }
        }
        maxLifetime_ = (int)timeToRunDaemons_ / 3;
        maxIdleTime_ = (int)timeToRunDaemons_ / 4;
    }
}

```

```

propertyCycle_ = timeToRunDaemons_ / 4;
poolHealthCheckCycle_ = Math.min(timeToRunDaemons_ / 4, 20*60*1000);
// at least once every 20 minutes (more frequently if shorter run-time)
daemonMaxSleepTime_ = Math.min(timeToRunDaemons_ / 3, 10*1000);
// at most 10 seconds (less if shorter run-time)
daemonMinSleepTime_ = 20; // milliseconds

if (DEBUG)
    System.out.println("setup: Constructing "
        + "AS400JDBCManagedConnectionPoolDataSource (cpds0)");
AS400JDBCManagedConnectionPoolDataSource cpds0 =
    new AS400JDBCManagedConnectionPoolDataSource();

// Set datasource properties. Note that both CPDS and MDS have these
// properties, and they might have different values.
cpds0.setServerName(host);
cpds0.setDatabaseName(host);//iasp can be here
cpds0.setUser(userid);
cpds0.setPassword(password);

cpds0.setSavePasswordWhenSerialized(true);

// Set connection pooling-specific properties.
cpds0.setInitialPoolSize(initialPoolSize_);
cpds0.setMinPoolSize(minPoolSize_);
cpds0.setMaxPoolSize(maxPoolSize_);
cpds0.setMaxLifetime((int)(maxLifetime_/1000)); // convert to seconds
cpds0.setMaxIdleTime((int)(maxIdleTime_/1000)); // convert to seconds
cpds0.setPropertyCycle((int)(propertyCycle_/1000)); // convert to seconds
//cpds0.setReuseConnections(false); // don't re-use connections

// Set the initial context factory to use.
System.setProperty(Context.INITIAL_CONTEXT_FACTORY,
    "com.sun.jndi.fscontext.RefFSContextFactory");

// Get the JNDI Initial Context.
Context ctx = new InitialContext();

// Note: The following is an alternative way to set context properties locally:
// Properties env = new Properties();
// env.put(Context.INITIAL_CONTEXT_FACTORY,
//     "com.sun.jndi.fscontext.RefFSContextFactory");
// Context ctx = new InitialContext(env);

ctx.rebind("mydatasource", cpds0);
// We can now do lookups on cpds, by the name"mydatasource".

if (DEBUG)
    System.out.println("setup: lookup(\"mydatasource\" + ")");
// AS400JDBCManagedConnectionPoolDataSource cpds1 =
//     (AS400JDBCManagedConnectionPoolDataSource)ctx.lookup("mydatasource");
// if (DEBUG) System.out.println("setup: cpds1.getUser() == |" + cpds1.getUser() + "|");

// Create a standard DataSource object that references it.

if (DEBUG)
    System.out.println("setup: Constructing AS400JDBCManagedDataSource (mds0)");
AS400JDBCManagedDataSource mds0 = new AS400JDBCManagedDataSource();
mds0.setDescription("DataSource supporting connection pooling");
mds0.setDataSourceName("mydatasource");
ctx.rebind("ConnectionPoolingDataSource", mds0);

if (DEBUG)
    System.out.println("setup: lookup(\"ConnectionPoolingDataSource\" + ")");
dataSource_ = (DataSource)ctx.lookup("ConnectionPoolingDataSource");
//dataSource_.setLogWriter(output_);
if (DEBUG)
    System.out.println("setup: dataSource_.getUser() == |" +
        ((AS400JDBCManagedDataSource)dataSource_).getUser() + "|");

mds_ = (AS400JDBCManagedDataSource)dataSource_;
}
catch (Exception e)
{
    e.printStackTrace();
    System.out.println("Setup error during Trace file creation.");
}
}

void displayConnectionType(Connection conn, boolean specifiedDefaultId)
{
    if (conn instanceof com.ibm.as400.access.AS400JDBCConnectionHandle)

```



```

        System.out.print("(" + (specifiedDefaultId ? "+" : "-") + "P");
    else
        System.out.print("(" + (specifiedDefaultId ? "+" : "-") + "NP");
}

/**
 * Gets and returns connections from and to a connection pool for a while.
 */
public void runTest()
{
    boolean ok = true;
    try
    {
        System.out.println("Started test run at " + new Date());

        if (DEBUG)
            System.out.println("Checking health just after datasource creation "
                + "(we expect that the pool does not exist yet) ...");
        if (mds_.checkPoolHealth(true)) {
            ok = false;
            System.out.println("\nERROR: Pool exists prior to first getConnection().");
        }

        // Verify some setters/getters for JDBC properties.
        System.out.println("Verifying setters/getters ...");

        mds_.setAccess("read only");
        if (!mds_.getAccess().equals("read only")) {
            ok = false;
            System.out.println("\nERROR: getAccess() returned unexpected value: "
                + "|" + mds_.getAccess()+"|");
        }

        boolean oldBool = mds_.isBigDecimal();
        boolean newBool = (oldBool ? false : true);
        mds_.setBigDecimal(newBool);
        if (mds_.isBigDecimal() != newBool) {
            ok = false;
            System.out.println("\nERROR: isBigDecimal() returned unexpected value: "
                + "|" + mds_.isBigDecimal()+"|");
        }
        mds_.setBigDecimal(oldBool);

        int oldInt = mds_.getBlockCriteria();
        int newInt = (oldInt == 2 ? 1 : 2);
        mds_.setBlockCriteria(newInt);
        if (mds_.getBlockCriteria() != newInt) {
            ok = false;
            System.out.println("\nERROR: getBlockCriteria() returned unexpected value: "
                + "|" + mds_.getBlockCriteria()+"|");
        }
        mds_.setBlockCriteria(oldInt);

        // Verify some setters and getters for socket properties.

        oldBool = mds_.isKeepAlive();
        newBool = (oldBool ? false : true);
        mds_.setKeepAlive(newBool);
        if (mds_.isKeepAlive() != newBool) {
            ok = false;
            System.out.println("\nERROR: isKeepAlive() returned unexpected value: "
                + "|" + mds_.isKeepAlive()+"|");
        }
        mds_.setKeepAlive(oldBool);

        oldInt = mds_.getReceiveBufferSize();
        newInt = (oldInt == 256 ? 512 : 256);
        mds_.setReceiveBufferSize(newInt);
        if (mds_.getReceiveBufferSize() != newInt) {
            ok = false;
            System.out.println("\nERROR: getReceiveBufferSize() returned unexpected value: "
                + "|" + mds_.getReceiveBufferSize()+"|");
        }
        mds_.setReceiveBufferSize(oldInt);

        System.out.println("CONNECTION 1");
        Object o = dataSource_.getConnection();
        System.out.println(o.getClass());
        System.out.println("*****LOOK ABOVE*****");
        Connection c1 = dataSource_.getConnection();
    }
}

```

```

if (DEBUG)
    displayConnectionType(c1, true);

if (DEBUG)
    System.out.println("Checking health after first getConnection() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after first getConnection().");
}

if (!TESTING_THREAD_SAFETY)
{
    try
    {
        c1.setAutoCommit(false);
        if (DEBUG)
            System.out.println("SELECT * FROM QIWS.QCUSTCDT");
        Statement s = c1.createStatement();
        ResultSet rs = s.executeQuery("SELECT * FROM QIWS.QCUSTCDT");
        while(rs.next()){
            if (DEBUG)
                System.out.println(rs.getString(2));
        }
        rs.close();
        s.close();
    }
    catch (Exception e) {
        e.printStackTrace();
        if (DEBUG)
            System.out.println("Checking health after fatal connection error ...");
        if (!mds_.checkPoolHealth(true)) {
            ok = false;
            System.out.println("\nERROR: Pool is not healthy after fatal connection "
                + "error.");
        }
    }
}

System.out.println("CONNECTION 2");
Connection c2 = dataSource_.getConnection(userid, password);
if (DEBUG)
    displayConnectionType(c2, false);
System.out.println("CONNECTION 3");
Connection c3 = dataSource_.getConnection();
if (DEBUG)
    displayConnectionType(c3, true);
c1.close();

if (DEBUG)
    System.out.println("Checking health after first close() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after first close().");
}

System.out.println("CONNECTION 4");
Connection c4 = dataSource_.getConnection();
if (DEBUG) displayConnectionType(c4, true);

c1.close(); // close this one again
c2.close();
c3.close();
c4.close();

if (DEBUG) System.out.println("Checking health after last close() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after last close().");
}

// Start the test daemons.
System.out.println("Starting test daemons");
startThreads();

// Run the test daemons for a while; check pool health periodically.

long startTime = System.currentTimeMillis();
long endTime = startTime + timeToRunDaemons_;
while (System.currentTimeMillis() < endTime)
{
    System.out.print("h");
}

```

```

        // Let the daemons run for a while, then check pool health.
        try {
            Thread.sleep(poolHealthCheckCycle_);
        }
        catch (InterruptedException ie) {}
        if (!mds_.checkPoolHealth(true)) {
            ok = false;
            System.out.println("\nERROR: Pool is not healthy after test daemons started.");
        }
    }

    // Stop the test daemons.
    System.out.println("\nStopping test daemons");
    stopThreads();

    if (DEBUG)
        System.out.println("Checking health after connectionGetter daemons have run...");
    if (!mds_.checkPoolHealth(true)) {
        ok = false;
        System.out.println("\nERROR: Pool is not healthy after test daemons stopped.");
    }

    if (!TESTING_THREAD_SAFETY)
    {
        System.out.println("CONNECTION 5");
        Connection c = dataSource_.getConnection();
        if (DEBUG) displayConnectionType(c, true);
        c.setAutoCommit(false);
        if (DEBUG) System.out.println("SELECT * FROM QIWS.QCUSTCDT");
        Statement s = c.createStatement();
        ResultSet rs = s.executeQuery("SELECT * FROM QIWS.QCUSTCDT");
        while(rs.next()){
            if (DEBUG) System.out.println(rs.getString(2));
        }
        rs.close();
        s.close();
        c.close();
    }

    System.out.println("\nClosing the pool...");
    mds_.closePool();

    if (DEBUG)
        System.out.println("Checking health after pool closed ...");
    Trace.setTraceJDBCOn(true); // make sure the final stats get printed out
    Trace.setTraceOn(true);
    if (!mds_.checkPoolHealth(true)) {
        ok = false;
        System.out.println("\nERROR: Pool is not healthy after pool closed.");
    }

    System.out.println();
    if(ok==true)
        System.out.println("test ran ok");
    else
        System.out.println("test failed");
}
catch (Exception e)
{
    System.out.println(e);
    e.printStackTrace();
}
finally {
    System.out.println("Ended test at " + new Date());
}
}

void startThreads()
{
    // Create a bunch of threads that call getConnection().
    Thread[] threads = new Thread[numDaemons_];
    for (int i=0; i<numDaemons_; i++)
    {
        ConnectionGetter getter;
        // Flip a coin to see if this daemon will specify the default uid, or unique uid.
        if (random_.nextBoolean())
        {
            getter = new ConnectionGetter(userid,password);
            if (TESTING_THREAD_SAFETY) { // we can use fictional userid
                getter = new ConnectionGetter("Thread"+i, "Pwd"+i);
            }
            else { // must use a real userid

```

```

        getter = new ConnectionGetter(userid,password);
    }
    else
        getter = new ConnectionGetter(null, null);

    threads[i] = new Thread(getter, "["+i+"]");
    threads[i].setDaemon(true);
}

// Start the threads.
for (int i=0; i<numDaemons_; i++)
{
    threads[i].start();
}
}

void stopThreads()
{
    // Tell the threads to stop.
    keepDaemonsAlive_ = false;
    synchronized (daemonSleepLock_) {
        daemonSleepLock_.notifyAll();
    }

    // Wait for the daemons to stop.
    try {
        Thread.sleep(3000);
    }
    catch (InterruptedException ie) {}
}

// ConnectionGetter -----
/**
 * Helper class. This daemon wakes up at random intervals and either
 * gets another connection from the connection pool or returns a
 * previously-gotten connection to the pool.
 */
private final class ConnectionGetter implements Runnable
{
    private String uid_;
    private String pwd_;
    private boolean useDefaultUid_;
    private long maxSleepTime_;
    private String threadName_;
    private boolean firstConnection_ = true;
    ArrayList connections_ = new ArrayList();
    // list of connections that this getter currently 'owns'.

    ConnectionGetter(String uid, String pwd) {
        uid_ = uid;
        pwd_ = pwd;
        if (uid_ == null) useDefaultUid_ = true;
        else useDefaultUid_ = false;
        maxSleepTime_ = daemonMaxSleepTime_; // our own copy that we can adjust
    }

    public void run()
    {
        threadName_ = Thread.currentThread().getName();
        if (DEBUG) System.out.println("ConnectionGetter("+threadName_+") Starting up");

        try
        {
            while (keepDaemonsAlive_)
            {
                try
                {
                    // Pick a random sleep-time, between min and max values.
                    long sleepTime = Math.max((long)(maxSleepTime_ * random_.nextFloat()),
                        daemonMinSleepTime_);
                    // Note: Must never call wait(0), because that waits forever.
                    synchronized (daemonSleepLock_) {
                        try {
                            daemonSleepLock_.wait(sleepTime);
                            System.out.print(".");
                        }
                        catch (InterruptedException ie) {}
                    }
                }
                if (!keepDaemonsAlive_) break;
            }
        }
    }
}

```

```

// Decide by chance whether to request another connection or return a
// previously-obtained connection.
Connection conn;
if (random_.nextBoolean()) // Leave the decision to chance.
{ // Request another connection.
    if (useDefaultUid_)
    {
        if (DEBUG)
            System.out.println("ConnectionGetter("+threadName_+") - get()");
        conn = dataSource_.getConnection();
    }
    else
    {
        if (DEBUG)
            System.out.println("ConnectionGetter("+threadName_+") - "
                + "get("+uid_+",***)");
        conn = dataSource_.getConnection(uid_, pwd_);
    }

    if (conn == null) {
        System.out.println("ConnectionGetter("+threadName_+") ERROR: "
            + "getConnection() returned null");
    }
    else
    {
        // Occasionally "forget" that we own a connection, and neglect to
        // close it.
        // Orphaned connections should eventually exceed their maximum
        // lifetime and get "reaped" by the connection manager.
        float val = random_.nextFloat();
        if (firstConnection_ || val < 0.1) {
            // 'orphan' a few gotten connections
            firstConnection_ = false;
        }
        else {
            connections_.add(conn);
        }
        if (DEBUG) displayConnectionType(conn, useDefaultUid_);
        if (conn instanceof com.ibm.as400.access.AS400JDBCConnectionHandle)
        { // We got a pooled connection. Try speeding up our cycle time.
            if (maxSleepTime_ > 100)
                maxSleepTime_--;
            else
                maxSleepTime_ = 100;
        }
        else
        { // We didn't get a pooled connection. That means that the pool
            // must be at capacity. Slow down our cycle time a bit.
            maxSleepTime_ = maxSleepTime_ + 50;
        }
    }
}
else { // Close a connection that we currently own.
    if (connections_.size() != 0) {
        conn = (Connection)connections_.remove(0);
        conn.close();
    }
}
} // inner try
catch (Exception e)
{
    e.printStackTrace();
}
} // outer while
} // outer try
finally
{
    if (DEBUG)
        System.out.println("ConnectionGetter("+threadName_+") Stopping");
    // Return all the connections that I still have in my list.
    for (int i=0; i<connections_.size(); i++) {
        Connection conn = (Connection)connections_.remove(0);
        try { conn.close(); } catch (Exception e) { e.printStackTrace(); }
    }
}
}
} // internal class 'ConnectionGetter'
}

```

## DatabaseMetaData interface

You can use a DatabaseMetaData object to obtain information about the database as a whole as well as catalog information.

The following example shows how to return a list of tables, which is a catalog function:

```
// Connect to the server.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem");

// Get the database metadata from the connection.
DatabaseMetaData dbMeta = c.getMetaData();

// Get a list of tables matching the following criteria.
String catalog = "myCatalog";
String schema = "mySchema";
String table = "myTable%"; // % indicates search pattern
String types[] = {"TABLE", "VIEW", "SYSTEM TABLE"};
ResultSet rs = dbMeta.getTables(catalog, schema, table, types);

// Iterate through the ResultSet to get the values.

// Close the Connection.
c.close();
```

### Related information

[AS400JDBCDatabaseMetaData Javadoc](#)

## AS400JDBCDataSource class

The AS400JDBCDataSource class represents a factory for IBM i database connections. The AS400JDBCConnectionPoolDataSource class represents a factory for AS400JDBCPooledConnection objects.

You can register either kind of data source object by using a Java Naming and Directory Interface (JNDI) service provider. For more information about JNDI service providers, see [“Related information for IBM Toolbox for Java”](#) on page 533.

## Examples

The following examples demonstrate ways to create and use AS400JDBCDataSource objects. The last two examples show how to register an AS400JDBCDataSource object with JNDI and then use the object returned from JNDI to obtain a database connection. Notice that even when using different JNDI service providers, the code is very similar.

### Example: Creating an AS400JDBCDataSource object

The following example shows you how to create an AS400JDBCDataSource object and connect it to a database:

```
// Create a data source for making the connection.
AS400JDBCDataSource datasource = new AS400JDBCDataSource("myAS400");
datasource.setUser("myUser");
datasource.setPassword("MYPWD");

// Create a database connection to the server.
Connection connection = datasource.getConnection();
```

### Example: Creating an AS400JDBCConnectionPoolDataSource object that can be used to cache JDBC connections

The following example shows how you can use an AS400JDBCConnectionPoolDataSource to cache JDBC connections.

```
// Create a data source for making the connection.
AS400JDBCConnectionPoolDataSource dataSource =
    new AS400JDBCConnectionPoolDataSource("myAS400");
dataSource.setUser("myUser");
dataSource.setPassword("MYPWD");
```

```
// Get the PooledConnection.  
PooledConnection pooledConnection = datasource.getPooledConnection();
```

### Example: Using JNDI service provider classes to store an AS400JDBCDataSource object

The following example shows how you can use JNDI service provider classes to store a DataSource object directly to the integrated file system on the server:

```
// Create a data source to the IBM i database.  
AS400JDBCDataSource dataSource = new AS400JDBCDataSource();  
dataSource.setServerName("myAS400");  
dataSource.setDatabaseName("myAS400 Database");  
  
// Register the datasource with the Java Naming and Directory Interface (JNDI).  
Hashtable env = new Hashtable();  
env.put(Context.INITIAL_CONTEXT_FACTORY, "com.sun.jndi.fscontext.RefFSContextFactory");  
Context context = new InitialContext(env);  
context.bind("jdbc/customer", dataSource);  
  
// Return an AS400JDBCDataSource object from JNDI and get a connection.  
AS400JDBCDataSource datasource = (AS400JDBCDataSource) context.lookup("jdbc/customer");  
Connection connection = datasource.getConnection("myUser", "MYPWD");
```

### Example: Using AS400JDBCDataSource objects and IBM SecureWay Directory classes with a Lightweight Directory Access Protocol (LDAP) directory server

The following examples shows how you can use IBM SecureWay Directory classes to store an object to a Lightweight Directory Access Protocol (LDAP) directory server:

```
// Create a data source to the IBM i database.  
AS400JDBCDataSource dataSource = new AS400JDBCDataSource();  
dataSource.setServerName("myAS400");  
dataSource.setDatabaseName("myAS400 Database");  
  
// Register the datasource with the Java Naming and Directory Interface (JNDI).  
Hashtable env = new Hashtable();  
env.put(Context.INITIAL_CONTEXT_FACTORY, "com.ibm.jndi.LDAPCtxFactory");  
Context context = new InitialContext(env);  
context.bind("cn=myDataSource, cn=myUsers, ou=myLocation, o=myCompany, c=myCountryRegion",  
dataSource);  
  
// Return an AS400JDBCDataSource object from JNDI and get a connection.  
AS400JDBCDataSource datasource = (AS400JDBCDataSource) context.lookup(  
"cn=myDataSource, cn=myUsers, ou=myLocation, o=myCompany, c=myCountryRegion");  
Connection connection = datasource.getConnection("myUser", "MYPWD");
```

[AS400JDBCDataSource Javadoc](#)

[AS400JDBCConnectionPoolDataSource Javadoc](#)

[AS400JDBCPooledConnection Javadoc](#)

### Registering the JDBC driver

Before using JDBC to access data in a server database file, you need to register the IBM Toolbox for Java JDBC driver with the DriverManager.

You can register the driver either by using a Java system property or by having the Java program register the driver:

- Register by using a system property

Each virtual machine has its own method of setting system properties. For example, the Java command from the JDK uses the -D option to set system properties. To set the driver using system properties, specify the following:

```
"-Djdbc.drivers=com.ibm.as400.access.AS400JDBCdriver"
```

- Register by using the Java program

To load the IBM Toolbox for Java JDBC driver, add the following to the Java program before the first JDBC call:

```
Class.forName("com.ibm.as400.access.AS400JDBCdriver");
```

The IBM Toolbox for Java JDBC driver registers itself when it is loaded, which is the preferred way to register the driver. You can also explicitly register the IBM Toolbox for Java JDBC driver by using the following:

```
java.sql.DriverManager.registerDriver (new com.ibm.as400.access.AS400JDBCdriver ());
```

Calling `DriverManager.registerDriver()` results in the IBM Toolbox for Java JDBC driver getting registered twice. Once when `AS400JDBCdriver` is loaded by the JVM and once for the explicit call to the `registerDriver()` method. This is a result of the `DriverManager` implementation, which IBM Toolbox for Java has no control over. Having a driver being listed twice in the `DriverManager`'s registry is normally not a problem. Although there may be situations where both registered driver listings get used. For example, this could happen when trying to get a connection with an incorrect password. The `DriverManager` will fail on the first registered driver to obtain a connection and so it will then try the second registered driver.

The IBM Toolbox for Java JDBC driver does not require an AS400 object as an input parameter like the other IBM Toolbox for Java classes that get data from a server. An AS400 object is used internally, however, to manage default user and password caching. When a connection is first made to the server, the user may be prompted for user ID and password. The user has the option to save the user ID as the default user ID and add the password to the password cache. As in the other IBM Toolbox for Java functions, if the user ID and password are supplied by the Java program, the default user is not set and the password is not cached. See [“Managing connections in Java programs” on page 338](#) for information about managing connections.

## Using the JDBC driver to connect to a database on the server

You can use the `DriverManager.getConnection()` method to connect to the server database.

`DriverManager.getConnection()` takes a uniform resource locator (URL) string as an argument. The JDBC driver manager attempts to locate a driver that can connect to the database that is represented by the URL. When using the IBM Toolbox for Java driver, use the following syntax for the URL:

```
"jdbc:as400://systemName/defaultSchema;listOfProperties"
```

**Note:** Either `systemName` or `defaultSchema` can be omitted from the URL.

To use Kerberos tickets, set only the system name (and not the password) on your JDBC URL object. The user identity is retrieved through the Java Generic Security Services (JGSS) framework, so you also do not need to specify a user on your JDBC URL. You can set only one means of authentication in an `AS400JDBCConnection` object at a time. Setting the password clears any Kerberos ticket or profile token. For more information, see [“AS400 class” on page 19](#).

## Examples: Using the JDBC driver to connect to a server

### Example: Using a URL in which a system name is not specified

This example results in the user being prompted to type in the name of the system to which he or she wants to connect.

```
// Connect to unnamed system.  
// User receives prompt to type system name.  
Connection c = DriverManager.getConnection("jdbc:as400:");
```



### Example: Connecting to the server database; no default SQL schema or properties specified

```
// Connect to system 'mySystem'. No
// default SQL schema or properties are specified.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem");
```

### Example: Connecting to the server database; default SQL schema specified

```
// Connect to system 'mySys2'. The
// default SQL schema 'myschema' is specified.
Connection c2 = DriverManager.getConnection("jdbc:as400://mySys2/mySchema");
```

### Example: Connecting to the server database and using java.util.Properties to specify properties

The Java program can specify a set of JDBC properties either by using the `java.util.Properties` interface or by specifying the properties as part of the URL. See [“IBM Toolbox for Java JDBC properties” on page 247](#) for a list of supported properties.

For example, to specify properties using the Properties interface, use the following code as an example:

```
// Create a properties object.
Properties p = new Properties();

// Set the properties for the connection.
p.put("naming", "sql");
p.put("errors", "full");

// Connect using the properties object.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem", p);
```

### Example: Connecting to the server database and using a uniform resource locator (URL) to specify properties

```
// Connect using properties. The
// properties are set on the URL
// instead of through a properties object.
Connection c = DriverManager.getConnection(
    "jdbc:as400://mySystem;naming=sql;errors=full");
```

### Example: Connecting to the server database and specifying user ID and password

```
// Connect using properties on the
// URL and specifying a user ID and password
Connection c = DriverManager.getConnection(
    "jdbc:as400://mySystem;naming=sql;errors=full",
    "auser",
    "apassword");
```

### Example: Disconnecting from the database

To disconnect from the server, use the `close()` method on the Connecting object. Use the following statement to close the connection created in the previous example:

```
c.close();
```

## AS400JDBCParameterMetaData Javadoc

### **AS400JDBCParameterMetaData class**

The `AS400JDBCParameterMetaData` class enables your programs to retrieve information about the properties of parameters in `PreparedStatement` and `CallableStatement` objects.

`AS400JDBCParameterMetaData` provides methods that allow you to perform the following actions:

- Get the class name of the parameter
- Get the number of parameters in the `PreparedStatement`
- Get the SQL type of the parameter
- Get the database-specific type name for the parameter

- Get the precision or the scale of the parameter

## Example: Using AS400JDBCParameterMetaData

The following example shows one way to use AS400JDBCParameterMetaData to retrieve parameters from a dynamically generated PreparedStatement object:

```
// Get a connection from the driver.
Class.forName("com.ibm.as400.access.AS400JDBCDriver");
Connection connection =
    DriverManager.getConnection("jdbc:as400://myAS400", "myUserId", "myPassword");

// Create a prepared statement object.
PreparedStatement ps =
    connection.prepareStatement("SELECT STUDENTS FROM STUDENTTABLE WHERE STUDENT_ID= ?");

// Set a student ID into parameter 1.
ps.setInt(1, 123456);

// Retrieve the parameter meta data for the prepared statement.
ParameterMetaData pMetaData = ps.getParameterMetaData();

// Retrieve the number of parameters in the prepared statement.
// Returns 1.
int parameterCount = pMetaData.getParameterCount();

// Find out what the parameter type name of parameter 1 is.
// Returns INTEGER.
String getParameterTypeName = pMetaData.getParameterTypeName(1);
```

### Related information

[AS400JDBCParameterMetaData Javadoc](#)

### *PreparedStatement interface*

You can use a PreparedStatement object when an SQL statement is going to be run many times. A prepared statement is an SQL statement that has been precompiled.

This approach is more efficient than running the same statement multiple times using a Statement object, which compiles the statement each time it is run. In addition, the SQL statement contained in a PreparedStatement object may have one or more IN parameters. Use Connection.prepareStatement() to create PreparedStatement objects.

The PreparedStatement object allows you to submit multiple SQL commands as a single group to a database through the use of batch support. You may improve performance by using batch support because processing a group of operations is typically faster than processing them one at a time.

## Example: Using PreparedStatement

The following example shows how to use the PreparedStatement interface.

```
// Connect to the server.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem");

// Create the PreparedStatement object. It precompiles the
// specified SQL statement. The question marks indicate where
// parameters must be set before the statement is run.
PreparedStatement ps =
    c.prepareStatement("INSERT INTO MYLIBRARY.MYTABLE (NAME, ID) VALUES (?, ?)");

// Set parameters and run the statement.
ps.setString(1, "JOSH");
ps.setInt(2, 789);
ps.executeUpdate();

// Set parameters and run the statement again.
ps.setString(1, "DAVE");
ps.setInt(2, 456);
ps.executeUpdate();

// Close PreparedStatement and the Connection.
```

```
ps.close();
c.close();
```

## Related information

[AS400JDBCPreparedStatement Javadoc](#)

## ResultSet class

You can use a `ResultSet` object to access a table of data that was generated by running a query. The table rows are retrieved in sequence. Within a row, column values can be accessed in any order.

The data stored in `ResultSet` is retrieved by using the various `get` methods, depending on the type of data being retrieved. The `next()` method is used to move to the next row.

`ResultSet` allows you to `get` and `update` columns by name, although using the column index results improves performance.

## Cursor movement

A cursor, which is an internal pointer, is used by a result set to point the row in the result set that is being accessed by the Java program.

The performance of the `getRow()` method has been improved. Before V5R2, using `ResultSet.last()`, `ResultSet.afterLast()`, and `ResultSet.absolute()` with a negative value made the current row number not available. The previous restrictions are lifted, which makes the `getRow()` method fully functional.

JDBC 2.0 and later JDBC specifications provide additional methods for accessing specific positions within a database:

Scrollable cursor positions	
absolute	isFirst
afterLast	isLast
beforeFirst	last
first	moveToCurrentRow
getRow	moveToInsertRow
isAfterLast	previous
isBeforeFirst	relative

## Scrolling capabilities

If a result set is created by executing a statement, you can move (scroll) backward (last-to-first) or forward (first-to-last) through the rows in a table.

A result set that supports this movement is called a scrollable result set. Scrollable result sets also support absolute positioning. Absolute positioning allows you to move directly to a row by specifying its position in the result set.

With JDBC 2.0 and later JDBC specifications, you have two additional scrolling capabilities available to use when working with the `ResultSet` class: scroll-insensitive and scroll-sensitive result sets.

A scroll-insensitive result set is not usually sensitive to changes that are made while it is open, while the scroll-sensitive result set is sensitive to changes.

**Note:** IBM i only allows read-only access for scrollable insensitive cursors. IBM Toolbox for Java supports a scroll-insensitive cursor if the result set concurrency is read-only. If the result set type is specified as insensitive and the concurrency is specified as updateable, the result set type changes to sensitive and issues a warning to you.

## Updateable result sets

In your application, you can use result sets that use either read-only concurrency (no updates can be made to the data) or updateable concurrency (allows updates to the data and uses database write locks

to control access to the same data item by different transactions). In an updateable result set, rows can be updated, inserted, and deleted. Numerous update methods are available for you to use in your program, for example:

- Update ASCII stream
- Update Big Decimal
- Update binary stream

See Method Summary in the AS400JDBCResultSet Javadoc for a complete listing of the update methods available through the ResultSet interface.

### Example: Updatable result sets

The following example shows how to use a result set that allows updates to the data (update concurrency) and allows changes to be made to the result set while it is open (scroll sensitive).

```
// Connect to the server.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem");

// Create a Statement object. Set the result set
// concurrency to updatable.
Statement s = c.createStatement(ResultSet.TYPE_SCROLL_SENSITIVE,
                                ResultSet.CONCUR_UPDATABLE);

// Run a query. The result is placed in a ResultSet object.
ResultSet rs = s.executeQuery ("SELECT NAME,ID FROM MYLIBRARY.MYTABLE FOR UPDATE");

// Iterate through the rows of the ResultSet.
// As we read the row, we will update it with a new ID.
int newId = 0;
while (rs.next ())
{
    // Get the values from the ResultSet. The first value
    // is a string, and the second value is an integer.
    String name = rs.getString("NAME");
    int id = rs.getInt("ID");

    System.out.println("Name = " + name);
    System.out.println("Old id = " + id);

    // Update the id with a new integer.
    rs.updateInt("ID", ++newId);

    // Send the updates to the server.
    rs.updateRow ();

    System.out.println("New id = " + newId);
}

// Close the Statement and the Connection.
s.close();
c.close();
```

### ResultSetMetaData

The ResultSetMetaData interface determines the types and properties of the columns in a ResultSet.

When connecting to a server running IBM i 5.2 or later, using the [extended metadata property](#) enables you to increase the accuracy of the following ResultSetMetaData methods:

- getColumnLabel(int)
- isReadOnly(int)
- isSearchable(int)
- isWritable(int)

Additionally, setting this property to true enables support for the ResultSetMetaData.getSchemaName(int) method. Be aware that using the extended metadata property may degrade performance because it requires retrieving more information from the server.

[AS400JDBCResultSet Javadoc](#)

[AS400ResultSetMetaData Javadoc](#)

### ***AS400JDBCRowSet class***

The AS400JDBCRowSet class represents a connected rowset that encapsulates a JDBC result set. The methods on AS400JDBCRowSet are very similar to those of the AS400JDBCResultSet. The database connection is maintained while in use.

You can use an instance of [AS400JDBCDataSource](#) or [AS400JDBCConnectionPoolDataSource](#) to create the connection to the database that you want to use to access the data for the AS400JDBCRowSet.

## **Examples**

The following examples show how you can use the AS400JDBCRowSet class.

### **Example: Creating, populating, and updating an AS400JDBCRowSet object**

```
DriverManager.registerDriver(new AS400JDBCDriver());
// Establish connection by using a URL.
AS400JDBCRowSet rowset = new AS400JDBCRowSet("jdbc:as400://mySystem","myUser",
"myPassword");

// Set the command used to populate the list.
rowset.setCommand("SELECT * FROM MYLIB.DATABASE");

// Populate the rowset.
rowset.execute();

// Update the customer balances.
while (rowset.next())
{
    double newBalance = rowset.getDouble("BALANCE") +
        july_statements.getPurchases(rowset.getString("CUSTNUM"));
    rowset.updateDouble("BALANCE", newBalance);
    rowset.updateRow();
}
```

### **Example: Creating and populating an AS400JDBCRowSet object, while getting the data source from JNDI**

```
// Get the data source that is registered in JNDI (assumes JNDI environment is set).
Context context = new InitialContext();
AS400JDBCDataSource dataSource = (AS400JDBCDataSource) context.lookup("jdbc/customer");

AS400JDBCRowSet rowset = new AS400JDBCRowSet();
// Establish connection by setting the data source name.
rowset.setDataSourceName("jdbc/customer");
rowset.setUsername("myuser");
rowset.setPassword("myPasswd");

// Set the prepared statement and initialize the parameters.
rowset.setCommand("SELECT * FROM MYLIBRARY.MYTABLE WHERE STATE = ? AND BALANCE > ?");
rowset.setString(1, "MINNESOTA");
rowset.setDouble(2, MAXIMUM_LIMIT);

// Populate the rowset.
rowset.execute();
```

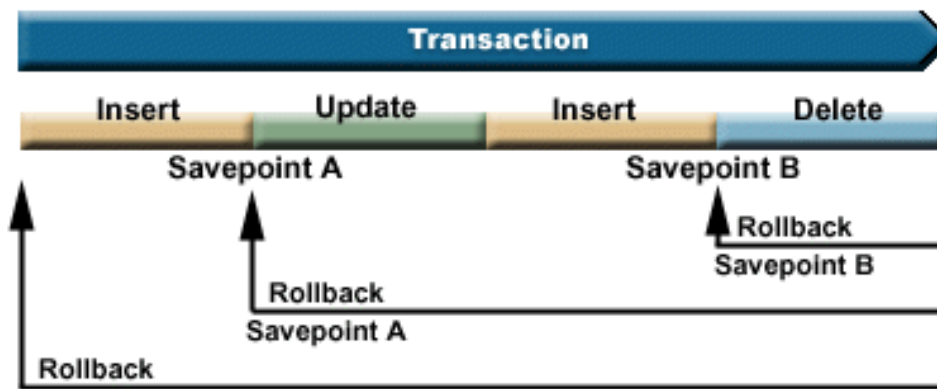
[AS400JDBCRowSet Javadoc](#)

[AS400JDBCResultSet Javadoc](#)

### ***AS400JDBCSavepoint class***

The IBM Toolbox for Java AS400JDBCSavepoint class represents a logical breaking point in a transaction. Using savepoints gives you more granular control over which changes are affected when you roll back a transaction.

### **Figure 1: Using savepoints to control rollbacks in a transaction**



For example, Figure 1 shows a transaction that includes two savepoints, A and B. Rolling back the transaction to either savepoint undoes (or reverses) only those changes from the point a rollback is called to the savepoint. This prevents having to undo all the changes in the entire transaction. Note that once you rollback to savepoint A, you cannot later rollback to savepoint B. You cannot access savepoint B after work is rolled back past it.

### Example: Using savepoints

In this scenario, assume that your application updates student records. At the end of updating a certain field in every student record, you perform a commit. Your code detects a particular error associated with updating this field and rolls back the work done when this error occurs. You know that this particular error affects only the work performed on the current record.

So, you set a savepoint between each update of student records. Now, when this error occurs, you rollback only the last update in the student table. Instead of having to roll back a large amount of work, you can now roll back only a small amount of work.

The following example code helps illustrate how you can use savepoints. The example assumes that the student ID for John is 123456 and the student ID for Jane is 987654.

```
// Get a connection from the driver
Class.forName("com.ibm.as400.access.AS400JDBCdriver");

// Get a statement object
Statement statement = connection.createStatement();

// Update John's record with his 'B' grade in gym.
int rows = statement.executeUpdate(
    "UPDATE STUDENTTABLE SET GRADE_SECOND_PERIOD = 'B' WHERE STUDENT_ID= '123456'");

// Set a savepoint marking an intermediate point in the transaction
Savepoint savepoint1 = connection.setSavepoint("SAVEPOINT_1");

// Update Jane's record with her 'C' grade in biochemistry.
int rows = statement.executeUpdate(
    "UPDATE STUDENTTABLE SET GRADE_SECOND_PERIOD = 'C' WHERE STUDENT_ID= '987654'");

// An error is detected, so we need to roll back Jane's record, but not John's.
// Rollback the transaction to savepoint 1. The change to Jane's record is
// removed while the change to John's record remains.
connection.rollback(savepoint1);

// Commit the transaction; only John's 'B' grade is committed to the database.
connection.commit();
```

### Considerations and restrictions

Using savepoints requires that you be aware of the following considerations and restrictions:

#### Considerations

IBM Toolbox for Java follows database rules regarding how rollbacks affect cursors and retained locks. For example, when you set the connection option to keep cursors open after a traditional rollback, cursors also remain open after a rollback to a savepoint. In other words, when a rollback request happens involving savepoints, IBM Toolbox for Java does not move or close the cursor when the underlying database does not support this.

Using a savepoint to roll back a transaction undoes only the actions performed from the point where you start the roll back to the savepoint. Actions performed before that savepoint remain. As in the previous example, be aware that you can commit a transaction that includes work performed before a particular savepoint but does not include work performed after the savepoint.

All savepoints are released and become invalid when the transaction is committed or when the entire transaction is rolled back. You can also release savepoints by calling `Connection.releaseSavepoint()`.

### Restrictions

The following restrictions apply when using savepoints:

- Named savepoints must be unique.
- You cannot reuse a savepoint name until the savepoint is released, committed, or rolled back.
- Auto-commit must be set to 'OFF' for savepoints to be valid. You can set auto-commit 'OFF' by using `Connection.setAutoCommit(false)`. Enabling auto-commit when using savepoints throws an exception.
- Savepoints are not valid across XA connections. Using an XA connection with savepoints throws an exception.
- Your server must be running IBM i Version 5 Release 2 or later. Using savepoints when connecting (or already connected) to a server running V5R1 or earlier version of IBM i throws an exception.

[AS400JDBCSavePoint Javadoc](#)

### Running SQL statements with Statement objects

Use a Statement object to run an SQL statement and optionally obtain the ResultSet produced by it.

PreparedStatement inherits from Statement, and CallableStatement inherits from PreparedStatement. Use the following Statement objects to run different SQL statements:

- [“Statement interface” on page 80](#): Runs a simple SQL statement that has no parameters.
- [“PreparedStatement interface” on page 74](#) - Runs a precompiled SQL statement that may or may not have IN parameters.
- [“CallableStatement interface” on page 57](#) - Runs a call to a database stored procedure. A CallableStatement may or may not have IN, OUT, and INOUT parameters.

The Statement object allows you to submit multiple SQL commands as a single group to a database through the use of batch support. You may improve performance by using batch support because processing a group of operations is typically faster than processing them one at a time.

When using batch updates, typically you turn off auto-commit. Turning off auto-commit allows your program to determine whether to commit the transaction if an error occurs and not all of the commands have executed. In JDBC 2.0 and later JDBC specifications, a Statement object can keep track of a list of commands that can be successfully submitted and executed together in a group. When this list of batch commands is executed by the `executeBatch()` method, the commands are executed in the order in which they were added to the list.

AS400JDBCStatement provides methods that enable you to perform many actions, including the following:

- Execute different kinds of statements
- Retrieve the values for different parameters of the Statement object, including:
  - The connection
  - Any auto-generated keys created as a result of executing the Statement

- The fetch size and fetch direction
- The maximum field size and maximum row limit
- The current result set, the next result set, the type of result set, the result set concurrency, and the result set cursor holdability
- Add an SQL statement to the current batch
- Run the current batch of SQL statements

## Statement interface

Use `Connection.createStatement()` to create new Statement objects.

The following example shows how to use a Statement object.

```
// Connect to the server.
Connection c = DriverManager.getConnection("jdbc:as400://mySystem");

// Create a Statement object.
Statement s = c.createStatement();

// Run an SQL statement that creates a table in the database.
s.executeUpdate("CREATE TABLE MYLIBRARY.MYTABLE (NAME VARCHAR(20), ID INTEGER)");

// Run an SQL statement that inserts a record into the table.
s.executeUpdate("INSERT INTO MYLIBRARY.MYTABLE (NAME, ID) VALUES ('DAVE', 123)");

// Run an SQL statement that inserts a record into the table.
s.executeUpdate("INSERT INTO MYLIBRARY.MYTABLE (NAME, ID) VALUES ('CINDY', 456)");

// Run an SQL query on the table.
ResultSet rs = s.executeQuery("SELECT * FROM MYLIBRARY.MYTABLE");

// Close the Statement and the Connection.
s.close();
c.close();
```

### AS400JDBCStatement Javadoc

## ***JDBC XA Distributed Transaction Management***

The JDBC XA distributed transaction management classes enable you to use the IBM Toolbox for Java JDBC driver within a distributed transaction. Using the XA classes to enable the IBM Toolbox for Java JDBC driver allows it to participate in transactions that span multiple data sources.

Typically, XA distributed transaction management classes are used and controlled directly by a transaction manager, which is separate from the JDBC driver. The distributed transaction management interfaces are defined as part of the JDBC 2.0 Optional Package and the Java Transaction API (JTA). Both are available from Sun as JAR files. The distributed transaction management interfaces are also supported in the JDBC 3.0 API, which is bundled with the Java 2 Platform, Standard Edition, version 1.4.

For more information, see the Sun Web sites for [JDBC](#)  and the [JTA](#) .

Use the following objects to enable the IBM Toolbox for Java JDBC driver to participate in XA distributed transactions:

- [AS400JDBCXADataSource](#) - A factory for `AS400JDBCXAConnection` objects. This is a subclass of `AS400JDBCDataSource`.
- [AS400JDBCXAConnection](#) - A pooled connection object that provides hooks for connection pool management and XA resource management.
- [AS400JDBCXAResource](#) - A resource manager for use in XA transaction management.

**Note:** Prior to V5R3, the database host server used XA APIs for Job Scoped Locks (XA model). In V5R3 and subsequent releases, the database host server uses XA APIs for Transaction Scoped Locks (NTS model) for all MTS functions. For more information about how these APIs differ, see [XA APIs](#).



## Example: Using XA classes

The following example shows simple usage of the XA classes. Keep in mind that the details would be filled in with work using other data sources. This type of code usually appears within a transaction manager.

```
// Create an XA data source for making the XA connection.
AS400JDBCXADataSource xaDataSource = new AS400JDBCXADataSource("myAS400");
xaDataSource.setUser("myUser");
xaDataSource.setPassword("myPasswd");

// Get an XAConnection and get the associated XAResource.
// This provides access to the resource manager.
XAConnection xaConnection = xaDataSource.getXAConnection();
XAResource xaResource = xaConnection.getXAResource();

// Generate a new Xid (this is up to the transaction manager).
Xid xid = ...;

// Start the transaction.
xaResource.start(xid, XAResource.TMNOFLAGS);

// ...Do some work with the database...

// End the transaction.
xaResource.end(xid, XAResource.TMSUCCESS);

// Prepare for a commit.
xaResource.prepare(xid);

// Commit the transaction.
xaResource.commit(xid, false);

// Close the XA connection when done. This implicitly
// closes the XA resource.
xaConnection.close();
```

## Jobs classes

The IBM Toolbox for Java Jobs classes, which are in the access package, allow a Java program to retrieve and change job information.

Use the Jobs classes to work with the following type of job information:

- Date and Time Information
- Job Queue
- Language Identifiers
- Message Logging
- Output Queue
- Printer Information

## Examples

The following examples show some of the ways you can use the Job, JobList, and JobLog classes. The first example shows one way to use a cache with the Job class. Links to other examples immediately follow the sample code.

**Note:** Read the [Code example disclaimer](#) for important legal information.

### Example: Using a cache when setting a value and getting a value

```
try {
    // Creates AS400 object.
    AS400 as400 = new AS400("systemName");

    // Constructs a Job object
    byte[] internalJobID = "xxxxxxxxxxxxxxxx".getBytes();
    Job job = new Job(as400, internalJobID);

    // Gets job information
```

```

System.out.println("User of this job :" + job.getUser());
System.out.println("CPU used : " + job.getCPUUsed());
System.out.println("Job enter system date : " + job.getJobEnterSystemDate());

// Sets cache mode
job.setCacheChanges(true);

// Changes will be store in the cache.
job.setRunPriority(66);
job.setDateFormat("*YMD");

// Commit changes. This will change the value on the system.
job.commitChanges();

// Set job information to system directly(without cache).
job.setCacheChanges(false);
job.setRunPriority(60);
} catch (Exception e)
{
    System.out.println("error :" + e);
}
}

```

The following examples show how to list the jobs belonging to a specific user, list jobs with the job status information, and display the messages in a job log:

[“Example: Using JobList to list job identification information” on page 408](#)

[“Example: Using JobList to get a list of jobs” on page 410](#)

[“Example: Using JobLog to display messages in the job log” on page 412](#)

[Access package Javadoc](#)

### **Job class**

The Job class (in the access package) allows a Java program to retrieve and change server job information.

The following type of job information can be retrieved and changed with the Job class:

- Job queues
- Output queues
- Message logging
- Printer device
- Country or region identifier
- Date format

The job class also allows the ability to change a single value at a time, or cache several changes using the `setCacheChanges(true)` method and committing the changes using the `commitChanges()` method. If caching is not turned on, you do not need to do a commit.

### **Example**

For a code example, see the Javadoc reference documentation for the Job class. The example shows how to set and get values to and from the cache in order to set the run priority with the `setRunPriority()` method and set the date format with the `setDateFormat()` method.

[Job Javadoc](#)

### **JobList class**

You can use the JobList class (in the access package) to list IBM i jobs.

With the JobList class, you can retrieve the following:

- All jobs
- Jobs by name, job number, or user

Use the `getJobs()` method to return a list of jobs or the `getLength()` method to return the number of jobs retrieved with the last `getJobs()`.

## Example: Using JobList

The following example lists all active jobs on the system:

```
// Create an AS400 object. List the
// jobs on this server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create the job list object.
JobList jobList = new JobList(sys);

// Get the list of active jobs.
Enumeration list = jobList.getJobs();

// For each active job on the system
// print job information.
while (list.hasMoreElements())
{
    Job j = (Job) list.nextElement();

    System.out.println(j.getName() + "." +
                      j.getUser() + "." +
                      j.getNumber());
}
```

[Job Javadoc](#)

## JobLog class

The `JobLog` class (in the `access` package) retrieves messages in the job log of a server job by calling `getMessages()`.

## Example: Using JobLog

The following example prints all messages in the job log for the specified user:

```
// ... Setup work to create an AS400
// object and a jobList object has
// already been done

// Get the list of active jobs on the server
Enumeration list = jobList.getJobs();

// Look through the list to find a
// job for the specified user.
while (list.hasMoreElements())
{
    Job j = (Job) list.nextElement();

    if (j.getUser().trim().equalsIgnoreCase(userID))
    {
        // A job matching the current user
        // was found. Create a job log
        // object for this job.
        JobLog jlog = new JobLog(system, j.getName(), j.getUser(), j.getNumber());

        // Enumerate the messages in the job
        // log then print them.
        Enumeration messageList = jlog.getMessages();

        while (messageList.hasMoreElements())
        {
            AS400Message message = (AS400Message) messageList.nextElement();
            System.out.println(message.getText());
        }
    }
}
```

[Job Javadoc](#)

## Message classes

The IBM Toolbox for Java AS400Message class and its associated classes represent a message returned from a server.

### AS400Message

The AS400Message object allows the Java program to retrieve an IBM i message that is generated from a previous operation (for example, from a command call). From a message object, the Java program can retrieve the following:

- The IBM i library and message file that contain the message
- The message ID
- The message type
- The message severity
- The message text
- The message help text

The following example shows how to use the AS400Message object:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Create a command call object.
CommandCall cmd = new CommandCall(sys, "myCommand");

// Run the command
cmd.run();

// Get the list of messages that are
// the result of the command that I just ran
AS400Message[] messageList = cmd.getMessageList();

// Iterate through the list displaying the messages
for (int i = 0; i < messageList.length; i++)
{
    System.out.println(messageList[i].getText());
}
```

### Examples: Using message lists

The following examples show how you can use message lists with CommandCall and ProgramCall.

- [“Example: Using CommandCall” on page 361](#)
- [“Example: Using ProgramCall” on page 423](#)

### QueuedMessage

The QueuedMessage class extends the AS400Message class.

The QueuedMessage class accesses information about a message on an IBM i message queue. With this class, a Java program can retrieve:

- Information about where a message originated, such as program, job number, and user.
- The message queue
- The message key
- The message reply status

The following example prints all messages in the message queue of the current (signed-on) user:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// The message queue is on this system.
AS400 sys = new AS400(mySystem.myCompany.com);
```

```

// Create the message queue object.
// This object will represent the
// queue for the current user.
MessageQueue queue = new MessageQueue(sys, MessageQueue.CURRENT);

// Get the list of messages currently in this user's queue.
Enumeration e = queue.getMessages();

// Print each message in the queue.
while (e.hasMoreElements())
{
    QueuedMessage msg = e.getNextElement();
    System.out.println(msg.getText());
}

```

## MessageFile

The MessageFile class allows you to receive a message from an IBM i message file. The MessageFile class returns an AS400Message object that contains the message. Using the MessageFile class, you can do the following:

- Return a message object that contains the message
- Return a message object that contains substitution text in the message

The following example shows how to retrieve and print a message:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

AS400 system = new AS400("mysystem.mycompany.com");
MessageFile messageFile = new MessageFile(system);
messageFile.setPath("/QSYS.LIB/QCPFMSG.MSGF");
AS400Message message = messageFile.getMessage("CPD0170");
System.out.println(message.getText());

```

## MessageQueue

The MessageQueue class allows a Java program to interact with an IBM i message queue.

The MessageQueue class acts as a container for the QueuedMessage class. The getMessages() method, in particular, returns a list of QueuedMessage objects. The MessageQueue class can do the following:

- Set message queue attributes
- Get information about a message queue
- Receive messages from a message queue
- Send messages to a message queue
- Reply to messages

The following example lists messages in the message queue for the current user:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

// The message queue is on this system.
AS400 sys = new AS400(mySystem.myCompany.com);

// Create the message queue object.
// This object will represent the
// queue for the current user.
MessageQueue queue = new MessageQueue(sys, MessageQueue.CURRENT);

// Get the list of messages currently in this user's queue.
Enumeration e = queue.getMessages();

// Print each message in the queue.
while (e.hasMoreElements())
{
    QueuedMessage msg = e.getNextElement();
    System.out.println(msg.getText());
}

```

[AS400Message Javadoc](#)  
[QueuedMessage Javadoc](#)  
[Access package summary](#)  
[MessageFile Javadoc](#)  
[MessageQueue Javadoc](#)

## NetServer class

The NetServer class has been deprecated and replaced by the ISeriesNetServer class.

The NetServer class represents the NetServer service on the server. NetServer objects allow you to query and modify the state and configuration of the NetServer service.

For example, you can use the NetServer class to:

- Start or stop the NetServer
- Get a list of all current file shares and print shares
- Get a list of all current sessions
- Query and change attribute values (using methods inherited from ChangeableResource)

**Note:** In order to use the NetServer class, you need a server user profile that has \*IOSYSCFG authority.

The NetServer class is an extension of ChangeableResource and Resource, so it provides a collection of "attributes" to represent the various NetServer values and settings. You query or change the attributes in order to access or change the configuration of your NetServer. Some of the NetServer attributes are:

- NAME
- NAME\_PENDING
- DOMAIN
- ALLOW\_SYSTEM\_NAME
- AUTOSTART
- CCSID
- WINS\_PRIMARY\_ADDRESS

## Pending attributes

Many of the NetServer attributes are pending (for example, NAME\_PENDING). Pending attributes represent NetServer values that take effect the next time you start (or restart) the NetServer on the server.

When you have a pair of related attributes and one attribute is pending while the other is nonpending:

- The pending attribute is read/write, so you can change it
- The nonpending attribute is read-only, so you can query it but you cannot change it

## Other NetServer classes

Related NetServer classes allow you to get and set detailed information about specific connections, sessions, file shares, and print shares:

- NetServerConnection: Represents a NetServer connection
- NetServerFileShare: Represents a NetServer file server share
- NetServerPrintShare: Represents a NetServer print server share
- NetServerSession: Represents a NetServer session
- NetServerShare: Represents a NetServer share

## Example: Using a NetServer object to change the name of the NetServer

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Create a system object to represent the server.
AS400 system = new AS400("MYSYSTEM", "MYUSERID", "MYPASSWD");

// Create an object with which to query and modify the NetServer.
NetServer nServer = new NetServer(system);

// Set the "pending name" to NEWNAME.
nServer.setAttributeValue(NetServer.NAME_PENDING, "NEWNAME");

// Commit the changes. This sends the changes to the server.
nServer.commitAttributeChanges();

// The NetServer name will get set to NEWNAME the next time the NetServer
// is ended and started.
```

## ObjectReferences class

The IBM Toolbox for Java ObjectReferences class represents the set of information about integrated file system references on an object that can be retrieved through the Retrieve Object References (QPOLROR) API.

A reference is an individual type of access or lock obtained on the object when using integrated file system interfaces. An object may have multiple references concurrently held, provided that the reference types do not conflict with one another. This class will not return information about byte range locks that may currently be held on an object.

The user must have execute (\*X) data authority to each directory preceding the object whose references are to be obtained. The user must have read (\*R) data authority to the object whose references are to be obtained.

For more information, see the ObjectReferences Javadoc.

### Related information

[ObjectReferences Javadoc](#)

[Retrieve Object References \(QPOLROR\) API](#)

## Permission classes

The IBM Toolbox for Java permission classes allow you to get and set object authority information. Object authority information is also known as permission. The Permission class represents a collection of many users' authority to a specific object. The UserPermission class represents a single user's authority to a specific object.

### Permission class

The Permission class allows you to retrieve and change object authority information. It includes a collection of many users who are authorized to the object. The Permission object allows the Java program to cache authority changes until the commit() method is called. Once the commit() method is called, all changes made up to that point are sent to the server. Some of the functions provided by the Permission class include:

- addAuthorizedUser(): Adds an authorized user.
- commit(): Commits the permission changes to the server.
- getAuthorizationList(): Returns the authorization list of the object.
- getAuthorizedUsers(): Returns an enumeration of authorized users.
- getOwner(): Returns the name of the object owner.
- getSensitivityLevel(): Returns the sensitivity level of the object.

- `getType()`: Returns the object authority type (QDLO, QSYS, or Root).
- `getUserPermission()`: Returns the permission of a specific user to the object.
- `getUserPermissions()`: Returns an enumeration of permissions of the users to the object.
- `setAuthorizationList()`: Sets the authorization list of the object.
- `setSensitivityLevel()`: Sets the sensitivity level of the object.

### Example: Using Permission

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows you how to create a permission and add an authorized user to an object.

```
// Create AS400 object
AS400 as400 = new AS400();

// Create Permission passing in the AS400 and object
Permission myPermission = new Permission(as400, "QSYS.LIB/myLib.LIB");

// Add a user to be authorized to the object
myPermission.addAuthorizedUser("User1");
```

### UserPermission class

The `UserPermission` class represents the authority of a single, specific user. `UserPermission` has three subclasses that handle the authority based on the object type:

- `DLOPermission`
- `QSYSPermission`
- `RootPermission`

The `UserPermission` class allows you to do the following:

- Determine if the user profile is a group profile
- Return the user profile name
- Indicate whether the user has authority
- Set the authority of authorization list management

### Example: Using UserPermission

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows you how to retrieve the users and groups that have permission on an object and print them out one at a time.

```
// Create a system object.
AS400 sys = new AS400("MYAS400", "USERID", "PASSWORD");

// Represent the permissions to an object on the system, such as a library.
Permission objectInQSYS = new Permission(sys, "/QSYS.LIB/FRED.LIB");

// Retrieve the various users/groups that have permissions set on that object.
Enumeration enum = objectInQSYS.getUserPermissions();
while (enum.hasMoreElements())
{
    // Print out the user/group profile names one at a time.
    UserPermission userPerm = (UserPermission)enum.nextElement();
    System.out.println(userPerm.getUserID());
}
}
```

[Permission Javadoc](#)

[UserPermission Javadoc](#)



## DLOPermission class

The DLOPermission class is a subclass of UserPermission. DLOPermission allows you to display and set the authorities a user has (called permissions) to a document library object (DLO). DLOs are stored in QDLS.

One of the following authority values is assigned to each user.

Authority value	Description
*ALL	The user can perform all operations except those operations that are controlled by authorization list management.
*AUTL	The authorization list is used to determine the authority for the document.
*CHANGE	The user can change and perform basic functions on the object.
*EXCLUDE	The user cannot access the object.
*USE	The user has object operational authority, read authority, and execute authority.

You must use one of the following methods to change or determine the user's authority:

- Use `getDataAuthority()` to display the authority value of the user
- Use `setDataAuthority()` to set the authority value of the user

After setting permissions, it is important that you use the `commit()` method from the `Permissions` class to send the changes to the server.

For more information about permissions and authorities, see the [Security reference](#) topic.

## Example: Using DLOPermission

The following example shows how to retrieve and print the DLO permissions, including the user profiles for each permission.

```
// Create a system object.
AS400 sys = new AS400("MYAS400", "USERID", "PASSWORD");
// Represent the permissions to a DLO object.
Permission objectInQDLS = new Permission(sys, "/QDLS/MyFolder");

// Print the object pathname and retrieve its permissions.
System.out.println("Permissions on " + objectInQDLS.getObjectPath() + " are as follows:");
Enumeration enum = objectInQDLS.getUserPermissions();
while (enum.hasMoreElements())
{
    // For each of the permissions, print out the user profile name
    // and that user's authorities to the object.
    DLOPermission dloPerm = (DLOPermission)enum.nextElement();
    System.out.println(dloPerm.getUserID() + ": " + dloPerm.getDataAuthority());
}
}
```

### Related information

[DLOPermission Javadoc](#)

## QSYSPermission

QSYSPermission is a subclass of the UserPermission class. QSYSPermission allows you to display and set the permission a user has for an object in the traditional IBM i library structure stored in QSYS.LIB. You can set authority for an object stored in QSYS.LIB by setting a system-defined authority value or by setting the individual object and data authorities.

The following table lists and describes the valid system-defined authority values:

System-defined authority value	Description
*ALL	The user can perform all operations except those operations that are controlled by authorization list management.
*AUTL	The authorization list is used to determine the authority for the document.
*CHANGE	The user can change and perform basic functions on the object.
*EXCLUDE	The user cannot access the object.
*USE	The user has object operational authority, read authority, and execute authority.

Each system-defined authority value actually represents a combination of the individual object authorities and data authorities. The following table illustrates the relationships of system-defined authorities to the individual object and data authorities:

*Table 1. Y refers to those authorities that can be assigned. n refers to those authorities that cannot be assigned.*

System-defined authority	Object authority					Data authority				
	Opr	Mgt	Exist	Alter	Ref	Read	Add	Upd	Dlt	Exe
<b>All</b>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
<b>Change</b>	Y	n	n	n	n	Y	Y	Y	Y	Y
<b>Exclude</b>	n	n	n	n	n	n	n	n	n	n
<b>Use</b>	Y	n	n	n	n	Y	n	n	n	Y
<b>Autl</b>	Only valid with user (*PUBLIC) and a specified authorization list that determines the individual object and data authorities.									

Specifying a system-defined authority automatically assigns the appropriate individual authorities. Likewise, specifying various individual authorities changes the appropriate individual authority values. When a combination of individual object authorities and data authorities does not map to a single system-defined authority value, then the single value becomes "User Defined."

Use the getObjectAuthority() method to display the current system-defined authority. Use the setObjectAuthority() method to set the current system-defined authority using a single value.

Use the appropriate set method to set individual object authority values on or off:

- setAlter()
- setExistence()
- setManagement()
- setOperational()
- setReference()

Use the appropriate set method to set individual data authority values on or off:

- setAdd()
- setDelete()
- setExecute()
- setRead()
- setUpdate()

For more information about the different authorities, see the [Security](#) reference topic. For information about using CL commands to grant and edit object authorities, see the CL commands [Grant Object Authority \(GRTOBJAUT\)](#) and [Edit Object Authority \(EDTOBJAUT\)](#).

### Example

This example shows you how to retrieve and print the permissions for a QSYS object.

```
// Create a system object.
AS400 sys = new AS400("MYAS400", "USERID", "PASSWORD");

// Represent the permissions to a QSYS object.
Permission objectInQSYS = new Permission(sys, "/QSYS.LIB/FRED.LIB");

// Print the object pathname and retrieve its permissions.
System.out.println("Permissions on "+objectInQSYS.getObjectPath()+" are as follows:");
Enumeration enum = objectInQSYS.getUserPermissions();
while (enum.hasMoreElements())
{
    // For each of the permissions, print out the user profile name
    // and that user's authorities to the object.
    QSYSPermission qsysPerm = (QSYSPermission)enum.nextElement();
    System.out.println(qsysPerm.getUserID()+" : "+qsysPerm.getObjectAuthority());
}
}
```

[QSYSPermission Javadoc](#)

["UserPermission class" on page 88](#)

### RootPermission

The `RootPermission` class represents a user's authority to objects contained in the root directory structure. `RootPermissions` objects are those objects not contained in `QSYS.LIB` or `QDLS`.

`RootPermission` is a subclass of the [UserPermission](#) class. The `RootPermission` class allows you to display and set the permissions for the user of an object contained in the root directory structure.

An object on the root directory structure can set the data authority or the object authority. You can set the data authority to the values listed in the following table. Use the `getDataAuthority()` method to display the current values and the `setDataAuthority()` method to set the data authority.

The following table lists and describes the valid data authority values:

Data authority value	Description
*none	The user has no authority to the object.
*RWX	The user has read, add, update, delete, and execute authorities.
*RW	The user has read, add, and delete authorities.
*RX	The user has read and execute authorities.
*WX	The user has add, update, delete, and execute authorities.
*R	The user has read authority.
*W	The user has add, update, and delete authorities.
*X	The user has execute authority.
*EXCLUDE	The user cannot access the object.
*AUTL	The public authorities on this object come from the authorization list.

The object authority can be set to one or more of the following values: alter, existence, management, or reference. You can use the `setAlter()`, `setExistence()`, `setManagement()`, or `setReference()` methods to set the values on or off.

After setting either the data authority or the object authority of an object, it is important that you use the `commit()` method from the [Permissions](#) class to send the changes to the server.

For more information about the different authorities, see the [Security reference](#) topic.

### Example

This example shows you how to retrieve and print the permissions for a root object.

```
// Create a system object.
AS400 sys = new AS400("MYAS400", "USERID", "PASSWORD");

// Represent the permissions to an object in the root file system.
Permission objectInRoot = new Permission(sys, "/fred");

// Print the object pathname and retrieve its permissions.
System.out.println("Permissions on "+objectInRoot.getObjectPath()+" are as follows:");
Enumeration enum = objectInRoot.getUserPermissions();
while (enum.hasMoreElements())
{
    // For each of the permissions, print out the user profile name
    // and that user's authorities to the object.
    RootPermission rootPerm = (RootPermission)enum.nextElement();
    System.out.println(rootPerm.getUserID()+" "+rootPerm.getDataAuthority());
}
```

### Related information

[RootPermission Javadoc](#)

## Print classes

Print objects include spooled files, output queues, printers, printer files, writer jobs, and Advanced Function Printing (AFP) resources, which include fonts, form definitions, overlays, page definitions, and page segments.

The IBM Toolbox for Java classes for print objects are organized on a base class, `PrintObject`, and on a subclass for each of the six types of print objects. The base class contains the methods and attributes common to all server print objects. The subclasses contain methods and attributes specific to each subtype.

## Examples

- [Example: Creating spooled files](#) shows how to create a spooled file on a server from an input stream
- [Example: Creating SCS spooled files](#) shows how to generate a SCS data stream using the `SCS3812Writer` class, and how to write the stream to a spooled file on the server
- [Example: Reading spooled files](#) shows how to use `PrintObjectInputStream` to read an existing server spooled file
- [Example: Reading and transforming spooled files](#) shows how to use `PrintObjectPageInputStream` and `PrintObjectTransformedInputStream` to obtain different transformations when reading spooled file data
- [Example: Copying a spooled file](#) shows how to copy a spooled file to the same queue that contains the file you want to copy.
- [Example: Listing spooled files asynchronously \(using listeners\)](#) shows how to asynchronously list all spooled files on a system and how to use the `PrintObjectListListener` interface to get feedback as the list is being built
- [Example: Listing spooled files asynchronously \(without using listeners\)](#) shows how to asynchronously list all spooled files on a system *without* using the `PrintObjectListListener` interface
- [Example: Listing spooled files synchronously](#) shows how to synchronously list all spooled files on a system

### Related information

[PrintObject Javadoc](#)

## Listing Print objects

You can use the IBM Toolbox for Java `PrintObjectList` class and its subclasses to work with lists of print objects. Print objects include spooled files, output queues, printers, Advanced Function Printing (AFP) resources, printer files, and writer jobs.

Each subclass has methods that allow filtering of the list based on what makes sense for that particular type of print object. For example, `SpooledFileList` allows you to filter a list of spooled files based on the user who created the spooled files, the output queue that the spooled files are on, the form type, or user data of the spooled files. Only those spooled files that match the filter criteria are listed. If no filters are set, a default for each of the filters are used.

To actually retrieve the list of print objects from the server, the `openSynchronously()` or `openAsynchronously()` methods are used. The `openSynchronously()` method does not return until all objects in the list have been retrieved from the server. The `openAsynchronously()` method returns immediately, and the caller can do other things in the foreground while waiting for the list to build. The asynchronously opened list also allows the caller to start displaying the objects to the user as the objects come back. Because the user can see the objects as they come back, the response time may seem faster to the user. In fact, the response time may actually take longer overall due to the extra processing being done on each object in the list.

If the list is opened asynchronously, the caller may get feedback on the building of the list. Methods, such as `isCompleted()` and `size()`, indicate whether the list has finished being built or return the current size of the list. Other methods, `waitForListToComplete()` and `waitForItem()`, allow the caller to wait for the list to complete or for a particular item. In addition to calling these `PrintObjectList` methods, the caller may register with the list as a listener. In this situation, the caller is notified of events that happen to the list. To register or unregister for the events, the caller uses `PrintObjectListener()`, and then calls `addPrintObjectListener()` to register `removePrintObjectListener()` or to unregister. The following table shows the events that are delivered from a `PrintObjectList`.

<b>PrintObjectList event</b>	<b>When event is delivered</b>
<code>listClosed</code>	When the list is closed.
<code>listCompleted</code>	When the list completes.
<code>listErrorOccurred</code>	If any exception is thrown while the list is being retrieved.
<code>listOpened</code>	When the list is opened.
<code>listObjectAdded</code>	When an object is added to the list.

After the list has been opened and the objects in the list processed, close the list using the `close()` method. This frees up any resources allocated to the garbage collector during the open. After a list has been closed, its filters can be modified, and the list can be opened again.

When print objects are listed, attributes about each print object listed are sent from the server and stored with the print object. These attributes can be updated using the `update()` method in the `PrintObject` class. Which attributes are sent back from the server depends on the type of print object being listed. A default list of attributes for each type of print object that can be overridden by using the `setAttributesToRetrieve()` method in `PrintObjectList` exists. See the [Retrieving PrintObject attributes](#) section for a list of the attributes each type of print object supports.

## Examples

The following examples show different ways to list spooled files.

[“Example: Listing spooled files asynchronously \(using listeners\)”](#) on page 418 shows how to asynchronously list all spooled files on a system and how to use the `PrintObjectListener` interface to get feedback as the list is being built

[“Example: Listing spooled files asynchronously \(without using listeners\)”](#) on page 420 shows how to asynchronously list all spooled files on a system *without* using the `PrintObjectListener` interface

[“Example: Listing spooled files synchronously” on page 422](#) shows how to synchronously list all spooled files on a system

[PrintObjectList Javadoc](#)

[SpooledFileList Javadoc](#)

[AFPResource Javadoc](#)

### ***Working with Print objects***

PrintObject is an abstract class. An abstract class does not allow you to create an instance of the class. Instead, you must create an instance of one of its subclasses to work with print objects.

Create objects of the subclasses in any of the following ways:

- If you know the system and the identifying attributes of the object, construct the object explicitly by calling its public constructor.
- You can use a PrintObjectList subclass to build a list of the objects and then get at the individual objects through the list.
- An object may be created and returned to you as a result of a method or set methods being called. For example, the static method start() in the WriterJob class returns a WriterJob object.

Use the base class, [PrintObjectjavadoc/com/ibm/as400/access/PrintObject.html#NAVBAR\\_TOP](#), and its subclasses to work with server print objects:

- OutputQueue
- Printer
- PrinterFile
- SpooledFile
- WriterJob

[PrintObject Javadoc](#)

[PrintObjectList Javadoc](#)

[OutputQueue Javadoc](#)

[Printer Javadoc](#)

[PrinterFile Javadoc](#)

[SpooledFile Javadoc](#)

[WriterJob Javadoc](#)

### ***Retrieving PrintObject attributes***

You can retrieve print object attributes by using the attribute ID and one of several methods from the base PrintObject class.

The methods you can use include the following:

- Use `getIntegerAttribute(int attributeID)` to retrieve an integer type attribute.
- Use `getFloatAttribute(int attributeID)` to retrieve a floating point type attribute.
- Use `getStringAttribute(int attributeID)` to retrieve a string type attribute.

The attributeID parameter is an integer that identifies which attribute to retrieve. All of the IDs are defined as public constants in the base PrintObject class. The `PrintAttributes` file contains an entry of each attribute ID. The entry includes a description of the attribute and its type (integer, floating point, or string). For a list of which attributes may be retrieved using these methods, select the following links:

- [AFPResourceAttrs](#) for AFP Resources
- [OutputQueueAttrs](#) for output queues
- [PrinterAttrs](#) for printers
- [PrinterFileAttrs](#) for printer files
- [SpooledFileAttrs](#) for spooled files

- [WriterJobAttrs](#) for writer jobs

To achieve acceptable performance, these attributes are copied to the client. These attributes are copied either when the objects are listed, or the first time they are needed if the object was created implicitly. This keeps the object from going to the host every time the application needs to retrieve an attribute. This also makes it possible for the Java print object instance to contain out-of-date information about the object on the server. The user of the object can refresh all of the attributes by calling the `update()` method on the object. In addition, if the application calls any methods on the object that would cause the object's attributes to change, the attributes are automatically updated. For example, if an output queue has a status attribute of `RELEASED` (`getStringAttribute(ATTR_OUTQSTS)`; returns a string of "RELEASED"), and the `hold()` method is called on the output queue, getting the status attribute after that returns `HELD`.

## setAttributes method

You can use the `SpooledFile` `setAttributes` method to change the attributes of spooled files and printer file objects. Select the following links for a list or which attributes may be set:

- [PrinterFileAttrs](#) file for printer files
- [SpooledFileAttrs](#) for spooled files

The `setAttributes` method takes a `PrintParameterList` parameter, which is a class that is used to hold a collection of attributes IDs and their values. The list starts out empty, and the caller can add attributes to the list by using the various `setParameter()` methods on it.

## PrintParameterList class

You can use the `PrintParameterList` class to pass a group of attributes to a method that takes any of a number of attributes as parameters. For example, you can send a spooled file using TCP (LPR) by using the `SpooledFile` method, `sendTCP()`. The `PrintParameterList` object contains the required parameters for the send command, such as the remote system and queue, plus any optional parameters desired, such as whether to delete the spooled file after it is sent. In these cases, the method documentation gives a list of required and optional attributes. The `PrintParameterList` `setParameter()` method does not check which attributes you are setting and the values that you set them to. The `PrintParameterList` `setParameter()` method simply contains the values to pass along to the method. In general, extra attributes in the `PrintParameterList` are ignored, and illegal values on the attributes that are used are diagnosed on the server.

[PrintObject Javadoc](#)

[SpooledFile Javadoc](#)

[PrintParameterList Javadoc](#)

## AFP Resource Attributes

This topic lists the attributes that can be retrieved and set for an AFP resource.

## Retrieve Attributes

The following attributes may be retrieved for an AFP resource using the appropriate `getIntegerAttribute()`, `getStringAttribute()`, or `getFloatAttribute()` method:

- [ATTR\\_AFP\\_RESOURCE](#) - AFP resource Integrated File System Path
- [ATTR\\_OBJEXTATTR](#) - Object Extended Attribute
- [ATTR\\_DESCRIPTION](#) - Text Description
- [ATTR\\_DATE](#) - Date File Opened
- [ATTR\\_TIME](#) - Time File Opened
- [ATTR\\_NUMBYTES](#) - Number of bytes to read/write

## Set Attributes

Attributes are not allowed to be set for an AFP resource.

### ***Output queue attributes***

This topic lists the attributes available for an output queue.

## Retrieve attributes

The following attributes may be retrieved for an output queue using the appropriate `getIntegerAttribute()`, `getStringAttribute()`, or `getFloatAttribute()` method:

- ATTR\_AUTHCHCK - Authority to Check
- ATTR\_DATA\_QUEUE - Data Queue Integrated File System Name
- ATTR\_DISPLAYANY - Display any File
- ATTR\_JOBSEPRATR - Job Separators
- ATTR\_NUMFILES - Number of Files
- ATTR\_NUMWRITERS - Number of Writers Started to Queue
- ATTR\_OPCNTRL - Operator Controlled
- ATTR\_ORDER - Order of Files On Queue
- ATTR\_OUTPUT\_QUEUE - Output Queue Integrated File System Name
- ATTR\_OUTQSTS - Output Queue Status
- ATTR\_PRINTER - Printer
- ATTR\_SEPPAGE - Separator page
- ATTR\_DESCRIPTION - Text Description
- ATTR\_USRDEFOPT - User defined option(s)
- ATTR\_USER\_DEFINED\_OBJECT - User defined object Integrated File System Name
- ATTR\_USER\_TRANSFORM\_PROG - User transform program Integrated File System Name
- ATTR\_USER\_DRIVER\_PROG - User driver program Integrated File System Name
- ATTR\_WTRJOBNAME - Writer Job Name
- ATTR\_WTRJOBNUM - Writer Job Number
- ATTR\_WTRJOBSTS - Writer Job Status
- ATTR\_WTRJOBUSER - Writer Job User Name

## Set attributes

Attributes are not allowed to be set for an output queue.

### ***Printer Attributes***

The following attributes may be retrieved for a printer using the appropriate `getIntegerAttribute()`, `getStringAttribute()`, or `getFloatAttribute()` method:

## Retrieve Attributes

- ATTR\_AFP - Advanced Function Printing
- ATTR\_ALIGNFORMS - Align Forms
- ATTR\_ALWDRTprt - Allow Direct Print
- ATTR\_BTWNCPYSTS - Between copies status
- ATTR\_BTWNFILESTS - Between files status
- ATTR\_CODEPAGE - Code Page



- ATTR\_CHANGES - Changes
- ATTR\_DEVCLASS - Device Class
- ATTR\_DEVMODEL - Device Model
- ATTR\_DEVTYPE - Device Type
- ATTR\_DEVSTATUS - Device Status
- ATTR\_DRWRSEP - Drawer for Separators
- ATTR\_ENDPNDSTS - End pending status
- ATTR\_FILESEP - File Separators
- ATTR\_FONTID - Font Identifier
- ATTR\_FORM\_DEFINITION - Form Definition Integrated File System Name
- ATTR\_FORMTYPE - Form Type
- ATTR\_FORMTYPEMSG - Form Type Message
- ATTR\_FORMFEED - Form Feed
- ATTR\_CHAR\_ID - Graphic Character Set
- ATTR\_HELDSTS - Held status
- ATTR\_HOLDPNDSTS - Hold pending status
- ATTR\_JOBUSER - Job User
- ATTR\_MFGTYPE - Manufacturer Type and Model
- ATTR\_MESSAGE\_QUEUE - Message Queue Integrated File System Name
- ATTR\_ONJOBQSTS - On job queue status
- ATTR\_OUTPUT\_QUEUE - Output Queue Integrated File System Name
- ATTR\_OVERALLSTS - Overall Status
- ATTR\_POINTSIZE - Point Size
- ATTR\_PRINTER - Printer
- ATTR\_PRTDEVTYPE - Printer Device Type
- ATTR\_PUBINF\_COLOR\_SUP - Publishing Info Color Supported
- ATTR\_PUBINF\_PPM\_COLOR - Publishing Info Pages per Minute (Color)
- ATTR\_PUBINF\_PPM - Publishing Info Pages per Minute (Monochrome)
- ATTR\_PUBINF\_DUPLEX\_SUP - Publishing Info Duplex Support
- ATTR\_PUBINF\_LOCATION - Publishing Info Location
- ATTR\_RMTLOCNAME - Remote Location Name
- ATTR\_SPOOLFILE - Spooled File Name
- ATTR\_SPLFNUM - Spooled File Number
- ATTR\_STARTEDBY - Started By User
- ATTR\_DESCRIPTION - Text Description
- ATTR\_USERDATA - User data
- ATTR\_USRDEFOPT - User defined option(s)
- ATTR\_USER\_DEFINED\_OBJECT - User defined object Integrated File System Name
- ATTR\_USER\_TRANSFORM\_PROG - User transform program Integrated File System Name
- ATTR\_USER\_DRIVER\_PROG - User driver program Integrated File System Name
- ATTR\_SCS2ASCII - Transform SCS to ASCII
- ATTR\_WTNGDATASTS - Waiting for data status
- ATTR\_WTNGDEVSTS - Waiting for device status

- [ATTR\\_WTNGMSGSTS](#) - Waiting for message status
- [ATTR\\_WTRAUTOEND](#) - When to Automatically End Writer
- [ATTR\\_WTRJOBNAME](#) - Writer Job Name
- [ATTR\\_WTRJOBSTS](#) - Writer Job Status
- [ATTR\\_WTRSTRTD](#) - Writer started
- [ATTR\\_WRTNGSTS](#) - Writing status

## Set Attributes

Attributes are not allowed to be set for a printer.

## *Printer file attributes*

This topic contains a list of printer file attributes for use with IBM Toolbox for Java.

## Retrieve attributes

The following attributes may be retrieved for a printer file using the appropriate `getIntegerAttribute()`, `getStringAttribute()`, or `getFloatAttribute()` method:

- [ATTR\\_ALIGN](#) - Align Page
- [ATTR\\_BKMGN\\_ACR](#) - Back Margin Offset Across
- [ATTR\\_BKMGN\\_DWN](#) - Back Margin Offset Down
- [ATTR\\_BACK\\_OVERLAY](#) - Back Overlay Integrated File System Name
- [ATTR\\_BKOVL\\_DWN](#) - Back Overlay Offset Down
- [ATTR\\_BKOVL\\_ACR](#) - Back Overlay offset across
- [ATTR\\_CPI](#) - Characters per Inch
- [ATTR\\_CODEDFNTLIB](#) - Coded Font Library Name
- [ATTR\\_CODEPAGE](#) - Code Page
- [ATTR\\_CODEDFNT](#) - Code Font Name
- [ATTR\\_CONTROLCHAR](#) - Control Character
- [ATTR\\_CONVERT\\_LINEDATA](#) - Convert Line Data
- [ATTR\\_COPIES](#) - Copies
- [ATTR\\_CORNER\\_STAPLE](#) - Corner staple
- [ATTR\\_DBCSDATA](#) - User Specified DBCS Data
- [ATTR\\_DBCSEXTENSN](#) - DBCS Extension Characters
- [ATTR\\_DBCSROTATE](#) - DBCS Character Rotation
- [ATTR\\_DBCSCPI](#) - DBCS Characters per Inch
- [ATTR\\_DBCSSISO](#) - DBCS SO/SI Spacing
- [ATTR\\_DFR\\_WRITE](#) - Defer Write
- [ATTR\\_PAGRRTT](#) - Degree of Page Rotation
- [ATTR\\_EDGESTITCH\\_NUMSTAPLES](#) - Edge Stitch Number of Staples
- [ATTR\\_EDGESTITCH\\_REF](#) - Edge Stitch Reference
- [ATTR\\_EDGESTITCH\\_REFOFF](#) - Edge Stitch Reference
- [ATTR\\_ENDPAGE](#) - Ending Page
- [ATTR\\_FILESEP](#) - File Separators
- [ATTR\\_FOLDREC](#) - Fold Records
- [ATTR\\_FONTID](#) - Font Identifier

- ATTR\_FORM\_DEFINITION - Form Definition Integrated File System Name
- ATTR\_FORMFEED - Form Feed
- ATTR\_FORMTYPE - Form Type
- ATTR\_FTMGN\_ACR - Front Margin Offset Across
- ATTR\_FTMGN\_DWN - Front Margin Offset Down
- ATTR\_FRONT\_OVERLAY - Front overlay Integrated File System Name
- ATTR\_FTOVL\_ACR - Front Overlay Offset Across
- ATTR\_FTOVL\_DWN - Front Overlay Offset Down
- ATTR\_CHAR\_ID - Graphic Character Set
- ATTR\_JUSTIFY - Hardware Justification
- ATTR\_HOLD - Hold Spool File
- ATTR\_LPI - Lines Per Inch
- ATTR\_MAXRCDS - Maximum Spooled Output Records
- ATTR\_OUTPTY - Output Priority
- ATTR\_OUTPUT\_QUEUE - Output Queue Integrated File System Name
- ATTR\_OVERFLOW - Overflow Line Number
- ATTR\_PAGE\_DEFINITION - Page Definition Integrated File System
- ATTR\_PAGELEN - Length of Page
- ATTR\_MEASMETHOD - Measurement Method
- ATTR\_PAGEWIDTH - Width of Page
- ATTR\_MULTIUP - Pages Per Side
- ATTR\_POINTSIZE - Point Size
- ATTR\_FIDELITY - Print Fidelity
- ATTR\_DUPLEX - Print on Both Sides
- ATTR\_PRTQUALITY - Print Quality
- ATTR\_PRTTEXT - Print Text
- ATTR\_PRINTER - Printer
- ATTR\_PRTDEVTYPE - Printer Device Type
- ATTR\_RPLUNPRT - Replace Unprintable Characters
- ATTR\_RPLCHAR - Replacement Character
- ATTR\_SADDLESTITCH\_NUMSTAPLES - Saddle Stitch Number of Staples
- ATTR\_SADDLESTITCH\_REF - Saddle Stitch Reference
- ATTR\_SAVE - Save Spooled File
- ATTR\_SRCDRWR - Source Drawer
- ATTR\_SPOOL - Spool the Data
- ATTR\_SCHEDULE - Spooled Output Schedule
- ATTR\_STARTPAGE - Starting Page
- ATTR\_DESCRIPTION - Text Description
- ATTR\_UNITOFMEAS - Unit of Measure
- ATTR\_USERDATA - User Data
- ATTR\_USRDEFDATA - User defined data
- ATTR\_USRDEFOPT - User defined option(s)
- ATTR\_USER\_DEFINED\_OBJECT - User defined object Integrated File System Name

## Set attributes

The following attributes may be set for a printer file using the `setAttributes()` method:

- [ATTR\\_ALIGN](#) - Align Page
- [ATTR\\_BKMGN\\_ACR](#) - Back Margin Offset Across
- [ATTR\\_BKMGN\\_DWN](#) - Back Margin Offset Down
- [ATTR\\_BACK\\_OVERLAY](#) - Back Overlay Integrated File System Name
- [ATTR\\_BKOVL\\_DWN](#) - Back Overlay Offset Down
- [ATTR\\_BKOVL\\_ACR](#) - Back Overlay offset across
- [ATTR\\_CPI](#) - Characters per Inch
- [ATTR\\_CODEDFNTLIB](#) - Coded Font Library Name
- [ATTR\\_CODEPAGE](#) - Code Page
- [ATTR\\_CODEDFNT](#) - Code Font Name
- [ATTR\\_CONTROLCHAR](#) - Control Character
- [ATTR\\_CONVERT\\_LINEDATA](#) - Convert Line Data
- [ATTR\\_COPIES](#) - Copies
- [ATTR\\_CORNER\\_STAPLE](#) - Corner staple
- [ATTR\\_DBCSDATA](#) - User Specified DBCS Data
- [ATTR\\_DBCSEXTENS](#) - DBCS Extension Characters
- [ATTR\\_DBCSROTATE](#) - DBCS Character Rotation
- [ATTR\\_DBCSCPI](#) - DBCS Characters per Inch
- [ATTR\\_DBCSSISO](#) - DBCS SO/SI Spacing
- [ATTR\\_DFR\\_WRITE](#) - Defer Write
- [ATTR\\_PAGRRT](#) - Degree of Page Rotation
- [ATTR\\_EDGESTITCH\\_NUMSTAPLES](#) - Edge Stitch Number of Staples
- [ATTR\\_EDGESTITCH\\_REF](#) - Edge Stitch Reference
- [ATTR\\_EDGESTITCH\\_REFOFF](#) - Edge Stitch Reference
- [ATTR\\_ENDPAGE](#) - Ending Page
- [ATTR\\_FILESEP](#) - File Separators
- [ATTR\\_FOLDREC](#) - Fold Records
- [ATTR\\_FONTID](#) - Font Identifier
- [ATTR\\_FORM\\_DEFINITION](#) - Form Definition Integrated File System Name
- [ATTR\\_FORMFEED](#) - Form Feed
- [ATTR\\_FORMTYPE](#) - Form Type
- [ATTR\\_FTMGN\\_ACR](#) - Front Margin Offset Across
- [ATTR\\_FTMGN\\_DWN](#) - Front Margin Offset Down
- [ATTR\\_FRONT\\_OVERLAY](#) - Front overlay Integrated File System Name
- [ATTR\\_FTOVL\\_ACR](#) - Front Overlay Offset Across
- [ATTR\\_FTOVL\\_DWN](#) - Front Overlay Offset Down
- [ATTR\\_CHAR\\_ID](#) - Graphic Character Set
- [ATTR\\_JUSTIFY](#) - Hardware Justification
- [ATTR\\_HOLD](#) - Hold Spool File

- ATTR\_LPI - Lines Per Inch
- ATTR\_MAXRCDS - Maximum Spooled Output Records
- ATTR\_OUTPTY - Output Priority
- ATTR\_OUTPUT\_QUEUE - Output Queue Integrated File System Name
- ATTR\_OVERFLOW - Overflow Line Number
- ATTR\_PAGE\_DEFINITION - Page Definition Integrated File System
- ATTR\_PAGELLEN - Length of Page
- ATTR\_MEASMETHOD - Measurement Method
- ATTR\_PAGEWIDTH - Width of Page
- ATTR\_MULTIUP - Pages Per Side
- ATTR\_POINTSIZE - Point Size
- ATTR\_FIDELITY - Print Fidelity
- ATTR\_DUPLEX - Print on Both Sides
- ATTR\_PRTQUALITY - Print Quality
- ATTR\_PRTTEXT - Print Text
- ATTR\_PRINTER - Printer
- ATTR\_PRTDEVTYPE - Printer Device Type
- ATTR\_RPLUNPRT - Replace Unprintable Characters
- ATTR\_RPLCHAR - Replacement Character
- ATTR\_SADDLESTITCH\_NUMSTAPLES - Saddle Stitch Number of Staples
- ATTR\_SADDLESTITCH\_REF - Saddle Stitch Reference
- ATTR\_SAVE - Save Spooled File
- ATTR\_SRCDRWR - Source Drawer
- ATTR\_SPOOL - Spool the Data
- ATTR\_SCHEDULE - Spooled Output Schedule
- ATTR\_STARTPAGE - Starting Page
- ATTR\_DESCRIPTION - Text Description
- ATTR\_UNITOFMEAS - Unit of Measure
- ATTR\_USERDATA - User Data
- ATTR\_USRDEFDATA - User defined data
- ATTR\_USRDEFOPT - User defined option(s)
- ATTR\_USER\_DEFINED\_OBJECT - User defined object Integrated File System Name

### ***Spooled file attributes***

This topic lists the attributes that can be retrieved and set for a spooled file.

#### **Retrieve attributes**

The following attributes may be retrieved for a spooled file using the appropriate `getIntegerAttribute()`, `getStringAttribute()`, or `getFloatAttribute()` method:

- ATTR\_AFP - Advanced Function Printing
- ATTR\_ALIGN - Align Page
- ATTR\_BKMGN\_ACR - Back Overlay offset across
- ATTR\_BKMGN\_DWN - Back Overlay Offset Down
- ATTR\_BACK\_OVERLAY - Back Overlay Integrated File System Name
- ATTR\_BKOVL\_DWN - Back Overlay Offset Down

- ATTR\_BKOVL\_ACR - Back Overlay offset across
- ATTR\_CPI - Characters per Inch
- ATTR\_CODEDFNTLIB - Coded Font Library Name
- ATTR\_CODEDFNT - Code Font Name
- ATTR\_CODEPAGE - Code Page
- ATTR\_CONTROLCHAR - Control Character
- ATTR\_COPIES - Copies
- ATTR\_COPIESLEFT - Copies left to Produce
- ATTR\_CORNER\_STAPLE - Corner staple
- ATTR\_CURPAGE - Current Page
- ATTR\_DATE - Date Object Created
- ATTR\_DATE\_WTR\_BEGAN\_FILE - Date Writer Began Processing Spooled File
- ATTR\_DATE\_WTR\_CMPL\_FILE - Date Writer Completed Processing Spooled File
- ATTR\_DBCSDATA - User Specified DBCS Data
- ATTR\_DBCSEXTENS - DBCS Extension Characters
- ATTR\_DBCSROTATE - DBCS Character Rotation
- ATTR\_DBCSCPI - DBCS Characters per Inch
- ATTR\_DBCSSISO - DBCS SO/SI Spacing
- ATTR\_PAGRRT - Degree of Page Rotation
- ATTR\_EDGESTITCH\_NUMSTAPLES - Edge Stitch Number of Staples
- ATTR\_EDGESTITCH\_REF - Edge Stitch Reference
- ATTR\_EDGESTITCH\_REFOFF - Edge Stitch Reference Offset
- ATTR\_ENDPAGE - Ending Page
- ATTR\_FILESEP - File Separators
- ATTR\_FOLDREC - Fold Records
- ATTR\_FONTID - Font Identifier
- ATTR\_FORM\_DEFINITION - Form definition Integrated File System Name
- ATTR\_FORMFEED - Form Feed
- ATTR\_FORMTYPE - Form Type
- ATTR\_FTMGN\_ACR - Front Margin Offset Across
- ATTR\_FTMGN\_DWN - Front Margin Offset Down
- ATTR\_FRONTSIDE\_OVERLAY - Front overlay Integrated File System Name
- ATTR\_FTOVL\_ACR - Front Overlay Offset Across
- ATTR\_FTOVL\_DWN - Front Overlay Offset Down
- ATTR\_CHAR\_ID - Graphic Character Set
- ATTR\_JUSTIFY - Hardware Justification
- ATTR\_HOLD - Hold Spool File
- ATTR\_IPP\_ATTR\_CHARSET - IPP Attributes-charset
- ATTR\_IPP\_JOB\_ID - IPP Job ID
- ATTR\_IPP\_JOB\_NAME - IPP Job Name
- ATTR\_IPP\_JOB\_NAME\_NL - IPP Job Name NL
- ATTR\_IPP\_JOB\_ORIGUSER - IPP Job Originating User
- ATTR\_IPP\_JOB\_ORIGUSER\_NL - IPP Job Originating User NL

- ATTR\_IPP\_PRINTER\_NAME - IPP Printer Name
- ATTR\_JOBNAME - Job Name
- ATTR\_JOBNUMBER - Job Number
- ATTR\_JOBUSER - Job User
- ATTR\_JOB\_SYSTEM - Job System
- ATTR\_LASTPAGE - Last Page Printed
- ATTR\_LINESPACING - Line Spacing
- ATTR\_LPI - Lines Per Inch
- ATTR\_MAXRCDS - Maximum Spooled Output Records
- ATTR\_PAGELEN - Length of Page
- ATTR\_PAGEWIDTH - Width of Page
- ATTR\_MEASMETHOD - Measurement Method
- ATTR\_NETWORK - Network Identifier
- ATTR\_NUMBYTES - Number of bytes to read/write
- ATTR\_OUTPUTBIN - Output Bin
- ATTR\_OUTPTY - Output Priority
- ATTR\_OUTPUT\_QUEUE - Output Queue Integrated File System Name
- ATTR\_OVERFLOW - Overflow Line Number
- ATTR\_MULTIUP - Pages Per Side
- ATTR\_POINTSIZE - Point Size
- ATTR\_FIDELITY - Print Fidelity
- ATTR\_DUPLEX - Print on Both Sides
- ATTR\_PRTQUALITY - Print Quality
- ATTR\_PRTTEXT - Print Text
- ATTR\_PRINTER - Printer
- ATTR\_PRTASSIGNED - Printer Assigned
- ATTR\_PRTDEVTYPE - Printer Device Type
- ATTR\_PRINTER\_FILE - Printer File Integrated File System Name
- ATTR\_RECLENGTH - Record Length
- ATTR\_REDUCE - Reduce Output
- ATTR\_RPLUNPRT - Replace Unprintable Characters
- ATTR\_RPLCHAR - Replacement Character
- ATTR\_RESTART - Restart Printing
- ATTR\_SADDLESTITCH\_NUMSTAPLES - Saddle Stitch Number of Staples
- ATTR\_SADDLESTITCH\_REF - Saddle Stitch Reference
- ATTR\_SAVE - Save Spooled File
- ATTR\_SRCDRWR - Source Drawer
- ATTR\_SPOOLFILE - Spooled File Name
- ATTR\_SPLFNUM - Spooled File Number
- ATTR\_SPLFSTATUS - Spooled File Status
- ATTR\_SCHEDULE - Spooled Output Schedule
- ATTR\_STARTPAGE - Starting Page
- ATTR\_SYSTEM - System Where Created

- ATTR\_TIME - Time Object Created
- ATTR\_TIME\_WTR\_BEGAN\_FILE - Time Writer Began Processing Spooled File
- ATTR\_TIME\_WTR\_CMPL\_FILE - Time Writer Completed Processing Spooled File
- ATTR\_PAGES - Total Pages
- ATTR\_UNITOFMEAS - Unit of Measure
- ATTR\_USERCMT - User Comment
- ATTR\_USERDATA - User Data
- ATTR\_USRDEFDATA - User Defined Data
- ATTR\_USRDEFFILE - User Defined File
- ATTR\_USRDEFOPT - User Defined Option(s)
- ATTR\_USER\_DEFINED\_OBJECT - User Defined Object Integrated File System Name

### **Set attributes**

The following attributes may be set for a spooled file using the setAttributes() method:

- ATTR\_ALIGN - Align Page
- ATTR\_BACK\_OVERLAY - Back Overlay Integrated File System Name
- ATTR\_BKOVL\_DWN - Back Overlay Offset Down
- ATTR\_BKOVL\_ACR - Back Overlay offset across
- ATTR\_COPIES - Copies
- ATTR\_ENDPAGE - Ending Page
- ATTR\_FILESEP - File Separators
- ATTR\_FORM\_DEFINITION - Form definition Integrated File System Name
- ATTR\_FORMFEED - Form Feed
- ATTR\_FORMTYPE - Form Type
- ATTR\_FRONTSIDE\_OVERLAY - Front overlay Integrated File System Name
- ATTR\_FTOVL\_ACR - Front Overlay Offset Across
- ATTR\_FTOVL\_DWN - Front Overlay Offset Down
- ATTR\_OUTPTY - Output Priority
- ATTR\_OUTPUT\_QUEUE - Output Queue Integrated File System Name
- ATTR\_MULTIUP - Pages Per Side
- ATTR\_FIDELITY - Print Fidelity
- ATTR\_DUPLEX - Print on Both Sides
- ATTR\_PRTQUALITY - Print Quality
- ATTR\_PRTSEQUENCE - Print Sequence
- ATTR\_PRINTER - Printer
- ATTR\_RESTART - Restart Printing
- ATTR\_SAVE - Save Spooled File
- ATTR\_SCHEDULE - Spooled Output Schedule
- ATTR\_STARTPAGE - Starting Page
- ATTR\_USERDATA - User Data
- ATTR\_USRDEFOPT - User defined option(s)
- ATTR\_USER\_DEFINED\_OBJECT - User defined object Integrated File System Name



## ***Writer Job Attributes***

This topic lists the attributes for writer jobs.

### **Retrieve Attributes**

The following attributes may be retrieved for a writer job using the appropriate `getIntegerAttribute()`, `getStringAttribute()`, or `getFloatAttribute()` method:

- [ATTR\\_WTRJOBNAME](#) - Writer Job Name
- [ATTR\\_WTRJOBNUM](#) - Writer Job Number
- [ATTR\\_WTRJOBSTS](#) - Writer Job Status
- [ATTR\\_WTRJOBUSER](#) - Writer Job User Name

### **Set Attributes**

Attributes are not allowed to be set for a writer job.

## ***Print Object Attributes***

This topic lists the attributes available for print objects.

- [Advanced Function Printing](#)
- [AFP Resource](#)
- [Align Forms](#)
- [Align Page](#)
- [Allow Direct Print](#)
- [Authority](#)
- [Authority to Check](#)
- [Automatically End Writer](#)
- [Auxiliary Storage](#)
- [Back Margin Offset Across](#)
- [Back Margin Offset Down](#)
- [Backside Overlay](#)
- [Back Overlay offset across](#)
- [Back Overlay Offset Down](#)
- [Between Copies Status](#)
- [Between Files Status](#)
- [Changes](#)
- [Characters per Inch](#)
- [Code Page](#)
- [Code Font Name](#)
- [Coded Font Library Name](#)
- [Control Character](#)
- [Convert line data](#)
- [Copies](#)
- [Copies left to Produce](#)
- [Corner staple](#)
- [Current Page](#)
- [Data Format](#)
- [Data Queue](#)
- [Date File Opened](#)

- [Date Spooled File Job Create End](#)
- [Date Writer Began Processing Spooled File](#)
- [Date Writer Completed Processing Spooled File](#)
- [User Specified DBCS Data](#)
- [DBCS Extension Characters](#)
- [DBCS Character Rotation](#)
- [DBCS Characters per Inch](#)
- [DBCS SO/SI Spacing](#)
- [Defer Write](#)
- [Degree of Page Rotation](#)
- [Delete File After Sending](#)
- [Destination Option](#)
- [Destination Type](#)
- [Device Class](#)
- [Device Model](#)
- [Device Status](#)
- [Device Type](#)
- [Display any File](#)
- [Drawer for Separators](#)
- [Edge Stitch Number of Staples](#)
- [Edge Stitch Reference](#)
- [Edge Stitch Reference Offset](#)
- [End Pending Status](#)
- [Ending Page](#)
- [Envelope Source](#)
- [File Separators](#)
- [Fold Records](#)
- [Font Identifier](#)
- [Form Definition](#)
- [Form Feed](#)
- [Form Type](#)
- [Form Type Message Option](#)
- [Front Margin Offset Across](#)
- [Front Margin Offset Down](#)
- [Front Overlay](#)
- [Front Overlay Offset Across](#)
- [Front Overlay Offset Down](#)
- [Graphic Character Set](#)
- [Hardware Justification](#)
- [Held Status](#)
- [Hold Spool File](#)
- [Hold Pending Status](#)
- [Image Configuration](#)

- [Initialize the writer](#)
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- [IPP Job Name](#)
- [IPP Job Name NL](#)
- [IPP Job Originating User Name](#)
- [IPP Job Originating User Name NL](#)
- [IPP IPP Printer Name](#)
- [Job Name](#)
- [Job Number](#)
- [Job Separators](#)
- [Job System](#)
- [Job User](#)
- [Last Page Printed](#)
- [Length of Page](#)
- [Library Name](#)
- [Lines Per Inch](#)
- [Line Spacing](#)
- [Manufacturer Type and Model](#)
- [Max Jobs per Client List](#)
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- [Publishing Info Color Supported](#)
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- [Replacement Character](#)
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- [Save Spooled File](#)
- [Seek Offset](#)
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- [Send Priority](#)
- [Separator page](#)

- [Source Drawer](#)
- [Spool SCS](#)
- [Spool the Data](#)
- [Spooled File Creation Authentication Method](#)
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- [User Driver Program Data](#)
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- [User Transform Program](#)
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- [Waiting for Data Status](#)
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- [When to Automatically End Writer](#)
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- [Writer Job Status](#)
- [Writer Job User Name](#)
- [Writer Started](#)
- [Writer Starting Page](#)
- [Writing Status](#)
- [NPS CCSID](#)
- [NPS Level](#)

## Advanced Function Printing

### ID

ATTR\_AFP

### Type

String

### Description

Indicates whether this spooled file uses AFP resources external to the spooled file. Valid values are \*YES and \*NO.

## AFP Resource

### ID

ATTR\_AFP\_RESOURCE

### Type

String

### Description

The Integrated File System path of the external AFP (Advanced Function Print) resource. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/resource.type" where *library* is the library that contains the resource, *resource* is the name of the resource and *type* is the resource type. Valid values for *type* include "FNTRSC", "FORMDF", "OVL", "PAGSEG", and "PAGDFN".

## Align Forms

### ID

ATTR\_ALIGNFORMS

### Type

String

### Description

The time at which a forms alignment message will be sent. Valid values are \*WTR, \*FILE, \*FIRST.

## Align Page

### ID

ATTR\_ALIGN

### Type

String

### Description

Indicates whether a forms alignment message is sent before printing this spooled file. Valid values are \*YES, \*NO.

## Allow Direct Print

### ID

ATTR\_ALWDRTPT

**Type**

String

**Description**

Indicates whether the printer writer allows the printer to be allocated to a job that prints directly to a printer. Valid values are \*YES, \*NO.

**Authority****ID**

ATTR\_AUT

**Type**

String

**Description**

Specifies the authority that is given to users who do not have specific authority to the output queue. Valid values are \*USE, \*ALL, \*CHANGE, \*EXCLUDE, \*LIBCRTAUT.

**Authority to Check****ID**

ATTR\_AUTCHK

**Type**

String

**Description**

Indicates what type of authorities to the output queue allow the user to control all the files on the output queue. Valid values are \*OWNER, \*DTAAUT.

**Automatically End Writer****ID**

ATTR\_AUTOEND

**Type**

String

**Description**

Specifies if the writer must be automatically ended. Valid values are \*NO, \*YES.

**Auxiliary Storage****ID**

ATTR\_AUX\_POOL

**Type**

Integer

**Description**

Specifies the number of the auxiliary storage pool (ASP) that the spooled file is stored on. The possible values are:

- 1: System ASP
- 2-32: One of the user ASPs

**Back Margin Offset Across****ID**

ATTR\_BACKMGN\_ACR

**Type**

Float

**Description**

For the back side of a piece of paper, it specifies, how far in from the left side of the page printing starts. The special value \*FRONTMGN will be encoded as -1.

**Back Margin Offset Down****ID**

ATTR\_BACKMGN\_DWN

**Type**

Float

**Description**

For the back side of a piece of paper, it specifies, how far down from the top of the page printing starts. The special value \*FRONTMGN will be encoded as -1.

**Back Overlay****ID**

ATTR\_BACK\_OVERLAY

**Type**

String

**Description**

The Integrated File System path of the back overlay or a special value. If the value is an Integrated File System path it will have the format "/QSYS.LIB/library.LIB/overlay.OVL" where *library* is the library of the resource and *overlay* is the name of the overlay. Valid special values include \*FRONTOVL.

**Back Overlay offset across****ID**

ATTR\_BKOVL\_ACR

**Type**

Float

**Description**

The offset across from the point of origin where the overlay is printed.

**Back Overlay Offset Down****ID**

ATTR\_BKOVL\_DWN

**Type**

Float

**Description**

The offset down from the point of origin where the overlay is printed.

**Between Copies Status****ID**

ATTR\_BTWNCPYSTS

**Type**

String

**Description**

Whether the writer is between copies of a multiple copy spooled file. Returned values are \*YES or \*NO.



## Between Files Status

**ID**

ATTR\_BTWNFILESTS

**Type**

String

**Description**

Whether the writer is between files. Returned values are \*YES or \*NO.

## Changes

**ID**

ATTR\_CHANGES

**Type**

String

**Description**

The time at which pending changes take effect. Valid values are \*NORDYF, \*FILEEND, or blank which implies no changes pending to the writer.

## Characters per Inch

**ID**

ATTR\_CPI

**Type**

Float

**Description**

The number of characters per horizontal inch.

## Code Page

**ID**

ATTR\_CODEPAGE

**Type**

String

**Description**

The mapping of graphic characters to code points for this spooled file. If the graphic character set field contains a special value, this field may contain a zero (0).

## Code Font Name

**ID**

ATTR\_CODEDFNT

**Type**

String

**Description**

The name of the coded font. A coded font is an AFP resource that is composed of a character set and a code page. Special values include \*FNTCHRSET.

## Coded Font Library Name

**ID**

ATTR\_CODEDFNTLIB

**Type**

String

**Description**

The name of the library that contains the coded font. This field may contain blanks if the coded font name field has a special value.

**Control Character****ID**

ATTR\_CONTROLCHAR

**Type**

String

**Description**

Whether this file uses the American National Standards printer control character. The possible values are \*NONE for no print control characters are passed in the data that is printed or \*FCFC which means that the first character of every record is an American National Standards printer control character.

**Convert Line Data****ID**

ATTR\_CONVERT\_LINEDATA

**Type**

String

**Description**

Whether the line data is converted to AFPDS before it is written to spool. The possible values are \*NO and \*YES.

**Copies****ID**

ATTR\_COPIES

**Type**

Integer

**Description**

The total number of copies to be produced for this spooled file.

**Copies left to Produce****ID**

ATTR\_COPIESLEFT

**Type**

Integer

**Description**

The remaining number of copies to be produced for this spooled file.

**Corner Staple****ID**

ATTR\_CORNER\_STAPLE

**Type**

String

**Description**

The reference corner to be used for a corner staple. A staple is driven into the media at the reference corner. Valid values are \*NONE, \*DEVD, \*BOTRIGHT, \*TOPRIGHT, \*TOPLEFT, and \*BOTLEFT.

## Current Page

### ID

ATTR\_CURPAGE

### Type

Integer

### Description

Current page that is being written by the writer job.

## Data Format

### ID

ATTR\_DATAFORMAT

### Type

String

### Description

Data format. Valid values are \*RCDDATA, \*ALLDATA.

## Data Queue

### ID

ATTR\_DATA\_QUEUE

### Type

String

### Description

Specifies the Integrated File System path of the data queue that is associated with the output queue or "\*NONE" if no data queue is associated with the the output queue. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/dataqueue.DTAQ" where *library* is the library that contains the data queue and *dataqueue* is the name of the data queue.

## Date File Opened

### ID

ATTR\_DATE

### Type

String

### Description

For spooled files this is the date the spooled file was opened. For AFP resources this is the date the object was last modified. The date is encoded in a character string with the following format, C YY MM DD.

## Date Spooled File Job Create End

### ID

ATTR\_DATE\_END

### Type

String

### Description

The date the job ended that created the spooled file on the system. If the Starting spooled file create date field is set to \*ALL, then this field must be set to blanks. If a date has been specified for the Starting spooled file create date field, then this field must be set to a valid date. The date must be in the CYYMMDD format or be one of the following special values:

- \*LAST: All spooled files with a create date and time equal to or later than the starting spooled file create date are to be returned.

- Date: All spooled files with a create date and time equal to or later than the starting spooled file create date and time and less than or equal to the ending spooled file create date and time are to be returned.

The date format CYYMMDD is defined as follows:

- C is the Century, where 0 indicates years 19xx and 1 indicates years 20xx
- YY is the Year
- MM is the Month
- DD is the Day

### **Date Writer Began Processing Spooled File**

**ID**

ATTR\_DATE\_WTR\_BEGAN\_FILE

**Type**

String

**Description**

Indicates the date at which the writer began processing this spooled file. The date is encoded in a character string with the following format, C YY MM DD.

### **Date Writer Completed Processing Spooled File**

**ID**

ATTR\_DATE\_WTR\_CMPL\_FILE

**Type**

String

**Description**

Indicates the date at which the writer began finished this spooled file. The date is encoded in a character string with the following format, C YY MM DD.

### **User Specified DBCS Data**

**ID**

ATTR\_DBCSDATA

**Type**

String

**Description**

Whether the spooled file contains double-byte character set (DBCS) data. Valid values are \*NO and \*YES.

### **DBCS Extension Characters**

**ID**

ATTR\_DBCSEXTENSN

**Type**

String

**Description**

Whether the system is to process the DBCS extension characters. Valid values are \*NO and \*YES.

### **DBCS Character Rotation**

**ID**

ATTR\_DBCAROTATE

**Type**

String

**Description**

Whether the DBCS characters are rotated 90 degrees counterclockwise before printing. Valid values are \*NO and \*YES.

**DBCS Characters per Inch****ID**

ATTR\_DBCSCPI

**Type**

Integer

**Description**

The number of double-byte characters to be printed per inch. Valid values are -1, -2, 5, 6, and 10. The value \*CPI is encoded as -1. The value \*CONDENSED is encoded as -2.

**DBCS SO/SI Spacing****ID**

ATTR\_DBCSSISO

**Type**

String

**Description**

Determines the presentation of shift-out and shift-in characters when printed. Valid values are \*NO, \*YES, and \*RIGHT.

**Defer Write****ID**

ATTR\_DFR\_WRITE

**Type**

String

**Description**

Whether print data is held in system buffers before

**Degree of Page Rotation****ID**

ATTR\_PAGRTT

**Type**

Integer

**Description**

The degree of rotation of the text on the page, with respect to the way the form is loaded into the printer. Valid values are -1, -2, -3, 0, 90, 180, 270. The value \*AUTO is encoded as -1, the value \*DEV D is encoded as -2, and the value \*COR is encoded as -3.

**Delete File After Sending****ID**

ATTR\_DELETESPLF

**Type**

String

**Description**

Delete the spooled file after sending? Valid values are \*NO and \*YES.

## Destination Option

### ID

ATTR\_DESTOPTION

### Type

String

### Description

Destination option. A text string that allows the user to pass options to the receiving system.

## Destination Type

### ID

ATTR\_DESTINATION

### Type

String

### Description

Destination type. Valid values are \*OTHER, \*AS400, \*PSF2.

## Device Class

### ID

ATTR\_DEVCLASS

### Type

String

### Description

The device class.

## Device Model

### ID

ATTR\_DEVMODEL

### Type

String

### Description

The model number of the device.

## Device Status

### ID

ATTR\_DEVSTATUS

### Type

Integer

### Description

The status of the printer device. Valid values are 0 (varied off), 10 (vary off pending), 20 (vary on pending), 30 (varied on), 40 (connect pending), 60 (active), 66 (active writer), 70 (held), 75 (powered off), 80 (recovery pending), 90 (recovery canceled), 100 (failed), 106 (failed writer), 110 (being serviced), 111 (damaged), 112 (locked), 113 (unknown).

## Device Type

### ID

ATTR\_DEVTYPE

### Type

String

**Description**

The device type.

**Display any File****ID**

ATTR\_DISPLAYANY

**Type**

String

**Description**

Whether users who have authority to read this output queue can display the output data of any output file on this queue or only the data in their own files. Valid values are \*YES, \*NO, \*OWNER.

**Drawer for Separators****ID**

ATTR\_DRWRSEP

**Type**

Integer

**Description**

Identifies the drawer from which the job and file separator pages are to be taken. Valid values are -1, -2, 1, 2, 3. The value \*FILE is encoded as -1, and the value \*DEVD is encoded as -2.

**Edge Stitch Number of Staples****ID**

ATTR\_EDGESTITCH\_NUMSTAPLES

**Type**

Integer

**Description**

The number of staples that are applied along the finishing operation axis.

**Edge Stitch Reference****ID**

ATTR\_EDGESTITCH\_REF

**Type**

String

**Description**

Where one or more staples are driven into the media along the finishing operation axis. Valid values are \*NONE, \*DEVD, \*BOTTOM, \*RIGHT, \*TOP, and \*LEFT.

**Edge Stitch Reference Offset****ID**

ATTR\_EDGESTITCH\_REFOFF

**Type**

Float

**Description**

The offset of the edge stitch from the reference edge toward the center of the media.

**End Pending Status****ID**

ATTR\_ENDPNDSTS

**Type**

String

**Description**

Whether an End Writer (ENDWTR) command has been issued for this writer. Possible values are \*NO - no ENDWTR command was issued, \*IMMED - the writer ends as soon as its output buffers are empty, \*CTRLD - the writer ends after the current copy of the spooled file has printed, \*PAGEEND - the writer ends at the end of the page.

**Ending Page****ID**

ATTR\_ENDPAGE

**Type**

Integer

**Description**

The page number at which to end printing the spooled file. Valid values are 0 or the ending page number. The value \*END is encoded as 0.

**Envelope Source****ID**

ATTR\_ENVLP\_SOURCE

**Type**

String

**Description**

The size of the envelope in the envelope source. If this field is not specified or the value is not valid, the special value of \*MFRTYPMDL is used. Valid values are \*NONE - there is no envelope source, \*MFRTYPMDL - the envelope size suggested by the manufacturer type and model is used, \*MONARCH (3.875 x 7.5 inches), \*NUMBER9 (3.875 x 8.875 inches), \*NUMBER10 (4.125 x 9.5 inches), \*B5 (176mm x 250mm), \*C5 (162mm x 229mm), \*DL (110mm x 220mm).

**File Separators****ID**

ATTR\_FILESEP

**Type**

Integer

**Description**

The number of file separator pages that are placed at the beginning of each copy of the spooled file. Valid values are -1, or the number of separators. The value \*FILE is encoded as -1.

**Fold Records****ID**

ATTR\_FOLDREC

**Type**

String

**Description**

Whether records that exceed the printer forms width are folded (wrapped) to the next line. Valid values are \*YES, \*NO.

**Font Identifier****ID**

ATTR\_FONTID



**Type**

String

**Description**

The printer font that is used. Valid special values include \*CPI and \*DEVD.

**Form Definition****ID**

ATTR\_FORM\_DEFINITION

**Type**

String

**Description**

The Integrated File System path name of the form definition or a special value. If an Integrated File System path is specified the format is "/QSYS.LIB/library.LIB/formdef.FORMDF" where *library* is the library of the form definition and *formdef* is the name of the form definition. Valid special values include \*NONE, \*INLINE, \*INLINED, and \*DEVD.

**Form Feed****ID**

ATTR\_FORMFEED

**Type**

String

**Description**

The manner in which forms feed to the printer. Valid values are \*CONT, \*CUT, \*AUTOCUT, \*DEVD.

**Form Type****ID**

ATTR\_FORMTYPE

**Type**

String

**Description**

The type of form to be loaded in the printer to print this spooled file.

**Form Type Message Option****ID**

ATTR\_FORMTYPEMSG

**Type**

String

**Description**

Message option for sending a message to the writer's message queue when the current form type is finished. Valid values are \*MSG, \*NOMSG, \*INFOMSG, \*INQMSG.

**Front Margin Offset Across****ID**

ATTR\_FTMGN\_ACR

**Type**

Float

**Description**

For the front side of a piece of paper, it specifies, how far in from the left side of the page printing starts. The special value \*DEVD is encoded as -2.

## Front Margin Offset Down

### ID

ATTR\_FTMGN\_DWN

### Type

Float

### Description

For the front side of a piece of paper, it specifies, how far down from the top of the page printing starts. The special value \*DEV D is encoded as -2.

## Front Overlay

### ID

ATTR\_FRONT\_OVERLAY

### Type

String

### Description

The Integrated File System path of the front overlay. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/overlay.OVL" where *library* is the library of the resource and *overlay* is the name of the overlay. The string "\*NONE" is used to indicate that no front overlay is specified.

## Front Overlay Offset Across

### ID

ATTR\_FTOVL\_ACR

### Type

Float

### Description

The offset across from the point of origin where the overlay is printed.

## Front Overlay Offset Down

### ID

ATTR\_FTOVL\_DWN

### Type

Float

### Description

The offset down from the point of origin where the overlay is printed.

## Graphic Character Set

### ID

ATTR\_CHAR\_ID

### Type

String

### Description

The set of graphic characters to be used when printing this file. Valid special values include \*DEV D, \*SYSVAL, and \*JOBCCSID.

## Hardware Justification

### ID

ATTR\_JUSTIFY

### Type

Integer

**Description**

The percentage that the output is right justified. Valid values are 0, 50, 100.

**Held Status****ID**

ATTR\_HELDSTS

**Type**

String

**Description**

Whether the writer is held. Valid values are \*YES, \*NO.

**Hold Spool File****ID**

ATTR\_HOLD

**Type**

String

**Description**

Whether the spooled file is held. Valid values are \*YES, \*NO.

**Hold Pending Status****ID**

ATTR\_HOLDPNDSTS

**Type**

String

**Description**

Whether a Hold Writer (HLDWTR) command has been issued for this writer. Possible values are \*NO - no HLDWTR command was issued, \*IMMED - the writer is held when its output buffers are empty, \*CTRLD - writer held after the current copy of the spooled file has printed, \*PAGEEND - writer held at the end of the page.

**Image Configuration****ID**

ATTR\_IMGCFG

**Type**

String

**Description**

The transform services for a variety of image and print data-stream formats.

**Initialize the writer****ID**

ATTR\_WTRINIT

**Type**

String

**Description**

The user can specify when to initialize the printer device. Valid values are \*WTR, \*FIRST, \*ALL.

**Internet Address****ID**

ATTR\_INTERNETADDR

**Type**

String

**Description**

The internet address of the receiving system.

**IPP Attributes-charset****ID**

ATTR\_IPP\_ATTR\_CHARSET

**Type**

String

**Description**

Indicates the charset (coded character set and encoding method) of the IPP specified spooled file attributes.

**IPP Job ID****ID**

ATTR\_IPP\_JOB\_ID

**Type**

Integer

**Description**

IPP Job ID relative to the IPP printer that created the job.

**IPP Job Name****ID**

ATTR\_IPP\_ATR\_CHARSET

**Type**

String

**Description**

User friendly name of job.

**IPP Job Name NL****ID**

ATTR\_IPP\_JOB\_NAME\_NL

**Type**

String

**Description**

Natural language of job name.

**IPP Job Originating User Name****ID**

ATTR\_IPP\_JOB\_ORIGUSER

**Type**

String

**Description**

Identifies the end user that submitted this IPP job.

**IPP Job Originating User Name NL****ID**

ATTR\_IPP\_JOB\_ORIGUSER\_NL

**Type**

String

**Description**

Identifies the natural language of job-originating user name.

**IPP Printer Name****ID**

ATTR\_IPP\_PRINTER\_NAME

**Type**

String

**Description**

Identifies the IPP printer that created this job.

**Job Name****ID**

ATTR\_JOBNAME

**Type**

String

**Description**

The name of the job that created the spooled file.

**Job Number****ID**

ATTR\_JOBNUMBER

**Type**

String

**Description**

The number of the job that created the spooled file.

**Job Separators****ID**

ATTR\_JOBSEPRATR

**Type**

Integer

**Description**

The number of job separators to be placed at the beginning of the output for each job having spooled files on this output queue. Valid values are -2, 0-9. The value \*MSG is encoded as -2. Job separators are specified when the output queue is created.

**Job System****ID**

ATTR\_JOBSYSTEM

**Type**

String

**Description**

The system job which created spooled file was running.

## Job User

### ID

ATTR\_JOBUSER

### Type

String

### Description

The name of the user that created the spooled file.

## Last Page Printed

### ID

ATTR\_LASTPAGE

### Type

Integer

### Description

The number of the last printed page is the file if printing ended before the job completed processing.

## Length of Page

### ID

ATTR\_PAGELEN

### Type

Float

### Description

The length of a page. Units of measurement are specified in the measurement method attribute.

## Library Name

### ID

ATTR\_LIBRARY

### Type

String

### Description

The name of the library.

## Lines Per Inch

### ID

ATTR\_LPI

### Type

Float

### Description

The number of lines per vertical inch in the spooled file.

## Line Spacing

### ID

ATTR\_LINESPACING

### Type

String

### Description

How a file's line data records are spaced when printed. The information is returned only for \*LINE and \*AFPDSLIN printer device types files. Valid values are \*SINGLE, \*DOUBLE, \*TRIPLE, or \*CTLCHAR.

## Manufacturer Type and Model

### ID

ATTR\_MFGTYPE

### Type

String

### Description

Specifies the manufacturer, type, and model when transforming print data from SCS to ASCII.

## Maximum Jobs per Client List

### ID

ATTR\_MAX\_JOBS\_PER\_CLIENT

### Type

Integer

### Description

Supplied by the client to indicate the maximum printer queue size of limitation.

## Maximum Spooled Output Records

### ID

ATTR\_MAXRECORDS

### Type

Integer

### Description

The maximum number of records allowed in this file at the time this file was opened. The value \*NOMAX is encoded as 0.

## Measurement Method

### ID

ATTR\_MEASMETHOD

### Type

String

### Description

The measurement method that is used for the length of page and width of page attributes. Valid values are \*ROWCOL, \*UOM.

## Message Help

### ID

ATTR\_MSGHELP

### Type

char(\*)

### Description

The message help, which is sometimes known as second-level text, can be returned by a "retrieve message" request. The system limits the length to 3000 characters (English version must be 30% less to allow for translation).

## Message ID

### ID

ATTR\_MESSAGEID

### Type

String

**Description**

The message ID.

**Message Queue****ID**

ATTR\_MESSAGE\_QUEUE

**Type**

String

**Description**

The Integrated File System path of the message queue that the writer uses for operational messages. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/messageque.MSGQ" where *library* is the library that contains the message queue and *messageque* is the name of the message queue.

**Message Reply****ID**

ATTR\_MSGREPLY

**Type**

String

**Description**

The message reply. Text string to be provided by the client which answers a message of type "inquiry". In the case of message retrieved, the attribute value is returned by the server and contains the default reply which the client can use. The system limits the length to 132 characters. Must be null-terminated due to variable length.

**Message Text****ID**

ATTR\_MSGTEXT

**Type**

String

**Description**

The message text, that is sometimes known as first-level text, can be returned by a "retrieve message" request. The system limits the length to 132 characters.

**Message Type****ID**

ATTR\_MSGTYPE

**Type**

String

**Description**

The message type, a 2-digit, EBCDIC encoding. Two types of messages indicate whether one can "answer" a "retrieved" message: '04' Informational messages convey information without asking for a reply (may require a corrective action instead), '05' Inquiry messages convey information and ask for a reply.

**Message Severity****ID**

ATTR\_MSGSEV

**Type**

Integer



**Description**

Message severity. Values range from 00 to 99. The higher the value, the more severe or important the condition.

**Multi-item Reply Capability****ID**

ATTR\_MULTI\_ITEM\_REPLY

**Type**

String

**Description**

When this attribute value is set to \*YES by the client, the performance of list spooled file operations can be greatly improved. The default value is \*NO.

**Network Identifier****ID**

ATTR\_NETWORK

**Type**

String

**Description**

The network identifier of the system where the file was created.

**Number of Bytes in Spooled File****ID**

ATTR\_NUMBYTES\_SPLF

**Type**

Integer

**Description**

The total number of bytes available in the stream or spooled file. The value indicates the number of bytes BEFORE any transform of the data takes place. In order to accommodate files of sizes greater than  $2^{31} - 1$  bytes, this value is scaled; the user needs to multiply the value by 10K to get the actual number of bytes. This attribute is not valid for spooled files being viewed in page-at-a-time mode.

**Number of Bytes to Read/Write****ID**

ATTR\_NUMBYTES

**Type**

Integer

**Description**

The number of bytes to read for a read operation, or the number of bytes to write for a write operation. The object action determines how to interpret this attribute.

**Number of Files****ID**

ATTR\_NUMFILES

**Type**

Integer

**Description**

The number of spooled files that exist on the output queue.

## Number of Writers Started to Queue

### ID

ATTR\_NUMWRITERS

### Type

Integer

### Description

The number of writer jobs started to the output queue.

## Object Extended Attribute

### ID

ATTR\_OBJEXTATTR

### Type

String

### Description

An "extended" attribute used by some objects like font resources. This value shows up via WRKOBJ and DSPOBJD commands on the server. The title on a server screen may just indicate "Attribute". In the case of object types of font resources, for example, common values are CDEPAG, CDEFNT, and FNTCHRSET.

## On Job Queue Status

### ID

ATTR\_ONJOBQSTS

### Type

String

### Description

Whether the writer is on a job queue and therefore is not currently running. The possible values are \*YES, \*NO.

## Open time commands

### ID

ATTR\_OPENCMDS

### Type

String

### Description

Specifies whether user wants SCS open time commands to be inserted into datastream before spool file data. Valid values are \*YES, \*NO.

## Operator Controlled

### ID

ATTR\_OPCNTRL

### Type

String

### Description

Whether users with job control authority are allowed to manage or control the spooled files on this queue. Valid values are \*YES, \*NO.

## Order of Files On Queue

### ID

ATTR\_ORDER

**Type**

String

**Description**

The order of spooled files on this output queue. Valid values are \*FIFO, \*JOBNBR.

**Output Bin****ID**

ATTR\_OUTPUTBIN

**Type**

Integer

**Description**

The output bin the printer uses for the printed output. Values range from 1 to 65535. The value \*DEV D is encoded as 0.

**Output Priority****ID**

ATTR\_OUTPTY

**Type**

String

**Description**

The priority of the spooled file. The priority ranges from 1 (highest) to 9 (lowest). Valid values are 0-9, where 0 represents \*JOB.

**Output Queue****ID**

ATTR\_OUTPUT\_QUEUE

**Type**

String

**Description**

The Integrated File System path of the output queue. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/queue.OUTQ" where *library* is the library that contains the output queue and *queue* is the name of the output queue.

**Output Queue Status****ID**

ATTR\_OUTQSTS

**Type**

String

**Description**

The status of the output queue. Valid values are RELEASED, HELD.

**Overall Status****ID**

ATTR\_OVERALLSTS

**Type**

Integer

**Description**

The overall status of the "logical printer". "Logical printer" refers to printer device, output queue and writer job. Valid values are 1 (unavailable), 2 (powered off or not yet available), 3 (stopped), 4 (message waiting), 5 (held), 6 (stop pending), 7 (hold pending), 8 (waiting for printer), 9 (waiting

to start), 10 (printing), 11 (waiting for output queue), 12 (connect pending), 13 (powered off), 14 (unusable), 15 (being serviced), 999 (unknown).

### **Overflow Line Number**

**ID**

ATTR\_OVERFLOW

**Type**

Integer

**Description**

The last line to be printed before the data that is being printed overflows to the next page.

### **Page At A Time**

**ID**

ATTR\_PAGE\_AT\_A\_TIME

**Type**

String

**Description**

Specifies whether the spooled file is to be opened in page-at-a-time mode. Valid values are \*YES and \*NO.

### **Page Count Estimated**

**ID**

ATTR\_PAGES\_EST

**Type**

String

**Description**

Specifies whether the page count is estimated rather than actual. Valid values are \*YES and \*NO.

### **Page Definition**

**ID**

ATTR\_PAGE\_DEFINITION

**Type**

String

**Description**

The Integrated File System path name of the page definition or a special value. If an Integrated File System path is specified the format is "/QSYS.LIB/library.LIB/pagedef.PAGDFN" where *library* is the library of the page definition and *pagedef* is the name of the page definition. Valid special values include \*NONE.

### **Page Number**

**ID**

ATTR\_PAGENUMBER

**Type**

Integer

**Description**

The number of the page to be read from a spooled file opened in page-at-a-time mode.

## Pages Per Side

### ID

ATTR\_MULTIUP

### Type

Integer

### Description

The number of logical pages that print on each side of each physical page when the file is printed. Valid values are 1, 2, 4.

## Paper Source 1

### ID

ATTR\_PAPER\_SOURCE\_1

### Type

String

### Description

The size of the paper in paper source one. If this field is not specified or the value is not valid, the special value of \*MFRTYPMDL is used. Valid values are \*NONE - there is no paper source one or the paper is manually fed into the printer, \*MFRTYPMDL - the paper size suggested by the manufacturer type and model is used, \*LETTER (8.5 x 11.0 inches), \*LEGAL (8.5 x 14.0 inches), \*EXECUTIVE (7.25 x 10.5 inches), \*LEDGER (17.0 x 11.0 inches), \*A3 (297mm x 420mm), \*A4 (210mm x 297mm), \*A5 (148mm x 210mm), \*B4 (257mm x 364mm), \*B5 (182mm x 257mm), \*CONT80 (8.0 inches wide with continuous form), \*CONT132 (13.2 inches wide with continuous form).

## Paper Source 2

### ID

ATTR\_PAPER\_SOURCE\_2

### Type

String

### Description

The size of the paper in paper source two. If this field is not specified or the value is not valid, the special value of \*MFRTYPMDL is used. Valid values are \*NONE - there is no paper source two or the paper is manually fed into the printer, \*MFRTYPMDL - the paper size suggested by the manufacturer type and model is used, \*LETTER (8.5 x 11.0 inches), \*LEGAL (8.5 x 14.0 inches), \*EXECUTIVE (7.25 x 10.5 inches), \*LEDGER (17.0 x 11.0 inches), \*A3 (297mm x 420mm), \*A4 (210mm x 297mm), \*A5 (148mm x 210mm), \*B4 (257mm x 364mm), \*B5 (182mm x 257mm), \*CONT80 (8.0 inches wide with continuous form), \*CONT132 (13.2 inches wide with continuous form).

## Pel Density

### ID

ATTR\_PELDENSITY

### Type

String

### Description

For font resources only, this value is an encoding of the number of pels ("1" represents a pel size of 240, "2" represents a pel size of 320). Additional values may become meaningful as the server defines them.

## Point Size

### ID

ATTR\_POINTSIZE

**Type**

Float

**Description**

The point size in which this spooled file's text is printed. The special value \*NONE will be encoded as 0.

**Print Fidelity****ID**

ATTR\_FIDELITY

**Type**

String

**Description**

The kind of error handling that is performed when printing. Valid values are \*ABSOLUTE, \*CONTENT.

**Print on Both Sides****ID**

ATTR\_DUPLEX

**Type**

String

**Description**

How the information prints. Valid values are \*FORMDF, \*NO, \*YES, \*TUMBLE.

**Print Quality****ID**

ATTR\_PRTQUALITY

**Type**

String

**Description**

The print quality that is used when printing this spooled file. Valid values are \*STD, \*DRAFT, \*NLQ, \*FASTDRAFT.

**Print Sequence****ID**

ATTR\_PRTSEQUENCE

**Type**

String

**Description**

Print sequence. Valid values are \*NEXT.

**Print Text****ID**

ATTR\_PRTTEXT

**Type**

String

**Description**

The text that is printed at the bottom of each page of printed output and on separator pages. Valid special values include \*BLANK and \*JOB.

## Printer

### ID

ATTR\_PRINTER

### Type

String

### Description

The name of the printer device.

## Printer Assigned

### ID

ATTR\_PRTASSIGNED

### Type

String

### Description

Indicates if the printer is assigned. Valid values are 1 (assigned to a specific printer), 2 (assigned to multiple printers), 3 (not assigned).

## Printer Device Type

### ID

ATTR\_PRTDEVTYPE

### Type

String

### Description

The printer data stream type. Valid values are \*SCS, \*IPDS, \*USERASCII, \*AFPDS, \*LINE.

## Printer File

### ID

ATTR\_PRINTER\_FILE

### Type

String

### Description

The Integrated File System path of the printer file. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/printerfile.FILE" where *library* is the library that contains the printer file and *printerfile* is the name of the printer file.

## Printer Queue

### ID

ATTR\_RMTprtQ

### Type

String

### Description

The name of the destination printer queue when sending spooled files via SNDTCPSPLF (LPR).

## Publishing Info Color Supported

### ID

ATTR\_PUBINF\_COLOR\_SUP

### Type

String

**Description**

Indicates color is supported for this publishing list entry.

**Publishing Info Pages per Minute (Color)****ID**

ATTR\_PUBINF\_PPM\_COLOR

**Type**

Integer

**Description**

The pages per minute supported in color mode for this publishing list entry.

**Publishing Info Pages per Minute (Monochrome)****ID**

ATTR\_PUBINF\_PPM

**Type**

Integer

**Description**

The pages per minute supported in monochrome for this publishing list entry.

**Publishing Info Duplex Support****ID**

ATTR\_PUBINF\_DUPLEX\_SUP

**Type**

String

**Description**

The duplex supported indicator for this publishing list entry.

**Publishing Info Location****ID**

ATTR\_PUBINF\_LOCATION

**Type**

String

**Description**

The location description for this publishing list entry.

**Remote Location Name****ID**

ATTR\_RMTLOCNAME

**Type**

String

**Description**

The printer device location name.

**Record Length****ID**

ATTR\_RECLENGTH

**Type**

Integer



**Description**

Record length.

**Reduce Output****ID**

ATTR\_REDUCE

**Type**

String

**Description**

The manner in which multiple logical pages print on each side of a physical page. Valid values \*TEXT or ????.

**Remote System****ID**

ATTR\_RMTSYSTEM

**Type**

String

**Description**

Remote system name. Valid special values include \*INTNETADR.

**Replace Unprintable Characters****ID**

ATTR\_RPLUNPRT

**Type**

String

**Description**

Whether characters that cannot be printed are to be replaced with another character. Valid values are \*YES or \*NO.

**Replacement Character****ID**

ATTR\_RPLCHAR

**Type**

String

**Description**

The character that replaces any unprintable characters.

**Restart Printing****ID**

ATTR\_RESTART

**Type**

Integer

**Description**

Restart printing. Valid values are -1, -2, -3, or the page number to restart at. The value \*STRPAGE is encoded as -1, the value \*ENDPAGE is encoded as -2, and the value \*NEXT is encoded as -3.

**Saddle Stitch Number of Staples****ID**

ATTR\_SADDLESTITCH\_NUMSTAPLES

**Type**

Integer

**Description**

The number of staples that are to be applied along the finishing operation axis.

**Saddle Stitch Reference****ID**

ATTR\_SADDLESTITCH\_REF

**Type**

String

**Description**

One or more staples are driven into the media along the finishing operation axis, which is positioned at the center of the media parallel to the reference edge. Valid values are \*NONE, \*DEVD, \*TOP, and \*LEFT.

**Save Spooled File****ID**

ATTR\_SAVESPLF

**Type**

String

**Description**

Whether the spooled file is to be saved after it is written. Valid values are \*YES, \*NO.

**Seek Offset****ID**

ATTR\_SEEKOFF

**Type**

Integer

**Description**

Seek offset. Allows both positive and negative values relative to the seek origin.

**Seek Origin****ID**

ATTR\_SEEKORG

**Type**

Integer

**Description**

Valid values include 1 (beginning or top), 2 (current), and 3 (end or bottom).

**Send Priority****ID**

ATTR\_SENDPTY

**Type**

String

**Description**

Send priority. Valid values are \*NORMAL, \*HIGH.

## Separator page

**ID**

ATTR\_SEPPAGE

**Type**

String

**Description**

Allows a user the option of printing a banner page or not. Valid values are \*YES or \*NO.

## Source Drawer

**ID**

ATTR\_SRCDRWR

**Type**

Integer

**Description**

The drawer to be used when the automatic cut sheet feed option is selected. Valid values are -1, -2, 1-255. The value \*E1 is encoded as -1, and the value \*FORMDF is encoded as -2.

## Spool SCS

**ID**

ATTR\_SPLSCS

**Type**

Long

**Description**

Determines how SCS data is used during create spool file.

## Spool the Data

**ID**

ATTR\_SPOOL

**Type**

String

**Description**

Whether the output data for the printer device is spooled. Valid values are \*YES, \*NO.

## Spooled File Creation Authentication Method

**ID**

ATTR\_SPLF\_AUTH\_METHOD

**Type**

Integer

**Description**

Indicates the client authentication method used to create this spooled file. Valid values include x'00'(\*NONE), x'01'(\*REQUESTER), x'02'(\*BASIC), x'03'(\*CERTIFICATE), and 'x'04'(\*DIGEST).

## Spooled File Creation Security Method

**ID**

ATTR\_SPLF\_SECURITY\_METHOD

**Type**

String

**Description**

Indicates the security method used to create this spooled file. Valid values are x'00'(\*NONE), x'01'(\*SSL3), and x'02'(\*TLS).

**Spooled File Name****ID**

ATTR\_SPOOLFILE

**Type**

String

**Description**

The name of the spooled file.

**Spooled File Number****ID**

ATTR\_SPLFNUM

**Type**

Integer

**Description**

The spooled file number. Special values allowed are -1 and 0. The value \*LAST is encoded as -1, the value \*ONLY is encoded as 0.

**Spooled File Status****ID**

ATTR\_SPLFSTATUS

**Type**

String

**Description**

The status of the spooled file. Valid values are \*CLOSED, \*HELD, \*MESSAGE, \*OPEN, \*PENDING, \*PRINTER, \*READY, \*SAVED, \*WRITING.

**Spooled Output Schedule****ID**

ATTR\_SCHEDULE

**Type**

String

**Description**

Specifies, for spooled files only, when the spooled file is available to the writer. Valid values are \*IMMED, \*FILEEND, \*JOBEND.

**Started By User****ID**

ATTR\_STARTEDBY

**Type**

String

**Description**

The name of the user who started the writer.

## Starting Page

### ID

ATTR\_STARTPAGE

### Type

Integer

### Description

The page number at which to start printing the spooled file. Valid values are -1, 0, 1, or the page number. The value \*ENDPAGE is encoded as -1. For the value 0, printing starts on page 1. For the value 1, the entire file prints.

## System Where Created

### ID

ATTR\_SYSTEM

### Type

String

### Description

The name of the system where the spooled file was created. When the name of the system where this spooled file was created cannot be determined, the receiving system name is used.

## Text Description

### ID

ATTR\_DESCRIPTION

### Type

String

### Description

Text to describe an instance of an AS400 object.

## Time File Opened

### ID

ATTR\_TIMEOPEN

### Type

String

### Description

For spooled files this is the time this spooled file was opened. For AFP resources this is the time the object was last modified. The time is encoded in a character string with the following format, HH MM SS.

## Time Spooled File Create Job End

### ID

ATTR\_TIME\_END

### Type

String

### Description

The time the job that created the spooled file on the system ended. This field must be set to blanks when special value \*ALL is used for field Starting spooled file create date or when special value \*LAST is used for field Ending spooled file create date. This field must have a value set if a date is specified for field Ending spooled file create date. The time must be in the HHMMSS format, defined as follows:

- HH - Hour
- MM - Minutes

- SS - Seconds

### **Time Writer Began Processing Spooled File**

**ID**

ATTR\_TIME\_WTR\_BEGAN\_FILE

**Type**

String

**Description**

Indicates the time at which the writer began processing the spooled file. The time is encoded in a character string with the following format, HH MM SS.

### **Time Writer Completed Processing Spooled File**

**ID**

ATTR\_TIME\_WTR\_CMPL\_FILE

**Type**

String

**Description**

Indicates the time at which the writer finished processing the spooled file. The time is encoded in a character string with the following format, HH MM SS.

### **Total Pages**

**ID**

ATTR\_PAGES

**Type**

Integer

**Description**

The number of pages that are contained in a spooled file.

### **Transform SCS to ASCII**

**ID**

ATTR\_SCS2ASCII

**Type**

String

**Description**

Whether the print data is to be transformed from SCS to ASCII. Valid values are \*YES, \*NO.

### **Unit of Measure**

**ID**

ATTR\_UNITOFMEAS

**Type**

String

**Description**

The unit of measure to use for specifying distances. Valid values are \*CM, \*INCH.

### **User Comment**

**ID**

ATTR\_USERCMT

**Type**

String

**Description**

The 100 characters of user-specified comment that describe the spooled file.

**User Data****ID**

ATTR\_USERDATA

**Type**

String

**Description**

The 10 characters of user-specified data that describe the spooled file. Valid special values include \*SOURCE.

**User Defined Data****ID**

ATTR\_USRDFNDTA

**Type**

String

**Description**

User defined data to be utilized by user applications or user specified programs that process spool files. All characters are acceptable. Max size is 255.

**User Defined File****ID**

ATTR\_USRDEFFILE

**Type**

String

**Description**

Whether the spooled file was created using an API. Valid values are \*YES, or \*NO.

**User Defined Object****ID**

ATTR\_USER\_DEFINED\_OBJECT

**Type**

String

**Description**

The Integrated File System path of the user defined object to be utilized by user applications that process spool files. If an Integrated File System path the format of the Integrated File System path is "/QSYS.LIB/library.LIB/object.type" where *library* is the name of the library that contains the object or one of the special values %LIBL% or %CURLIB%. *object* is the name of the object and *type* is the object type. Valid values for *type* include "DTAARA", "DTAQ", "FILE", "PSFCFG", "USRIDX", "USRQ" and "USRSPC". The string "\*NONE" is used to indicate no user defined object is to be used.

**User Defined Option(s)****ID**

ATTR\_USEDFNOPTS

**Type**

String

**Description**

User defined options to be utilized by user applications that process spool files. Up to 4 options may be specified, each value is length char(10). All characters are acceptable.

## User Driver Program Data

### ID

ATTR\_USRDRVPGMDTA

### Type

String

### Description

User data to be used with the user driver program. All characters are acceptable. Maximum size is 5000 characters.

## User Driver Program

### ID

ATTR\_USER\_DRIVER\_PROG

### Type

String

### Description

The Integrated File System path of the user defined driver program that processes spooled files. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/program.PGM" where *library* is the name of the library that contains the program and *program* is the program name. The *library* may be one of the special values %LIBL% and %CURLIB% or a specific library name. The string "\*NONE" is used to indicate that no driver program is defined.

## User ID

### ID

ATTR\_TOUSERID

### Type

String

### Description

User id to whom the spooled file is sent.

## User ID Address

### ID

ATTR\_TOADDRESS

### Type

String

### Description

Address of user to whom the spooled file is sent.

## User Transform Program

### ID

ATTR\_USER\_TRANSFORM\_PROG

### Type

String

### Description

The Integrated File System path of the user defined transform program that transforms spool file data before it is processed by the driver program. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/program.PGM" where *library* is the name of the library that contains the program and *program* is the program name. The *library* may be one of the special values %LIBL% and %CURLIB% or a specific library name. The string "\*NONE" is used to indicate that no transform program is defined.



## Viewing Fidelity

**ID**

ATTR\_VIEWING\_FIDELITY

**Type**

String

**Description**

The processing to take place when viewing a page of spooled file data (in page-at-a-time mode). Valid values are \*ABSOLUTE and \*CONTENT(default). To process all non-raster data (commands) prior to the current page, \*ABSOLUTE is used. For SCS files, \*CONTENT is used to process only open time commands plus the current page. For AFPDS files, \*CONTENT is used to process the first page of data plus the current page.

## VM/MVS Class

**ID**

ATTR\_VMMVSCCLASS

**Type**

String

**Description**

VM/MVS class. Valid values are A-Z and 0-9.

## Waiting for Data Status

**ID**

ATTR\_WTNGDATASTS

**Type**

String

**Description**

Whether the writer has written all the data currently in the spooled file and is waiting for more data. Possible values are \*NO - the writer is not waiting for more data, \*YES - the writer has written all the data currently in the spooled file and is waiting for more data. This condition occurs when the writer is producing an open spooled file with SCHEDULE(\*IMMED) specified.

## Waiting for Device Status

**ID**

ATTR\_WTNGDEVSTS

**Type**

String

**Description**

Whether the writer is waiting to get the device from a job that is printing directly to the printer. Values are \*NO - the writer is not waiting for the device, \*YES - the writer is waiting for the device.

## Waiting for Message Status

**ID**

ATTR\_WTNGMSGSTS

**Type**

String

**Description**

Whether the writer is waiting for a reply to an inquiry message. Values are \*NO and \*YES.

## When to Automatically End Writer

### ID

ATTR\_WTRAUTOEND

### Type

String

### Description

When to end the writer if it is to be ended automatically. Valid values are \*NORDYF, \*FILEEND. Attribute Automatically end writer must be set to \*YES.

## When to End Writer

### ID

ATTR\_WTREND

### Type

String

### Description

When to end the writer. Valid value are \*CNTRL, \*IMMED, and \*PAGEEND. This is different from when to automatically end the writer.

## When to Hold File

### ID

ATTR\_HOLDTYPE

### Type

String

### Description

When to hold the spooled file. Valid values are \*IMMED, and \*PAGEEND.

## Width of Page

### ID

ATTR\_PAGEWIDTH

### Type

Float

### Description

The width of a page. Units of measurement are specified in the measurement method attribute.

## Workstation Customizing Object

### ID

ATTR\_WORKSTATION\_CUST\_OBJECT

### Type

String

### Description

The Integrated File System path of the workstation customizing object. The format of the Integrated File System path is "/QSYS.LIB/library.LIB/custobj.WSCST" where *library* is the library that contains the customization object and *custobj* is the name of the workstation customization object.

## Writer Job Name

### ID

ATTR\_WRITER

### Type

String

**Description**

The name of the writer job.

**Writer Job Number****ID**

ATTR\_WTRJOBNUM

**Type**

String

**Description**

The writer job number.

**Writer Job Status****ID**

ATTR\_WTRJOBSTS

**Type**

String

**Description**

The status of the writer job. Valid values are STR, END, JOBQ, HLD, MSGW.

**Writer Job User Name****ID**

ATTR\_WTRJOBUSER

**Type**

String

**Description**

The name of the user that started the writer job.

**Writer Started****ID**

ATTR\_WTRSTRTD

**Type**

String

**Description**

Indicates whether a writer is started for this printer. Values are 1 - yes a writer is started, 0 - no writer is started.

**Writer Starting Page****ID**

ATTR\_WTRSTRPAGE

**Type**

Integer

**Description**

Specifies the page number of the first page to print from the first spooled file when the writer job starts. This is only valid if the spooled file name is also specified when the writer starts.

**Writing Status****ID**

ATTR\_WRTNGSTS

**Type**

String

**Description**

Indicates whether the print writer is in writing status. Values are \*YES - the writer is in writing status, \*NO - the writer is not in writing status, \*FILE - the writer is writing the file separators.

**Network Print Server Object Attributes****NPS CCSID****ID**

ATTR\_NPSCCSID

**Type**

Integer

**Description**

CCSID that the Network Print Server expects that all strings will be encoded in.

**NPS Level****ID**

ATTR\_NPSLEVEL

**Description**

The version, release, and modification level of the Network Print Server. This attribute is a character string encoded as VXRYMY (ie. "V3R1M0") where

```
X is in (0..9)
Y is in (0..9,A..Z)
```



**Copying spooled files**

You can use the copy method of the SpooledFile class to create a copy of the spooled file that the SpooledFile object represents.

Using SpooledFile.copy() performs the following actions:

- Creates the new spooled file on the same output queue and on the same system as the original spooled file
- Returns a reference to the new spooled file

SpooledFile.copy() is a new method available to you only if you download JTOpen 3.2 or later or apply an IBM i fix. It is recommended that the better solution is to download and use JTOpen. For more information, see the following:

- [IBM Toolbox for Java and JTOpen: Downloads](#) 
- [IBM Toolbox for Java and JTOpen: Service Packs](#) 

The copy method uses the Create Spooled File (QSPCRTSP) API within the network print server job to create an exact replica of the spooled file. You need only a unique creation date and time to preserve the identity of the newly created copy of the spooled file.

Specifying an output queue as a parameter to the copy method creates the copy of the spooled file to the first position on the specified output queue. Both the output queue and the original spooled file must reside on the same system

**Example: Copying a spooled file using SpooledFile.copy()**

**Note:** Read the [Code example disclaimer](#) for important legal information.

This example shows how to use `SpooledFile.copy()` to copy a spooled file to the same queue that contains the file you want to copy. When you want to route the newly copied spooled file to a specific output queue, pass the output queue as a parameter to the copy method:

```
SpooledFile newSplf = new sourceSpooledFile.copy(<outqname>);
```

where `<outqname>` is the `OutputQueue` object.

```
public static void main(String args[]) {
    // Create the system object
    AS400 as400 = new AS400(<systemname>,<username>, <password>);
    // Identify the output queue that contains the spooled file you want to copy.
    OutputQueue outputQueue =
        new OutputQueue(as400, "/QSYS.LIB/QUSRSYS.LIB/<outqname>.OUTQ");

    // Create an array that contains all the elements required to
    // uniquely identify a spooled file on the server.
    String[][] splfTags = { {
        <spoolfilename>,
        <spoolfilenum>,
        <jobname>,
        <username>,
        <jobnumber>,
        // Note that <systemname>,<date>, and <time> are optional.
        // If you do not include them, remove the corresponding
        // splfTags[i],[j], where j has the value of 5,6, or 7.
        <systemname>,
        <date>,
        <time>}
    };

    // Print the information that identifies the spooled file to System.out
    for ( int i=0; i<splfTags.length; i++) {
        System.out.println("Copying -> " + splfTags[i][0] + ","
            + splfTags[i][1] + ","
            + splfTags[i][2] + ","
            + splfTags[i][3] + ","
            + splfTags[i][4] + ","
            + splfTags[i][5] + ","
            + splfTags[i][6] + ","
            + splfTags[i][7] );

        // Create the SpooledFile object for the source spooled file.
        SpooledFile sourceSpooledFile =
            new SpooledFile(as400,
                splfTags[i][0],
                Integer.parseInt(splfTags[i][1]),
                splfTags[i][2],
                splfTags[i][3],
                splfTags[i][5],
                splfTags[i][6],
                splfTags[i][7] );

    }

    // Copy the spooled file, which creates a new SpooledFile object.
    // To route the copy of the spooled file to a specific output queue,
    // use the following code:
    // SpooledFile newSplf = new sourceSpooledFile.copy(<outqname>);
    // where <outqname> is an OutputQueue object. Specify the output
    // queue in the following way:
    // OutputQueue outputQueue =
    //     new OutputQueue(as400, "/QSYS.LIB/QUSRSYS.LIB/<outqname>.OUTQ");
    try { SpooledFile newSplf = new sourceSpooledFile.copy();
    }

    catch ( Exception e){
    }
}
```

[SpooledFile Javadoc](#)

[Create Spooled File \(QSPCRTSP\) API](#)

## Creating new spooled files

You can use the `SpooledFileOutputStream` class to create new server spooled files. The class derives from the standard JDK `java.io.OutputStream` class; after its construction, it can be used anywhere an `OutputStream` is used.

When creating a new `SpooledFileOutputStream`, the caller may specify the following:

- Which printer file to use
- Which output queue to put the spooled file on
- A `PrintParameterList` object that may contain parameters to override fields in the printer file

These parameters are all optional (the caller may pass null of any or all of them). If a printer file is not specified, the network print server uses the default network print printer file, `QPNPSRPTF`. The output queue parameter is there as a convenience; it also can be specified in the `PrintParameterList`. If the output queue parameter is specified in both places, the `PrintParameterList` field overrides the output queue parameter. See the documentation of the `SpooledFileOutputStream` constructor in the Javadoc for a complete list of which attributes may be set in the `PrintParameterList` for creating new spooled files.

Use one of the `write()` methods to write data into the spooled file. The `SpooledFileOutputStream` object buffers the data and sends it when either the output stream is closed or the buffer is full. Buffering is done for two reasons:

- It allows the automatic data typing (see [Data stream types in spooled files](#)) to analyze a full-buffer of data to determine the data type
- It makes the output stream work faster because not every write request is communicated to the server

Use the `flush()` method to force the data to be written to the server.

When the caller is finished writing data to the new spooled file, the `close()` method is called to close the spooled file. Once the spooled file has been closed, no more data can be written to it. By calling the `getSpooledFile()` method once the spooled file has been closed, the caller can get a reference to a `SpooledFile` object that represents the spooled file.

## Data stream types in spooled files

Use the `Printer Data Type` attribute of the spooled file to set the type of data to be put into the spooled file. If the caller does not specify a printer data type, the default is to use automatic data typing. This method looks at the first few thousand bytes of the spooled file data, determines if it fits either SNA Character Stream (SCS) or Advanced Function Printing data stream (AFPDS) data stream architectures, and then sets the attribute appropriately. If the bytes of spooled file data do not match either of these architectures, the data is tagged as `*USERASCII`. Automatic data typing works most of the time. The caller generally uses it unless the caller has a specific case in which automatic data typing does not work. In those cases, the caller can set the `Printer Data Type` attribute to a specific value (for example, `*SCS`). If the caller wants to use the printer data that is in the printer file, the caller must use the special value `*PRTF`. If the caller overrides the default data type when creating a spooled file, caution must be used to ensure that the data put into the spooled file matches the data type attribute. Putting non-SCS data into a spooled file that is marked to receive SCS data triggers an error message from the host and the loss of the spooled file.

Generally, this attribute can have three values:

- **\*SCS** - an EBCDIC, text-based printer data stream.
- **\*AFPDS** (Advanced Function Presentation Data Stream) - another data stream supported on the server. `*AFPDS` can contain text, image, and graphics, and can use external resources such as page overlays and external images in page segments.
- **\*USERASCII** - any non-SCS and non-AFPDS printer data that the server handles by just passing it through. Postscript and HP-PCL data streams are examples data streams that are in a `*USERASCII` spooled file.

[SpooledFileOutputStream Javadoc](#)

[“Example: Creating spooled files” on page 414](#)

This example shows how to create a spooled file on a server from an input stream.

[“Example: Creating SCS spooled files” on page 415](#)

This example uses the `SCS3812Writer` class to generate an SCS data stream and write it to a spooled file on the server.

### **Generating an SCS data stream**

To generate spooled files that will print on certain printers attached to the server, an SNA Character Stream (SCS) data stream must be created. SCS is a text-based, EBCDIC data stream that can be printed on SCS printers, IPDS printers, or to PC printers. SCS can be printed by converting it using an emulator or the host print transform on the server.

You can use the SCS writer classes to generate such an SCS data stream. The SCS writer classes convert Java Unicode characters and formatting options into an SCS data stream. Five SCS writer classes generate varying levels of SCS data streams. The caller chooses the writer that matches the final printer destination to which the caller or end user will be printing.

Use the following SCS writer classes to generate an SCS printer data stream:

<b>SCS writer class</b>	<b>Description</b>
<a href="#">SCS5256Writer</a>	The simplest SCS writer class. Supports text, carriage return, line feed, new line, form feed, absolute horizontal and vertical positioning, relative horizontal and vertical positioning, and set vertical format.
<a href="#">SCS5224Writer</a>	Extends the 5256 writer and adds methods to set character per inch (CPI) and lines per inch (LPI).
<a href="#">SCS5219Writer</a>	Extends the 5224 writer and adds support for left margin, underline, form type (paper or envelope), form size, print quality, code page, character set, source drawer number, and destination drawer number.
<a href="#">SCS5553Writer</a>	Extends the 5219 writer and adds support for character rotation, grid lines, and font scaling. The 5553 is a double-byte character set (DBCS) data stream.
<a href="#">SCS3812Writer</a>	Extends the 5219 writer and adds support for bold, duplex, text orientation, and fonts.

To construct an SCS writer, the caller needs an output stream and, optionally, an encoding. The data stream is written to the output stream. To create an SCS spooled file, the caller first constructs a `SpooledFileOutputStream`, and then uses that to construct an SCS writer object. The encoding parameter gives a target EBCDIC coded character set identifier (CCSID) to convert the characters to.

Once the writer is constructed, use the `write()` methods to output text. Use the `carriageReturn()`, `lineFeed()`, and `newLine()` methods to position the write cursor on the page. Use the `endPage()` method to end the current page and start a new page.

When all of the data has been written, use the `close()` method to end the data stream and close the output stream.

### **Example**

[“Example: Creating SCS spooled files” on page 415](#) shows how to generate a SCS data stream using the `SCS3812Writer` class, and how to write the stream to a spooled file on the server:

### ***Reading spooled files and AFP resources***

You can use the `PrintObjectInputStream` class to read the raw contents of a spooled file or Advanced Function Printing (AFP) resource from the server. The class extends the standard JDK `java.io.InputStream` class so that it can be used anywhere an `InputStream` is used.

Obtain a `PrintObjectInputStream` object by calling either the `getInputStream()` method on an instance of the `SpooledFile` class or the `getInputStream()` method on an instance of the `AFPResource` class.

Use one of the `read()` methods for reading from the input stream. These methods all return the number of bytes actually read, or `-1` if no bytes were read and the end of file was reached.

Use the `available()` method of `PrintObjectInputStream` to return the total number of bytes in the spooled file or AFP resource. The `PrintObjectInputStream` class supports marking the input stream, so `PrintObjectInputStream` always returns `true` from the `markSupported()` method. The caller can use the `mark()` and `reset()` methods to move the current read position backward in the input stream. Use the `skip()` method to move the read position forward in the input stream without reading the data.

### **Example**

The following example shows how to use `PrintObjectInputStream` to read an existing server spooled file

[Example: Reading spooled files](#)

[PrintObjectInputStream Javadoc](#)

### ***Reading spooled files using `PrintObjectPageInputStream` and `PrintObjectTransformedInputStream`***

You can use the `PrintObjectPageInputStream` class to read the data out of a server AFP and SCS spooled file one page at a time.

You can obtain a `PrintObjectPageInputStream` object with the `getPageInputStream()` method.

Use one of the `read()` methods for reading from the input stream. All these methods return the number of bytes actually read, or `-1` if no bytes were read and the end of page was reached.

Use the `available()` method of `PrintObjectPageInputStream` to return the total number of bytes in the current page. The `PrintObjectPageInputStream` class supports marking the input stream, so `PrintObjectPageInputStream` always returns `true` from the `markSupported()` method. The caller can use the `mark()` and `reset()` methods to move the current read position backward in the input stream so that subsequent reads reread the same bytes. The caller can use the `skip()` method to move the read position forward in the input stream without reading the data.

However, when transforming an entire spooled file data stream is desired, use the `PrintObjectTransformedInputStream` class.

### **Example**

The following example shows how to use `PrintObjectPageInputStream` and `PrintObjectTransformedInputStream` to obtain different transformations when reading spooled file data:

[“Example: Reading and transforming spooled files” on page 417](#)

### **Related information**

[PrintObjectPageInputStream Javadoc](#)

[PrintObjectTransformedInputStream Javadoc](#)



## ProductLicense class

The ProductLicense class enables you to request licenses for products installed on the system. To be compatible with other IBM i license users, the class works through IBM i product license support when requesting or releasing a license.

The class does not enforce the license policy but returns enough information such that the application can enforce the policy. When a license is requested the ProductLicense class will return the status of the request -- license granted or denied. If the request is denied the application must disable the behavior that required the license because the IBM Toolbox for Java does not know which function to disable.

Use the ProductLicense class with IBM i license support to enforce the license of your application:

- The server side of your application registers your product and license terms with IBM i license support.
- The client side of your application uses the ProductLicense object to request and release licenses.

### Example: ProductLicense scenario

For example, suppose your customer bought 15 concurrent use licenses for your product. Concurrent use means 15 users can use the product at the same time, but it does not need to be 15 specific users. It can be any 15 users in the organization. This information is registered with IBM i license support. As users connect your application uses the ProductLicense class to request a license.

- When the number of concurrent users is fewer than 15, the request is successful and your application runs.
- When the 16th user connects, the ProductLicense request fails. Your application then displays an error message and terminates.

When a user stops running the application, your application releases the license by way of the ProductLicense class. The license is now available for someone else to use.

### Related information

[ProductLicense Javadoc](#)

## ProgramCall class

The IBM Toolbox for Java ProgramCall class allows the Java program to call a IBM i program. You can use the ProgramParameter class to specify input, output, and input/output parameters. If the program runs, the output and input/output parameters contain the data that is returned by the IBM i program. If the IBM i program fails to run successfully, the Java program can retrieve any resulting IBM i messages as a list of AS400Message objects.

Required parameters are as follows:

- The program and parameters to run
- The AS400 object that represents the server that has the program.

The program name and parameter list can be set on the constructor, through the ProgramCall setProgram() method, or on the run() method. The run() method calls the program.

Using the ProgramCall class causes the AS400 object to connect to the server. See [managing connections](#) for information about managing connections.

### Example: Using ProgramCall

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to use the ProgramCall class:

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a program object. I choose
// to set the program to run later.
ProgramCall pgm = new ProgramCall(sys);
```

```

// Set the name of the program.
// Because the program does not take
// any parameters, pass null for the
// ProgramParameter[] argument.
pgm.setProgram(QSYSObjectPathName.toPath("MYLIB", "MYPROG", "PGM"));

// Run the program. My program has
// no parms. If it fails to run, the failure
// is returned as a set of messages
// in the message list.
if (pgm.run() != true)
{
    // If you get here, the program
    // failed to run. Get the list of
    // messages to determine why the
    // program didn't run.
    AS400Message[] messageList = pgm.getMessageList();

    // ... Process the message list.
}

// Disconnect since I am done running programs
sys.disconnectService(AS400.COMMAND);

```

The ProgramCall object requires the [integrated file system path name](#) of the program.

The default behavior is for IBM i programs to run in a separate server job, even when the Java program and the IBM i program are on the same server. You can override the default behavior and have the IBM i program run in the Java job using the ProgramCall setThreadSafe() method.

## Using ProgramParameter objects

You can use the ProgramParameter objects to pass parameter data between the Java program and the IBM i program. Set the input data with the setInputData() method. After the program is run, retrieve the output data with the getOutputData() method. Each parameter is a byte array. The Java program must convert the byte array between Java and IBM i formats. The [data conversion classes](#) provide methods for converting data. Parameters are added to the ProgramCall object as a list.

### Example: Using ProgramParameter

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to use the ProgramParameter object to pass parameter data.

```

// Create an AS400 object
AS400 sys = new AS400("mySystem.myCompany.com");

// My program has two parameters.
// Create a list to hold these parameters.
ProgramParameter[] parmList = new ProgramParameter[2];

// First parameter is an input parameter
byte[] key = {1, 2, 3};
parmList[0] = new ProgramParameter(key);

// Second parameter is an output
// parameter. A four-byte number is returned.
parmList[1] = new ProgramParameter(4);

// Create a program object specifying the name of the
// program and the parameter list.
ProgramCall pgm = new ProgramCall(sys, "/QSYS.LIB/MYLIB.LIB/MYPROG.PGM", parmList);

// Run the program.
if (pgm.run() != true)
{
    // If the system cannot run the
    // program, look at the message list
    // to find out why it didn't run.
    AS400Message[] messageList = pgm.getMessageList();
}
else
{
    // Else the program ran. Process the
    // second parameter, which contains the returned data.
}

```

```

// Create a converter for this data type
AS400Bin4 bin4Converter = new AS400Bin4();

// Convert from system type to Java
// object. The number starts at the
// beginning of the buffer.
byte[] data = parmList[1].getOutputData();
int i = bin4Converter.toInt(data);
}

// Disconnect since I am done running programs
sys.disconnectService(AS400.COMMAND);

```

[ProgramCall Javadoc](#)

[ProgramParameter Javadoc](#)

[AS400Message Javadoc](#)

[AS400 Javadoc](#)

[CommandCall Javadoc](#)

[ProgramParameter Javadoc](#)

## QSYSObjectPathName class

You can use the QSYSObjectPathName class to represent an object in the integrated file system. Use this class to build an integrated file system name or to parse an integrated file system name into its components.

Several of the IBM Toolbox for Java classes require an integrated file system path name in order to be used. Use a QSYSObjectPathName object to build the name.

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following examples show how to use the QSYSObjectPathName class:

**Example 1:** The ProgramCall object requires the integrated file system name of the server program to call. A QSYSObjectPathName object is used to build the name. To call program PRINT\_IT in library REPORTS using a QSYSObjectPathName:

```

// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a program call object.
ProgramCall pgm = new ProgramCall(sys);

// Create a path name object that
// represents program PRINT_IT in library REPORTS.
QSYSObjectPathName pgmName =
    new QSYSObjectPathName("REPORTS", "PRINT_IT", "PGM");

// Use the path name object to set
// the name on the program call object.
pgm.setProgram(pgmName.getPath());

// ... run the program, process the
// results

```

**Example 2:** If the name of the object is used just once, the Java program can use the toPath() method to build the name. This method is more efficient than creating a QSYSObjectPathName object.

```

// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a program call object.
ProgramCall pgm = new ProgramCall(sys);

// Use the toPath method to create
// the name that represents program
// PRINT_IT in library REPORTS.
pgm.setProgram(QSYSObjectPathName.toPath("REPORTS",
                                         "PRINT_IT",
                                         "PGM"));

```

```
// ... run the program, process the
// results
```

**Example 3:** In this example, a Java program was given an integrated file system path. The `QSYSObjectPathName` class can be used to parse this name into its components.

```
// Create a path name object from
// the fully qualified integrated
// file system name.
QSYSObjectPathName ifsName = new QSYSObjectPathName(pathName);

// Use the path name object to get
// the library, name and type of server object.
String library = ifsName.getLibraryName();
String name    = ifsName.getObjectNames();
String type    = ifsName.getObjectType();
```

[QSYSObjectPathName Javadoc](#)

## Record-level access

The record-level access classes create, read, update, and delete IBM i files and members.

- Create a IBM i physical file specifying one of the following:
  - The record length
  - An existing data description specifications (DDS) source file
  - A RecordFormat object
- Retrieve the record format from a physical or logical file, or the record formats from a IBM i multiple format logical file.

**Note:** The record format of the file is not retrieved in its entirety. The record formats retrieved are meant to be used when setting the record format for an `AS400File` object. Only enough information is retrieved to describe the contents of a record of the file. Record format information, such as column headings and aliases, is not retrieved.

- Access the records in an IBM i file sequentially, by record number, or by key.
- Write records to a system file.
- Update records in a system file sequentially, by record number, or by key.
- Delete records in a system file sequentially, by record number, or by key.
- Lock a file for different types of access.
- Use commitment control to allow a Java program to do the following:
  - Start commitment control for the connection.
  - Specify different commitment control lock levels for different files.
  - Commit and rollback transactions.
- Delete system files.
- Delete a member from a system file.

**Note:** The record-level access classes do not support logical join files or null key fields.

The following classes perform these functions:

- The `AS400File` class is the abstract base class for the record-level access classes. It provides the methods for sequential record access, creation and deletion of files and members, and commitment control activities.
- The `KeyedFile` class represents a system file that has access by key.
- The `SequentialFile` class represents a system file that has access by record number.
- The `AS400FileRecordDescription` class provides the methods for retrieving the record format of a system file.

The record-level access classes require an [AS400](#) object that represents the system that has the database files. Using the record-level access classes causes the AS400 object to connect to the IBM i system. See [managing connections](#) for information about managing connections.

The record-level access classes require the integrated file system path name of the data base file. See [integrated file system path names](#) for more information.

The record-level access classes use the following:

- The [RecordFormat](#) class to describe a record of the database file
- The [Record](#) class to provide access to the records of the database file
- The [LineDataRecordWriter](#) class to write a record in line data format

These classes are described in the [data conversion](#) section.

### Examples

- The [sequential access example](#) shows how to access a system file sequentially.
- The [read file example](#) shows how to use the record-level access classes to read a system file.
- The [keyed file example](#) shows how to use the record-level access classes to read records by key from a system file.

### AS400File

The AS400File class provides the methods for several actions.

- [Creating and deleting server physical files and members](#)
- [Reading and writing records in server files](#)
- [Locking files](#) for different types of access
- [Using record blocking](#) to improve performance
- [Setting the cursor position](#) within an open server file
- [Managing commitment control](#) activities

### Related information

[AS400File Javadoc](#)

### KeyedFile

The KeyedFile class gives a Java program keyed access to a file on the server. Keyed access means that the Java program can access the records of a file by specifying a key. Methods exist to position the cursor, read, update, and delete records by key.

To position the cursor, use the following methods:

- `positionCursor(Object[])` - set cursor to the first record with the specified key.
- `positionCursorAfter(Object[])` - set cursor to the record after the first record with the specified key.
- `positionCursorBefore(Object[])` - set cursor to the record before the first record with the specified key.

To delete a record, use the following method:

- `deleteRecord(Object[])` - delete the first record with the specified key.

The read methods are:

- `read(Object[])` - read the first record with the specified key.
- `readAfter(Object[])` - read the record after the first record with the specified key.
- `readBefore(Object[])` - read the record before the first record with the specified key.
- `readNextEqual()` - read the next record whose key matches the specified key. Searching starts from the record after the current cursor position.
- `readPreviousEqual()` - read the previous record whose key matches the specified key. Searching starts from the record before the current cursor position.

To update a record, use the following method:

- `update(Object[])` - update the record with the specified key.

Methods are also provided for specifying a search criteria when positioning, reading, and updating by key. Valid search criteria values are as follows:

- Equal - find the first record whose key matches the specified key.
- Less than - find the last record whose key comes before the specified key in the key order of the file.
- Less than or equal - find the first record whose key matches the specified key. If no record matches the specified key, find the last record whose key comes before the specified key in the key order of the file.
- Greater than - find the first record whose key comes after the specified key in the key order of the file.
- Greater than or equal - find the first record whose key matches the specified key. If no record matches the specified key, find the first record whose key comes after the specified key in the key order of the file.

`KeyedFile` is a subclass of `AS400File`; all methods in `AS400File` are available to `KeyedFile`.

### Specifying the key

The key for a `KeyedFile` object is represented by an array of Java Objects whose types and order correspond to the types and order of the key fields as specified by the [RecordFormat](#) object for the file.

The following example shows how to specify the key for the `KeyedFile` object.

```
// Specify the key for a file whose key fields, in order,
// are:
//   CUSTNAME   CHAR(10)
//   CUSTNUM    BINARY(9)
//   CUSTADDR   CHAR(100)VARLEN()
// Note that the last field is a variable-length field.
Object[] theKey = new Object[3];
theKey[0] = "John Doe";
theKey[1] = new Integer(445123);
theKey[2] = "2227 John Doe Lane, ANYTOWN, NY 11199";
```

A `KeyedFile` object accepts partial keys as well as complete keys. However, the key field values that are specified must be in order.

For example:

```
// Specify a partial key for a file whose key fields,
// in order, are:
//   CUSTNAME   CHAR(10)
//   CUSTNUM    BINARY(9)
//   CUSTADDR   CHAR(100)VARLEN()
Object[] partialKey = new Object[2];
partialKey[0] = "John Doe";
partialKey[1] = new Integer(445123);

// Example of an INVALID partial key
Object[] INVALIDPartialKey = new Object[2];
INVALIDPartialKey[0] = new Integer(445123);
INVALIDPartialKey[1] = "2227 John Doe Lane, ANYTOWN, NY 11199";
```

Null keys and null key fields are not supported.

The key field values for a record can be obtained from the [Record](#) object for a file through the `getKeyFields()` method.

The following example shows how to read from a file by key:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
KeyedFile myFile =
    new KeyedFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/%FILE%.MBR");
```

```

// Assume that the AS400FileRecordDescription class
// was used to generate the code for a subclass of
// RecordFormat that represents the record format
// of file MYFILE in library MYLIB. The code was
// compiled and is available for use by the Java program.
RecordFormat recordFormat = new MYKEYEDFILEFormat();

// Set the record format for myFile. This must
// be done before invoking open()
myFile.setRecordFormat(recordFormat);

// Open the file.
myFile.open(AS400File.READ_WRITE, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);

// The record format for the file contains
// four key fields, CUSTNUM, CUSTNAME, PARTNUM
// and ORDNUM in that order.
// The partialKey will contain 2 key field
// values. Because the key field values must be
// in order, the partialKey will consist of values for
// CUSTNUM and CUSTNAME.
Object[] partialKey = new Object[2];
partialKey[0] = new Integer(1);
partialKey[1] = "John Doe";

// Read the first record matching partialKey
Record keyedRecord = myFile.read(partialKey);

// If the record was not found, null is returned.
if (keyedRecord != null)
{ // Found the record for John Doe, print out the info.
  System.out.println("Information for customer " + (String)partialKey[1] + ":");
  System.out.println(keyedRecord);
}

....

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

## Related information

[KeyedFile Javadoc](#)

## SequentialFile

The `SequentialFile` class gives a Java program access to a file on the server by record number. Methods exist to position the cursor, read, update, and delete records by record number.

To position the cursor, use the following methods:

- `positionCursor(int)` - set cursor to the record with the specified record number.
- `positionCursorAfter(int)` - set cursor to the record after the specified record number.
- `positionCursorBefore(int)` - set cursor to the record before the specified record number.

To delete a record, use the following method:

- `deleteRecord(int)` - delete the record with the specified record number.

To read a record, use the following methods:

- `read(int)` - read the record with the specified record number.
- `readAfter(int)` - read the record after the specified record number.
- `readBefore(int)` - read the record before the specified record number.

To update a record, use the following method:

- `update(int)` - update the record with the specified record number.

`SequentialFile` is a subclass of `AS400File`; all methods in `AS400File` are available to `SequentialFile`.

The following example shows how to use the `SequentialFile` class:

```

// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/
%FILE%.MBR");

// Assume that the AS400FileRecordDescription class
// was used to generate the code for a subclass of
// RecordFormat that represents the record format
// of file MYFILE in library MYLIB. The code was
// compiled and is available for use by the Java program.
RecordFormat recordFormat = new MYFILEFormat();

// Set the record format for myFile. This must
// be done before invoking open()
myFile.setRecordFormat(recordFormat);

// Open the file.
myFile.open(AS400File.READ_WRITE, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Delete record number 2.
myFile.delete(2);

// Read record number 5 and update it
Record updateRec = myFile.read(5);
updateRec.setField("CUSTNAME", newName);

// Use the base class' update() method since I am
// already positioned on the record.
myFile.update(updateRec);

// Update record number 7
updateRec.setField("CUSTNAME", nextNewName);
updateRec.setField("CUSTNUM", new Integer(7));
myFile.update(7, updateRec);

// ...

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

## Related information

[SequentialFile Javadoc](#)

### ***AS400FileRecordDescription***

The IBM Toolbox for Java AS400FileRecordDescription class provides the methods for retrieving the record format of a file on the server.

This class provides methods for creating Java source code for subclasses of RecordFormat and for returning RecordFormat objects, which describe the record formats of user-specified physical or logical files on the server. The output of these methods can be used as input to an AS400File object when setting the record format.

It is recommended that the AS400FileRecordDescription class always be used to generate the RecordFormat object when the file already exists on the server.

**Note:** The AS400FileRecordDescription class does not retrieve the entire record format of a file. Only enough information is retrieved to describe the contents of the records that make up the file. Information such as column headings, aliases, and reference fields is not retrieved. Therefore, the record formats retrieved cannot necessarily be used to create a file whose record format is identical to the file from which the format was retrieved.

### **Creating Java source code for subclasses of RecordFormat to represent the record format of files on the server**

The AS400FileRecordDescription createRecordFormatSource() method creates Java source files for subclasses of the RecordFormat class. The files can be compiled and used by an application or applet as input to the AS400File.setRecordFormat() method.



The `createRecordFormatSource()` method should be used as a development time tool to retrieve the record formats of existing files on the server. This method allows the source for the subclass of the `RecordFormat` class to be created once, modified if necessary, compiled, and then used by many Java programs accessing the same files on the server. Because this method creates files on the local system, it can be used only by Java applications. The output (the Java source code), however, can be compiled and then used by Java applications and applets alike.

**Note:** This method overwrites files with the same names as the Java source files being created.

**Example 1:** The following example shows how to use the `createRecordFormatSource()` method:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create an AS400FileRecordDescription object that represents the file
AS400FileRecordDescription myFile = new AS400FileRecordDescription(sys,
    "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE");
// Create the Java source file in the current working directory.
// Specify "package com.myCompany.myProduct;" for the
// package statement in the source since I will ship the class
// as part of my product.
myFile.createRecordFormatSource(null, "com.myCompany.myProduct");

// Assuming that the format name for file MYFILE is FILE1, the
// file FILE1Format.java will be created in the current working directory.
// It will overwrite any file by the same name. The name of the class
// will be FILE1Format. The class will extend from RecordFormat.
```

**Example 2:** Compile the file you created above, `FILE1Format.java`, and use it as follows:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create an AS400File object that represents the file
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE");

// Set the record format
// This assumes that import.com.myCompany.myProduct.FILE1Format;
// has been done.

myFile.setRecordFormat(new FILE1Format());

// Open the file and read from it
// ....

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using record-level access
sys.disconnectService(AS400.RECORDACCESS);
```

### Creating `RecordFormat` objects to represent the record format of files on the server

The `AS400FileRecordDescription` `retrieveRecordFormat()` method returns an array of `RecordFormat` objects that represent the record formats of an existing file on the server. Typically, only one `RecordFormat` object is returned in the array. When the file for which the record format is being retrieved is a multiple format logical file, more than one `RecordFormat` object is returned. Use this method to dynamically retrieve the record format of an existing file on the server during runtime. The `RecordFormat` object then can be used as input to the `AS400File.setRecordFormat()` method.

The following example shows how to use the `retrieveRecordFormat()` method:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create an AS400FileRecordDescription object that represents the file
AS400FileRecordDescription myFile = new AS400FileRecordDescription(sys,
    "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE");
// Retrieve the record format for the file
RecordFormat[] format = myFile.retrieveRecordFormat();
```

```

// Create an AS400File object that represents the file
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE");

// Set the record format
myFile.setRecordFormat(format[0]);

// Open the file and read from it
// ....

// Close the file as I am done using it
myFile.close();

// Disconnect since I am done using record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

[AS400FileRecordDescription Javadoc](#)

[RecordFormat Javadoc](#)

[AS400File Javadoc](#)

### ***Creating and deleting files and members***

Physical files on the server are created by specifying a record length, an existing server data description specifications (DDS) source file, or a RecordFormat object.

When you create a file and specify a record length, a data file or a source file can be created. The method sets the record format for the object. Do not call the setRecordFormat() method for the object.

A data file has one field. The field name is the name of the file, the field type is of type character, and the field length is the length that is specified on the create method.

A source file has three fields:

- Field SRCSEQ is ZONED DECIMAL (6,2)
- Field SRCDAT is ZONED DECIMAL (6,0)
- SRCDTA is a character field with a length that is the length specified on the create method minus 12

The following examples show how to create files and members.

**Example 1:** To create a data file with a 128-byte record:

```

// Create an AS400 object, the file
// will be created on this server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
SequentialFile newFile =
    new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/%FILE%.MBR");

// Create the file
newFile.create(128, "*DATA", "Data file with a 128 byte record");

// Open the file for writing only.
// Note: The record format for the file
// has already been set by create()
newFile.open(AS400File.WRITE_ONLY, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Write a record to the file. Because the record
// format was set on the create(), getRecordFormat()
// can be called to get a record properly formatted
// for this file.
Record writeRec = newFile.getRecordFormat().getNewRecord();
writeRec.setField(0, "Record one");
newFile.write(writeRec);

// ....

// Close the file since I am done using it
newFile.close();

// Disconnect since I am done using record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

**Example 2:** When creating a file specifying an existing DDS source file, the DDS source file is specified on the create() method. The record format for the file must be set using the setRecordFormat() method before the file can be opened. For example:

```
// Create an AS400 object, the
// file will be created on this server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create QSYSObjectPathName objects for
// both the new file and the DDS file.
QSYSObjectPathName file = new QSYSObjectPathName("MYLIB", "MYFILE", "FILE", "MBR");
QSYSObjectPathName ddsFile = new QSYSObjectPathName("MYLIB", "DDSFIL", "FILE", "MBR");

// Create a file object that represents the file
SequentialFile newFile = new SequentialFile(sys, file);

// Create the file
newFile.create(ddsFile, "File created using DDSFile description");

// Set the record format for the file
// by retrieving it from the server.
newFile.setRecordFormat(new AS400FileRecordDescription(sys,
newFile.getPath()).retrieveRecordFormat()[0]);

// Open the file for writing
newFile.open(AS400File.WRITE_ONLY, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Write a record to the file. The getRecordFormat()
// method followed by the getNewRecord() method is used to get
// a default record for the file.
Record writeRec = newFile.getRecordFormat().getNewRecord();
newFile.write(writeRec);

// ....

// Close the file since I am done using it
newFile.close();

// Disconnect since I am done using
// record-level access
sys.disconnectService(AS400.RECORDACCESS);
```

**Example 3:** When creating a file specifying a RecordFormat object, the RecordFormat object is specified on the create() method. The method sets the record format for the object. The setRecordFormat() method must not be called for the object.

```
// Create an AS400 object, the file will be created
// on this server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
SequentialFile newFile =
    new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/%FILE%.MBR");

// Retrieve the record format from an existing file
RecordFormat recordFormat = new AS400FileRecordDescription(sys,
"/QSYS.LIB/MYLIB.LIB/EXISTING.FILE/MBR1.MBR").retrieveRecordFormat()[0];

// Create the file
newFile.create(recordFormat, "File created using record format object");

// Open the file for writing only.
// Note: The record format for the file
// has already been set by create()
newFile.open(AS400File.WRITE_ONLY, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Write a record to the file. The recordFormat
// object is used to get a default record
// properly formatted for the file.
Record writeRec = recordFormat.getNewRecord();
newFile.write(writeRec);

// ....

// Close the file since I am done using it
newFile.close();
// Disconnect since I am done using
```

```
// record-level access
sys.disconnectService(AS400.RECORDACCESS);
```

When deleting files and members, use these methods:

- Use the `delete()` method to delete server files and all of their members.
- Use the `deleteMember()` method to delete just one member of a file.

Use the `addPhysicalFileMember()` method to add members to a file.

### Related information

[AS400File Javadoc](#)

### Reading and writing records

You can use the `AS400File` class to read, write, update, and delete records in files on the server.

The record is accessed through the `Record` class, which is described by a `RecordFormat` class. The record format must be set through the `setRecordFormat()` method before the file is opened, unless the file was just created (without an intervening `close()`) by one of the `create()` methods, which sets the record format for the object.

Use the `read()` methods to read a record from the file. Methods are provided to do the following:

- `read()` - read the record at the current cursor position
- `readFirst()` - read the first record of the file
- `readLast()` - read the last record of the file
- `readNext()` - read the next record in the file
- `readPrevious()` - read the previous record in the file

The following example shows how to use the `readNext()` method:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/
%FILE%.MBR");

// Assume that the AS400FileRecordDescription class
// was used to generate the code for a subclass of
// RecordFormat that represents the record format
// of file MYFILE in library MYLIB. The code was
// compiled and is available for use by the Java
// program.
RecordFormat recordFormat = new MYFILEFormat();

// Set the record format for myFile. This must
// be done before invoking open()
myFile.setRecordFormat(recordFormat);

// Open the file.
myFile.open(AS400File.READ_ONLY, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Read each record in the file writing field
// CUSTNAME to System.out
System.out.println("          CUSTOMER LIST");
System.out.println("-----");

Record record = myFile.readNext();
while(record != null)
{
    System.out.println(record.getField("CUSTNAME"));
    record = myFile.readNext();
}

    ....

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using
```

```
// record-level access.  
sys.disconnectService(AS400.RECORDACCESS);
```

Use the `update()` method to update the record at the cursor position.

For example:

```
// Create an AS400 object, the file exists on this  
// server.  
AS400 sys = new AS400("mySystem.myCompany.com");  
  
// Create a file object that represents the file  
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/  
%FILE%.MBR");  
  
// Assume that the AS400FileRecordDescription class  
// was used to generate the code for a subclass of  
// RecordFormat that represents the record format  
// of file MYFILE in library MYLIB. The code was  
// compiled and is available for use by the Java program.  
RecordFormat recordFormat = new MYFILEFormat();  
  
// Set the record format for myFile. This must  
// be done prior to invoking open()  
myFile.setRecordFormat(recordFormat);  
  
// Open the file for updating  
myFile.open(AS400File.READ_WRITE, 0, AS400File.COMMIT_LOCK_LEVEL_NONE);  
  
// Update the first record in the file. Assume  
// that newName is a String with the new name for  
// CUSTNAME  
Record updateRec = myFile.readFirst();  
updateRec.setField("CUSTNAME", newName);  
myFile.update(updateRec);  
  
....  
  
// Close the file since I am done using it  
myFile.close();  
  
// Disconnect since I am done using record-level access  
sys.disconnectService(AS400.RECORDACCESS);
```

Use the `write()` method to append records to the end of a file. A single record or an array of records can be appended to the file.

Use the `deleteCurrentRecord()` method to delete the record at the cursor position.

### Related information

[AS400File Javadoc](#)

### Locking files

The Java program can lock a file to prevent other users from accessing the file while the first Java program is using the file.

Lock types are as follows. You can find more information about the lock types in the AS400File Javadoc.

- Read/Exclusive Lock - The current Java program reads records, and no other program can access the file.
- Read/Allow shared read Lock - The current Java program reads records, and other programs can read records from the file.
- Read/Allow shared write Lock - The current Java program reads records, and other programs can change the file.
- Write/Exclusive Lock - The current Java program changes the file, and no other program can access the file.
- Write/Allow shared read Lock - The current Java program changes the file, and other programs can read records from the file.

- Write/Allow shared write Lock - The current Java program changes the file, and other programs can change the file.

To give up the locks obtained through the lock() method, the Java program starts the releaseExplicitLocks() method.

### Related information

[AS400File Javadoc](#)

### Using record blocking

The IBM Toolbox for Java AS400File class uses record blocking to improve performance.

- If the file is opened for read-only access, a block of records is read when the Java program reads a record. Blocking improves performance because subsequent read requests may be handled without accessing the server. Little performance difference exists between reading a single record and reading several records. Performance improves significantly if records can be served out of the block of records cached on the client.

The number of records to read in each block can be set when the file is opened. For example:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/
%FILE%.MBR");

// Assume that the AS400FileRecordDescription class
// was used to generate the code for a subclass of
// RecordFormat that represents the record format
// of file MYFILE in library MYLIB. The code was
// compiled and is available for use by the Java
// program.
RecordFormat recordFormat = new MYFILEFormat();

// Set the record format for myFile. This must
// be done before invoking open()
myFile.setRecordFormat(recordFormat);

// Open the file. Specify a blocking factor of 50.
int blockingFactor = 50;
myFile.open(AS400File.READ_ONLY, blockingFactor, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Read the first record of the file. Because
// a blocking factor was specified, 50 records
// are retrieved during this read() invocation.
Record record = myFile.readFirst();
for (int i = 1; i < 50 && record != null; i++)
{

    // The records read in this loop will be served out of the block of
    // records cached on the client.
    record = myFile.readNext();
}

    ....

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using
// record-level access
sys.disconnectService(AS400.RECORDACCESS);
```

- If the file is opened for write-only access, the blocking factor indicates how many records are written to the file at one time when the write(Record[]) method is invoked.

For example:

```
// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file
```

```

SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/
%FILE%.MBR");

// Assume that the AS400FileRecordDescription class
// was used to generate the code for a subclass of
// RecordFormat that represents the record format
// of file MYFILE in library MYLIB. The code was
// compiled and is available for use by the Java
// program.
RecordFormat recordFormat = new MYFILEFormat();

// Set the record format for myFile. This must
// be done prior to invoking open()
myFile.setRecordFormat(recordFormat);

// Open the file. Specify a blocking factor of 50.
int blockingFactor = 50;
myFile.open(AS400File.WRITE_ONLY, blockingFactor, AS400File.COMMIT_LOCK_LEVEL_NONE);

// Create an array of records to write to the file
Record[] records = new Record[100];
for (int i = 0; i < 100; i++)
{
    // Assume the file has two fields,
    // CUSTNAME and CUSTNUM
    records[i] = recordFormat.getNewRecord();
    records[i].setField("CUSTNAME", "Customer " + String.valueOf(i));
    records[i].setField("CUSTNUM", new Integer(i));
}

// Write the records to the file. Because the
// blocking factor is 50, only two trips to the
// server are made with each trip writing 50 records
myFile.write(records);

....

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using
// record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

- If the file is opened for read-write access, no blocking is done. Any blocking factor specified on open() is ignored.

#### AS400File Javadoc

### **Setting the cursor position**

An open file has a cursor. The cursor points to the record to be read, updated, or deleted. When a file is first opened the cursor points to the beginning of the file. The beginning of the file is before the first record.

Use the following methods to set the cursor position:

- positionCursorAfterLast() - Set cursor to after the last record. This method exists so Java programs can use the readPrevious() method to access records in the file.
- positionCursorBeforeFirst() - Set cursor to before the first record. This method exists so Java programs can use the readNext() method to access records in the file.
- positionCursorToFirst() - Set the cursor to the first record.
- positionCursorToLast() - Set the cursor to the last record.
- positionCursorToNext() - Move the cursor to the next record.
- positionCursorToPrevious() - Move the cursor to the previous record.

The following example shows how to use the positionCursorToFirst() method to position the cursor.

```

// Create an AS400 object, the file exists on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file

```

```

SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/
%FILE%.MBR");

// Assume that the AS400FileRecordDescription class
// was used to generate the code for a subclass of
// RecordFormat that represents the record format
// of file MYFILE in library MYLIB. The code was
// compiled and is available for use by the Java
// program.
RecordFormat recordFormat = new MYFILEFormat();

// Set the record format for myFile. This must
// be done before invoking open()
myFile.setRecordFormat(recordFormat);

// Open the file.
myFile.open(AS400File.READ_WRITE, 1, AS400File.COMMIT_LOCK_LEVEL_NONE);

// I want to delete the first record of the file.
myFile.positionCursorToFirst();
myFile.deleteCurrentRecord();

    ....

// Close the file since I am done using it
myFile.close();

// Disconnect since I am done using
// record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

## Related information

[AS400File Javadoc](#)

### ***Commitment control***

Through commitment control, your Java program has another level of control over changing a file. With commitment control turned on, transactions to a file are pending until they are either committed or rolled back. If committed, all changes are put to the file. If rolled back, all changes are discarded. The transaction can be changing an existing record, adding a record, deleting a record, or even reading a record depending on the commitment control lock level specified on the `open()`.

The levels of commitment control are as follows. To see more details about each level, refer to the AS400File Javadoc.

- All - Every record accessed in the file is locked until the transaction is committed or rolled back.
- Change - Updated, added, and deleted records in the file are locked until the transaction is committed or rolled back.
- Cursor Stability - Updated, added, and deleted records in the file are locked until the transaction is committed or rolled back. Records that are accessed but not changed are locked only until another record is accessed.
- None - There is no commitment control on the file. Changes are immediately put to the file and cannot be rolled back.

You can use the AS400File `startCommitmentControl()` method to start commitment control. Commitment control applies to the AS400 **connection**. Once commitment control is started for a connection, it applies to all files opened under that connection from the time that commitment control was started. Files opened before commitment control is started are not under commitment control. The level of commitment control for individual files is specified on the `open()` method. Specify `COMMIT_LOCK_LEVEL_DEFAULT` to use the same level of commitment control as was specified on the `startCommitmentControl()` method.

For example:

```

// Create an AS400 object, the files exist on this
// server.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create three file objects
SequentialFile myFile = new SequentialFile(sys, "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/

```



```

%FILE%.MBR");
SequentialFile yourFile = new SequentialFile(sys, "/QSYS.LIB/YOURLIB.LIB/YOURFILE.FILE/
%FILE%.MBR");
SequentialFile ourFile = new SequentialFile(sys, "/QSYS.LIB/OURLIB.LIB/OURFILE.FILE/
%FILE%.MBR");

// Open yourFile before starting commitment control
// No commitment control applies to this file. The
// commit lock level parameter is ignored because
// commitment control is not started for the connection.
yourFile.setRecordFormat(new YOURFILEFormat());
yourFile.open(AS400File.READ_WRITE, 0, AS400File.COMMIT_LOCK_LEVEL_DEFAULT);

// Start commitment control for the connection.
// Note: Any of the three files might be used for
// this call to startCommitmentControl().
myFile.startCommitmentControl(AS400File.COMMIT_LOCK_LEVEL_CHANGE);

// Open myFile and ourFile
myFile.setRecordFormat(new MYFILEFormat());

// Use the same commit lock level as specified
// when commitment control was started
myFile.open(AS400File.WRITE_ONLY, 0, COMMIT_LOCK_LEVEL_DEFAULT);

ourFile.setRecordFormat(new OURFILEFormat());
// Specify a different commit lock level than
// when commitment control was started
ourFile.open(AS400File.READ_WRITE, 0, COMMIT_LOCK_LEVEL_CURSOR_STABILITY);

// write and update records in all three files
....

// Commit the changes for files myFile and ourFile.
// Note that the commit commits all changes for the connection
// even though it is invoked on only one AS400File object.
myFile.commit();
// Close the files
myFile.close();
yourFile.close();
ourFile.close();

// End commitment control
// This ends commitment control for the connection.
ourFile.endCommitmentControl();

// Disconnect since I am done using record-level access
sys.disconnectService(AS400.RECORDACCESS);

```

The `commit()` method commits all transactions since the last commit boundary for the **connection**. The `rollback()` method discards all transactions since the last commit boundary for the **connection**. Commitment control for a connection is ended through the `endCommitmentControl()` method. If a file is closed before invoking the `commit()` or `rollback()` method, all uncommitted transactions are rolled back. All files opened under commitment control must be closed before the `endCommitmentControl()` method is called.

The following examples shows how to start commitment control, commit or roll back functions, and then end commitment control:

```

// ... assume the AS400 object and file have been
// instantiated.

// Start commitment control for *CHANGE
aFile.startCommitmentControl(AS400File.COMMIT_LOCK_LEVEL_CHANGE);

// ... open the file and do several changes. For
// example, update, add or delete records.

// Based on a flag either save or discard the
// transactions.
if (saveChanges)
    aFile.commit();
else
    aFile.rollback();

// Close the file
aFile.close();

```

```
// End commitment control for the connection.  
aFile.endCommitmentControl();
```

### **Related information**

[AS400File Javadoc](#)

## **SaveFile class**

The SaveFile class represents a save file on a server.

### **Related information**

[SaveFile Javadoc](#)

## **ServiceProgramCall class**

The IBM Toolbox for Java ServiceProgramCall class allows you to call an IBM i service program. ServiceProgramCall is a subclass of the ProgramCall class that you use to call IBM i programs. If you want to call an IBM i program, use the ProgramCall class.

The ServiceProgramCall class makes it possible for you to call an IBM i service program, pass data to a service program through input parameters, and access data the service program returns through output parameters. Using ServiceProgramCall causes the AS400 object to connect to the server. See [managing connections](#) for information about managing connections.

The default behavior is for service programs to run in a separate server job, even when the Java program and the service program are on the same server. You can override the default behavior and have the service program run in the Java job using the setThreadSafe() method, inherited from ProgramCall.

### **Using the ServiceProgramCall class**

In order to use the ServiceProgramCall class, you must be sure to meet the following requirements:

- The service program must be on an server
- You can pass no more than seven parameters to the service program
- The return value of the service program is void or numeric

### **Working with ProgramParameter objects**

The ProgramParameter class works with the ServiceProgramCall class to pass parameter data to and from an IBM i service program. You pass input data to the service program with setInputData().

You request the amount of output data you want returned with setOutputDataLength(). You retrieve the output data after the service program is finished running with getOutputData(). In addition to the data itself, ServiceProgramCall needs to know how to pass parameter data to the service program. The setParameterType() method of ProgramParameter is used to supply this information. The type indicates if the parameter is pass by value or pass by reference. In either case, data is sent from the client to the server. Once the data is on the server, the server uses the parameter type to correctly call the service program.

All parameters will be in the form of a byte array. Therefore, to convert between IBM i and Java formats, you use the [data conversion and description](#) classes.

[ServiceProgramCall Javadoc](#)

[ProgramCall Javadoc](#)

[ProgramParameter Javadoc](#)

## **Subsystem class**

The Subsystem class represents a subsystem on the server.

### **Related information**

[Subsystem Javadoc](#)

## SystemStatus classes

The SystemStatus classes allow you to retrieve system status information and to retrieve and change system pool information.

The SystemStatus object allows you to retrieve system status information including the following:

- `getUsersCurrentSignedOn()`: Returns the number of users currently signed on the system
- `getUsersTemporarilySignedOff()`: Returns the number of interactive jobs that are disconnected
- `getDateAndTimeStatusGathered()`: Returns the date and time when the system status information was gathered
- `getJobsInSystem()`: Returns the total number of user and system jobs that are currently running
- `getBatchJobsRunning()`: Returns the number of batch jobs currently running on the system
- `getBatchJobsEnding()`: Returns the number of batch jobs that are in the process of ending
- `getSystemPools()`: Returns an enumeration containing a SystemPool object for each system pool

In addition to the methods within the SystemStatus class, you also can access [SystemPool](#) through SystemStatus. SystemPool allows you to get information about system pools and change system pool information.

### Example

**Note:** Read the [Code example disclaimer](#) for important legal information.

This example shows you how to use caching with the SystemStatus class:

```
AS400 system = new AS400("MyAS400");
SystemStatus status = new SystemStatus(system);

// Turn on caching. It is off by default.
status.setCaching(true);

// This will retrieve the value from the system.
// Every subsequent call will use the cached value
// instead of retrieving it from the system.
int jobs = status.getJobsInSystem();

// ... Perform other operations here ...

// This determines if caching is still enabled.
if (status.isCaching())
{
    // This will retrieve the value from the cache.
    jobs = status.getJobsInSystem();
}

// Go to the system next time, regardless if caching is enabled.
status.refreshCache();

// This will retrieve the value from the system.
jobs = status.getJobsInSystem();

// Turn off caching. Every subsequent call will go to the system.
status.setCaching(false);

// This will retrieve the value from the system.
jobs = status.getJobsInSystem();
```

[SystemStatus Javadoc](#)

### SystemPool class

The SystemPool class allows you to retrieve and change system pool information.

The SystemPool class includes the following methods:

- The `getPoolSize()` method returns the size of the pool, and the `setPoolSize()` method sets the size of the pool.

- The `getPoolName()` method retrieves the name of the pool, and the `setPoolName()` method sets the pool's name.
- The `getReservedSize()` method returns the amount of storage in the pool that is reserved for system use.
- The `getDescription()` method returns the description of the system pool.
- The `getMaximumActiveThreads()` method returns the maximum number of threads that can be active in the pool at any one time.
- The `setMaximumFaults()` method sets the maximum faults-per-second guideline to use for this system pool.
- The `setPriority()` method sets the priority of this system pool relative to the priority of the other system pools.

### Example

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
//Create AS400 object.
AS400 as400 = new AS400("system name");

//Construct a system pool object.
SystemPool systemPool = new SystemPool(as400,"*SP00L");

//Get system pool paging option
System.out.println("Paging option : "+systemPool.getPagingOption());
```

### Related information

[SystemPool Javadoc](#)

## System values

The system value classes allow a Java program to retrieve and change system values and network attributes. You can also define your own group to contain the system values you want.

A `SystemValue` object primarily contains the following information:

- Name
- Description
- Release
- Value

Using the `SystemValue` class, retrieve a single system value by using the `getValue()` method and change a system value by using the `setValue()` method.

You can also retrieve group information about a particular system value:

- To retrieve the system-defined group to which a system value belongs, use the `getGroup()` method.
- To retrieve the user-defined group to which a `SystemValue` object belongs (if any), use the `getGroupName()` and `getGroupDescription()` methods.

Whenever the value of a system value is retrieved for the first time, the value is retrieved from the server and cached. On subsequent retrievals, the cached value is returned. If the current value is what you want instead of the cached value, a `clear()` must be done to clear the current cache.

## System value list

`SystemValueList` represents a list of system values on the specified server. The list is divided into several system-defined groups that allow the Java program to access a portion of the system values at a time.

### System value group

`SystemValueGroup` represents a user-defined collection of system values and network attributes. Rather than a container, it is instead a factory for generating and maintaining unique collections of system values.

You can create a `SystemValueGroup` by specifying one of the system-defined groups (one of the constants in the `SystemValueList` class) or by specifying an array of system value names.

You can individually add the names of system values to include in the group by using the `add()` method. You can also remove them by using the `remove()` method.

Once the `SystemValueGroup` is populated with the required system value names, obtain the real `SystemValue` objects from the group by calling the `getSystemValues()` method. In this way, a `SystemValueGroup` object takes a set of system value names and generates a `Vector` of `SystemValue` objects, all having the system, group name, and group description of the `SystemValueGroup`.

To refresh a `Vector` of `SystemValue` objects all at once, use the `refresh()` method.

## Examples of using the `SystemValue` and `SystemValueList` classes

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to create and retrieve a system value:

```
//Create an AS400 object
AS400 sys = new AS400("mySystem.myCompany.com");

//Create a system value representing the current second on the system.
SystemValue sysval = new SystemValue(sys, "QSECOND");

//Retrieve the value.
String second = (String)sysval.getValue();

//At this point QSECOND is cached. Clear the cache to retrieve the most
//up-to-date value from the system.
sysval.clear();
second = (String)sysval.getValue();

//Create a system value list.
SystemValueList list = new SystemValueList(sys);

//Retrieve all the of the date/time system values.
Vector vec = list.getGroup(SystemValueList.GROUP_DATTIM);

//Disconnect from the system.
sys.disconnectAllServices();
```

## Examples of using the `SystemValueGroup` class

The following example shows how to build a group of system value names and then manipulate them:

```
//Create an AS400 object
AS400 sys = new AS400("mySystem.myCompany.com");

//Create a system value group initially representing all of the network attributes on the
system.
String name = "My Group";
String description = "This is one of my system values.";
SystemValueGroup svGroup = new SystemValueGroup(sys, name, description,
SystemValueList.GROUP_NET);

//Add some more system value names to the group and remove some we do not want.
svGroup.add("QDATE");
svGroup.add("QTIME");
svGroup.remove("NETSERVER");
svGroup.remove("SYSNAME");

//Obtain the actual SystemValue objects. They are returned inside a Vector.
Vector sysvals = svGroup.getSystemValues();

//You will notice that this is one of my system values.
SystemValue mySystemValue = (SystemValue)sysvals.elementAt(0);
System.out.println(mySystemValue.getName()+" - "+mySystemValue.getGroupDescription());

//We can add another SystemValue object from another system into the group.
AS400 sys2 = new AS400("otherSystem.myCompany.com");
SystemValue sv = new SystemValue(sys2, "QDATE");
sysvals.addElement(sv);

//Now refresh the entire group of system values all at once.
```

```
//It does not matter if some system values are from different System i servers.
//It does not matter if some system values were generated using SystemValueGroup and some were
not.
SystemValueGroup.refresh(sysvals);

//Disconnect from the systems.
sys.disconnectAllServices();
sys2.disconnectAllServices();
```

[SystemValue Javadoc](#)

[SystemValueList Javadoc](#)

[SystemValueGroup Javadoc](#)

## Trace class

The Trace class allows the Java program to log trace points and diagnostic messages. This information helps reproduce and diagnose problems.

**Note:** You can also set tracing by using the [trace system properties](#).

The Trace class logs the following categories of information:

Information category	Description
Conversion	Logs character set conversions between Unicode and code pages. This category is used only by the IBM Toolbox for Java classes.
Datastream	Logs the data that flows between the system and the Java program. This category is used only by the IBM Toolbox for Java classes.
Diagnostic	Logs state information.
Error	Logs additional errors that cause an exception.
Information	Traces the flow through a program.
PCML	This category is used to determine how PCML interprets the data that is sent to and from the server.
Proxy	This category is used by IBM Toolbox for Java classes to log data flow between the client and the proxy server.
Warning	Logs information about errors the program was able to recover from.
All	This category is used to enable or disable tracing for all of the above categories at once. Trace information cannot be directly logged to this category.

The IBM Toolbox for Java classes also use the trace categories. When a Java program enables logging, IBM Toolbox for Java information is included with the information that is recorded by the application.

**You can enable the trace for a single category or a set of categories.** Once the categories are selected, use the `setTraceOn` method to turn tracing on and off. Data is written to the log using the `log` method.

**You can send trace data for different components to separate logs.** Trace data, by default, is written to the default log. Use component tracing to write application-specific trace data to a separate log or standard output. By using component tracing, you can easily separate trace data for a specific application from other data.

**Excessive logging can impact performance.** Use the `isTraceOn` method to query the current state of the trace. Your Java program can use this method to determine whether it builds the trace record before it calls the log method. Calling the log method when logging is off is not an error, but it takes more time.

**The default is to write log information to standard out.** To redirect the log to a file, call the `setFileName()` method from your Java application. In general, this works only for Java applications because most browsers do not give applets access to write to the local file system.

**Logging is off by default.** Java programs provide a way for the user to turn on logging so that it is easy to enable logging. For example, the application can parse for a command line parameter that indicates which category of data is logged. The user can set this parameter when log information is needed.

## Examples

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following examples show how to use the Trace class.

### Example Using `setTraceOn()` and writing data to a log by using the log method

```
// Enable diagnostic, information, and warning logging.
Trace.setTraceDiagnosticOn(true);
Trace.setTraceInformationOn(true);
Trace.setTraceWarningOn(true);

// Turn tracing on.
Trace.setTraceOn(true);

// ... At this point in the Java program, write to the log.
Trace.log(Trace.INFORMATION, "Just entered class xxx, method xxx");

// Turning tracing off.
Trace.setTraceOn(false);
```

### Example: Using Trace

In the following code, Method 2 is the preferable way to use Trace.

```
// Method 1 - build a trace record
// then call the log method and let the trace class determine if the
// data should be logged. This will work but will be slower than the
// following code.
String traceData = new String("Just entered class xxx, data = ");
traceData = traceData + data + "state = " + state;
Trace.log(Trace.INFORMATION, traceData);

// Method 2 - check the log status before building the information to
// log. This is faster when tracing is not active.
if (Trace.isTraceOn() && Trace.isTraceInformationOn())
{
    String traceData = new String("just entered class xxx, data = ");
    traceData = traceData + data + "state = " + state;
    Trace.log(Trace.INFORMATION, traceData);
}
```

### Example: Using component tracing

```
// Create a component string. It is more efficient to create an
// object than many String literals.
String myComponent1 = "com.myCompany.xyzComponent";
String myComponent2 = "com.myCompany.abcComponent";

// Send IBM Toolbox for Java and the component trace data each to separate files.
// The trace will contain all trace information, while each
// component log file will only contain trace information specific to
// that component. If a Trace file is not specified, all trace data
// will go to standard out with the component specified in front of
// each trace message.

// Trace.setFileName("c:\\bit.bucket");
// Trace.setFileName(myComponent1, "c:\\Component1.log");
// Trace.setFileName(myComponent2, "c:\\Component2.log");

Trace.setTraceOn(true); // Turn trace on.
```

```

Trace.setTraceInformationOn(true); // Enable information messages.

// Log component specific trace data or general IBM Toolbox for Java
// trace data.

Trace.setFileName("c:\\bit.bucket");
Trace.setFileName(myComponent1, "c:\\Component1.log");

```

## Related information

[Trace Javadoc](#)

## User and group classes

The IBM Toolbox for Java user and group classes allow you to get a list of users and user groups on the server as well as information about each user through a Java program.

Some of the user information you can retrieve includes previous sign-on date, status, date the password was last changed, date the password expires, and user class. When you access the User object, use the `setSystem()` method to set the system name and the `setName()` method to set the user name. After those steps, you use the `loadUserInformation()` method to get the information from the server.

The UserGroup object represents a special user whose user profile is a group profile. Using the `getMembers()` method, a list of users that are members of the group can be returned.

The Java program can iterate through the list using an enumeration. All elements in the enumeration are User objects; for example:

```

// Create an AS400 object.
AS400 system = new AS400 ("mySystem.myCompany.com");

// Create the UserList object.
UserList userList = new UserList (system);

// Get the list of all users and groups.
Enumeration enum = userList.getUsers ();

// Iterate through the list.
while (enum.hasMoreElements ())
{
    User u = (User) enum.nextElement ();
    System.out.println (u);
}

```

## Retrieving information about users and groups

You use a UserList to get a list of the following:

- All users and groups
- Only groups
- All users who are members of groups
- All users who are not members of groups

The only property of the UserList object that must be set is the AS400 object that represents the system from which the list of users is to be retrieved.

By default, all users are returned. Use a combination of UserList methods `setUserInfo()` and `setGroupInfo()` to specify exactly which users are returned.

[User Javadoc](#)

[UserGroup Javadoc](#)

[UserList Javadoc](#)

[AS400 Javadoc](#)

[“Example: Using UserList to list all of the user in a given group” on page 433](#)



This source is an example of IBM Toolbox for Java UserList. This program lists all of the users in a given group.

## UserSpace class

The UserSpace class represents a user space on the server. Required parameters are the name of the user space and the AS400 object that represents the server that has the user space.

Methods exist in user space class to do the following:

- Create a user space.
- Delete a user space.
- Read from a user space.
- Write to user space.
- Get the attributes of a user space. A Java program can get the initial value, length value, and automatic extendible attributes of a user space.
- Set the attributes of a user space. A Java program can set the initial value, length value, and automatic extendible attributes of a user space.

The UserSpace object requires the integrated file system path name of the program. See [integrated file system path names](#) for more information.

Using the UserSpace class causes the AS400 object to connect to the server. See [managing connections](#) for information about managing connections.

The following example creates a user space, then writes data to it.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a user space object.
UserSpace US = new UserSpace(sys,
    "/QSYS.LIB/MYLIB.LIB/MYSPACE.USRSPC");

// Use the create method to create the user space on
// the server.
US.create(10240,                // The initial size is 10KB
    true,                      // Replace if the user space already exists
    " ",                       // No extended attribute
    (byte) 0x00,              // The initial value is a null
    "Created by a Java program", // The description of the user space
    "*USE");                  // Public has use authority to the user space

// Use the write method to write bytes to the user space.
US.write("Write this string to the user space.", 0);
```

[UserSpace Javadoc](#)

[AS400 Javadoc](#)

## Commtrace classes

The IBM Toolbox for Java commtrace classes enable your Java programs to work with communications trace data for a specified LAN (Ethernet or token ring) line description. The commtrace package includes a class that you can run as a standalone utility program to format communications trace data.

When you dump a communications trace for a server to a stream file, the information is saved in a binary format. The commtrace classes enable you to work with the various components of the stream file.

**Note:** Communications trace files may contain confidential information, for example, unencrypted passwords. When the communications trace file is on server, only users who have \*SERVICE special authority can access the trace data. If you move the file to a client, make sure that you protect the file in

an appropriate manner. For more information about communications traces, see the links at the bottom of this page.

Use the commtrace classes to perform the following tasks:

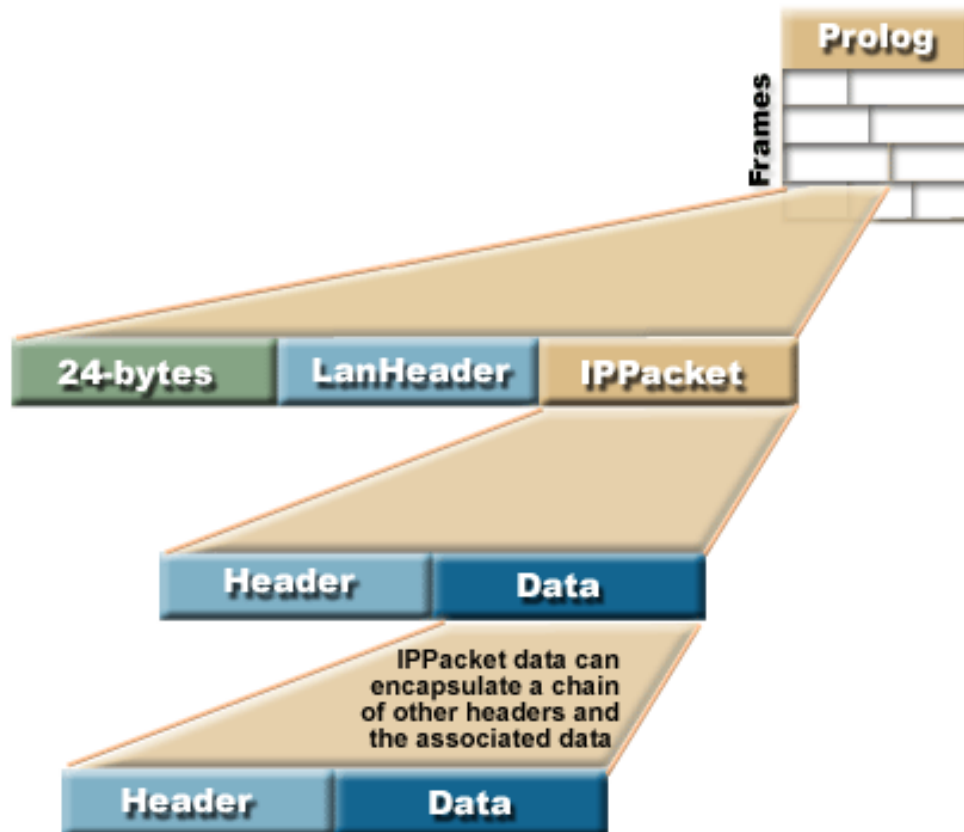
- Format the raw trace data.
- Parse any of the data to extract the information you want. You can parse both raw and formatted data, provided that you used the commtrace classes to format the data.

Other classes in the `com.ibm.as400.commtrace` package not listed here are specific to the type of trace data that you want to work with. For more information about communications traces and about all the commtrace classes, see [Communications trace](#).

## Commtrace model

The following illustration shows how the commtrace classes correspond to a communications trace file. The graphic also indicates the naming conventions that the commtrace classes use for the components in a communications trace.

**Figure 1: Commtrace model**



Each Frame in the trace file contains two initial sections (that provide general information about the contents of the frame) and the packet that the server transmitted between itself and a different point on the network.

The very first 24-byte section of data contains general information about the contents of the frame, such as the frame number and data length. Use the Frame class to process this information.

## Format and FormatProperties classes

The IBM Toolbox for Java Format class reads both raw data and formatted data from a communications trace. FormatProperties sets the properties for your Format object, such as start and end times, IP addresses, and ports.

The Format class serves as the interface between the calling program and the frames of the trace. The FormatProperties class enables you to set and retrieve properties that determine how the Format object behaves when it encounters information in the Frames of the trace.

### Format class

Use the format class to read both the raw trace data and the trace data that you have already formatted by using the commtrace classes.

**Note:** You cannot use the commtrace classes to read a communications trace that you formatted by using the Print Communications Trace (PRTCMNTRC) control language command.

Use the Format class to parse and format the information in a trace, then send that formatted information to a file or a print device. Additionally, you might want to create a graphical front end that displays the information in a standalone application or within a browser. When you want to select only specific data, use the Format class to supply that information to your Java program. For example you could use the Format class to read IP addresses out of a trace and then use that data in your program.

The Format constructors accept arguments that represent unformatted data, such as an IFSFileInputStream object, a local file, or the binary trace file. To display a trace that you have already formatted, use the default Format constructor, then use Format.openIFSFile() or Format.openLclFile() to specify the formatted file that you want to display.

### Examples

The following examples show how you can display a saved trace or format a binary trace.

**Note:** Read the [Code example disclaimer](#) for important legal information.

#### Example: Displaying a saved trace

```
Format fmt = new Format();
fmt.openLclFile("/path/to/file");

// Read the Prolog
System.out.println(fmt.getRecFromFile());
// The total number of records in the trace TCP and non-TCP
System.out.println("Total Records:" + fmt.getIntFromFile());
String rec;
// Read in records until we reach the end.
while((rec = fmt.getRecFromFile())!=null) {
System.out.println(rec);
```

#### Example: Formatting a binary trace

```
// Create a FormatProperties. By default display everything.
FormatProperties fmtprop = new FormatProperties();

Format fmt = new Format("/path/to/file");
// Sets the filtering properties for this format
fmt.setFilterProperties(fmtprop);
fmt.setOutFile("/path/to/output/file");
// Format the prolog
fmt.formatProlog();
// Format the trace and send data to the specified file
fmt.toLclBinFile();
```

## Running Format as a standalone utility

You can also run the Format class as a standalone utility program. For more information, see the following topic:

[Running Format as a standalone program](#)

## FormatProperties class

Use the FormatProperties class to specify and retrieve the properties for your Format object. In other words, when you use the Format class to send information to a file, use the FormatProperties class to filter the information that you want to send.

These properties specify how you want your Format object to handle the information that it encounters in the Frames of the communications trace. The default behavior is for the Format object to ignore properties for which you have not given a specific value.

The FormatProperties class provides constants that you use to set properties. Setting properties enables the Format object to verify which filters you want to use. For example, the following code sets a Format object to display a progress dialog and not display broadcast frames:

```
FormatProperties prop = new FormatProperties();
prop.setProgress(FormatProperties.TRUE);
prop.setBroadcast(FormatProperties.NO);
```

Most of the properties are available to your Format object as filters that you set to explicitly include specific data. Once you set the filters, the Format object displays only data that matches those filters. For example, the following code set a filter to display frames that occurred between a particular start and end time:

```
FormatProperties prop = new FormatProperties();
// Set the filter to start and end times of 22 July, 2002,
// 2:30 p.m. and 2:45 p.m. GMT.
// The time is expressed as a Unix(™) timestamp, which is
// based on the standard epoch of 01/01/1970 at 00:00:00 GMT.
prop.setStartTime("1027348200");
prop.setEndTime("1027349100");
```

## Example

The following example shows how you can use many of the commtrace classes, including the Format and FormatProperties classes, to display trace information to your monitor:

[“Example: Using the commtrace classes” on page 184](#)

[Format Javadoc](#)

[FormatProperties Javadoc](#)

## Running Format as a standalone program

In addition to using the Format class in your Java programs, you can run it as a standalone, command line utility to format a communications trace. The program connects an IFSFileOutputStream to the specified outfile and writes the data to that file.

Running format as a standalone utility enables you to format files by using the processing power and storage space of your server.

## Running Format from a command line

To run the Format utility from a command line prompt, use the following command:

```
java com.ibm.as400.commtrace.Format [options]
```

where [options] equals one or more of the available options. Options include:

- The system to which you want to connect
- The userID and password for the system
- The communications trace that you want to parse
- The file in which you want to store the results

For a complete list of available options, see the Javadoc reference documentation for the Format class.

## Running Format remotely

To run this class remotely use the JavaApplicationCall class:

```
// Construct a JavaApplicationCall object.
jaCall = new JavaApplicationCall(sys);

// Set the Java application you want to run.
jaCall.setJavaApplication("com.ibm.as400.util.commtrace.Format");

// Set the classpath environment variable used by the JVM on
// the server, so it can find the class to run.
jaCall.setClassPath("/QIBM/ProdData/OS400/JT400/lib/JT400Native.jar");

String[] args2 =
{ "-c", "true", "-t", "/path/to/trace", "-o", "/path/to/trace.extension"};

jaCall.setParameters(args2);

if (jaCall.run() != true) {
    // Call Failed
}
```

### Related information

[Format Javadoc](#)

## Prolog class

The IBM Toolbox for Java Prolog class represents the initial 256-byte section of a communications trace for a LAN line description. The Prolog contains general information about the trace, such as start and end times, number of bytes collected, and so on. Use the Prolog class to retrieve information from this section of trace, which you can then print, display, filter, or process in some other way.

The Prolog class provides methods that allow you to perform a variety of actions that include the following:

- Retrieve values from the fields of the prolog, such as the trace description, Ethernet Type, data direction, IP address, and so on
- Return a formatted String that contains all the fields of the prolog
- Test the prolog fields for invalid data

## Example

The following example shows how you can use many of the commtrace classes, including the Prolog class, to display trace information to your monitor:

[“Example: Using the commtrace classes” on page 184](#)

### Related information

[Prolog Javadoc](#)

## Frame class

The Frame class represents all the data in one record, or frame, in a communications trace for a LAN line description.

Each Frame contains three main sections of data that appear in the following order:

1. An initial 24-byte section that contains general information about the frame
2. General information about the frame (represented by the LanHeader class)
3. The packet data (represented by subclasses of the IPacket abstract class)

Use the Frame class to parse and create a printable representation the data in the frame. The Frame class maintains the packet data in a linked list-like structure that uses specific formats. For specific information about the possible formats for packet data in a frame and for general information about the structure of a frame, see [“Commtrace model” on page 178](#).

The Frame class provides methods that allow you to perform a variety of actions that include the following:

- Retrieve the data packet
- Retrieve the number, status, and type of the frame
- Return specific data from the frame as a formatted String

You can use the following process to access the data in a packet:

1. Use `Frame.getPacket()` to retrieve the packet
2. Access the data in the header by calling `Packet.getHeader()`
3. After you retrieve the header, call `Header.getType()` to find the type
4. Use the specific Header subclass to access the data associated with that header (the payload) and any additional headers

## Example

The following example shows how you can use many of the commtrace classes, including the Format and FormatProperties classes, to display trace information to your monitor:

[“Example: Using the commtrace classes” on page 184](#)

## LanHeader class

The LanHeader class retrieves information from the section of data that occurs once, near the beginning of a frame, in the initial 24-byte section. This section typically contains hardware-specific information that includes general information about the frame, such as the frame number, and data length.

Use the LanHeader class to parse and print the information in the LanHeader. The kind of information contained by the LanHeader includes:

- The byte that identifies the start of the first header in this packet
- Medium Access Control (MAC) addresses
- Token ring addresses and routing information

LanHeader also provides two methods that enable you to return a formatted String that contains the following:

- Token ring routing data
- Source MAC addresses, destination MAC addresses, frame format, and frame type

## Related information

[LanHeader Javadoc](#)

## IPPacket class

The IBM Toolbox for Java IPPacket class represents all the data packets that the network transmitted for this frame during the communications trace. IPPacket is an abstract class, so you will use the various concrete subclasses to process the headers and data in the packets.

The subclasses of IPPacket include:

- ARPPacket
- IP4Packet
- IP6Packet
- UnknownPacket

Packet classes enable you to retrieve the type of packet and access the raw data (the header and payload) that the packet contains. All the subclasses use similar constructors and include one additional method that returns a printable version of the packet contents as a String.

All the Packet class constructors take a byte array of packet data as an argument, but the ARPPacket also requires an integer that specifies the type of frame. Creating an instance of a Packet class automatically creates the appropriate Header object.

The Packet classes provide methods that allow you to perform a variety of actions that include the following:

- Retrieve the name and type of the packet
- Set the type of the packet
- Return the top-level Header object associated with the packet
- Return all the packet data as an unformatted String
- Return specific data from the packet as a formatted String

[IPPacket Javadoc](#)

[ARPPacket Javadoc](#)

[IP4Packet Javadoc](#)

[IP6Packet Javadoc](#)

[UnknownPacket Javadoc](#)

## Header class

The Header class is the abstract superclass for creating classes that represent specific kinds of packet headers. Packet headers include the associated data (or payload), which can be other headers and payloads.

The subclasses of Header include:

- ARPHeader
- ExtHeader
- ICMP4Header
- ICMP6Header
- IP4Header
- IP6Header
- TCPHeader
- UDPHeader
- UnknownHeader

Header classes enable you to retrieve the data for the header and the payload. One header can encapsulate other headers and their payloads.

Creating an instance of a Packet class automatically creates the appropriate Header object. The Header classes provide methods that allow you to perform a variety of actions that include the following:

- Return the length, name, and type of the header
- Retrieve the data in the header as a byte array
- Retrieve the next header in the packet
- Retrieve the payload as a byte array, ASCII string, and hexadecimal string

- Return all the header data as an unformatted String
- Return specific data from the header as a formatted String

[Header Javadoc](#)

[ARPHeader Javadoc](#)

[ExtHeader Javadoc](#)

[ICMP4Header Javadoc](#)

[ICMP6Header Javadoc](#)

[IP4Header Javadoc](#)

[IP6Header Javadoc](#)

[TCPHeader Javadoc](#)

[UDPHeader Javadoc](#)

[UnknownHeader Javadoc](#)

## Example: Using the commtrace classes

This example uses the IBM Toolbox for Java commtrace classes to print communications trace data to a monitor by using a communications trace binary file as the source for the data.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example using the commtrace classes to print communications trace
// data to a monitor by using a communications trace binary file as
// the source for the data.
//
// Command syntax:
//   java CommTraceExample
//
////////////////////////////////////

import com.ibm.as400.util.commtrace.*;

public class CommTraceExample {

    public CommTraceExample() {
        // Create a FormatProperties. By default display everything.
        FormatProperties fmtprop = new FormatProperties();

        Format fmt = new Format("/path/to/file");
        // Sets the filtering properties for this format
        fmt.setFilterProperties(fmtprop);
        fmt.formatProlog(); // Format the prolog

        Prolog pro = fmt.getProlog();
        System.out.println(pro.toString());

        // If this is not a valid trace
        if (!pro.invalidData()) {
            Frame rec;

            // Get the records
            while ((rec = fmt.getNextRecord()) != null) {

                // Print out the Frame Number
                System.out.print("Record:" + rec.getRecNum());
                // Print out the time
                System.out.println(" Time:" + rec.getTime());
                // Get this records packet
                IPPacket p = rec.getPacket();
                // Get the first header
                Header h = p.getHeader();

                // If IP6 IPPacket
                if (p.getType() == IPPacket.IP6) {

                    // If IP6 Header
                    if (h.getType() == Header.IP6) {

```



```

        // Cast to IP6 so we can access methods
        IP6Header ip6 = (IP6Header) h;

        System.out.println(h.getName() + " src:" + ip6.getSrcAddr() + " dst:" +
ip6.getDstAddr());
        // Print the header as hex
        System.out.println(ip6.printHexHeader());
        // Print a string representation of the header.
        System.out.println("Complete " + h.getName() + ":\n" + ip6.toString(fmtprop));

        // Get the rest of the headers
        while ((h = h.getNextHeader()) != null) {

            // If it is a TCP header
            if (h.getType() == Header.TCP) {
                // Cast so we can access methods
                TCPHeader tcp = (TCPHeader) h;
                System.out.println(h.getName() + " src:" + tcp.getSrcPort() + " dst:" +
tcp.getDstPort());
                System.out.println("Complete " + h.getName() + ":\n" + tcp.toString(fmtprop));

                // If it is a UDP header
            } else if (h.getType() == Header.UDP) {
                // Cast so we can access methods
                UDPHeader udp = (UDPHeader) h;
                System.out.println(h.getName() + " src:" + udp.getSrcPort() + " dst:" +
udp.getDstPort());
                System.out.println("Complete " + h.getName() + ":\n" + udp.toString(fmtprop));
            }
        }
    }
}

public static void main(String[] args) {
    CommTraceExample e = new CommTraceExample();
}
}

```

## HTML Classes

The IBM Toolbox for Java HTML classes provide representations for many common HTML tag elements.

IBM Toolbox for Java HTML classes assist you in:

- Setting up forms and tables for HTML pages
- Aligning text
- Working with a variety of HTML tags
- Creating Extensible Stylesheet Language (XSL) formatting object (FO) source data
- Altering the language and direction of text
- Creating ordered and unordered lists
- Creating file lists and HTML hierarchical trees (and the elements within them)
- Adding tag attributes not already defined in the HTML classes (for example, bgcolor and style attributes)

The HTML classes implement the HTMLTagElement interface. Each class produces an HTML tag for a specific element type. The tag may be retrieved using the getTag() method and can then be embedded into any HTML document. The tags you generate with the HTML classes are consistent with the HTML 3.2 specification.

The HTML classes can work with [servlet](#) classes to get data from the server. However, they can also be used alone if you supply the table or form data.

Additionally, you can use the HTMLDocument class to easily create HTML pages or XSL FO source data. You can convert XSL FO data into Portable Document Format (PDF) documents. Using the PDF format enables your documents to retain the same graphical appearance when you print them as when you view them electronically.

**Note:** The jt400Servlet.jar file includes both the HTML and Servlet classes. You must update your CLASSPATH to point to the jt400Servlet.jar file if you want to use the classes in the com.ibm.as400.util.html package.

### Related information

[HTMLTagElement Javadoc](#)

[DirFilter Javadoc - Use to determine if a File object is a directory](#)

[HTMLFileFilter Javadoc - Use to determine if a File object is a file](#)

[URLEncoder Javadoc - Encodes delimiters to use in a URL string](#)

[URLParser Javadoc - Allows you to parse a URL string for the URI, properties, and reference](#)

## BidiOrdering class

The IBM Toolbox for Java BidiOrdering class represents an HTML tag that alters the language and direction of text. An HTML <BDO> string requires two attributes, one for language and the other for the direction of the text.

The BidiOrdering class allows you to:

- Get and set the language attribute
- Get and set the direction of text

For more information about using the <BDO> HTML tag, see the [W3C](#)  Web site.

### Example: Using BidiOrdering

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example creates a BidiOrdering object and sets its language and direction:

```
// Create a BidiOrdering object and set the language and direction.
BidiOrdering bdo = new BidiOrdering();
bdo.setDirection(HTMLConstants.RTL);
bdo.setLanguage("AR");

// Create some text.
HTMLText text = new HTMLText("Some Arabic Text.");
text.setBold(true);

// Add the text to the BidiOrdering and get the HTML tag.
bdo.addItem(text);
bdo.getTag();
```

The print statement produces the following tag:

```
<bdo lang="AR" dir="rtl">
  <b>Some Arabic Text.</b>
</bdo>
```

When you use this tag in an HTML page, browsers that can understand the <BDO> tag display the example like this:

**.txeT cibarA emoS**

### Related information

[BidiOrdering Javadoc](#)

## HTMLAlign class

The IBM Toolbox for Java HTMLAlign class enables you to align sections of your HTML document, instead of just aligning individual items such as paragraphs or headings.

The HTMLAlign class represents the <DIV> tag and its associated align attribute. You can use right, left, or center alignment.

You can use this class to perform a variety of actions that include the following:

- Add or remove items from the list of tags you want to align
- Get and set the alignment
- Get and set the direction of the text interpretation
- Get and set the language of the input element
- Get a string representation of the HTMLAlign object

### Example: Creating HTMLAlign objects

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example creates an unordered list, then creates an HTMLAlign object to align the entire list:

```
// Create an unordered list.
UnorderedList uList = new UnorderedList();
uList.setType(HTMLConstants.DISC);
UnorderedListItem uListItem1 = new UnorderedListItem();
uListItem1.setItemData(new HTMLText("Centered unordered list"));
uList.addListItem(uListItem1);
UnorderedListItem uListItem2 = new UnorderedListItem();
uListItem2.setItemData(new HTMLText("Another item"));
uList.addListItem(uListItem2);

// Align the list.
HTMLAlign align = new HTMLAlign(uList, HTMLConstants.CENTER);
System.out.println(align);
```

The previous example produces the following tag:

```
<div align="center">
<ul type="disc">
  <li>Centered unordered list</li>
  <li>Another item</li>
</ul>
```

When you use this tag in an HTML page, it looks like this:

- Centered unordered list
- Another item

### Related information

[HTMLAlign Javadoc](#)

## HTMLDocument class

The HTMLDocument class enables you to use existing IBM Toolbox for Java HTML classes to create either HTML pages or Portable Document Format (PDF) documents.

When you create an HTMLDocument, you specify whether it contains HTML tags or Extensible Stylesheet Language (XSL) Formatting Object (FOs) tags:

- When you want to create HTML pages, the HTMLDocument class offers you an easier way to group all the required HTML tags. However, HTML pages do not always look the same when you print them as when you view them in a Web browser.
- When you want to create PDF documents, the HTMLDocument class offers you the ability to create XSL FO source that contains all the information you need to produce a PDF document. PDF documents retain the same graphical appearance when you print them as when you view them electronically.

To use HTMLDocument, you need to include an XML parser and an XSLT processor in your CLASSPATH environment variable. For more information, see the following pages:

- [“JAR files” on page 7](#)
- [“XML parser and XSLT processor” on page 311](#)

You can process the resulting HTML or XSL source data the way you want, for example, by displaying the HTML, saving the XSL to a file, or using the streamed data in another part of your Java program.

For more information about creating HTML pages and XSL FO source data, see the following pages:

- [“Using HTMLDocument to create HTML data” on page 188](#)
- [“Using HTMLDocument to create XSL FO data” on page 189](#)
- [“Examples: Using HTMLDocument” on page 191](#)

[HTMLDocument Javadoc](#)

### **Using HTMLDocument to create HTML data**

An HTMLDocument functions as a wrapper that holds the information necessary to create either HTML or Extensible Stylesheet Language (XSL) Formatting Object (FO) source data. When you want to create HTML pages, the HTMLDocument class offers you an easier way to group all the required HTML tags.

### **Generating HTML source data**

When creating HTML source, HTMLDocument retrieves HTML tags from the HTML objects you have created. You can use either HTMLDocument.getTag() to stream all the elements you have defined or the getTag() for each individual HTML object.

HTMLDocument generates HTML data as you define it in your Java program, so be sure that the resulting HTML is complete and correct.

When you call HTMLDocument.getTag(), the HTMLDocument object performs the following actions:

- Generates the opening <HTML> tag. At the end of the data, it generates the closing </HTML> tag.
- Converts your HTMLHead and HTMLMeta objects into HTML tags.
- Generates the opening <BODY> tag immediately after the <HEAD> tag. At the end of the data, just before the closing </HTML> tag, it generates the closing </BODY> tag.

**Note:** If you do not specify a <HEAD> tag, HTMLDocument generates the <BODY> tag after the <HTML> tag.

- Converts your remaining HTML objects into HTML tags as your program directs.

**Note:** HTMLDocument streams the HTML tags as your Java program directs, so make sure that you call the tags in the proper order.

### **Examples: Using HTMLDocument**

The following example shows how to use HTMLDocument to generate HTML source data (and XSL FO source):

[“Example: Using HTMLDocument to generate both HTML source and XSL FO source” on page 193](#)

### **Javadoc reference documentation**

For more information about the HTMLDocument class, see the following Javadoc reference documentation:

[HTMLDocument](#)

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### ***Using HTMLDocument to create XSL FO data***

An HTMLDocument functions as a wrapper that holds the information necessary to create either Extensible Stylesheet Language (XSL) Formatting Object (FO) or HTML source data.

Generated XSL FO source follows the XSL FO formatting model. The model uses rectangular elements, called areas, to hold the individual content elements, which can be images, text, other XSL FOs, or nothing. The following list describes the four basic types of areas:

- Regions function as the highest level container.
- Block areas represent block level elements, for example, paragraphs or list items.
- Line areas represent a line of text inside of a block.
- Inline areas represent parts of a line, for example, a single character, a footnote, or a mathematical equation.

XSL FO tags created by IBM Toolbox for Java adhere to the XSL standards described the W3C recommendation. For more information about XSL, XSL FOs, and the W3C recommendation, see the following:

[Extensible Stylesheet Language \(XSL\) Version 1.0](#)

### **Generating XSL FO source data**

When creating XSL FO source, HTMLDocument properties represent XSL FO tags that specify page size, orientation, and margins. Additionally, HTMLDocument retrieves from many HTML classes the corresponding XSL FO tags for that content element.

After you use HTMLDocument to generate the XSL FO source, you can use an XSL formatter (for example, the XSLReportWriter class) to place the content elements on the pages of a document.

HTMLDocument generates XSL FO source data in two major sections:

- The first section contains the <fo:root> and <fo:layout-master-set> XSL FO tags that hold general page layout information for page height, page width, and page margins. To specify the values for the layout information, use HTMLDocument set methods to set the values for the associated properties.
- The second section contains the XSL FO <fo:page-sequence> tag that holds the individual content elements. To specify individual content elements, which are instances of HTML classes, retrieve the corresponding XSL FO tag from the HTML object. Make sure that for your content elements you use only HTML classes that have the getFoTag() method.

**Note:** Trying to retrieve XSL FO tags from HTML classes that do not have the getFoTag() method results in a comment tag.

For more information about the HTML classes that include methods for working with XSL FO tags, see the following Javadoc reference documentation:

["XSL FO-enabled classes" on page 190](#)

After you create an instance of HTMLDocument and set the layout properties, retrieve XSL FO tags from HTML objects by using the setUseFO(), getFoTag(), and getTag() methods.

- You can use setUseFO() on either the HTMLDocument or the individual HTML objects. When you use setUseFO(), you can retrieve XSL FO tags by using HTMLDocument.getTag().

- Alternatively, you can use the `getFoTag()` method on either the `HTMLDocument` or the individual `HTML` objects. You might want to use this alternative method when you need to be able to generate both XSL FO and HTML source from the `HTMLDocument` or the `HTML` objects.

### Example: Using HTMLDocument

After you create XSL FO source data, you need to convert that XSL FO data to a form that your users can view and print. The following examples show how to generate XSL FO source data (and HTML source) and convert the XSL FO source data to a PDF document by using the `XSLReportWriter` and `Context` classes:

[“Example: Using HTMLDocument to generate both HTML source and XSL FO source” on page 193](#)

[“Example: Converting XSL FO source data to a PDF” on page 191](#)

### Javadoc reference documentation

For more information about the `HTMLDocument` class, see the following Javadoc reference documentation:

[HTMLDocument](#)

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#### XSL FO-enabled classes

This topic describes the IBM Toolbox for Java classes that are compatible with the `HTMLDocument` class.

Many IBM Toolbox for Java HTML classes feature the following methods, which enable instances of those classes to work with `HTMLDocument`:

- `getFoTag()`
- `getTag()`
- `setUseFO()`

For more information about the `HTMLDocument` class and about the HTML classes that include methods for working with XSL FOs, see the following Javadoc reference documentation:

- [HTMLDocument](#)
- [BidiOrdering](#)
- [HTMLAlign](#)
- [HTMLHead](#)
- [HTMLHeading](#)
- [HTMLImage](#)
- [HTMList](#)
- [HTMListItem](#)
- [HTMLTable](#)
- [HTMLTableCaption](#)

- [HTMLTableCell](#)
- [HTMLTableHeader](#)
- [HTMLTableRow](#)
- [HTMLTagElement](#)
- [OrderedList](#)
- [UnorderedList](#)

### **Examples: Using HTMLDocument**

The following examples show ways that you can use the HTMLDocument class to generate HTML and Extensible Stylesheet Language (XSL) Formatting Object (FO) source data.

### **Example: Using HTMLDocument to generate both HTML source and XSL FO source**

The following example shows how to generate both HTML source data and XSL FO source data at the same time:

[“Example: Using HTMLDocument to generate both HTML source and XSL FO source” on page 193](#)

### **Example: Converting XSL FO source data to a PDF**

After you create XSL FO source data, you need to convert that XSL FO data to a form that your users can view and print. The following example shows how to convert a file that contains XSL FO source data to a PDF document by using the XSLReportWriter and Context classes:

[“Example: Converting XSL FO source data to a PDF” on page 191](#)

The following disclaimer applies to all of the IBM Toolbox for Java examples:

#### **Code example disclaimer**

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*Example: Converting XSL FO source data to a PDF*

This example program should not be used as the XSLReportProcessor class is no longer supported.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example: Converting XSL FO source to a PDF.
//
// This program uses the IBM Toolbox for Java ReportWriter classes to convert
// XSL FO source data (created by using HTMLDocument) to a PDF.
//
// This example requires the following jars to be in the classpath.
//
// composer.jar
// outputwriters.jar
// reportwriter.jar
// x4j400.jar
// xslparser.jar
//
// These JAR files are part of the IBM ToolBox for Java, and reside in directory
// /QIBM/ProdData/HTTP/Public/jt400/lib on your server.
//
// You will also need the class definition for

```

```

// org/apache/xerces/dom/NodeContainer, which resides
// in directory /QIBM/ProdData/OS400/xml/lib.
//
// Command syntax:
//   ProcessXslFo F0filename PDFfilename
//
////////////////////////////////////

import java.io.FileInputStream;
import java.io.FileOutputStream;

import java.awt.print.Paper;
import java.awt.print.PageFormat;

import org.w3c.dom.Document;

import com.ibm.xsl.composer.framework.Context;

import com.ibm.as400.util.reportwriter.pdfwriter.PDFContext;
import com.ibm.as400.util.reportwriter.processor.XSLReportProcessor;

public class ProcessXslFo
{
    public static void main(String args[])
    {
        if (args.length != 2)
        {
            System.out.println("Usage: java ProcessXslFo <fo file name> <pdf file name>");
            System.exit(0);
        }

        try
        {
            String inName = args[0];
            String outName = args[1];

            /* Input. File containing XML FO. */
            FileInputStream fin = null;

            /* Output. Which in this example will be PDF. */
            FileOutputStream fout = null;

            try
            {
                fin = new FileInputStream(inName);
                fout = new FileOutputStream(outName);
            }
            catch (Exception e)
            {
                e.printStackTrace();
                System.exit(0);
            }

            /*
            * Setup Page format.
            */
            Paper paper = new Paper();
            paper.setSize(612, 792);
            paper.setImageableArea(0, 0, 756, 936);

            PageFormat pageFormat = new PageFormat();
            pageFormat.setPaper(paper);

            /*
            * Create a PDF context. Set output file name.
            */
            PDFContext pdfContext = new PDFContext(fout, pageFormat);

            /*
            * Create XSLReportProcessor instance.
            */
            XSLReportProcessor report = new XSLReportProcessor(pdfContext);

            /*
            * Open XML FO source.
            */
            try
            {
                report.setXSLF0Source(fin);
            }
            catch (Exception e)

```



```

        {
            e.printStackTrace();
            System.exit(0);
        }

        /*
        * Process the report.
        */
        try
        {
            report.processReport();
        }
        catch (Exception e)
        {
            e.printStackTrace();
            System.exit(0);
        }
    }
    catch (Exception e)
    {
        e.printStackTrace();
        System.exit(0);
    }

    /* exit */
    System.exit(0);
}
}

```

*Example: Using HTMLDocument to generate both HTML source and XSL FO source*

This example uses the HTMLDocument class to generate HTML and XSL FO source data.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example: Using the Toolbox HTMLDocument Class
// to generate both HTML and XSL FO source data.
//
// This program uses the HTMLDocument class to
// generate two files: one that has HTML source and
// another than has XSL FO source.
//
// Command syntax:
//   HTMLDocumentExample
//
////////////////////////////////////

import com.ibm.as400.util.html.*;
import java.*;
import java.io.*;
import java.lang.*;
import java.beans.PropertyVetoException;

public class HTMLDocumentExample
{
    public static void main (String[] args)
    {
        //Create the HTMLDocument that holds necessary document properties
        HTMLDocument doc = new HTMLDocument();

        //Set page and margin properties. Numbers are in inches.
        doc.setPageWidth(8.5);
        doc.setPageHeight(11);
        doc.setMarginTop(1);
        doc.setMarginBottom(1);
        doc.setMarginLeft(1);
        doc.setMarginRight(1);

        //Create a header for the page.
        HTMLHead head = new HTMLHead();
        //Set the title for the header
        head.setTitle("This is the page header.");

        //Create several headings
        HTMLHeading h1 = new HTMLHeading(1, "Heading 1");
        HTMLHeading h2 = new HTMLHeading(2, "Heading 2");
        HTMLHeading h3 = new HTMLHeading(3, "Heading 3");
    }
}

```

```

HTMLHeading h4 = new HTMLHeading(4, "Heading 4");
HTMLHeading h5 = new HTMLHeading(5, "Heading 5");
HTMLHeading h6 = new HTMLHeading(6, "Heading 6");

//Create some text that is printed from right to left.
//Create BidiOrdering object and set the direction
BidiOrdering bdo = new BidiOrdering();
bdo.setDirection(HTMLConstants.RTL);

//Create some text
HTMLText text = new HTMLText("This is Arabic text.");
//Add the text to the bidi-ordering object
bdo.addItem(text);

// Create an UnorderedList.
UnorderedList uList = new UnorderedList(HTMLConstants.SQUARE);
// Create and set the data for UnorderedListItems.
UnorderedListItem listItem1 = new UnorderedListItem();
UnorderedListItem listItem2 = new UnorderedListItem();
listItem1.setItemData(new HTMLText("First item"));
listItem2.setItemData(new HTMLText("Second item"));
// Add the list items to the UnorderedList.
uList.addListItem(listItem1);
uList.addListItem(listItem2);

// Create an OrderedList.
OrderedList oList = new OrderedList(HTMLConstants.SMALL_ROMAN);
// Create the OrderedListItems.
OrderedListItem oListItem1 = new OrderedListItem();
OrderedListItem oListItem2 = new OrderedListItem();
OrderedListItem oListItem3 = new OrderedListItem();
// Set the data in the OrderedListItems.
oListItem1.setItemData(new HTMLText("First item"));
oListItem2.setItemData(new HTMLText("Second item"));
oListItem3.setItemData(new HTMLText("Third item"));
// Add the list items to the OrderedList.
oList.addListItem(oListItem1);
oList.addListItem(oListItem2);
// Add (nest) the unordered list to OrderedListItem2
oList.addList(uList);
// Add another OrderedListItem to the OrderedList
// after the nested UnorderedList.
oList.addListItem(oListItem3);

// Create a default HTMLTable object.
HTMLTable table = new HTMLTable();
try
{
    // Set the table attributes.
    table.setAlignment(HTMLTable.LEFT);
    table.setBorderWidth(1);

    // Create a default HTMLTableCaption object and set the caption text.
    HTMLTableCaption caption = new HTMLTableCaption();
    caption.setElement("Customer Account Balances - January 1, 2000");

    // Set the caption.
    table.setCaption(caption);

    // Create the table headers and add to the table.
    HTMLTableHeader account_header = new HTMLTableHeader(new HTMLText("ACCOUNT"));
    HTMLTableHeader name_header = new HTMLTableHeader(new HTMLText("NAME"));
    HTMLTableHeader balance_header = new HTMLTableHeader(new HTMLText("BALANCE"));

    table.addColumnHeader(account_header);
    table.addColumnHeader(name_header);
    table.addColumnHeader(balance_header);

    // Add rows to the table. Each customer record represents a row in the table.
    int numCols = 3;
    for (int rowIndex=0; rowIndex< 5; rowIndex++)
    {
        HTMLTableRow row = new HTMLTableRow();
        row.setHorizontalAlignment(HTMLTableRow.CENTER);

        HTMLText account = new HTMLText("000" + rowIndex);
        HTMLText name = new HTMLText("Customer" + rowIndex);
        HTMLText balance = new HTMLText(" " + (rowIndex + 1)*200);

        row.addColumn(new HTMLTableCell(account));
        row.addColumn(new HTMLTableCell(name));
        row.addColumn(new HTMLTableCell(balance));
    }
}

```

```

        // Add the row to the table.
        table.addRow(row);
    }
}
catch(Exception e)
{
    System.out.println("Problem creating table");
    System.exit(0);
}

//Add the items to the HTMLDocument
doc.addElement(head);
doc.addElement(h1);
doc.addElement(h2);
doc.addElement(h3);
doc.addElement(h4);
doc.addElement(h5);
doc.addElement(h6);
doc.addElement(oList);
doc.addElement(table);
doc.addElement(bdo);

//Print the fo tags to a file.
try
{
    FileOutputStream fout = new FileOutputStream("FOFILE.fo");
    PrintStream pout = new PrintStream(fout);
    pout.println(doc.getFOtag());
}
catch (Exception e)
{
    System.out.println("Unable to write fo tags to FOFILE.fo");
}

//Print the html tags to a file
try
{
    FileOutputStream htmlout = new FileOutputStream("HTMLFILE.html");
    PrintStream phtmlout = new PrintStream(htmlout);
    phtmlout.println(doc.getTag());
}
catch (Exception e)
{
    System.out.println("Unable to write html tags to HTMLFILE.html");
}
}
}
}

```

## HTML form classes

The IBM Toolbox for Java HTMLForm class represents an HTML form. Use these classes to make forms more easily than you could with CGI scripting.

This class allows you to:

- Add an element, like a button, hyperlink or HTML table to a form
- Remove an element from a form
- Set other form attributes, such as which method to use to send form contents to the server, the hidden parameter list, or the action URL address

The constructor for the HTMLForm object takes a URL address. This address is referred to as an action URL. It is the location of the application on the server that will process the form input. The action URL can be specified on the constructor or by setting the address using the `setURL()` method. Form attributes are set using various `set` methods and retrieved using various `get` methods.

Any HTML tag element may be added to an HTMLForm object using `addElement()` and removed using `removeElement()`.

Of course, you can add other tag elements to a form, including HTMLText, HTMLHyperlink, and HTMLTable.

[HTMLForm Javadoc](#)

[“HTML Text class” on page 212](#)

The IBM Toolbox for Java HTMLText class allows you to access text properties for your HTML page. Using the HTMLText class, you can get, set, and check the status of many text attributes.

[“HTMLHyperlink class” on page 205](#)

The IBM Toolbox for Java HTMLHyperlink class represents an HTML hyperlink tag. You use the HTMLHyperlink class to create a link within your HTML page.

[“HTML Table classes” on page 210](#)

The IBM Toolbox for Java HTMLTable class allows you to easily set up tables that you can use in HTML pages.

[“Example: Using the HTML form classes” on page 443](#)

The following IBM Toolbox for Java example shows you how to use the HTML form classes.

[“HTML class example output” on page 451](#)

These are some possible sample outputs you may get from running the HTML class example.

### ***FormInput classes***

The IBM Toolbox for Java FormInput class represents an input element in an HTML form.

The FormInput class allows you to:

- Get and set the name of an input element
- Get and set the size of an input element
- Get and set the initial value of an input element

The FormInput class is extended by the classes in the following list. These classes provide a way to create specific types of form input elements and allow you to get and set various attributes or retrieve the HTML tag for the input element:

- [ButtonFormInput](#): Represents a button element for an HTML form
- [FileFormInput](#): Represents a file input type, for an HTML form
- [HiddenFormInput](#): Represents a hidden input type for an HTML form
- [ImageFormInput](#): Represents an image input type for an HTML form.
- [ResetFormInput](#): Represents a reset button input for an HTML form
- [SubmitFormInput](#): Represents a submit button input for an HTML form
- [TextFormInput](#): Represents a single line of text input for an HTML form where you define the maximum number of characters in a line. For a password input type, you use [PasswordFormInput](#), which extends TextFormInput and represents a password input type for an HTML form
- [ToggleFormInput](#): Represents a toggle input type for an HTML form. The user can set or get the text label and specify whether the toggle should be checked or selected. The toggle input type can be one of two:
  - [RadioFormInput](#): Represents a radio button input type for an HTML form. Radio buttons may be placed in groups with the RadioFormInputGroup class; this creates a group of radio buttons where the user selects only one of the choices presented.
  - [CheckboxFormInput](#): Represents a checkbox input type for an HTML form where the user may select more than one from the choices presented, and where the checkbox is initialized as either checked or unchecked.

[FormInput Javadoc](#)

[ToggleFormInput Javadoc](#)

[RadioFormInputGroup Javadoc](#)

### *ButtonFormInput class*

The ButtonFormInput class represents a button element for an HTML form.

The following example shows you how to create a ButtonFormInput object:

```
ButtonFormInput button = new ButtonFormInput("button1", "Press Me", "test()");
System.out.println(button.getTag());
```

This example produces the following tag:

```
<input type="button" name="button1" value="Press Me" onclick="test()" />
```

### **Related information**

[ButtonFormInput Javadoc](#)

### *FileFormInput class*

The IBM Toolbox for Java FileFormInput class represents a file input type in an HTML form.

The following code example shows you how to create a new FileFormInput object

```
FileFormInput file = new FileFormInput("myFile");
System.out.println(file.getTag());
```

The above code creates the following output:

```
<input type="file" name="myFile" />
```

### **Related information**

[FileFormInput Javadoc](#)

### *HiddenFormInput class*

The IBM Toolbox for Java HiddenFormInput class represents a hidden input type in an HTML form.

The following code example shows how to create a HiddenFormInput object:

```
HiddenFormInput hidden = new HiddenFormInput("account", "123456");
System.out.println(hidden.getTag());
```

The previous code generates the following tag:

```
<input type="hidden" name="account" value="123456" />
```

In an HTML page, the HiddenInputType does not display. It sends the information (in this case the account number) back to the server.

### **Related information**

[HiddenFormInput Javadoc](#)

### *ImageFormInput class*

The ImageFormInput class represents an image input type in an HTML form.

You can retrieve and update many of the attributes for the ImageFormInput class by using the methods provided.

- Get or set the source
- Get or set the alignment
- Get or set the height
- Get or set the width

## Example: Creating an ImageFormInput object

The following code example shows you how to create an ImageFormInput object:

```
ImageFormInput image = new ImageFormInput("myPicture", "myPicture.gif");
image.setAlignment(HTMLConstants.TOP);
image.setHeight(81);
image.setWidth(100);
```

The above code example generates the following tag:

```
<input type="image" name="MyPicture" src="myPicture.gif" align="top" height="81"
width="100" />
```

### Related information

[ImageFormInput Javadoc](#)

#### *ResetFormInput class*

The ResetFormInput class represents a reset button input type in an HTML form.

The following code example shows you how to create a ResetFormInput object:

```
ResetFormInput reset = new ResetFormInput();
reset.setValue("Reset");
System.out.println(reset.getTag());
```

The above code example generates the following HTML tag:

```
<input type="reset" value="Reset" />
```

### Related information

[ResetFormInput Javadoc](#)

#### *SubmitFormInput class*

The SubmitFormInput class represents a submit button input type in an HTML form.

The following code example shows you how to create a SubmitFormInput object:

```
SubmitFormInput submit = new SubmitFormInput();
submit.setValue("Send");
System.out.println(submit.getTag());
```

The code example above generates the following output:

```
<input type="submit" value="Send" />
```

### Related information

[SubmitFormInput Javadoc](#)

#### *TextFormInput class*

The TextFormInput class represents a single line text input type in an HTML form. The TextFormInput class provides methods that let you get and set the maximum number of characters a user can enter in the text field.

The following example shows you how to create a new TextFormInput object:

```
TextFormInput text = new TextFormInput("userID");
text.setSize(40);
System.out.println(text.getTag());
```

The code example above generates the following tag:

```
<input type="text" name="userID" size="40" />
```

## Related information

[TextFormInput Javadoc](#)

### *PasswordFormInput class*

The PasswordFormInput class represents a password input field type in an HTML form.

The following code example shows you how to create a new PasswordFormInput object:

```
PasswordFormInput pwd = new PasswordFormInput("password");
pwd.setSize(12);
System.out.println(pwd.getTag());
```

The code example above generates the following tag:

```
<input type="password" name="password" size="12" />
```

## Related information

[PasswordFormInput Javadoc](#)

### *RadioFormInput class*

The RadioFormInput class represents a radio button input type in an HTML form. The radio button may be initialized as selected when constructed.

A set of radio buttons with the same control name make a radio button group. The RadioFormInputGroup class creates radio button groups. Only one radio button within the group may be selected at any time. Also, a specific button may be initialized as selected when the group is constructed.

The following code example shows you how to create a RadioFormInput object:

```
RadioFormInput radio = new RadioFormInput("age", "twentysomething", "Age 20 - 29", true);
System.out.println(radio.getTag());
```

The above code example generates the following tag:

```
<input type="radio" name="age" value="twentysomething" checked="checked" />
```

[RadioFormInput Javadoc](#)

[RadioFormInputGroup Javadoc](#)

### *CheckboxFormInput class*

The IBM Toolbox for Java CheckboxFormInput class represents a checkbox input type in an HTML form. The user may select more than one of the choices presented as checkboxes within a form.

The following example shows you how to create a new CheckboxFormInput object:

```
CheckboxFormInput checkbox = new CheckboxFormInput("uscitizen", "yes", "textLabel", true);
System.out.println(checkbox.getTag());
```

The code above produces the following output:

```
<input type="checkbox" name="uscitizen" value="yes" checked="checked" /> textLabel
```

## **LayoutFormPanel class**

The IBM Toolbox for Java LayoutFormPanel class represents a layout of form elements for an HTML form. You can use the methods provided by the LayoutFormPanel to add and remove elements from a panel or get the number of elements in the layout.

You may choose to use one of two layouts:

- GridLayoutFormPanel: Represents a grid layout of form elements for an HTML form
- LineLayoutFormPanel: Represents a line layout of form elements for an HTML form

[LayoutFormPanel Javadoc](#)

### [“GridLayoutFormPanel” on page 200](#)

The GridLayoutFormPanel class represents a grid layout of form elements. You use this layout for an HTML form where you specify the number of columns for the grid.

### [“LineLayoutFormPanel class” on page 201](#)

The LineLayoutFormPanel class represents a line layout of form elements for an HTML form. The form elements are arranged in a single row within a panel.

#### *GridLayoutFormPanel*

The GridLayoutFormPanel class represents a grid layout of form elements. You use this layout for an HTML form where you specify the number of columns for the grid.

The following example creates a GridLayoutFormPanel object with two columns:

```
// Create a text form input element for the system.
LabelFormElement sysPrompt = new LabelFormElement("System:");
TextFormInput system = new TextFormInput("System");

// Create a text form input element for the userId.
LabelFormElement userPrompt = new LabelFormElement("User:");
TextFormInput user = new TextFormInput("User");

// Create a password form input element for the password.
LabelFormElement passwordPrompt = new LabelFormElement("Password:");
PasswordFormInput password = new PasswordFormInput("Password");

// Create the GridLayoutFormPanel object with two columns and add the form elements.
GridLayoutFormPanel panel = new GridLayoutFormPanel(2);
panel.addElement(sysPrompt);
panel.addElement(system);
panel.addElement(userPrompt);
panel.addElement(user);
panel.addElement(passwordPrompt);
panel.addElement(password);

// Create the submit button to the form.
SubmitFormInput logonButton = new SubmitFormInput("logon", "Logon");

// Create HTMLForm object and add the panel to it.
HTMLForm form = new HTMLForm(servletURI);
form.addElement(panel);
form.addElement(logonButton);
```

This example produces the following HTML code:

```
<form action=servletURI method="get">
<table border="0">
<tr>
<td>System:</td>
<td><input type="text" name="System" /></td>
</tr>
<tr>
<td>User:</td>
<td><input type="text" name="User" /></td>
</tr>
<tr>
<td>Password:</td>
<td><input type="password" name="Password" /></td>
</tr>
</table>
<input type="submit" name="logon" value="Logon" />
</form>
```

#### **Related information**

[GridLayoutFormPanel Javadoc](#)



### *LinearLayoutFormPanel class*

The `LinearLayoutFormPanel` class represents a line layout of form elements for an HTML form. The form elements are arranged in a single row within a panel.

## **Example: Using `LinearLayoutFormPanel`**

This example creates a `LinearLayoutFormPanel` object and adds two form elements.

```
CheckboxFormInput privacyCheckbox =
    new CheckboxFormInput("confidential", "yes", "Confidential", true);
CheckboxFormInput mailCheckbox =
    new CheckboxFormInput("mailingList", "yes", "Join our mailing list", false);
LinearLayoutFormPanel panel = new LinearLayoutFormPanel();
panel.addElement(privacyCheckbox);
panel.addElement(mailCheckbox);
String tag = panel.getTag();
```

The code example above generates the following HTML code:

```
<input type="checkbox" name="confidential" value="yes" checked="checked" /> Confidential
<input type="checkbox" name="mailingList" value="yes" /> Join our mailing list <br/>
```

### **Related information**

[LinearLayoutFormPanel Javadoc](#)

### ***TextAreaFormElement class***

The `TextAreaFormElement` class represents a text area element in an HTML form. You specify the size of the text area by setting the number of rows and columns. You can determine the size that a text area element is set for with the `getRows()` and `getColumns()` methods.

You set the initial text within the text area with the `setText()` method. You use the `getText()` method to see what the initial text has been set to.

The following example shows you how to create a `TextAreaFormElement`:

```
TextAreaFormElement textArea = new TextAreaFormElement("foo", 3, 40);
textArea.setText("Default TEXTAREA value goes here");
System.out.println(textArea.getTag());
```

The code example above generates the following HTML code:

```
<form>
<textarea name="foo" rows="3" cols="40">
Default TEXTAREA value goes here
</textarea>
</form>
```

[TextAreaFormElement Javadoc](#)

### ***LabelFormElement class***

The `LabelFormElement` class represents a label for an HTML form element.

You use the `LabelFormElement` class to label elements of an HTML form such as a text area or [password form input](#). The label is one line of text that you set using the `setLabel()` method. This text does not respond to user input and is there to make the form easier for the user to understand.

## **Example: Using `LabelFormElement`**

The following code example shows you how to create a `LabelFormElement` object:

```
LabelFormElement label = new LabelFormElement("Account Balance");
System.out.println(label.getTag());
```

This example produces the following output:

```
Account Balance
```

## Related information

[LabelFormElement Javadoc](#)

### SelectFormElement class

The `SelectFormElement` class represents a select input type for an HTML form. You can add and remove various options within the select element.

`SelectFormElement` has methods available that allow you to view and change attributes of the select element:

- Use `setMultiple()` to set whether or not the user can select more than one option
- Use `getOptionCount()` to determine how many elements are in the option layout
- Use `setSize()` to set the number of options visible within the select element and use `getSize()` to determine the number of visible options.

The following example creates a `SelectFormElement` object with three options. The `SelectFormElement` object named `list`, is highlighted. The first two options added specify the option text, name, and select attributes. The third option added is defined by a `SelectOption` object.

```
SelectFormElement list = new SelectFormElement("list1");
SelectOption option1 = list.addOption("Option1", "opt1");
SelectOption option2 = list.addOption("Option2", "opt2", false);
SelectOption option3 = new SelectOption("Option3", "opt3", true);
list.addOption(option3);
System.out.println(list.getTag());
```

The above code example produces the following HTML code:

```
<select name="list1">
<option value="opt1">Option1</option>
<option value="opt2">Option2</option>
<option value="opt3" selected="selected">Option3</option>
</select>
```

## Related reference

[“SelectOption class” on page 202](#)

The `SelectOption` class represents an option in an HTML `SelectFormElement`. You use the option form element in a select form.

## Related information

[SelectFormElement Javadoc](#)

### SelectOption class

The `SelectOption` class represents an option in an HTML `SelectFormElement`. You use the option form element in a select form.

Methods are provided that you can use to retrieve and set attributes within a `SelectOption`. For instance, you can set whether the option defaults to being selected. You can also set the input value it will use when the form is submitted.

The following example creates three `SelectOption` objects within a select form. Each of the following `SelectOption` objects are highlighted. They are named `option1`, `option2` and `option3`. The `option3` object is initially selected.

```
SelectFormElement list = new SelectFormElement("list1");
SelectOption option1 = list.addOption("Option1", "opt1");
SelectOption option2 = list.addOption("Option2", "opt2", false);
SelectOption option3 = new SelectOption("Option3", "opt3", true);
list.addOption(option3);
System.out.println(list.getTag());
```

The above code example produces the following HTML tag:

```
<select name="list1">
<option value="opt1">Option1</option>
<option value="opt2">Option2</option>
<option value="opt3" selected="selected">Option3</option>
</select>
```

### Related reference

[“SelectFormElement class” on page 202](#)

The SelectFormElement class represents a select input type for an HTML form. You can add and remove various options within the select element.

### Related information

[SelectOption Javadoc](#)

### RadioFormInputGroup class

The RadioFormInputGroup class represents a group of RadioFormInput objects. A user can select only one of the RadioFormInput objects from a RadioFormInputGroup.

The RadioFormInputGroup class methods allow you to work with various attributes of a group of radio buttons. With these methods, you can:

- Add a radio button
- Remove a radio button
- Get or set the name of the radio group

The following example creates a radio button group:

```
// Create some radio buttons.
RadioFormInput radio0 = new RadioFormInput("age", "kid", "0-12", true);
RadioFormInput radio1 = new RadioFormInput("age", "teen", "13-19", false);
RadioFormInput radio2 = new RadioFormInput("age", "twentysomething", "20-29", false);
RadioFormInput radio3 = new RadioFormInput("age", "thirtysomething", "30-39", false);
// Create a radio button group and add the radio buttons.
RadioFormInputGroup ageGroup = new RadioFormInputGroup("age");
ageGroup.add(radio0);
ageGroup.add(radio1);
ageGroup.add(radio2);
ageGroup.add(radio3);
System.out.println(ageGroup.getTag());
```

The code example above generates the following HTML code:

```
<input type="radio" name="age" value="kid" checked="checked" /> 0-12
<input type="radio" name="age" value="teen" /> 13-19
<input type="radio" name="age" value="twentysomething" /> 20-29
<input type="radio" name="age" value="thirtysomething" /> 30-39
```

### Related information

[RadioFormInputGroup Javadoc](#)

[RadioFormInput Javadoc](#)

### HTMLHead class

The IBM Toolbox for Java HTMLHead class represents an HTML head tag. The head section of an HTML page features an opening and closing head tag that typically contains other tags. Typically, the head tag contains a title tag and possibly meta tags.

Constructors for HTMLHead enable you to construct a head tag that is empty, that contains a title tag, or that contains a title tag and a meta tag. You can easily add title and meta tags to the empty HTMLHead object.

Methods for the HTMLHead class include setting and getting the page title and the meta tags. Define the contents of the meta tags by using the HTMLMeta class.

The following code shows one way to create an HTMLHead tag:

```
// Create an empty HTMLHead.  
HTMLHead head = new HTMLHead("My Main Page");  
  
// Add the title.  
head.setTitle("My main page");  
  
// Define your meta information and add it to HTMLHead.  
HTMLMeta meta = new HTMLMeta("Content-Type", "text/html; charset=iso-8859-1");  
head.addMetaInformation(meta);
```

This is the output of the example HTMLHead tag:

```
<head>  
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"/>  
<title>My main page</title>  
</head>
```

### Related reference

[“HTMLMeta class” on page 208](#)

The IBM Toolbox for Java HTMLMeta class represents meta-information used within an HTMLHead tag. Attributes in META tags are used when identifying, indexing, and defining information within the HTML document.

### Related information

[HTMLHead Javadoc](#)

## HTMLHeading class

The IBM Toolbox for Java HTMLHeading class represents an HTML heading. Each heading can have its own alignment and level from 1 (largest font, most importance) to 6.

Methods for the HTMLHeading class include:

- Get and set the text for the heading
- Get and set the level of the heading
- Get and set the alignment of the heading
- Get and set the direction of the text interpretation
- Get and set the language of the input element
- Get a String representation of the HTMLHeading object

### Example: Creating HTMLHeading objects

The following example creates three HTMLHeading objects:

```
// Create and display three HTMLHeading objects.  
HTMLHeading h1 = new HTMLHeading(1, "Heading", HTMLConstants.LEFT);  
HTMLHeading h2 = new HTMLHeading(2, "Subheading", HTMLConstants.CENTER);  
HTMLHeading h3 = new HTMLHeading(3, "Item", HTMLConstants.RIGHT);  
System.out.print(h1 + "\r\n" + h2 + "\r\n" + h3);
```

The previous example produces the following tags:

```
<h1 align="left">Heading</h1>  
<h2 align="center">Subheading</h2>  
<h3 align="right">Item</h3>
```

### Related information

[HTMLHeading Javadoc](#)

## HTMLHyperlink class

The IBM Toolbox for Java HTMLHyperlink class represents an HTML hyperlink tag. You use the HTMLHyperlink class to create a link within your HTML page.

You can get and set many attributes of hyperlinks with this class, including:

- Get and set the Uniform Resource Identifier for the link
- Get or set the title for the link
- Get or set the target frame for the link

The HTMLHyperlink class can print the full hyperlink with defined properties so that you can use the output in your HTML page.

The following is an example for HTMLHyperlink:

```
// Create an HTML hyperlink to the IBM Toolbox for Java home page.
HTMLHyperlink toolbox =
    new HTMLHyperlink("http://www.ibm.com/as400/toolbox", "IBM Toolbox for Java home page");
toolbox.setTarget(TARGET_BLANK);

// Display the toolbox link tag.
System.out.println(toolbox.toString());
```

The code above produces the following tag:

```
<a href="http://www.ibm.com/as400/toolbox">IBM Toolbox for Java home page</a>
```

### Related information

[HTMLHyperlink Javadoc](#)

## HTMLImage class

The HTMLImage class allows you to create image tags for your HTML page.

The HTMLImage class provides methods that allow you to get and set image attributes, including the following:

- Get or set the height of the image
- Get or set the width of the image
- Get or set the name of the image
- Get or set the alternate text for the image
- Get or set the horizontal space around the image
- Get or set the vertical space around the image
- Get or set the absolute or relative reference to the image
- Retrieve a string representation of the HTMLImage object

The following example shows one way to create an HTMLImage object:

```
// Create an HTMLImage.
HTMLImage image = new HTMLImage("http://myWebSite/picture.gif", "Alternate text for this
graphic");
image.setHeight(94);
image.setWidth(105);
System.out.println(image);
```

The print statement produces the following tag on a single line. Text wrapping is for display purposes only.

```

```

## Related information

[HTMLImage Javadoc](#)

## HTMList classes

The IBM Toolbox for Java HTMList classes allow you to easily create lists within your HTML pages. These classes provide methods to get and set various attributes of the lists and the items within the lists.

In particular, the parent class [HTMList](#) provides a method to produce a compact list that displays items in as small a vertical space as possible.

- Methods for [HTMList](#) include:
  - Compact the list
  - Add and remove items from the list
  - Add and remove lists from the list (making it possible to nest lists)
- Methods for [HTMListItem](#) include:
  - Get and set the contents of the item
  - Get and set the direction of the text interpretation
  - Get and set the language of the input element

Use the subclasses of [HTMList](#) and [HTMListItem](#) to create your HTML lists:

- [OrderedList](#) and [OrderedListItem](#)
- [UnorderedList](#) and [UnorderedListItem](#)

For coding snippets, see the following examples:

- Example: [Creating ordered lists](#)
- Example: [Creating unordered lists](#)
- Example: [Creating nested lists](#)

## OrderedList and OrderedListItem

Use the [OrderedList](#) and [OrderedListItem](#) classes to create ordered lists in your HTML pages.

- Methods for [OrderedList](#) include:
  - Get and set the starting number for the first item in the list
  - Get and set the type (or style) for the item numbers
- Methods for [OrderedListItem](#) include:
  - Get and set the number for the item
  - Get and set the type (or style) for the item number

By using the methods in [OrderedListItem](#), you can override the numbering and type for a specific item in the list.

See the example for [creating ordered lists](#).

## UnorderedList and UnorderedListItem

Use the [UnorderedList](#) and [UnorderedListItem](#) classes to create unordered lists in your HTML pages.

- Methods for [UnorderedList](#) include:
  - Get and set the type (or style) for the items
- Methods for [UnorderedListItem](#) include:
  - Get and set the type (or style) for the item

See the example for [creating unordered lists](#).

## Examples: Using HTMLList classes

The following examples show you how to use the HTMLList classes to create ordered lists, unordered lists, and nested lists.

### Example: Creating ordered lists

The following example creates an ordered list:

```
// Create an OrderedList.
OrderedList oList = new OrderedList(HTMLConstants.SMALL_ROMAN);
// Create the OrderedListItems.
OrderedListItem listItem1 = new OrderedListItem();
OrderedListItem listItem2 = new OrderedListItem();
// Set the data in the OrderedListItems.
listItem1.setItemData(new HTMLText("First item"));
listItem2.setItemData(new HTMLText("Second item"));
// Add the list items to the OrderedList.
oList.addListItem(listItem1);
oList.addListItem(listItem2);
System.out.println(oList.getTag());
```

The previous example produces the following tags:

```
<ol type="i">
<li>First item</li>
<li>Second item</li>
</ol>
```

### Example: Creating unordered lists

The following example creates an unordered list:

```
// Create an UnorderedList.
UnorderedList uList = new UnorderedList(HTMLConstants.SQUARE);
// Create the UnorderedListItems.
UnorderedListItem listItem1 = new UnorderedListItem();
UnorderedListItem listItem2 = new UnorderedListItem();
// Set the data in the UnorderedListItems.
listItem1.setItemData(new HTMLText("First item"));
listItem2.setItemData(new HTMLText("Second item"));
// Add the list items to the UnorderedList.
uList.addListItem(listItem1);
uList.addListItem(listItem2);
System.out.println(uList.getTag());
```

The previous example produces the following tags:

```
<ul type="square">
<li>First item</li>
<li>Second item</li>
</ul>
```

### Example: Creating nested lists

The following example creates a nested list:

```
// Create an UnorderedList.
UnorderedList uList = new UnorderedList(HTMLConstants.SQUARE);
// Create and set the data for UnorderedListItems.
UnorderedListItem listItem1 = new UnorderedListItem();
UnorderedListItem listItem2 = new UnorderedListItem();
listItem1.setItemData(new HTMLText("First item"));
listItem2.setItemData(new HTMLText("Second item"));
// Add the list items to the UnorderedList.
uList.addListItem(listItem1);
uList.addListItem(listItem2);

// Create an OrderedList.
OrderedList oList = new OrderedList(HTMLConstants.SMALL_ROMAN);
// Create the OrderedListItems.
```

```

OrderedListItem listItem1 = new OrderedListItem();
OrderedListItem listItem2 = new OrderedListItem();
OrderedListItem listItem3 = new OrderedListItem();
    // Set the data in the OrderedListItems.
listItem1.setItemData(new HTMLText("First item"));
listItem2.setItemData(new HTMLText("Second item"));
listItem3.setItemData(new HTMLText("Third item"));
    // Add the list items to the OrderedList.
oList.addListItem(listItem1);
oList.addListItem(listItem2);
    // Add (nest) the unordered list to OrderedListItem2
oList.addList(uList);
    // Add another OrderedListItem to the OrderedList
    // after the nested UnorderedList.
oList.addListItem(listItem3);
System.out.println(oList.getTag());

```

The previous example produces the following tags:

```

<ol type="i">
<li>First item</li>
<li>Second item</li>
<ul type="square">
<li>First item</li>
<li>Second item</li>
</ul>
<li>Third item</li>
</ol>

```

[HTMLList Javadoc](#)

[HTMLListItem Javadoc](#)

## HTMLMeta class

The IBM Toolbox for Java HTMLMeta class represents meta-information used within an HTMLHead tag. Attributes in META tags are used when identifying, indexing, and defining information within the HTML document.

Attributes of the META tag include:

- NAME - the name associated with the contents of the META tag
- CONTENT - values associated with the NAME attribute
- HTTP-EQUIV - information gathered by HTTP servers for response message headers
- LANG - the language
- URL - used to redirect users from the current page to another URL

For example, to help search engines determine the contents of a page, you might use the following META tag:

```
<META name="keywords" lang="en-us" content="games, cards, bridge">
```

You can also use HTMLMeta to redirect a user from one page to another.

Methods for the HTMLMeta class include:

- Get and set the NAME attribute
- Get and set the CONTENT attribute
- Get and set the HTTP-EQUIV attribute
- Get and set the LANG attribute
- Get and set the URL attribute



## Example: Creating META tags

The following example creates two META tags:

```
// Create a META tag to help search engines determine page content.
HTMLMeta meta1 = new HTMLMeta();
meta1.setName("keywords");
meta1.setLang("en-us");
meta1.setContent("games, cards, bridge");
// Create a META tag used by caches to determine when to refresh the page.
HTMLMeta meta2 = new HTMLMeta("Expires", "Mon, 01 Jun 2000 12:00:00 GMT");
System.out.print(meta1 + "\r\n" + meta2);
```

The previous example produces the following tags:

```
<meta name="keywords" content="games, cards, bridge">
<meta http-equiv="Expires" content="Mon, 01 Jun 2000 12:00:00 GMT">
```

### Related information

[HTMLMeta Javadoc](#)

## HTMLParameter class

The HTMLParameter class represents the parameters you can use with the HTMLServlet class. Each parameter has its own name and value.

Methods for the HTMLParameter class include:

- Get and set the name of the parameter
- Get and set the value of the parameter

### Example: Creating HTMLParameter tags

The following example creates an HTMLParameter tag:

```
// Create an HTMLServletParameter.
HTMLParameter parm = new HTMLParameter ("age", "21");
System.out.println(parm);
```

The previous example produces the following tag:

```
<param name="age" value="21">
```

### Related information

[HTMLParameter Javadoc](#)

## HTMLServlet class

The HTMLServlet class represents a server-side include. The servlet object specifies the name of the servlet and, optionally, its location. You may also choose to use the default location on the local system.

The HTMLServlet class works with the HTMLParameter class, which specifies the parameters available to the servlet.

Methods for the HTMLServlet class include:

- Add and remove HTMLParameters from the servlet tag
- Get and set the location of the servlet
- Get and set the name of the servlet
- Get and set the alternate text of the servlet

## Example: Creating HTMLServlet tags

The following example an HTMLServlet tag:

```
// Create an HTMLServlet.  
HTMLServlet servlet = new HTMLServlet("myServlet", "http://server:port/dir");  
  
// Create a parameter, then add it to the servlet.  
HTMLParameter param = new HTMLParameter("parm1", "value1");  
servlet.addParameter(param);  
  
// Create and add second parameter  
HTMLParameter param2 = servlet.add("parm2", "value2");  
  
// Create the alternate text if the Web server does not support the servlet tag.  
servlet.setText("The Web server providing this page does not support the SERVLET tag.");  
System.out.println(servlet);
```

The previous example produces the following tags:

```
<servlet name="myServlet" codebase="http://server:port/dir">  
<param name="parm1" value="value1">  
<param name="parm2" value="value2">  
The Web server providing this page does not support the SERVLET tag.  
</servlet>
```

### HTMLServlet Javadoc

[“HTMLParameter class” on page 209](#)

The HTMLParameter class represents the parameters you can use with the HTMLServlet class. Each parameter has its own name and value.

## HTML Table classes

The IBM Toolbox for Java HTMLTable class allows you to easily set up tables that you can use in HTML pages.

This class provides methods to get and set various attributes of the table, including:

- Get and set the width of the border
- Get the number of rows in the table
- Add a column or row to the end of the table
- Remove a column or row at a specified column or row position

## Example: Using HTMLTable classes

The following example shows how to use the HTMLTable classes::

[“Example: Using HTMLTable classes” on page 460](#)

### **Related information**

[HTMLTable Javadoc](#)

### **HTMLTableCell class**

The HTMLTableCell class takes any HTMLTagElement object as input and creates the table cell tag with the specified element. The element can be set on the constructor or through either of two setElement() methods.

Many cell attributes can be retrieved or updating using methods that are provided in the HTMLTableCell class. Some of the actions you can do with these methods are:

- Get or set the row span
- Get or set the cell height
- Set whether the cell data will use normal HTML line breaking conventions

The following example creates an HTMLTableCell object and displays the tag:

```
//Create an HTMLHyperlink object.
HTMLHyperlink link = new HTMLHyperlink("http://www.ibm.com",
    "IBM Home Page");
HTMLTableCell cell = new HTMLTableCell(link);
cell.setHorizontalAlignment(HTMLConstants.CENTER);
System.out.println(cell.getTag());
```

The getTag() method above gives the output of the example:

```
<td align="center"><a href="http://www.ibm.com">IBM Home Page</a></td>
```

[HTMLTableCell Javadoc](#)

[HTMLTagElement Javadoc](#)

### ***HTMLTableRow class***

The HTMLTableRow class creates a row within a table. This class provides various methods for getting and setting attributes of a row.

The methods of the HTMLTableRow class allow you to:

- Add or remove a column from the row
- Get column data at the specified column Index
- Get column index for the column with the specified cell.
- Get the number of columns in a row
- Set horizontal and vertical alignments

The following is an example for HTMLTableRow:

```
// Create a row and set the alignment.
HTMLTableRow row = new HTMLTableRow();
row.setHorizontalAlignment(HTMLTableRow.CENTER);

// Create and add the column information to the row.
HTMLText account = new HTMLText(customers_[rowIndex].getAccount());
HTMLText name = new HTMLText(customers_[rowIndex].getName());
HTMLText balance = new HTMLText(customers_[rowIndex].getBalance());

row.addColumn(new HTMLTableCell(account));
row.addColumn(new HTMLTableCell(name));
row.addColumn(new HTMLTableCell(balance));

// Add the row to an HTMLTable object (assume that the table already exists).
table.addRow(row);
```

### **Related information**

[HTMLTableRow Javadoc](#)

### ***HTMLTableHeader class***

The HTMLTableHeader class inherits from the HTMLTableCell class. It creates a specific type of cell, the header cell, giving you a <th> cell instead of a <td> cell. Like the HTMLTableCell class, you call various methods in order to update or retrieve attributes of the header cell.

The following is an example for HTMLTableHeader:

```
// Create the table headers.
HTMLTableHeader account_header = new HTMLTableHeader(new HTMLText("ACCOUNT"));
HTMLTableHeader name_header = new HTMLTableHeader(new HTMLText("NAME"));
HTMLTableHeader balance_header = new HTMLTableHeader();
HTMLText balance = new HTMLText("BALANCE");
balance_header.setElement(balance);

// Add the table headers to an HTMLTable object (assume that the table already exists).
table.addColumnHeader(account_header);
table.addColumnHeader(name_header);
table.addColumnHeader(balance_header);
```

## Related information

[HTMLTableHeader Javadoc](#)

### **HTMLTableCaption class**

The HTMLTableCaption class creates a caption for your HTML table. The class provides methods for updating and retrieving the attributes of the caption. For example, you can use the `setAlignment()` method to specify to which part of the table the caption should be aligned.

The following is an example for HTMLTableCaption:

```
// Create a default HTMLTableCaption object and set the caption text.
HTMLTableCaption caption = new HTMLTableCaption();
caption.setElement("Customer Account Balances - January 1, 2000");

// Add the table caption to an HTMLTable object (assume that the table already exists).
table.setCaption(caption);
```

## Related information

[HTMLTableCaption Javadoc](#)

### **HTML Text class**

The IBM Toolbox for Java HTMLText class allows you to access text properties for your HTML page. Using the HTMLText class, you can get, set, and check the status of many text attributes.

These attributes include the following:

- Get or set the size of the font
- Set the bold attribute on (true) or off (false) or determine if it is already on
- Set the underscore attribute on (true) or off (false) or determine if it is already on
- Get or set the horizontal alignment of the text

The following example shows you how to create an HTMLText object and set its bold attribute on and its font size to 5.

```
HTMLText text = new HTMLText("IBM");
text.setBold(true);
text.setSize(5);
System.out.println(text.getTag());
```

The print statement produces the following tag:

```
<font size="5"><b>IBM</b></font>
```

When you use this tag in an HTML page, it looks like this:

## **IBM**

## Related information

[HTMLText Javadoc](#)

### **HTMLTree classes**

The HTMLTree class allows you to easily set up a hierarchical tree of HTML elements that you can use in HTML pages.

This class provides methods to get and set various attributes of the tree, in addition to methods allowing you to:

- Get and set the HTTP Servlet Request
- Add an HTMLTreeElement or FileTreeElement to the tree
- Remove an HTMLTreeElement or FileTreeElement from the tree

## Examples: Using HTMLTree classes

The following examples show different ways to use the HTMLTree classes.

- [“Example: Using HTMLTree classes” on page 452](#)
- [“Example: Creating a traversable integrated file system tree” on page 213](#)

### Related information

[HTMLTree Javadoc](#)

#### ***Example: Creating a traversable integrated file system tree***

The following example is made of three files that, together, show how you can create a traversable integrated file system tree. The example uses frames to display an HTMLTree and FileListElement in a servlet.

- [FileTreeExample.java](#) - generates the HTML frames and starts the servlet
- [TreeNav.java](#) - builds and manages the tree
- [TreeList.java](#) - displays the contents of selections made in the TreeNav.java class

### ***HTMLTreeElement class***

The HTMLTreeElement class represents an hierarchical element within an HTMLTree or other HTMLTreeElements.

Many tree element attributes can be retrieved or updating using methods that are provided in the HTMLTreeElement class. Some of the actions you can do with these methods are:

- Get or set the visible text of the tree element
- Get or set the URL for the expanded and collapsed icon
- Set whether the tree element will be expanded

The following example creates an HTMLTreeElement object and displays the tag:

```
// Create an HTMLTree.
HTMLTree tree = new HTMLTree();

// Create parent HTMLTreeElement.
HTMLTreeElement parentElement = new HTMLTreeElement();
parentElement.setTextUrl(new HTMLHyperlink("http://myWebPage", "My Web Page"));

// Create HTMLTreeElement Child.
HTMLTreeElement childElement = new HTMLTreeElement();
childElement.setTextUrl(new HTMLHyperlink("http://anotherWebPage", "Another Web Page"));
parentElement.addElement(childElement);

// Add the tree element to the tree.
tree.addElement(parentElement);
System.out.println(tree.getTag());
```

The getTag() method in the above example generates HTML tags like the following:

```
<table cellpadding="0" cellspacing="3">
<tr>
<td><font color="#0000FF"><u>-</u></font> </td>
<td><font color="#0000FF"><u>My Web Page</u></font></td>
</tr>

<tr>
<td> </td>
<td>
<table cellpadding="0" cellspacing="3">
<tr>
<td><font color="#0000FF"><u>-</u></font> </td>
<td><font color="#0000FF"><u>Another Web Page</u></font> </td>
</tr>
</table>
</td>
```

```
</tr>
</table>
```

## Related information

[HTMLTreeElement Javadoc](#)

### ***FileTreeElement class***

The IBM Toolbox for Java FileTreeElement class represents the Integrated File System within an HTMLTree view.

Many tree element attributes can be retrieved or updating using methods that are provided in the HTMLTreeElement class. You can also get and set the name and path of NetServer shared drives.

Some of the actions these methods enable you to perform are:

- Get or set the URL for the expanded and collapsed icon (inherited method)
- Set whether the tree element will be expanded (inherited method)
- Get or set the name of the NetServer shared drive
- Get or set the path of the NetServer shared drive

### **Example: Using FileTreeElement**

The following example creates a FileTreeElement object and displays the tag:

```
// Create an HTMLTree.
HTMLTree tree = new HTMLTree();

// Create a URLParser object.
URLParser urlParser = new URLParser(httpServletRequest.getRequestURI());

// Create an AS400 object.
AS400 system = new AS400(mySystem, myUserId, myPassword);

// Create an IFSJavaFile object.
IFSJavaFile root = new IFSJavaFile(system, "/QIBM");

// Create a DirFilter object and get the directories.
DirFilter filter = new DirFilter();
File[] dirList = root.listFiles(filter);

for (int i=0; i < dirList.length; i++)
{
    // Create a FileTreeElement.
    FileTreeElement node = new FileTreeElement(dirList[i]);

    // Set the Icon URL.
    ServletHyperlink sl = new ServletHyperlink(urlParser.getURI());
    sl.setHttpServletResponse(resp);
    element.setIconUrl(sl);

    // Add the FileTreeElement to the tree.
    tree.addElement(element);
}

System.out.println(tree.getTag());
```

The getTag() method above gives the output of the example.

## Related information

[FileTreeElement Javadoc](#)

### ***FileListElement class***

The IBM Toolbox for Java FileListElement class allows you to create a file list element, which represents the contents of an integrated file system directory.

You can use the FileListElement object to represent the contents of a NetServer shared drive by getting and setting the name and path of NetServer shared drives.

The `FileListElement` class provides methods that allow you to:

- List and sort the elements of the file list
- Get and set the HTTP Servlet Request
- Get and set the `FileListRenderer`
- Get and set the `HTMLTable` with which to display the file list
- Get and set the name of a NetServer shared drive
- Get and set the path of a NetServer shared drive

You can use the `FileListElement` class with other classes in the `html` package:

- With a `FileListRenderer`, you can specify how you want to display the list of files
- With the `FileTreeElement` class, you can create a traversable list of integrated file system files or NetServer shared files

### **Example: Using `FileListElement` to create a traversable integrated file system tree**

The following example shows how you can use the `FileListElement` class with `HTMLTree` classes (`FileTreeElement` and `HTMLTreeElement`) to create a traversable integrated file system tree. The example also includes code for setting the path of a NetServer shared drive.

[“Example: Creating a traversable integrated file system tree” on page 213](#)

#### **Related information**

[FileListElement Javadoc](#)

[FileTreeElement Javadoc](#)

[HTMLTreeElement Javadoc](#)

#### ***FileListRenderer* class**

The IBM Toolbox for Java `FileListRenderer` class renders any field for File objects (directories and files) in a `FileListElement`.

The `FileListRenderer` class offers methods that allow you to perform the following actions:

- Get the name of the directory
- Get the name of the file
- Get the name of the parent directory
- Return the row data that you want to display in the `FileListElement`

This example creates an `FileListElement` object with a renderer:

```
// Create a FileListElement.
FileListElement fileList = new FileListElement(sys, httpServletRequest);

// Set the renderer specific to this servlet, which extends
// FileListRenderer and overrides applicable methods.
fileList.setRenderer(new myFileListRenderer(request));
```

If you don't want to use the default renderer, you can extend `FileListRenderer` and override methods or create new ones. For example, you might want to ensure that you prevent passing the names of specific directories or files with certain extensions to the `FileListElement`. By extending the class and overriding the appropriate method, you can return null for these files and directories, ensuring that they are not displayed.

To fully customize the rows within a `FileListElement`, use the `getRowData()` method. An example of customizing row data using `getRowData()` might be adding a column to the row data or rearranging the columns. When the default behavior of `FileListRenderer` is satisfactory, you need no additional programming because the `FileListElement` class creates a default `FileListRenderer`.

#### **Related reference**

[“FileListElement class” on page 214](#)

The IBM Toolbox for Java FileListElement class allows you to create a file list element, which represents the contents of an integrated file system directory.

### **Related information**

[FileListRenderer Javadoc](#)

## **ReportWriter classes**

The com.ibm.as400.util.reportwriter package provides classes that enable you to easily access and format data from an XML source file or data produced by servlets or JavaServer Pages.

The reportwriter package is a convenient way to name three different but related packages:

- com.ibm.as400.util.reportwriter.pclwriter
- com.ibm.as400.util.reportwriter.pdfwriter
- com.ibm.as400.util.reportwriter.processor

These packages include a variety of classes that allow you to format XML data streams and generate reports in those formats. Make sure you have the necessary JAR files in your CLASSPATH, including an XML parser and an XSLT processor. For more information, see the following pages:

- [JAR files](#)

Context classes (in the pclwriter and pdfwriter packages) define methods that the ReportProcessor classes need to render XML and JSP data in the chosen format:

- Use PCLContext in combination with a ReportWriter class to generate a report in the Hewlett Packard Printer Control Language (PCL) format.
- Use PDFContext in combination with a ReportWriter class to generate a report in the Adobe Portable Document Format (PDF).

ReportProcessor classes (in the processor package) enable you to generate formatted reports from information your application gathers from Java servlets and JavaServer Pages (JSPs).

- Use the [JSPReportProcessor](#) class to retrieve data from servlets and JSP pages to produce reports in the available formats (contexts).

## **Context classes**

The IBM Toolbox for Java context classes support specific data formats, that, in combination with the OutputQueue and SpooledFileOutputStream classes, enable the ReportWriter classes to generate reports in that format and put those reports in a spool file.

Your application only has to create an instance of the Context class, which the ReportWriter classes then use to generate the reports. Your application never directly calls any of the methods in either Context class. The PCLContext and PDFContext methods are meant to be used internally by the ReportWriter classes.

Constructing an instance of the Context class requires an OutputStream (from the java.io package) and a PageFormat (from the java.awt.print package). Example: Using JSPReportProcessor with PDFContext show how you can construct and use the Context classes with other ReportWriter classes to generate reports.

[OutputQueue Javadoc](#)

[SpooledFileOutputStream Javadoc](#)

[“ReportWriter classes” on page 216](#)

The com.ibm.as400.util.reportwriter package provides classes that enable you to easily access and format data from an XML source file or data produced by servlets or JavaServer Pages.

[“Example: Using XSLReportProcessor with PCLContext” on page 473](#)

This example should not be used as the XSLReportProcessor class is no longer supported.

[“Example: Using JSPReportProcessor with PDFContext” on page 469](#)



This example uses the JSPReportProcessor and the PDFContext classes to obtain data from a specified URL and convert the data to the PDF format. The data is then streamed to a file as a PDF document.

## JSPReportProcessor class

The JSPReportProcessor class enables you to create a document or report from the contents of a JavaServer Page (JSP) or Java servlet.

Use this class to obtain a JSP or servlet from a given URL and create a document from the contents. The JSP or servlet must provide the document data, including XSL formatting objects. You must specify the output context and the JSP input data source before you can generate any pages of the document. You can then convert the report data to a specified output data stream format.

The JSPReportProcessor class allows you to:

- Process the report
- Set a URL as the template

The following examples show how you can use the JSPReportProcessor and the PDFContext classes to generate a report. The examples include both the Java and the JSP code, which you can view by using the following links. You can also [download a ZIP file](#) that contains the example JSP, XML, and XSL source files for the JSPReportProcessor examples:

- [“Example: Using JSPReportProcessor with PDFContext” on page 469](#)
- [“Example: JSPReportProcessor sample JSP file” on page 471](#)

[Java Server Pages technology](#)

## XSLReportProcessor class

The XSLReportProcessor class is no longer supported and should not be used.

The XSLReportProcessor class enables you to create a document or report by transforming and formatting your XML source data using an XSL stylesheet. Use this class to create the report by using an XSL stylesheet that contains XSL formatting objects (FOs), which must conform to the XSL specification. You then use a Context class to convert the report data to a specified output data stream format.

The XSLReportProcessor class allows you to:

- Set the XSL stylesheet
- Set the XML data source
- Set the XSL FO source
- Process a report

## Examples

The following examples show how you can use the XSLReportProcessor and the PCLContext classes to generate a report. The examples include the Java, XML, and XSL code, which you can view by using the following links. You can also [download a zip file](#) that contains the example XML, XSL, and JSP source files for both the XSLReportProcessor and JSPReportProcessor examples:

- [Example: Using XSLReportProcessor with PCLContext](#)
- [Example: XSLReportProcessor sample XML file](#)
- [Example: XSLReportProcessor sample XSL file](#)

For more information about XML and XSL, see the [XML Toolkit](#) topic in the Information Center.

## Security classes

You use the IBM Toolbox for Java security classes to provide secured connections to a server, verify a user's identity, and associate a user with the operating system thread when running on the local server.

The security services included are:

- Communications infrastructure using [Java Secure Socket Extension \(JSSE\)](#) provides secure connections both by encrypting the data exchanged between a client and a server session and by performing server authentication.
- [Authentication Services](#) provide the ability to:
  - Authenticate a user identity and password against the IBM i user registry.
  - Ability to assign an identity to the current IBM i thread.

## Secure Sockets Layer

Secure Sockets Layer (SSL) provides secure connections by encrypting the data exchanged between a client and server session, and by performing server authentication.

Using SSL negatively affects performance because SSL connections perform more slowly than connections that do not have encryption. Use SSL connections when the security of the data transferred is a higher priority than performance, for example, when transferring credit card or bank statement information.

Contact your IBM representative for more information.

[Using encryption between the IBM Toolbox for Java classes and the IBM i servers](#)

### ***Using SSL to encrypt data between IBM Toolbox for Java and IBM i servers***

You can use SSL to encrypt data exchanged between IBM Toolbox for Java classes and IBM i servers.

On the client side, use JSSE to encrypt the data. On the server side, you must use the IBM i digital certificate manager to configure the IBM i servers to exchange encrypted data.

### **Setting up your client and server to use SSL**

To encrypt data flowing between the IBM Toolbox for Java classes and IBM i servers, complete the following tasks:

1. [Set up your servers](#) to exchange encrypted data.
2. Use the [SecureAS400 object](#) to force IBM Toolbox for Java to encrypt data.

**Note:** Completing the first two steps above only creates a secure path between the client and the server. Your application must use the SecureAS400 object to tell the IBM Toolbox for Java which data to encrypt. Data that flows through the SecureAS400 object is the only data that is encrypted. If you use an AS400 object, data is not encrypted and the normal path to the server is used.

### *Setting up IBM i to use SSL*


To set up your system to use SSL with IBM Toolbox for Java, complete the following steps.

1. [Get and configure the server certificate.](#)
2. Apply the certificate to the following systems that are used by IBM Toolbox for Java:
  - QIBM\_OS400\_QZBS\_SVR\_CENTRAL
  - QIBM\_OS400\_QZBS\_SVR\_DATABASE
  - QIBM\_OS400\_QZBS\_SVR\_DTAQ
  - QIBM\_OS400\_QZBS\_SVR\_NETPRT
  - QIBM\_OS400\_QZBS\_SVR\_RMTCMD
  - QIBM\_OS400\_QZBS\_SVR\_SIGNON
  - QIBM\_OS400\_QZBS\_SVR\_FILE

- QIBM\_OS400\_QRW\_SVR\_DDM\_DRDA

## Getting and configuring server certificates

Before you get and configure your server certificate, you need to install the following products:

- [IBM HTTP Server](#)  (5770-DG1) licensed program
- [Base operating system option 34 \(Digital Certificate Manager\)](#)

The process you follow to get and configure your server certificate depends on the kind of certificate you use:

- If you get a certificate from a trusted authority (such as VeriSign, Inc., or RSA Data Security, Inc.), install the certificate on the system then apply it to the host servers.
- If you choose not to use a certificate from a trusted authority, you can build your own certificate to be used on the system. Build the certificate by using [Digital Certificate Manager](#):
  1. Create the certificate authority on the system. See the Information Center topic [Acting as your own CA](#).
  2. Create a system certificate from the certificate authority that you created.
  3. Assign which host servers will use the system certificate that you created.


## Authentication services

Classes are provided by the IBM Toolbox for Java that interact with the security services provided by IBM i.

Specifically, support is provided to authenticate a user identity, sometimes referred to as a *principal*, and password against the IBM i user registry. A credential representing the authenticated user can then be established. You can use the credential to alter the identity of the current IBM i thread to perform work under the authorities and permissions of the authenticated user. In effect, this swap of identity results in the thread acting as if a signon was performed by the authenticated user.

## Overview of support provided

The AS400 object provides authentication for a given user profile and password against the server. You can also retrieve Kerberos tickets and profile tokens that represent authenticated user profiles and passwords for the system.

**Note:** Using Kerberos tickets requires that you configure the Java General Security Services (JGSS) Application Programming Interface. For more information about JGSS, see the [Java Security Documentation](#) .

To use Kerberos tickets, set only the system name (and not the password) into the AS400 object. The user identity is retrieved through the JGSS framework. You can set only one means of authentication in an AS400 object at a time. Setting the password clears any Kerberos ticket or profile token.

To use profile tokens, use the `getProfileToken()` methods to retrieve instances of the `ProfileTokenCredential` class. Think of profile tokens as a representation of an authenticated user profile and password for a specific server. Profile tokens expire based on time, up to one hour, but can be refreshed in certain cases to provide an extended life span.

**Note:** If you use the `ProfileTokenCredential` class, make sure to review the information at the bottom of this page that discuss the methods for setting tokens.

The following example creates a system object and uses that object to generate a profile token. The example then uses the profile token to create another system object, and uses the second system object to connect to the command service:

```
AS400 system = new AS400("mySystemName", "MYUSERID", "MYPASSWORD");
ProfileTokenCredential myPT = system.getProfileToken();
AS400 system2 = new AS400("mySystemName", myPT);
system2.connectService(AS400.COMMAND);
```

## Setting thread identities

You can establish a credential on either a remote or local context. Once created, you can serialize or distribute the credential as required by the calling application. When passed to a running process on the associated server, a credential can be used to modify or *swap* the IBM i thread identity and perform work on behalf of the previously authenticated user.

A practical application of this support might be in a two tier application, with authentication of a user profile and password being performed by a graphical user interface on the first tier (i.e. a PC) and work being performed for that user on the second tier (the server). By utilizing ProfileTokenCredentials, the application can avoid directly passing user IDs and passwords over the network. The profile token can then be distributed to the program on the second tier, which can perform the *swap()* and operate under the IBM i authorities and permissions assigned to the user.

**Note:** While inherently more secure than passing a user profile and password due to limited life span, profile tokens should still be considered sensitive information by the application and handled accordingly. Since the token represents an authenticated user and password, it could potentially be exploited by a hostile application to perform work on behalf of that user. It is ultimately the responsibility of the application to ensure that credentials are accessed in a secure manner.

## Methods for setting tokens in ProfileTokenCredential

The methods for setting tokens in ProfileTokenCredential class require that you distinguish different ways to specify passwords:

- As a special value, such as \*NOPWD or \*NOPWDCHK, by using a defined special value integer
- As the password for the user profile by using a String that represents the password

**Note:** In V5R3, IBM Toolbox for Java deprecates the setToken methods that do not require you to distinguish how to specify the password.

Additionally, the setToken methods allow remote users to specify password special values and allow longer user profile passwords of up to 128 characters.

To specify a password special value integer, such as \*NOPWD or \*NOPWDCHK, use one of the following methods:

- setToken(AS400Principal principal, int passwordSpecialValue)
- setToken(String name, int passwordSpecialValue)

The ProfileTokenCredential class includes the following static constants for password special value integers:

- ProfileTokenCredential.PW\_NOPWD: indicates \*NOPWD
- ProfileTokenCredential.PW\_NOPWDCHK: indicates \*NOPWDCHK

To specify a user profile password as a String, use one of the following methods:

- setTokenExtended(AS400Principal principal, String password)
- setTokenExtended(String name, String password)

The setTokenExtended methods do not allow you to pass password special value strings as the password parameter. For example, these methods do not allow a password string of \*NOPWD.

For more information, see the ProfileTokenCredential Javadoc reference information.

## Example

Refer to this [code](#) for an example of how to use a profile token credential to swap the IBM i thread identity and perform work on behalf of a specific user.

[AS400 Javadoc](#)

[ProfileTokenCredential Javadoc](#)

## Servlet classes

The servlet classes that are provided with IBM Toolbox for Java work with the access classes, which are located on the Webserver, to give you access to information located on the server. You decide how to use the servlet classes to assist you with your own servlet projects.

The following diagram shows how the servlet classes work between the browser, webserver, and IBM i data. A browser connects to the webserver that is running the servlet. `jt400Servlet.jar` and `jt400.jar` files reside on the webserver because the servlet classes use some of the access classes to retrieve the data and the HTML classes to present the data. The webserver is connected to the server where the data is.

**Figure 1: How servlets work**

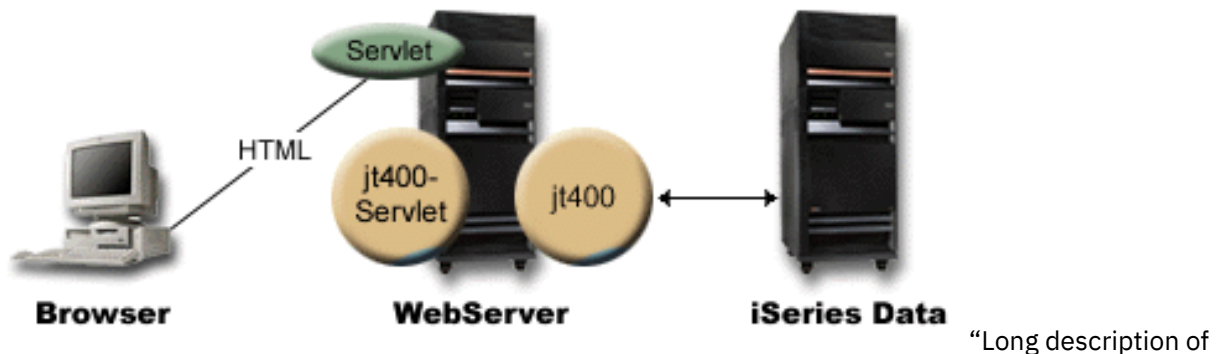


Figure 1: How servlets work (rzahh585.gif)” on page 221

**Note:** The `jt400Servlet.jar` file includes both the `HTML` and `Servlet` classes. You must update your `CLASSPATH` to point to both `jt400Servlet.jar` and `jt400.jar` if you want to use classes in the `com.ibm.as400.util.html` and `com.ibm.as400.util.servlet` packages.

For more information about servlets in general, see the [reference](#) section.

### Long description of Figure 1: How servlets work (rzahh585.gif)

#### found in IBM Toolbox for Java: Servlet classes

This figure illustrates in a general way how servlets work.

#### Description

The figure is composed of the following:

- An image on the left of a personal computer, labeled 'Browser,' that represents an instance of a browser running on a personal computer.
- An image of an IBM i server on the right, labeled 'IBM i Data,' that represents the location of the data that you want the servlet to access.
- An image of an IBM i server in the middle (between the other two images), labeled 'WebServer,' that represents the Web server. Several labeled shapes on the WebServer image indicate files or functions that reside on the Web server:
  - A green oval labeled `Servlet` that represents the location of the servlet code.
  - A tan circle labeled `jt400Servlet` that indicates the location of the `jt400Servlet.jar` file.
  - A tan circle labeled `jt400` that indicates the location of the `jt400.jar` file.

**Note:** The Web server does not have to be on an IBM i server, but it can be, and can even be the same server as that indicated by the IBM i Data image.

- Lines that connect the images together.

A line labeled `HTML` connects the Browser (the left image) to a `Servlet` (the green oval) on the Web server (middle image). The line is labeled `HTML` because servlets most often use `HTML` to 'serve' data to the browser.

The Web server is running two IBM Toolbox for Java JAR files (the tan circles), jt400Servlet.jar and jt400.jar. The classes in jt400Servlet.jar, along with the classes in jt400.jar, enable the Web server to run a servlet that easily connects to servers that contain IBM i data (the right image). The line with arrowheads on both ends that connects the two images indicates this connection.

## Authentication classes

Two classes in the servlet package perform authentication for servlets, AuthenticationServlet and AS400Servlet.

### AuthenticationServlet class

AuthenticationServlet is an HttpServlet implementation that performs basic authentication for servlets. Subclasses of AuthenticationServlet override one or more of the following methods:

- Override the validateAuthority() method to perform the authentication (required)
- Override the bypassAuthentication() method so that the subclass authenticates only certain requests
- Override the postValidation() method to allow additional processing of the request after authentication

The AuthenticationServlet class provides methods that allow you to:

- Initialize the servlet
- Get the authenticated user ID
- Set a user ID after bypassing authentication
- Log exceptions and messages

### AS400Servlet class

The AS400Servlet class is an abstract subclass of AuthenticationServlet that represents an HTML servlet. You can use a [connection pool](#) to share connections and manage the number of connections to the server that a servlet user can have.

The AS400Servlet class provides methods that allow you to:

- Validate user authority (by overriding the validateAuthority() method of the [AuthenticationServlet](#) class)
- Connect to a system
- Get and return connection pool objects to and from the pool
- Close a connection pool
- Get and set the HTML document head tags
- Get and set the HTML document end tags

For more information about servlets in general, see the [reference](#) section.

[AuthenticationServlet Javadoc](#)

[AS400Servlet Javadoc](#)

## RowData class

The RowData class is an abstract class that provides a way to describe and access a list of data.

The RowData classes allow you to:

- Get and set the [current position](#)
- Get the row data at a given column using the getObject() method
- Get the meta data for the row
- Get or set the properties for an object at a given column
- Get the number of rows in the list using the length() method.

### RowData position

There are several methods that allow you to get and set the current position within a list. The following table lists both the set and get methods for the RowData classes.

Set methods		Get methods
absolute()	next()	getCurrentPosition()
afterLast()	previous()	isAfterLast()
beforeFirst()	relative()	isBeforeFirst()
first()		isFirst()
last()		isLast()

### Related information

[RowData Javadoc](#)

### **ListRowData class**

The IBM Toolbox for Java ListRowData class represents a list of data in table form. In the table, each row contains a finite number of columns determined by the ListMetaData object and each column within a row contains an individual data item. The data can be a directory in the integrated file system, a list of jobs, a list of printers, or a variety of other data.

The ListRowData class allows you to do the following:

- Add and remove rows to and from the result list.
- Get and set the row
- Get information about the list's columns with the getMetaData() method
- Set column information with the setMetaData() method

The ListRowData class represents a list of data. ListRowData can represent many types of information, including the following, through IBM Toolbox for Java access classes:

- A directory in the [integrated file system](#)
- A list of [jobs](#)
- A list of messages in a [message queue](#)
- A list of [users](#)
- A list of [printers](#)

### Example

The following example shows how the ListRowData and HTMLTableConverter classes work. The example shows the Java code, HTML code, and HTML look and feel.

[“Example: Using ListRowData” on page 485](#)

[ListRowData Javadoc](#)

### **RecordListRowData class**

The IBM Toolbox for Java RecordListRowData class allows you to do the following:

- Add and remove rows to and from the record list.
- Get and set the row
- Set the record format with the setRecordFormat method
- Get the record format

The RecordListRowData class represents a list of records. A record can be obtained from the server in different formats, including:

- A record to be written to or read from a server file

- An entry in a data queue
- The parameter data from a program call
- Any data returned that needs to be converted between the server format and Java format

This [example](#) shows you how `RecordListRowData` and `HTMLTableConverter` work. It shows the java code, HTML code, and HTML look and feel.

### **Related information**

[RecordListRowData Javadoc](#)

### ***ResourceListRowData class***

The IBM Toolbox for Java `ResourceListRowData` class represents a resource list of data. Use `ResourceListRowData` objects to represent any implementation of the `ResourceList` interface.

Resource lists are formatted into a series of rows, where each row contains a finite number of columns determined by the number of column attribute IDs. Each column within a row contains an individual data item.

The `ResourceListRowData` class offers methods that enable you to perform the following actions:

- Get and set column attribute IDs
- Get and set the resource list
- Retrieve the number of rows in the list
- Get the column data for the current row
- Get the property list of the data object
- Get the metadata for the list

**Example:** [Presenting a resource list in a servlet](#)

### **Code example disclaimer**

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### **Related information**

[ResourceListRowData Javadoc](#)

### ***SQLResultSetRowData class***

The `SQLResultSetRowData` class represents an SQL result set as a list of data. This data is generated by an SQL statement through JDBC. With methods provided, you can get set the result set metadata.

This [example](#) shows you how `ListRowData` and `HTMLTableConverter` work. It shows the Java code, HTML code, and HTML look and feel.

### **Related reference**

[“JDBC classes” on page 54](#)

JDBC is an application programming interface (API) included in the Java platform that enables Java programs to connect to a wide range of databases.

### **Related information**

[SQLResultSetRowData Javadoc](#)



## RowMetaData classes

The RowMetaData class defines an interface that you use to find out information about the columns of a RowData object.

With the RowMetaData classes you can do the following:

- Get the number of columns
- Get the name, type, or size of the column
- Get or set the column label
- Get the precision or scale of the column data
- Determine if the column data is text data

### Related information

[RowMetaData Javadoc](#)

### ListMetaData class

The IBM Toolbox for Java ListMetaData class lets you get information about and change settings for the columns in a ListRowData class. It uses the setColumns() method to set the number of columns, clearing any previous column information. Alternatively, you can also pass the number of columns when you set the constructor's parameters.

### Example

The following example shows how ListMetaData, ListRowData and HTMLTableConverter work. It shows the Java code, HTML code, and HTML look and feel.

[“Example: Using ListRowData” on page 485](#)

[ListMetaData Javadoc](#)

[“ListRowData class” on page 223](#)

The IBM Toolbox for Java ListRowData class represents a list of data in table form. In the table, each row contains a finite number of columns determined by the ListMetaData object and each column within a row contains an individual data item. The data can be a directory in the integrated file system, a list of jobs, a list of printers, or a variety of other data.

### RecordFormatMetaData class

The RecordFormatMetaData makes use of the IBM Toolbox for Java RecordFormat class. It allows you to provide the record format when you set the constructor's parameters or use the get set methods to access the record format.

The following example shows you how to create a RecordFormatMetaData object:

```
// Create a RecordFormatMetaData object from a sequential file's record format.
RecordFormat recordFormat = sequentialFile.getRecordFormat();
RecordFormatMetaData metadata = new RecordFormatMetaData(recordFormat);

// Display the file's column names.
int numberOfColumns = metadata.getColumnCount();
for (int column=0; column < numberOfColumns; column++)
{
    System.out.println(metadata.getColumnName(column));
}
```

### Related information

[RecordFormatMetaData Javadoc](#)

[RecordFormat Javadoc](#)

## ***SQLResultSetMetaData class***

The `SQLResultSetMetaData` class returns information about the columns of an `SQLResultSetRowData` object. You can either provide the result set when you set the constructor's parameters or use the get and set methods to access the result set meta data.

The following example shows you how to create an `SQLResultSetMetaData` object:

```
// Create an SQLResultSetMetaData object from the result set's metadata.
SQLResultSetRowData rowdata = new SQLResultSetRowData(resultSet);
SQLResultSetMetaData sqlMetadata = rowdata.getMetaData();

// Display the column precision for non-text columns.
String name = null;
int numberOfColumns = sqlMetadata.getColumnCount();
for (int column=0; column < numberOfColumns; column++)
{
    name = sqlMetadata.getColumnName(column);
    if (sqlMetadata.isTextData(column))
    {
        System.out.println("Column: " + name + " contains text data.");
    }
    else
    {
        System.out.println("Column: " + name + " has a precision of " +
sqlMetadata.getPrecision(column));
    }
}
}
```

### SQLResultSetMetaData Javadoc

[“SQLResultSetRowData class” on page 224](#)

The `SQLResultSetRowData` class represents an SQL result set as a list of data. This data is generated by an SQL statement through JDBC. With methods provided, you can get set the result set metadata.

## **Converter classes**

You use the IBM Toolbox for Java converter classes to convert row data into formatted string arrays.

The result is in HTML format and ready for presentation on your HTML page. The following classes take care of the conversion for you:

### ***StringConverter class***

The `StringConverter` class is an abstract class that represents a row data string converter. It provides a `convert()` method to convert row data. This returns a string array representation of that row's data.

#### **Related information**

[StringConverter Javadoc](#)

### ***HTMLFormConverter class***

The IBM Toolbox for Java `HTMLFormConverter` classes extend `StringConverter` by providing an additional `convertToForms()` method. This method converts row data into an array of single-row HTML tables. You can use these table tags to display the formatted information on a browser.

You can tailor the appearance of the HTML form by using the various get and set methods to view or change the attributes of the form. For example, some of the attributes that you can set include:

- Alignment
- Cell spacing
- Header hyper links
- Width

#### **Example: Using HTMLFormConverter**

The following example illustrates using `HTMLFormConverter`. (You can compile and run this example with a webserver running.)

[Using HTMLFormConverter](#)

## Related reference

[“StringConverter class” on page 226](#)

The StringConverter class is an abstract class that represents a row data string converter. It provides a convert() method to convert row data. This returns a string array representation of that row's data.

## Related information

[HTMLFormConverter Javadoc](#)

## HTMLTableConverter class

The HTMLTableConverter class extends StringConverter by providing a convertToTables() method. This method converts row data into an array of HTML tables that a servlet can use to display the list on a browser.

You can use the getTable() and setTable() methods to choose a default table that will be used during conversion. You can set table headers within the HTML table object or you can use the meta data for the header information by setting setUseMetaData() to true.

The setMaximumTableSize() method allows you to limit the number of rows in a single table. If the row data does not all fit within the specified size of table, the converter will produce another HTML table object in the output array. This will continue until all row data has been converted.

## Examples

The following examples illustrate how to use the HTMLTableConverter class:

- Example: [Using ListRowData](#)
- Example: [Using RecordListRowData](#)
- Example: [Using SQLResultSetRowData](#)
- Example: [Presenting ResourceList in a servlet](#)

## Code example disclaimer

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[HTMLTableConverter Javadoc](#)

## Utility classes

The utility classes enable you to do administrative tasks, such as using the AS400JarMaker class.

IBM Toolbox for Java offers the following utilities:

## Client installation and update classes

For most installation and update purposes, the IBM Toolbox for Java classes can be referenced at their location in the integrated file system on the server.

Because program temporary fixes (PTFs) are applied to this location, Java programs that access these classes directly on the server automatically receive these updates. But, accessing the classes from the server does not always work, specifically for the following situations:

- If a low-speed communication link connects server and the client, the performance of loading the classes from the server may be unacceptable.
- If Java applications use the CLASSPATH environment variable to access the classes on the client file system, you need IBM i Access for Windows to redirect file system calls to the server. It may not be possible for IBM i Access for Windows to reside on the client.

In these cases, installing the classes on the client is a better solution.

## AS400ToolboxJarMaker

While the JAR file format was designed to speed up the downloading of Java program files, the AS400ToolboxJarMaker generates an even faster loading IBM Toolbox for Java JAR file through its ability to create a smaller JAR file from a larger one.

Also, the AS400ToolboxJarMaker class can unzip a JAR file for you to gain access to the individual content files for basic use.

## Flexibility of AS400ToolboxJarMaker

All of the AS400ToolboxJarMaker functions are performed with the JarMaker class and the AS400ToolboxJarMaker subclass:

- The generic `JarMaker` tool operates on any JAR or Zip file; it splits a JAR file or reduces the size of a JAR file by removing classes that are not used.
- The `AS400ToolboxJarMaker` customizes and extends JarMaker functions for easier use with IBM Toolbox for Java JAR files.

According to your needs, you can invoke the AS400ToolboxJarMaker methods from within your own Java program or from a command line. Call AS400ToolboxJarMaker from the command line by using the following syntax:

```
java utilities.JarMaker [options]
```

where

- options = one or more of the available options

For a complete set of options available to run at a command line prompt, see the following in the Javadoc:

- Options for the JarMaker base class
- Extended options for the AS00ToolboxJarMaker subclass

## Using AS400ToolboxJarMaker

You can use AS400ToolboxJarMaker to work with JAR files in several ways:

- Uncompress one file bundled within a JAR file
- Split a large JAR file into smaller JAR files
- Exclude any IBM Toolbox for Java files that your application does not need to run

### Uncompressing a JAR file

Suppose you wanted to uncompress just one file bundled within a JAR file. AS400ToolboxJarMaker allows you to expand the file into one of the following:

- Current directory (`extract(jarFile)`)
- Another directory (`extract(jarFile, outputDirectory)`)

For example, with the following code, you are extracting AS400.class and all of its dependent classes from jt400.jar:

```
java utilities.AS400ToolboxJarMaker -source jt400.jar
  -extract outputDir
  -requiredFile com/ibm/as400/access/AS400.class
```

### Splitting up a single JAR file into multiple, smaller JAR files

Suppose you wanted to split up a large JAR file into smaller JAR files, according to your preference for maximum JAR file size. AS400ToolboxJarMaker, accordingly, provides you with the split(jarFile, splitSize) function.

In the following code, jt400.jar is split into a set of smaller JAR files, none larger than 300KB:

```
java utilities.AS400ToolboxJarMaker -split 300
```

### Removing unused files from a JAR file

With AS400ToolboxJarMaker, you can exclude any IBM Toolbox for Java files not needed by your application by selecting only the IBM Toolbox for Java [components](#), [languages](#), and [CCSIDs](#) that you need to make your application run. AS400ToolboxJarMaker also provides you with the option of including or excluding the JavaBean files associated with the components you select.

For example, the following command creates a JAR file that contains only those IBM Toolbox for Java classes needed to make the CommandCall and ProgramCall components of the IBM Toolbox for Java work:

```
java utilities.AS400ToolboxJarMaker -component CommandCall,ProgramCall
```

Additionally, if it is unnecessary to convert text strings between Unicode and the double byte character set (DBCS) conversion tables, you can create a 400KB byte smaller JAR file by omitting the unneeded conversion tables with the -ccsid option:

```
java utilities.AS400ToolboxJarMaker -component CommandCall,ProgramCall -ccsid 61952
```

**Note:** Conversion classes are not included with the program call classes. When including program call classes, you must also explicitly include the conversion classes used by your program by using the -ccsid option.

[JarMaker Javadoc](#)

[AS400ToolboxJarMaker Javadoc](#)

### Components supported by IBM Toolbox for Java

Following table lists the component IDs that you can specify when invoking the AS400ToolboxJarMaker tool.

- The Component column lists the common name for the component.
- The Keyword column lists the keyword that you should specify when using the -component option tag.
- The Constant column lists the Integer value that you should specify in setComponents() and getComponents().

Component	Keyword	Constant
Server object	AS400	AS400ToolboxJarMaker.AS400
Command Call	CommandCall	AS400ToolboxJarMaker.COMMAND_CALL
Connection Pool	ConnectionPool	AS400ToolboxJarMaker.CONNECTION_POOL
Data Areas	DataArea	AS400ToolboxJarMaker.DATA_AREA

<b>Component</b>	<b>Keyword</b>	<b>Constant</b>
Data Description and Conversion	DataDescription	AS400ToolboxJarMaker.DATA_DESCRIPTION
Data Queues	DataQueue	AS400ToolboxJarMaker.DATA_QUEUE
Digital Certificates	DigitalCertificate	AS400ToolboxJarMaker.DIGITAL_CERTIFICATE
FTP	FTP	AS400ToolboxJarMaker.FTP
Integrated File System	IntegratedFileSystem	AS400ToolboxJarMaker.INTEGRATED_FILE_SYSTEM
JAAS	JAAS	AS400ToolboxJarMaker.JAAS
Java Application Call	JavaApplicationCall	AS400ToolboxJarMaker.JAVA_APPLICATION_CALL
JDBC	JDBC	AS400ToolboxJarMaker.JDBC
Jobs and Job Queues	Job	AS400ToolboxJarMaker.JOB
Messages and Message Queues	Message	AS400ToolboxJarMaker.MESSAGE
Numeric Data Types	NumericDataTypes	AS400ToolboxJarMaker.NUMERIC_DATA_TYPES
NetServer	NetServer	AS400ToolboxJarMaker.NETSERVER
Network Print	Print	AS400ToolboxJarMaker.PRINT
Program Call	ProgramCall	AS400ToolboxJarMaker.PROGRAM_CALL
Record Level Access	RecordLevelAccess	AS400ToolboxJarMaker.RECORD_LEVEL_ACCESS
Secure server	SecureAS400	AS400ToolboxJarMaker.SECURE_AS400
Service Program Call	ServiceProgramCall	AS400ToolboxJarMaker.SERVICE_PROGRAM_CALL
System Status	SystemStatus	AS400ToolboxJarMaker.SYSTEM_STATUS
System Values	SystemValue	AS400ToolboxJarMaker.SYSTEM_VALUE
Trace and Logging	Trace	AS400ToolboxJarMaker.TRACE
Users and Groups	User	AS400ToolboxJarMaker.USER
User Spaces	UserSpace	AS400ToolboxJarMaker.USER_SPACE
Visual server object	AS400Visual	AS400ToolboxJarMaker.AS400_VISUAL
Visual Command Call	CommandCallVisual	AS400ToolboxJarMaker.COMMAND_CALL_VISUAL
Visual Data Queues	DataQueueVisual	AS400ToolboxJarMaker.DATA_QUEUE_VISUAL

Component	Keyword	Constant
Visual Integrated File System	IntegratedFileSystemVisual	AS400ToolboxJarMaker.INTEGRATED_FILE_SYSTEM_VISUAL
Visual Java Application Call	JavaApplicationCallVisual	AS400ToolboxJarMaker.JAVA_APPLICATION_CALL_VISUAL
Visual JDBC	JDBCVisual	AS400ToolboxJarMaker.JDBC_VISUAL
Visual Jobs and Job Queues	JobVisual	AS400ToolboxJarMaker.JOB_VISUAL
Visual Messages and Message Queues	MessageVisual	AS400ToolboxJarMaker.MESSAGE_VISUAL
Visual Network Print	PrintVisual	AS400ToolboxJarMaker.PRINT_VISUAL
Visual Program Call	ProgramCallVisual	AS400ToolboxJarMaker.PROGRAM_CALL_VISUAL
Visual Record Level Access	RecordLevelAccessVisual	AS400ToolboxJarMaker.RECORD_LEVEL_ACCESS_VISUAL
Visual Users and Groups	UserVisual	AS400ToolboxJarMaker.USER_VISUAL

### ***CCSID and encoding values supported by IBM Toolbox for Java***

IBM Toolbox for Java is shipped with a set of conversion tables, named according to the CCSID.

These tables are used internally by IBM Toolbox for Java classes (such as CharConverter) when converting data that is transferred to or from an IBM i system. For example, the conversion table for CCSID 1027 is in file `com/ibm/as400/access/ConvTable1027.class`. Conversion tables for the following CCSIDs are included in the IBM Toolbox for Java JAR file; other encodings are supported by using the JDK. The central server on the server is no longer used to download tables at runtime. Any specified CCSID for which a conversion table or a JDK encoding cannot be found will cause an exception to be thrown. Some of these tables may be redundant to tables included in your JDK. IBM Toolbox for Java presently supports the following 122 different IBM i CCSIDs.

For additional information about CCSIDs, including a complete list of CCSIDs that are recognized on the IBM i platform, see [Globalization](#).

### **Supported CCSIDs in IBM Toolbox for Java**

CCSID	Format	Description
37	Single-byte EBCDIC	United States and others
273	Single-byte EBCDIC	Austria, Germany
277	Single-byte EBCDIC	Denmark, Norway
278	Single-byte EBCDIC	Finland, Sweden
280	Single-byte EBCDIC	Italy
284	Single-byte EBCDIC	Spain, Latin America
285	Single-byte EBCDIC	United Kingdom

<b>CCSID</b>	<b>Format</b>	<b>Description</b>
290	Single-byte EBCDIC	Japanese Katakana (single-byte only)
297	Single-byte EBCDIC	France
300	Double-byte EBCDIC	Japanese Graphic (subset of 16684)
367	ASCII/ISO/Windows	ASCII (ANSI X3.4 standard)
420	Single-byte EBCDIC (bidirectional)	Arabic EBCDIC ST4
423	Single-byte EBCDIC	Greek (for compatibility; see 875)
424	Single-byte EBCDIC (bidirectional)	Hebrew EBCDIC ST4
437	ASCII/ISO/Windows	ASCII (USA PC Data)
500	Single-byte EBCDIC	Latin-1 (MNCS)
720	ASCII/ISO/Windows	Arabic (MS-DOS)
737	ASCII/ISO/Windows	Greek (MS-DOS)
775	ASCII/ISO/Windows	Baltic (MS-DOS)
813	ASCII/ISO/Windows	ISO 8859-7 (Greek/Latin)
819	ASCII/ISO/Windows	ISO 8859-1 (Latin-1)
833	Single-byte EBCDIC	Korean (single-byte only)
834	Double-byte EBCDIC	Korean Graphic (subset of 4930)
835	Double-byte EBCDIC	Traditional Chinese Graphic
836	Single-byte EBCDIC	Simplified Chinese (single-byte only)
837	Double-byte EBCDIC	Simplified Chinese Graphic
838	Single-byte EBCDIC	Thai
850	ASCII/ISO/Windows	Latin-1
851	ASCII/ISO/Windows	Greek
852	ASCII/ISO/Windows	Latin-2
855	ASCII/ISO/Windows	Cyrillic
857	ASCII/ISO/Windows	Turkish
860	ASCII/ISO/Windows	Portuguese
861	ASCII/ISO/Windows	Iceland
862	ASCII/ISO/Windows (bidirectional)	Hebrew ASCII ST4
863	ASCII/ISO/Windows	Canada
864	ASCII/ISO/Windows (bidirectional)	Arabic ASCII ST5
865	ASCII/ISO/Windows	Denmark/Norway



<b>CCSID</b>	<b>Format</b>	<b>Description</b>
866	ASCII/ISO/Windows	Cyrillic/Russian
869	ASCII/ISO/Windows	Greek
870	Single-byte EBCDIC	Latin-2
871	Single-byte EBCDIC	Iceland
874	ASCII/ISO/Windows	Thai (subset of 9066)
875	Single-byte EBCDIC	Greek
878	ASCII/ISO/Windows	Russian
880	Single-byte EBCDIC	Cyrillic Multilingual (for compatibility; see 1025)
912	ASCII/ISO/Windows	ISO 8859-2 (Latin-2)
914	ASCII/ISO/Windows	ISO 8859-4 (Latin-4)
915	ASCII/ISO/Windows	ISO 8859-5 (Cyrillic 8-bit)
916	ASCII/ISO/Windows (bidirectional)	ISO 8859-8 (Hebrew) ST5
920	ASCII/ISO/Windows	ISO 8859-9 (Latin-5)
921	ASCII/ISO/Windows	ISO 8859-13 (Baltic 8-bit)
922	ASCII/ISO/Windows	Estonia ISO-8
923	ASCII/ISO/Windows	ISO 8859-15 (Latin-9)
930	Mixed-byte EBCDIC	Japanese (subset of 5026)
933	Mixed-byte EBCDIC	Korean (subset of 1364)
935	Mixed-byte EBCDIC	Simplified Chinese (subset of 1388)
937	Mixed-byte EBCDIC	Traditional Chinese
939	Mixed-byte EBCDIC	Japanese (subset of 5035)
1025	Single-byte EBCDIC	Cyrillic
1026	Single-byte EBCDIC	Turkish
1027	Single-byte EBCDIC	Japanese Latin (single-byte only)
1046	ASCII/ISO/Windows (bidirectional)	Windows Arabic ST5
1089	ASCII/ISO/Windows (bidirectional)	ISO 8859-6 (Arabic) ST5
1112	Single-byte EBCDIC	Baltic Multilingual
1122	Single-byte EBCDIC	Estonian
1123	Single-byte EBCDIC	Ukraine
1125	ASCII/ISO/Windows	Ukraine
1129	ASCII/ISO/Windows	Vietnamese
1130	Single-byte EBCDIC	Vietnamese

<b>CCSID</b>	<b>Format</b>	<b>Description</b>
1131	ASCII/ISO/Windows	Belarus
1132	Single-byte EBCDIC	Lao
1140	Single-byte EBCDIC	United States and others (Euro support)
1141	Single-byte EBCDIC	Austria, Germany (Euro support)
1142	Single-byte EBCDIC	Denmark, Norway (Euro support)
1143	Single-byte EBCDIC	Finland, Sweden (Euro support)
1144	Single-byte EBCDIC	Italy (Euro support)
1145	Single-byte EBCDIC	Spain, Latin America (Euro support)
1146	Single-byte EBCDIC	United Kingdom (Euro support)
1147	Single-byte EBCDIC	France (Euro support)
1148	Single-byte EBCDIC	Latin-1 (MNCS) (Euro support)
1149	Single-byte EBCDIC	Iceland (Euro support)
1200	Unicode	Unicode UCS-2 (little-endian)
1250	ASCII/ISO/Windows	Windows Latin-2
1251	ASCII/ISO/Windows	Windows Cyrillic
1252	ASCII/ISO/Windows	Windows Latin-1
1253	ASCII/ISO/Windows	Windows Greek
1254	ASCII/ISO/Windows	Windows Turkey
1255	ASCII/ISO/Windows (bidirectional)	Windows Hebrew ST5
1256	ASCII/ISO/Windows (bidirectional)	Windows Arabic ST5
1257	ASCII/ISO/Windows	Windows Baltic
1258	ASCII/ISO/Windows	Windows Vietnam
1364	Mixed-byte EBCDIC	Japanese
1388	Mixed-byte EBCDIC	Simplified Chinese
1399	Mixed-byte EBCDIC	Japanese (in V4R5 and higher)
4396	Double-byte EBCDIC	Japanese (subset of 300)
4930	Double-byte EBCDIC	Korean
4931	Double-byte EBCDIC	Traditional Chinese (subset of 835)
4933	Double-byte EBCDIC	Simplified Chinese GBK Graphic
4948	ASCII/ISO/Windows	Latin-2 (subset of 852)
4951	ASCII/ISO/Windows	Cyrillic (subset of 855)
5026	Mixed-byte EBCDIC	Japanese

CCSID	Format	Description
5035	Mixed-byte EBCDIC	Japanese
5123	Single-byte EBCDIC	Japanese (single-byte only, Euro support)
5351	ASCII/ISO/Windows (bidirectional)	Windows Hebrew (Euro support) ST5
8492	Double-byte EBCDIC	Japanese (subset of 300)
8612	Single-byte EBCDIC	Arabic EBCDIC ST5
9026	Double-byte EBCDIC	Korean (subset of 834)
9029	Double-byte EBCDIC	Simplified Chinese (subset of 4933)
9066	ASCII/ISO/Windows	Thai (SBCS extended)
12588	Double-byte EBCDIC	Japanese (subset of 300)
13122	Double-byte EBCDIC	Korean (subset of 834)
16684	Double-byte EBCDIC	Japanese (available in V4R5)
17218	Double-byte EBCDIC	Korean (subset of 834)
12708	Single-byte EBCDIC	Arabic EBCDIC ST7
13488	Unicode	Unicode UCS-2 (big-endian)
28709	Single-byte EBCDIC	Traditional Chinese (single-byte only)
61952	Unicode	IBM i Unicode (used primarily in the integrated file system)
62211	Single-byte EBCDIC	Hebrew EBCDIC ST5
62224	Single-byte EBCDIC	Arabic EBCDIC ST6
62235	Single-byte EBCDIC	Hebrew EBCDIC ST6
62245	Single-byte EBCDIC	Hebrew EBCDIC ST10

## CommandHelpRetriever class

The CommandHelpRetriever class retrieves help text for IBM i control language (CL) commands and generates that text either in HTML or User Interface Manager (UIM) format. You can run CommandHelpRetriever from a command line or embed the functionality into your Java program.

To use CommandHelpRetriever, your server must have an XML parser and XSL processor in the CLASSPATH environment variable. For more information, see [“XML parser and XSLT processor”](#) on page 311.

Additionally, the Generate Command Documentation (GENCMDDOC) CL command uses the CommandHelpRetriever class. So you can simply use the GENCMDDOC command to take advantage of the functionality offered by the CommandHelpRetriever class. For more information, see [Generate Command Documentation \(GENCMDDOC\)](#) in the CL reference topic.

## Running CommandHelpRetriever from a command line

You can run the CommandHelpRetriever class as a stand-alone command line program. To run CommandHelpRetriever from a command line, you must pass the following minimum parameters:

- The library on your server that contains the CL command. System commands reside in the QSYS library.
- The CL command.

You can also pass optional parameters to `CommandHelpRetriever` that include the server, the user ID, password, and the location for the generated file.

For more information, see the Javadoc reference documentation for `CommandHelpRetriever`.

Example: Using `CommandHelpRetriever` from a command line

The following example generates an HTML file called `CRTLIB.html` in the current directory.

**Note:** The example command appears on two lines for display purposes only. Type your command on a single line.

```
java com.ibm.as400.util.CommandHelpRetriever -library QSYS -command CRTLIB
  -system MySystem -userid MyUserID -password MyPassword
```

## Embedding the `CommandHelpRetriever` class in your program

You can also use the `CommandHelpRetriever` class in your Java application to display the help documentation for specified CL commands. After you create a `CommandHelpRetriever` object, you can use the `generateHTML` and `generateUIM` methods to generate help documentation in either format.

When you use `generateHTML()`, you can display the generated HTML in the panel group for the command or you can specify a different panel group.

The following example creates a `CommandHelpRetriever` object and generates String objects that represent the HTML and UIM help documentation for the `CRTLIB` command.

```
CommandHelpRetriever helpGenerator = new CommandHelpRetriever();
AS400 system = new AS400("MySystem", "MyUserID", "MyPassword");
Command crtlibCommand = new Command(system, "/QSYS.LIB/CRTLIB.CMD");
String html = helpGenerator.generateHTML(crtlibCommand);
String uim = helpGenerator.generateUIM(crtlibCommand);
```

### Related information

[CommandHelpRetriever Javadoc](#)

## CommandPrompter class

The IBM Toolbox for Java `CommandPrompter` class prompts for the parameter on a given command.


The `CommandPrompter` class offers functionality that is similar to the CL command prompt (pressing F4).

Using `CommandPrompter` requires that you have the following JAR files in your CLASSPATH:

- `jt400.jar`
- `jui400.jar`
- `util400.jar`
- `jhall.jar`

You must also have an XML parser in your CLASSPATH. For more information about using a suitable XML parser, see the following page:

[“XML parser and XSLT processor” on page 311](#)

All of the JAR files, except for `jhall.jar`, are included in IBM Toolbox for Java. For more information about IBM Toolbox for Java JAR files, see [Jar files](#). For more information about downloading `jhall.jar`, see the [Sun JavaHelp Web site](#) .

To construct a `CommandPrompter` object, you pass it parameters for the parent frame that launches the prompter, the AS400 object on which the command will be prompted, and the command string. The command string can be a command name, a full command string, or a partial command name, such as `crt*`.

The CommandPrompter display is a modal dialog that the user must close before returning to the parent frame. The CommandPrompter handles any errors encountered during prompting. For a programming example that shows one way to use the CommandPrompter, see the following page:

[“Example: Using CommandPrompter” on page 522](#)

## RunJavaApplication

The RunJavaApplication and VRunJavaApplication classes are utilities to run Java programs on the IBM i JVM.

Unlike JavaApplicationCall and VJavaApplicationCall classes that you call from your Java program, RunJavaApplication and VRunJavaApplication are complete programs.

The RunJavaApplication class is a command line utility. It lets you set the environment (CLASSPATH and properties, for example) for the Java program. You specify the name of the Java program and its parameters, then you start the program. Once started, you can send input to the Java program which it receives via standard input. The Java program writes output to standard output and standard error.

The VRunJavaApplication utility has the same capabilities. The difference is VJavaApplicationCall uses a graphical user interface while JavaApplicationCall is a command line interface.

[RunJavaApplication Javadoc](#)

[VRunJavaApplication Javadoc](#)

[“JavaApplicationCall class” on page 54](#)

The JavaApplicationCall class provides you with the ability to have your client use the server JVM to run a Java program that resides on the server.

## JPing

The JPing class is a command line utility that allows you to query your servers to see which services are running and which ports are in service. To query your servers from within a Java application, use the AS400JPing class.

See the JPing Javadoc for more information about using JPing from within your Java application.

Call JPing from the command line by using the following syntax:

```
java utilities.JPing System [options]
```

where:

- System = the system that you want to query
- [options] = one or more of the available options

## Options

You can use one or more of the following options. For options that have abbreviations, the abbreviation is listed in parenthesis.

### **-help (-h or -?)**

Displays the help text.

### **-service *i\_Service* (-s *i\_Service*)**

Specifies one specific service to ping. The default action is to ping all services. You can use this option to specify one of the following services: as-file, as-netprt, as-rmtcmd, as-dtaq, as-database, as-ddm, as-central, and as-signon.

### **-ssl**

Specifies whether or not to ping the ssl ports. The default action is not to ping the ssl ports.

### **-timeout (-t)**

Specifies the timeout period in milliseconds. The default setting is 20000, or 20 seconds.

## Example: Using JPing from the command line

For example, use the following command to ping the as-dtaq service, including ssl ports, with a timeout of 5 seconds:

```
java utilities.JPing myServer -s as-dtaq -ssl -t 5000
```

### Related information

[JPing Javadoc](#)

[AS400JPing Javadoc](#)

## IBM Toolbox for Java beans

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JavaBeans are reusable software components that are written in Java. The component is a piece of program code that provides a well-defined, functional unit, which can be as small as a label for a button on a window or as large as an entire application.

JavaBeans can be either visual or nonvisual components. Non-visual JavaBeans still have a visual representation, such as an icon or a name, to allow visual manipulation.

Many IBM Toolbox for Java public classes are also JavaBeans. These classes were built to JavaSoft JavaBean standards; they function as reusable components. The properties and methods for an IBM Toolbox for Java bean are the same as the properties and methods of the class.

JavaBeans can be used within an application program or they can be visually manipulated in builder tools, such as the IBM VisualAge® for Java product.

### Examples

The following examples show how to use JavaBeans in your program and how to create a program from JavaBeans by using a visual bean builder:

[“Example: IBM Toolbox for Java bean code” on page 434](#)

[“Example: Creating beans with a visual bean builder” on page 436](#)

## JDBC

---

JDBC is an application programming interface (API) included in the Java platform that enables Java programs to connect to a wide range of databases.

The IBM Toolbox for Java JDBC driver allows you to use JDBC API interfaces to issue structured query language (SQL) statements to and process results from databases on the server. You can also use [IBM Developer Kit for Java JDBC driver](#), called the 'native' JDBC driver:

- Use the IBM Toolbox JDBC driver when the Java program is on one system and the database files are on another system, as in a client/server environment
- Use the native JDBC driver when both the Java program and database files are on the same server

### Different versions of JDBC

Different versions of the JDBC API exist, and the IBM Toolbox for Java JDBC driver supports the following versions:

- JDBC 3.0 API (the java.sql and javax.sql packages) is included in J2SE, Version 1.4 and 5.0.
- JDBC 4.0 API is included in Java SE Version 6.
- JDBC 4.1 API is included in Java SE Version 7.

## Enhancements to IBM Toolbox for Java JDBC support for IBM i 7.2

Many additions were made to JDBC support in IBM i 7.2.

The enhancements to IBM Toolbox for Java JDBC support are detailed in the following sections:

- [“Increase precision timestamp support” on page 239](#)
- [“New QueryTimeoutMechanism JDBC connection property” on page 239](#)

### Increase precision timestamp support

In IBM i 7.2, the maximum precision of a timestamp increases from 6 to 12. The toolbox JDBC driver has been enhanced to retrieve these larger timestamp values. Since the Java class `java.sql.Timestamp` only supports 9 digits of precision, a new class, `AS400JDBCTimestamp`, has been created to handle those cases where the data from the server includes more than 9 digits of precision.

### New QueryTimeoutMechanism JDBC connection property

The toolbox JDBC driver originally implemented the `queryTimeout` feature using the `QQRYTIMLMT` feature of the database engine. However, this mechanism does not correctly allow for the ending of long running operations.

The `QueryTimeoutMechanism` connection property allows the `queryTimeout` to be implemented using a database `CANCEL`. The possible values are `qqrytimlmt` and `cancel`. If `qqrytimlmt` is specified, the `QQRYTIMLMT` feature of the database engine will be used to limit how long queries can run. If `cancel` is specified, the running SQL statement will be cancelled after the specified timeout expires.

## Enhancements to IBM Toolbox for Java JDBC support for IBM i 7.1

Many additions were made to JDBC support in IBM i 7.1.

The enhancements to IBM Toolbox for Java JDBC support are detailed in the following sections:

- [“XML data type support” on page 239](#)
- [“Database metadata updates” on page 240](#)
- [“Currently committed support” on page 240](#)
- [“Array type support” on page 241](#)
- [“Long schema name support” on page 241](#)

### XML data type support

The JDBC 4.0 interface specification adds new methods and classes for XML data type support. IBM Toolbox for Java implements XML support in its JDBC 4.0 driver. This allows JDBC clients easy access to IBM i 7.1 XML support.

You can set the data in the JDBC `SQLXML` object by passing in various data types such as Java String. As is done for all other text column data types, IBM Toolbox for Java or the Database Management System (DBMS) does the necessary conversions of XML data to match column CCSID for the XML column.

The DBMS reads and writes XML data using SQL locators.

XML being sent as input to the DBMS has to be handled with a few special rules in order for correct CCSID conversion. Input XML data which has an XML declaration with encoding specified must correctly encode the XML data with that specified encoding. For example XML encoded in UTF-16 (Java String), but having a UTF-8 specified in its encoding in the XML declaration is incorrect. If the XML input data has no declaration, then the DBMS expects the data stream to be sent in UTF-8. In this case IBM Toolbox for Java first converts the XML data to UTF-8 before sending the data to the DBMS for processing.

**Note:** XML columns in the database are stored without the XML declaration. When the XML data is retrieved, the XML declaration is dynamically generated, which can lead to the XML data not being identical to the XML data that was sent as input.

The DBMS may optimize XML data when appropriate. For example an empty tag, "<tag><tag/>", becomes "</tag>". Generally if input XML data that is not in UTF-16 and has an XML declaration along with an encoding specified, it should not be passed into JDBC through `PreparedStatement.setString`. This is because the data in Strings is UTF-16 and it does not match the specified encoding.

There are some rules that govern how XML declarations are returned from a query. JDBC handles the declaration visibility depending on which type `ResultSet` getter method called. Methods that return characters, such as `getString()` and `getClob()`, do not return the XML declaration with the data. Methods that return binary data, such as `getBytes()` and `getBlob()`, will return the XML declaration. This is due to the difference in XML declaration encoding and the CCSID of the actual XML column on the table. Note that calling `getString()` will return a Unicode String, which could be different from the CCSID specified in the XML declaration encoding. Because of this anomaly, the declaration is simply discarded unless accessed with binary getter methods. The retrieval of XML tags with methods such as `getString` will allow XML data to be easily concatenated with other XML data since it will have its declaration removed already.

XML JDBC support is implemented in the following IBM Toolbox for Java JDBC methods:

- `AS400JDBCConnection.createSQLXML()`
- `AS400JDBCSQLXML` - all methods in this new class
- `AS400JDBCPreparedStatement.setSQLXML(int parameterIndex, SQLXML xmlObject)`
- `AS400JDBCCallableStatement.setSQLXML(String parameterName, SQLXML xmlObject)`
- `AS400JDBCCallableStatement.getSQLXML(int parameterIndex)`
- `AS400JDBCCallableStatement.getSQLXML(String parameterName)`
- `AS400JDBCResultSet.getSQLXML(int columnIndex)`
- `AS400JDBCResultSet.getSQLXML(String columnLabel)`
- `AS400JDBCResultSet.updateSQLXML(int columnIndex, SQLXML xmlObject)`
- `AS400JDBCResultSet.updateSQLXML(String columnLabel, SQLXML xmlObject)`
- `AS400JDBCRowSet.setSQLXML(int parameterIndex, SQLXML xmlObject)`
- `AS400JDBCRowSet.setSQLXML(String parameterName, SQLXML xmlObject)`

## Database metadata updates

Database metadata is obtained by calling the various methods of the `AS400JDBCDatabaseMetaData` class. Starting with IBM i 7.1, the default behavior of IBM Toolbox for Java JDBC is to obtain this metadata from a set of standard system stored procedures. This brings IBM Toolbox for Java into alignment with IBM i native JDBC support in addition to JDBC drivers on other platforms. Prior to IBM i 7.1, IBM Toolbox for Java obtained the metadata from the host servers ROI data server. This approach has worked well, and has also kept IBM Toolbox for Java in alignment with ODBC, .net, and other IBM i clients. The problem with this approach though, is that across IBM, all JDBC DB2 drivers should function the same way. This can be achieved by using a set of system stored procedures that are common across all of the DB2 platforms. These system stored procedures are called to obtain system database metadata.

In order to provide backwards compatibility of the metadata functionality, a new connection property, "metadata source", can be used to force IBM Toolbox for Java JDBC to use the old method of retrieval of database metadata.

## Currently committed support

Lock timeouts and deadlocks can occur under the isolation levels that perform row-level locking, especially with applications that are not designed to prevent such problems. Some high throughput database applications cannot tolerate waiting on locks that are issued during transaction processing, and some applications cannot tolerate processing uncommitted data, but still require non-blocking behavior for read transactions.

Under the new *currently committed* semantics, if *currently committed* is enabled then only committed data is returned, as was the case previously, but now readers do not wait for writers to release row locks.



Instead, the data returned to readers is based on the currently committed version; that is, data prior to the start of the write operation.

This feature also implements a way to direct the database manager to wait for the outcome when encountering data in the process of being updated.

IBM Toolbox for Java JDBC has added support for currently committed semantics on data sources and connections. This support is added with the following class updates:

- AS400JDBCDataSource.CONCURRENTACCESS\_NOT\_SET
- AS400JDBCDataSource.CONCURRENTACCESS\_USE\_CURRENTLY\_COMMITTED
- AS400JDBCDataSource.CONCURRENTACCESS\_WAIT\_FOR\_OUTCOME
- AS400JDBCDataSource.CONCURRENTACCESS\_SKIP\_LOCKS
- AS400JDBCDataSource.setConcurrentAccessResolution (int)
- AS400JDBCDataSource.getConcurrentAccessResolution ()
- AS400JDBCConnection.setConcurrentAccessResolution (int)
- AS400JDBCConnection.getConcurrentAccessResolution ()

**Note:** Setting concurrent access resolution on the connection only affects new statements created on the connections following the change. Existing statements continue to use the value that was in effect when the statement was created. A corresponding connection property "concurrent access resolution" is also available for setting this information.

## Array type support

IBM Toolbox for Java supports the IBM i 7.1 SQL array data type in stored procedure parameters. Arrays of all of the various DB2 types are supported except data that is returned in a locator.

IBM Toolbox for Java JDBC adds support for arrays as IN, OUT, and INOUT parameters to stored procedures. However, ResultSets returned from stored procedures or other queries containing arrays is not supported.

JDBC supports the calling of stored procedures in the `java.sql.CallableStatement` class, which IBM Toolbox for Java implements in `AS400JDBCCallableStatement`.

The JDBC specification from Sun says that JDBC drivers support arrays by implementing `java.sql.Array` interface. The IBM Toolbox for Java implementation exists in the class `com.ibm.as400.access.AS400JDBCArray`. Below are new interfaces and methods which IBM Toolbox for Java has implemented to support arrays:

- `AS400JDBC.PreparedStatement.setArray (int parameterIndex, Array x)`
- `AS400JDBCCallableStatement.getArray()`
- `AS400JDBCArray.getResultSet()`
- `AS400JDBCArray.getBaseType()`
- `AS400JDBCArray.getBaseTypeName()`
- `AS400JDBCArrayResultSet` - all methods in this new class
- `AS400JDBCConnection.createArrayOf(String typeName, Object[] elements)`

**Note:** An `AS400JDBCArrayResultSet` is a local copy of the array data in a `ResultSet` interface object.

## Long schema name support

IBM i 7.1 DBMS has added support for 128 byte schema names. IBM Toolbox for Java JDBC is also adding support for long schema names.

IBM Toolbox for Java converts schemas from Java Strings to the system CCSID prior to sending the data to the host DBMS. IBM Toolbox for Java does allow a long schema name as the default-schema. However, long schema names in the library list is not supported. If a long schema name is specified in the "libraries"

property, a warning back from host and trace that the library was not added will be issued. If a long schema name is specified as the first name in the "libraries" property, then IBM Toolbox for Java still sets the name as the default schema, but does not add it to the library list. Clients which need to use long schema names in the library list have to make use of the DB2 SET PATH command.

Database metadata also supports long schema names for parameters and ResultSets returned.

The following metadata methods provide support for long schema names:

- AS400JDBCDatabaseMetadata.getMaxSchemaNameLength()
- AS400JDBCDatabaseMetadata.getProcedures(String catalog, String schemaPattern, String procedureNamePattern)
- AS400JDBCDatabaseMetadata.getProcedureColumns(String catalog, String schemaPattern, String procedureNamePattern, String columnNamePattern)
- AS400JDBCDatabaseMetadata.getTables(String catalog, String schemaPattern, String tableNamePattern, String types[])
- AS400JDBCDatabaseMetadata.getSchemas()
- AS400JDBCDatabaseMetadata.getColumns(String catalog, String schemaPattern, String tableNamePattern, String columnNamePattern)
- AS400JDBCDatabaseMetadata.getColumnPrivileges(String catalog, String schema, String table, String columnNamePattern)
- AS400JDBCDatabaseMetadata.getTablePrivileges(String catalog, String schemaPattern, String tableNamePattern)
- AS400JDBCDatabaseMetadata.getBestRowIdentifier(String catalog, String schema, String table, int scope, boolean nullable)
- AS400JDBCDatabaseMetadata.getVersionColumns(String catalog, String schema, String table)
- AS400JDBCDatabaseMetadata.getPrimaryKeys(String catalog, String schema, String table)
- AS400JDBCDatabaseMetadata.getImportedKeys(String catalog, String schema, String table)
- AS400JDBCDatabaseMetadata.getCrossReference( String parentCatalog, String parentSchema, String parentTable, String foreignCatalog, String foreignSchema, String foreignTable)
- AS400JDBCDatabaseMetadata.getIndexInfo(String catalog, String schema, String table, boolean unique, boolean approximate)
- AS400JDBCDatabaseMetadata.getUDTs(String catalog, String schemaPattern, String typeNamePattern, int[] types)
- AS400JDBCDatabaseMetadata.getSuperTypes(String catalog, String schemaPattern, String typeNamePattern)
- AS400JDBCDatabaseMetadata.getSuperTables(String catalog, String schemaPattern, String tableNamePattern)
- AS400JDBCDatabaseMetadata.getAttributes(String catalog, String schemaPattern, String typeNamePattern, String attributeNamePattern)
- AS400JDBCDatabaseMetadata.getSchemas(String catalog, String schemaPattern)
- AS400JDBCDatabaseMetadata.getFunctions(String catalog, String schemaPattern, String functionNamePattern)
- AS400JDBCDatabaseMetadata.getFunctionColumns(String catalog, String schemaPattern, String functionNamePattern, String columnNamePattern)

## Enhancements to IBM Toolbox for Java JDBC support for IBM i 6.1

Many additions were made to JDBC support in IBM i 6.1.

The enhancements to IBM Toolbox for Java JDBC support are detailed in the following sections:

- [“Support for JDBC 4.0” on page 243](#)

- [“Query storage limit” on page 243](#)
- [“Decimal float \(DECFLOAT\) data type” on page 243](#)
- [“Passing the client type and application name to the server” on page 244](#)
- [“Maximum length of cursor names extended” on page 245](#)
- [“Generated key support” on page 245](#)
- [“Improved default value support” on page 246](#)
- [“Increased maximum in GROUP BY clause” on page 246](#)
- [“Batch update support” on page 246](#)

## Support for JDBC 4.0

Support for the JDBC 4.0 API with Java SE Version 6 is available using one of the following JAR files:

- /QIBM/ProdData/HTTP/Public/jt400/lib/java6/jt400.jar
- /QIBM/ProdData/OS400/jt400/lib/java6/jt400Native.jar

## Query storage limit

You can use the query storage limit property to limit the storage used by a query. This property compares the storage limit you specify to the estimated storage usage of the query. If the estimated storage usage exceeds the specified storage limit, the query is not allowed to run.

Beginning in V6R1, the IBM Toolbox for Java JDBC driver will add the following methods to the AS400JDBCDataSource class:

```
setQueryStorageLimit()
    public void setQueryStorageLimit(int limit);
```

Specifies the query storage limit value to be used when statements in a connection are executed. Valid values are -1 to 2 147 352 578. The default is value -1, indicating a special value of \*NOMAX.

```
getQueryStorageLimit()
    public int getQueryStorageLimit()
```

Returns the query storage limit value used when statements in a connection are executed. The default value is -1, indicating a special value of \*NOMAX.

Systems that run a release of IBM i prior to V6R1 will ignore the getQueryStorageLimit property.

## Decimal float (DECFLOAT) data type

The decimal float (DECFLOAT) inherits favorable properties from both float and decimal data types. Data values of DECFLOAT are stored such that trailing zeros are significant: for example, 2.0 and 2.00 are different binary representations. In SQL comparisons, however, the values are treated as equal.

The IBM Toolbox for Java JDBC driver has added the following methods to the AS400JDBCDataSource class:

```
setDecfloatRoundingMode()
    public void setDecfloatRoundingMode(int String mode)
```

Specifies the rounding mode to be used for DECFLOAT numbers.

```
getDecfloatRoundingMode()
    public intString getDecfloatRoundingMode()
```

Returns the rounding mode to be used for DECFLOAT numbers.

Valid values for these methods include:

**half even (default value)**

Round to nearest digit. If equidistant between two digits, round to the nearest even digit. The numeric value of this constant is 0.

**half up**

Round to nearest digit. If equidistant between two digits, round up. The numeric value of this constant is 1.

**down**

Round to nearest lower digit. The numeric value of this constant is 2.

**ceiling**

Round towards positive infinity. The numeric value of this constant is 3.

**floor**

Round towards negative infinity. The numeric value of this constant is 4.

**half down**

Round to the nearest digit. If equidistant between two digits, round down. The numeric value of this constant is 5.

**up**

Round to nearest higher digit. The numeric value of this constant is 6.

**Passing the client type and application name to the server**

Web applications need a way to pass end-user-client information to the database server so that more detailed information may be logged. The IBM Toolbox for Java JDBC driver allows an application to override this information by calling the following `java.sql.Connection.setClientInfo()` methods:

```
void AS400JDBCConnection.setClientInfo(java.lang.String name, java.lang.String value)
```

This method sets the value of the client info property specified by name to the value specified by value. See the `DatabaseMetadata.getClientInfoProperties` method description for the client info properties supported by the IBM Toolbox for Java JDBC driver.

```
void AS400JDBCConnection.setClientInfo(java.util.Properties properties)
```

This method sets the value of the connection's client info properties. The `Properties` object contains the names and values of the client info properties to be set. The set of client info properties contained in the properties list replaces the current set of client info properties on the connection. If a property that is currently set on the connection is not present in the properties list, that property is cleared. Specifying an empty properties list will clear all of the properties on the connection.

```
String AS400JDBCConnection.getClientInfo(java.lang.String name)
```

This method returns the value of the client info property specified by name. This method may return `null` if the specified client info property has not been set and does not have a default value.

```
Properties AS400JDBCConnection.getClientInfo()
```

This method returns a list containing the name and current value of each client info property supported by the driver. The value of a client info property may be `null` if the property has not been set and does not have a default value.

```
ResultSet AS400JDBCDatabaseMetaData.getClientInfoProperties()
```

This method retrieves a list of the client info properties that the driver supports. The IBM Toolbox for Java JDBC driver returns a result set with the following information:

Table 2. Result set for `getClientInfoProperties`

Name	Maximum length	Default value	Description
ApplicationName	255	""	The name of the application currently utilizing the connection.
ClientAccounting	255	""	Accounting information.
ClientHostname	255	""	The hostname of the computer the application using the connection is running on.
ClientProgramID	255	""	The client program identification.
ClientUser	255	""	The name of the user that the application using the connection is performing work for. This may not be the same as the user name that was used in establishing the connection.

### Maximum length of cursor names extended

Beginning in V6R1, the maximum length of cursors will be 128 characters. The previous maximum length was 8 characters. An application can set the name of a cursor by calling the `java.sql.Statement.setCursorName()` method.

### Generated key support

In past releases, only one row of information could be returned from a multiple row insert operation. Beginning in V6R1, you will be able to access more information about a multiple row insert operation. This will allow you to retrieve generated column information such as ROWID, identity column, sequence, or generated expressions. Generated key support will be implemented in the following IBM Toolbox for Java JDBC methods:

- `AS400JDBCStatement.getGeneratedKeys()`
- `AS400JDBCStatement.execute(String sql, int autoGeneratedKeys)`
- `AS400JDBCStatement.execute (String sql, int[] columnIndexes)`
- `AS400JDBCStatement.execute (String sql, String[] columnNames)`
- `AS400JDBCStatement.executeUpdate(String sql, int[] autoGeneratedKeys)`
- `AS400JDBCStatement.executeUpdate (String sql, int[] columnIndexes)`
- `AS400JDBCStatement.executeUpdate (String sql, String[] columnNames)`
- `AS400JDBCConnection.prepareStatement(String sql, int autoGeneratedKeys)`
- `AS400JDBCConnection.prepareStatement(String sql, int[] columnIndexes)`
- `AS400JDBCConnection.prepareStatement(String sql, String[] columnNames)`

## Improved default value support

Beginning in V6R1, The IBM Toolbox for Java JDBC driver will return a column's default value as a string through the `DatabaseMetaData.getColumns()` method. If the default value is null, a string with the value 'NULL' will be returned.

## Increased maximum in GROUP BY clause

The new value for `DatabaseMetaData.getMaxColumnsInGroupBy()` is 8000.

## Batch update support

The improved batch update support in V6R1 will provide better information to you when you are running a multiple-row batched insert statement. There will be a field in the diagnostics area and SQLCA that will contain the count of successful statements so that you can better determine the location of any errors.

The IBM Toolbox for Java JDBC driver will use this information when creating a `java.sql.BatchUpdateException`. `AS400JDBCStatement` and `AS400JDBCPreparedStatement` will also use this information to return the correct information back from the `executeBatch()` method.

## Enhancements to IBM Toolbox for Java JDBC support for IBM i 5.4

Several JDBC functions were enhanced for IBM i 5.4.

The enhancements to IBM Toolbox for Java JDBC support are detailed in the following sections:

- [“2 MB statement size” on page 246](#)
- [“128 byte column name support” on page 246](#)
- [“Database host server trace support” on page 246](#)
- [“eWLM Correlator support” on page 247](#)

### 2 MB statement size

Prior to V5R4, the limit on SQL statement size was 65 535 bytes. This corresponds to 65 535 characters when the statement text is represented using a single-byte CCSID, and 32 767 characters when the statement text is represented using a double-byte CCSID. Some customers, particularly those using applications that automatically generate SQL statements, were affected by this limit.

In V5R4, the IBM i statement size limit has been increased to two megabytes, or 2 097 152 bytes. The IBM Toolbox for Java JDBC driver always sends statement text in two byte Unicode. Therefore, the maximum statement length in characters will be one megabyte or 1 048 576 characters.

### 128 byte column name support

Starting with V5R4, the database will support column names up to 128 bytes for SQL tables. Prior to V5R4, column names up to 30 bytes were supported. The IBM Toolbox for Java JDBC driver will provide these possibly longer names to its users.

There is one exception where 128 byte column names will not be returned. When local package caching is used and column names exceed 30 characters, the server will return the column names as the system column name.

### Database host server trace support

A new option was added to the Toolbox for Java JDBC driver to turn on database host server tracing. To support this feature, option "64" was added to the "server trace" connection property. For more details, see [“IBM Toolbox for Java JDBC properties” on page 247](#).

## eWLM Correlator support


The IBM Toolbox for Java will accept an IBM Enterprise Workload Manager (eWLM) correlator and pass it on to the host as a connection attribute correlator for use with the Application Response Measurement (ARM) APIs. This correlator can be sent to the host at any time after a connection is made using the following method in the AS400JDBCConnection class:

### setDB2eWLMCorrelator

```
public void setDB2eWLMCorrelator(byte[] bytes)
    throws SQLException
```

Sets the eWLM Correlator. It is assumed a valid correlator value is used. If the value is null, all ARM/eWLM implementation will be turned off. eWLM correlators require i5/OS V5R3 or later servers. This request is ignored when running to V5R2 or earlier servers.

#### Parameters:

- bytes: The eWLM correlator value
- SQLException: See the [Class SQLException](#)  Javadoc.

## IBM Toolbox for Java JDBC properties

Many properties can be specified when connecting to a server database using JDBC. All properties are optional and can be specified either as part of the URL or in a java.util.Properties object. If a property is set in both the URL and a Properties object, the value in the URL will be used.

**Note:** The following list does not include DataSource properties.

The following tables list the different connection properties that are recognized by this driver. Some of these properties affect performance and others are server job attributes. The tables organize the properties into the following categories:

- [“General properties” on page 247](#)
- [“Server properties” on page 248](#)
- [“Format properties” on page 252](#)
- [“Performance properties” on page 252](#)
- [“Sort properties” on page 257](#)
- [“Other properties” on page 258](#)

### General properties

General properties are system attributes that specify the user, password, and whether a prompt is necessary to connect to the server.

Property	Description	Required	Choices	Default
"password"	Specifies the password for connecting to the server. If none is specified, then the user will be prompted, unless the "prompt" property is set to "false", in which case an attempt to connect will fail.	no	system password	(user will be prompted)
"prompt"	Specifies whether the user is prompted if a user name or password is needed to connect to the server. If a connection cannot be made without prompting the user, and this property is set to "false", then an attempt to connect will fail.	no	"true" "false"	"true"

Property	Description	Required	Choices	Default
"user"	Specifies the user name for connecting to the server. If none is specified, then the user will be prompted, unless the "prompt" property is set to "false", in which case an attempt to connect will fail.	no	server user	(user will be prompted)

## Server properties

Server properties specify attributes that govern transactions, libraries, and databases.

Property	Description	Required	Choices	Default
"auto commit"	Specifies whether auto-commit mode is the default connection mode for new connections. Calling <code>AS400JDBCConnection.setAutoCommit()</code> will override this property on a per-connection basis.  <b>Note:</b> In order to use transaction isolation levels other than *NONE when using auto-commit mode, the property "true autocommit" needs to be set to true.	no	"true" "false"	"true"
"concurrent access resolution"	Specifies whether "currently committed" access is used on the connection. A value of 1 indicates that "currently committed" will be used. A value of 2 indicates that "wait for outcome" will be used. A value of 3 indicates that "skip locks" will be used.	no	"1" "2" "3"	(system default)
"cursor hold"	Specifies whether to hold the cursor across transactions. If this property is set to "true", cursors are not closed when a transaction is committed or rolled back. All resources acquired during the unit of work are held, but locks on specific rows and objects implicitly acquired during the unit of work are released.	no	"true" "false"	"true"
"cursor sensitivity"	Specifies the cursor sensitivity to request from the database. The behavior depends on the <code>resultSetType</code> :  <ul style="list-style-type: none"> <li>• <code>ResultSet.TYPE_FORWARD_ONLY</code> or <code>ResultSet.TYPE_SCROLL_SENSITIVE</code> means that the value of this property controls what cursor sensitivity the Java program requests from the database.</li> <li>• <code>ResultSet.TYPE_SCROLL_INSENSITIVE</code> causes this property to be ignored.</li> </ul>	no	"asensitive" "sensitive" "insensitive"	"asensitive"



Property	Description	Required	Choices	Default
"database name"	<p>Specifies the database to use for the connection to an <u>independent auxiliary storage pool (ASP)</u>. This property applies only when connecting to an IBM i server. When you specify a database name, the name must exist in the relational database directory on the server and correspond to either an independent ASP or the system default database. The following criteria determine which database is accessed:</p> <ul style="list-style-type: none"> <li>• When this property is used to specify a database which corresponds to an independent ASP, the connection is made to the independent ASP. When the specified database does not exist, the connection fails.</li> <li>• When this property is used to specify *SYSBAS as the database name, the system default database is used.</li> <li>• When this property is omitted, the initial ASP group specified in the job description for the user profile is used. When the job description does not specify an initial ASP group, the system default database is used.</li> </ul>	no	Database name "*SYSBAS"	The database name specified in the job description for the user profile is used. When the job description does not specify a database name, the system default database is used.
"decfloat rounding mode"	Specifies the rounding mode to use when working with the decfloat data type. This property is ignored when connecting to systems running IBM i 5.4 and earlier.	no	"half even" "half up" "down" "ceiling" "floor" "half down" "up"	"half even"

Property	Description	Required	Choices	Default
"libraries"	<p>Specifies one or more libraries that you want to add to or replace the library list of the server job, and optionally sets the default SQL schema (default library). Note that libraries cannot be longer than 10 characters in length. You must use the SET PATH SQL statement if you have libraries longer than 10 characters.</p> <p><b>Library list</b> The server uses specified libraries to resolve unqualified stored procedure names, and stored procedures use them to resolve unqualified names. To specify multiple libraries, use commas or spaces to separate individual entries. You can use *LIBL as a placeholder for the current library list of the server job</p> <ul style="list-style-type: none"> <li>• When the first entry is *LIBL, the specified libraries are added to the current library list of the server job</li> <li>• When you do not use *LIBL, the specified libraries replace the current library list of the server job</li> </ul> <p>For more information about library list properties, see <a href="#">JDBC LibraryList</a> property.</p> <p><b>Default SQL schema</b> The server uses the default SQL schema to resolve unqualified names in SQL statements. For example, in the statement "SELECT * FROM MYTABLE", the server looks only in the default SQL schema for MYTABLE. You can specify the default SQL schema on the connection URL. When you do not specify the default SQL schema on the connection URL, the following conditions apply, depending on the SQL naming convention that is used:</p> <ul style="list-style-type: none"> <li>• If <b>SQL Naming</b> is being used: <ul style="list-style-type: none"> <li>– The first entry (unless it is *LIBL) becomes the default SQL schema</li> <li>– When the first entry is *LIBL, the second entry becomes the default SQL schema</li> <li>– When you do not set this property or when it contains only *LIBL, the user profile becomes the default SQL schema</li> </ul> </li> <li>• If <b>System Naming</b> is being used: <ul style="list-style-type: none"> <li>– No default SQL schema is set, and the server uses the specified libraries to search for unqualified names</li> <li>– When you do not set this property or when it contains only *LIBL, the server uses the current library list of the server job to search for unqualified names</li> </ul> </li> </ul>	no	List of server libraries, separated by commas or spaces	"*LIBL"

Property	Description	Required	Choices	Default
"maximum precision"	Specifies the maximum decimal precision the database might use.	no	"31" "63"	"31"
"maximum scale"	Specifies the maximum scale the database might use.	no	"0"- "63"	"31"
"minimum divide scale"	Specifies the minimum scale value for the result of decimal division.	no	"0" "1" "2" "3" "4" "5" "6" "7" "8" "9"	"0"
"package ccsid"	Specifies the character encoding to use for the SQL package and any statements sent to the server.	no	"1200" (UCS-2) "13488" (UTF-16)	"13488"
"transaction isolation"	Specifies the default transaction isolation.	no	"none"  "read uncommitted"  "read committed"  "repeatable read"  "serializable"	"read uncommitted"
"translate hex"	Specifies how hexadecimal literals are interpreted.	no	"character" (Interpret hexadecimal literals as character data) "binary" (Interpret hexadecimal literals as binary data)	"character"
"true autocommit"	Specifies whether the connection should use true auto commit support. True autocommit means that autocommit is on and is running under a isolation level other than *NONE. By default, the driver handles autocommit by running under the server isolation level of *NONE.	no	"true" (Use true autocommit.) "false" (Do not use true autocommit.)	"false"

Property	Description	Required	Choices	Default
"xa loosely coupled support"	Specifies whether lock sharing is allowed for loosely coupled transaction branches. <b>Note:</b> This setting is ignored when running to IBM i 5.3 or earlier.	no	"0" = Locks cannot be shared "1" = Locks can be shared	"0"

## Format properties

Format properties specify date and time formats, date and decimal separators, and table naming conventions used within SQL statements.

Property	Description	Required	Choices	Default
"date format"	Specifies the date format used in date literals within SQL statements.	no	"mdy" "dmy" "ymd" "usa" "iso" "eur" "jis" "julian"	(server job)
"date separator"	Specifies the date separator used in date literals within SQL statements. This property has no effect unless the "date format" property is set to "julian", "mdy", "dmy" or "ymd".	no	"/" (slash) "-" (dash) "." (period) "," (comma) "b" (space)	(server job)
"decimal separator"	Specifies the decimal separator used in numeric literals within SQL statements.	no	"." (period) "," (comma)	(server job)
"naming"	Specifies the naming convention used when referring to tables.	no	"sql" (as in schema.table) "system" (as in schema/table)	"sql"
"time format"	Specifies the time format used in time literals within SQL statements.	no	"hms" "usa" "iso" "eur" "jis"	(server job)
"time separator"	Specifies the time separator used in time literals within SQL statements. This property has no effect unless the "time format" property is set to "hms".	no	":" (colon) "." (period) "," (comma) "b" (space)	(server job)

## Performance properties

Performance properties are attributes that include caching, data conversion, data compression, and prefetching that affect performance.

Property	Description	Required	Choices	Default
"big decimal"	Specifies whether an intermediate java.math.BigDecimal object is used for packed and zoned decimal conversions. If this property is set to "true", an intermediate java.math.BigDecimal object is used for packed and zoned decimal conversions as described by the JDBC specification. If this property is set to "false", no intermediate objects are used for packed and zoned decimal conversions. Instead, such values are converted directly to and from Java double values. Such conversions will be faster but may not follow all conversion and data truncation rules documented by the JDBC specification.	no	"true" "false"	"true"
"block criteria"	Specifies the criteria for retrieving data from the server in blocks of records. Specifying a non-zero value for this property will reduce the frequency of communication to the server, and therefore improve performance.  Ensure that record blocking is off if the cursor is going to be used for subsequent UPDATES, or else the row that is updated will not necessarily be the current row.	no	"0" (no record blocking) "1" (block if FOR FETCH ONLY is specified) "2" (block unless FOR UPDATE is specified)	"2"
"block size"	Specifies the block size (in kilobytes) to retrieve from the server and cache on the client. This property has no effect unless the "block criteria" property is non-zero. Larger block sizes reduce the frequency of communication to the server, and therefore may improve performance.	no	"0" "8" "16" "32" "64" "128" "256" "512"	"32"
"data compression"	Specifies whether result set data is compressed. If this property is set to "true", then result set data is compressed. If this property is set to "false", then result set data is not compressed. Data compression may improve performance when retrieving large result sets.	no	"true" "false"	"true"

Property	Description	Required	Choices	Default
"extended dynamic"	Specifies whether to use extended dynamic support. Extended dynamic support provides a mechanism for caching dynamic SQL statements on the server. The first time a particular SQL statement is prepared, it is stored in a SQL package on the server. If the package does not exist, it is automatically created. On subsequent prepares of the same SQL statement, the server can skip a significant part of the processing by using information stored in the SQL package. If this is set to "true", then a package name must be set using the "package" property.	no	"true" "false"	"false"
"lazy close"	Specifies whether to delay closing cursors until subsequent requests. This will improve overall performance by reducing the total number of requests.	no	"true" "false"	"false"
"lob threshold"	Specifies the maximum LOB (large object) size (in bytes) that can be retrieved as part of a result set. LOBs that are larger than this threshold will be retrieved in pieces using extra communication to the server. Larger LOB thresholds will reduce the frequency of communication to the server, but will download more LOB data, even if it is not used. Smaller LOB thresholds may increase frequency of communication to the server, but will only download LOB data as it is needed.	no	"0" - "16777216"	"32768"
"package"	Specifies the base name of the SQL package. Note that only the first six characters are used to generate the name of the SQL package on the server. This property has no effect unless the "extended dynamic" property is set to "true". In addition, this property must be set if the "extended dynamic" property is set to "true".	no	SQL package	""
"package add"	Specifies whether to add newly prepared statements to the SQL package specified on the "package" property. This property has no effect unless the "extended dynamic" property is set to "true".	no	"true" "false"	"true"

Property	Description	Required	Choices	Default
"package cache"	Specifies whether to cache a subset of the SQL package information in client memory. Caching SQL packages locally reduces the amount of communication to the server for prepares and describes. This property has no effect unless the "extended dynamic" property is set to "true".	no	"true" "false"	"false"
"package criteria"	Specifies the type of SQL statements to be stored in the SQL package. This can be useful to improve the performance of complex join conditions. This property has no effect unless the "extended dynamic" property is set to "true".	no	"default" (only store SQL statements with parameter markers in the package) "select" (store all SQL SELECT statements in the package)	"default"
"package error"	Specifies the action to take when SQL package errors occur. When a SQL package error occurs, the driver will optionally throw a SQLException or post a notice to the Connection, based on the value of this property. This property has no effect unless the "extended dynamic" property is set to "true".	no	"exception" "warning" "none"	"warning"
"package library"	Specifies the library for the SQL package. This property has no effect unless the "extended dynamic" property is set to "true".	no	Library for SQL package	"QGPL"
"prefetch"	Specifies whether to prefetch data upon executing a SELECT statement. This will improve performance when accessing the initial rows in the ResultSet.	no	"true" "false"	"true"
"qaqqinilib"	Specifies a QAQQINI library name. Used to specify the library that contains the qaqqini file to use. A qaqqini file contains all of the attributes that can potentially impact the performance of the Db2® for i database engine.	no	"QAQQINI library name"	(server default)

Property	Description	Required	Choices	Default
"query optimize goal"	<p>Specifies the goal the server should use with optimization of queries. This setting corresponds to the server's QAQQINI option called OPTIMIZATION_GOAL.</p> <p><b>Note:</b> This property is ignored when connecting to systems running to IBM i 5.3 and earlier.</p>	no	<p>"0" = Optimize query for first block of data (*FIRSTIO) when extended dynamic packages are used; Optimize query for entire result set (*ALLIO) when packages are not used "1" = Optimize query for first block of data (*FIRSTIO) "2" = Optimize query for entire result set (*ALLIO)</p>	"0"
"query storage limit"	Limits the storage used by a query. This property compares the storage limit you specify to the estimated storage usage of the query. If the estimated storage usage exceeds the specified storage limit, the query is not allowed to execute.	no	-1 (*NOMAX) to 2 147 352 578	-1, which indicates a special value of *NOMAX



Property	Description	Required	Choices	Default
"query timeout mechanism"	Specifies the mechanism to implement the queryTimeout feature.	no	"qqrytimlmt" = The queryTimeout feature uses the "QQRYSIMLMT" feature of the database engine. "cancel" = The queryTimeout feature uses a database CANCEL request to cancel a running SQL statement after the specified timeout expires.	"qqrytimlmt"
"receive buffer size"	Specifies the buffer size used to receive data through the socket connection between the front-end driver and the system.  <b>Note:</b> This does not specify the actual receive buffer size. It is only used as a hint by the underlying socket code.	no	"1" - max size	(platform dependent)
"send buffer size"	Specifies the buffer size used to send data through the socket connection between the front-end driver and the system.  <b>Note:</b> This does not specify the actual send buffer size. It is only used as a hint by the underlying socket code.	no	"1" - max size	(platform dependent)
"use block update"	This property allows the toolbox JDBC driver to use a block update mode when updating blocks of data into the database. This is an optimized version of the batch update.	no	"true" "false"	"false"
"variable field compression"	Specifies whether variable-length fields should be compressed.	no	"true" "false"	"true"

## Sort properties

Sort properties specify how the server performs stores and performs sorts.

Sort property	Description	Required	Choices	Default
"sort"	Specifies how the server sorts records before sending them to the client.	no	"hex" (base the sort on hexadecimal values) "language" (base the sort on the language set in the "sort language" property) "table" (base the sort on the sort sequence table set in the "sort table" property)	"hex"
"sort language"	Specifies a 3-character language id to use for selection of a sort sequence. This property has no effect unless the "sort" property is set to "language".	no	Language id	ENU
"sort table"	Specifies the library and file name of a sort sequence table stored on the server. This property has no effect unless the "sort" property is set to "table".	no	Qualified sort table name	""
"sort weight"	Specifies how the server treats case while sorting records. This property has no effect unless the "sort" property is set to "language".	no	"shared" (upper- and lowercase characters sort as the same character) "unique" (upper- and lowercase characters sort as different characters)	"shared"

### Other properties

Other properties are those properties not easily categorized. These properties determine which JDBC driver is used, and specify options related to level of database access, bidirectional string type, data truncation and so on.

Other property	Description	Required	Choices	Default
"access"	Specifies the level of database access for the connection.	no	"all" (all SQL statements allowed) "read call" (SELECT and CALL statements allowed) "read only" (SELECT statements only)	"all"

Other property	Description	Required	Choices	Default
"autocommit exception"	Specifies whether to throw an SQLException when Connection.commit() or Connection.rollback() is called if autocommit is enabled.	no	"true" "false"	"false"
"bidi string type"	Specifies the output string type of bidirectional data. See <a href="#">BidiStringType</a> for more information.	no	"" (use the CCSID to determine bidirectional string type) "0" (the default string type for nonbidirectional data (LTR)) "4" "5" "6" "7" "8" "9" "10" "11"	""
"bidi implicit reordering"	Specifies if bidi implicit LTR-RTL reordering should be used.	no	"true" "false"	"true"
"bidi numeric ordering"	Specifies if the numeric ordering round trip feature should be used.	no	"true" "false"	"false"
"data truncation"	<p>Specifies whether truncation of <b>character data</b> generates attention notices and exceptions. When this property is "true", the following apply:</p> <ul style="list-style-type: none"> <li>• Writing truncated character data to the database throws an exception</li> <li>• Using truncated character data in a query posts an attention notice.</li> </ul> <p>When this property is "false", writing truncated data to the database or using such data in a query generates no exception or attention notice.</p> <p>The default value is "true".</p> <p>This property does not affect <b>numeric data</b>. Writing truncated numeric data to the database always throws an error and using truncated numeric data in a query always posts attention notices.</p>	no	"true" "false"	"true"

Other property	Description	Required	Choices	Default
"driver"	Specifies the JDBC driver implementation. The IBM Toolbox for Java JDBC driver can use different JDBC driver implementations based on the environment. If the environment is an IBM i JVM on the same server as the database to which the program is connecting, the native IBM Developer Kit for Java JDBC driver can be used. In any other environment, the IBM Toolbox for Java JDBC driver is used. This property has no effect if the "secondary URL" property is set.	no	"toolbox" (use only the IBM Toolbox for Java JDBC driver) "native" (use the IBM Developer Kit for Java JDBC driver if running on the server, otherwise use the IBM Toolbox for Java JDBC driver)	"toolbox"
"errors"	Specifies the amount of detail to be returned in the message for errors that occur on the server.	no	"basic" "full"	"basic"
"extended metadata"	Specifies whether the driver requests extended metadata from the server. Setting this property to true increases the accuracy of the information returned from the following ResultSetMetaData methods: <ul style="list-style-type: none"> <li>• getColumnLabel(int)</li> <li>• isReadOnly(int)</li> <li>• isSearchable(int)</li> <li>• isWritable(int)</li> </ul> Additionally, setting this property to true enables support for the ResultSetMetaData.getSchemaName(int) and ResultSetMetaData.isAutoIncrement(int) methods. <p><b>Note:</b> Setting this property to true may degrade performance because it requires retrieving more information from the server. Leave the property as the default (false) unless you need more specific information from the listed methods. For example, when this property is off (false), ResultSetMetaData.isSearchable(int) always returns "true" because the driver does not have enough information from the server to make a judgment. Turning on this property (true) forces the driver to get the correct data from the server.</p>	no	"true" "false"	"false"
"full open"	Specifies whether the server fully opens a file for each query. By default the server optimizes open requests. This optimization improves performance but may fail if a database monitor is active when a query is run more than once. Set the property to true only when identical queries are issued when monitors are active.	no	"true" "false"	"false"

Other property	Description	Required	Choices	Default
"hold input locators"	Specifies whether input locators should be allocated as type hold locators or not hold locators. If the locators are of type hold, they will not be released when a commit is done.	no	"true" (type hold) "false"	"true"
"hold statements"	Specifies if statements should remain open until a transaction boundary when autocommit is off and they are associated with a LOB locator. By default, all the resources associated with a statement are released when the statement is closed. Set this property to true only when access to a LOB locator is needed after a statement has been closed.	no	"true" "false"	"false"
"ignore warnings"	Specifies a list of SQL states for which the driver should not create warning objects. By default, the IBM Toolbox for Java JDBC driver will internally create a java.sql.SQLException object for each warning returned by the database. For example, a warning with the SQLSTATE 0100C is created every time a result set is returned from a stored procedure. This warning can be safely ignored to improve the performance of applications that call stored procedures.	no	A comma separated list of SQL states that should be ignored.	""
"keep alive"	Specifies whether socket connection is to be periodically checked for operational status.	no	"true" "false"	(platform dependent)
"key ring name"	Specifies the key ring class name used for SSL connections with the server. This property has no effect unless "secure" is set to true and a key ring password is set using the "key ring password" property.	no	"key ring name"	""
"key ring password"	Specifies the password for the key ring class used for SSL communications with the server. This property has no effect unless "secure" is set to true and a key ring name is set using the "key ring name" property.	no	"key ring password"	""
"metadata source"	Specifies how to retrieve DatabaseMetaData. If set to "0," database metadata will be retrieved through the Retrieve Object Information (ROI) data flow.  If set to "1," database metadata will be retrieved by calling system stored procedures.	no	"0" (ROI access) "1" (SQL stored procedures)	"0" for IBM i 6.1 and older releases, "1" for all other releases

Other property	Description	Required	Choices	Default
"proxy server"	Specifies the host name and port of the middle-tier machine where the proxy server is running. The format for this is <i>hostname[:port]</i> , where the port is optional. If this is not set, then the hostname and port are retrieved from the <i>com.ibm.as400.access.AS400.proxyServer</i> property. The default port is 3470 (if the connection uses SSL, the default port is 3471). The ProxyServer must be running on the middle-tier machine.  The name of the middle-tier machine is ignored in a two-tier environment.	no	Proxy server host name and port	(value of the proxyServer property, or none if not set)
"remarks"	Specifies the source of the text for REMARKS columns in ResultSets returned by DatabaseMetaData methods. This property is only used if the "metadata source" property is set to "0".	no	"sql" (SQL object comment) "system" (IBM i object description)	"system"
"secondary URL"	Specifies the URL to be used for a connection on the middle-tier's DriverManager in a multiple tier environment, if it is different than already specified. This property allows you to use this driver to connect to other databases. Use a backslash as an escape character before backslashes and semicolons in the URL.	no	JDBC URL	(current JDBC URL)
"secure"	Specifies whether a Secure Sockets Layer (SSL) connection is used to communicate with the server.	no	"true" (encrypt all client/server communication) "false" (encrypt only the password)	"false"

Other property	Description	Required	Choices	Default
"server trace"	Specifies the level of tracing of the JDBC server job. When tracing is enabled, tracing starts when the client connects to the server and ends when the connection is disconnected. You must start tracing before connecting to the server, because the client enables server tracing only at connect time.	no	"0" (trace is not active) "2" (start the database monitor on the JDBC server job) "4" (start debug on the JDBC server job) "8" (save the job log when the JDBC server job ends) "16" (start job trace on the JDBC server job) "32" (save SQL information) "64" (supports the activation of database host server tracing)  Multiple types of trace can be started by adding these values together. For example, "6" starts the database monitor and starts debug.	"0"
"thread used"	Specifies whether threads are used in communication with the host servers.	no	"true" "false"	"true"

Other property	Description	Required	Choices	Default
"toolbox trace"	Specifies what category of an IBM Toolbox for Java trace to log. Trace messages are useful for debugging programs that call JDBC. However, there is a performance penalty associated with logging trace messages, so this property is only set for debugging. Trace messages are logged to System.out.	no	"" "none" "datastream" (log data flow between the local host and the remote system) "diagnostic" (log object state information) "error" (log errors that cause an exception) "information" (used to track the flow of control through the code) "warning" (log errors that are recoverable) "conversion" (log character set conversions between Unicode and native code pages) "proxy" (log data flow between the client and the proxy server) "pcml" (used to determine how PCML interprets the data that is sent to and from the server) "jdbc" (log jdbc information) "all" (log all categories) "thread" (log thread information)	""
"trace"	Specifies whether trace messages are logged. Trace messages are useful for debugging programs that call JDBC. However, there is a performance penalty associated with logging trace messages, so this property only set to "true" for debugging. Trace messages are logged to System.out.	no	"true" "false"	"false"



Other property	Description	Required	Choices	Default
"translate binary"	Specifies whether binary data is translated. If this property is set to "true", then BINARY and VARBINARY fields are treated as CHAR and VARCHAR fields.	no	"true" "false"	"false"
"translate boolean"	Specifies how Boolean objects are interpreted when setting the value for a character field/parameter using the PreparedStatement.setObject(), CallableStatement.setObject() or ResultSet.updateObject() methods. Setting the property to "true" would store the Boolean object in the character field as either "true" or "false." Setting the property to "false" would store the Boolean object in the character field as either "1" or "0."	no	"true" "false"	"true"

### Related reference

[“Registering the JDBC driver” on page 71](#)

Before using JDBC to access data in a server database file, you need to register the IBM Toolbox for Java JDBC driver with the DriverManager.

### JDBC Librarylist property

The JDBC LibraryList property specifies one or more libraries that you want to add to or replace the library list of the server job, and optionally sets the default library (default SQL schema).

The examples in the following table make these assumptions:

- A library called MYLIBDAW contains MYFILE\_DAW
- You are running this SQL statement:

```
"SELECT * FROM MYFILE_DAW"
```

Scenario	SQL Naming	System Naming
Basic Rules	<p>Only one library is searched.</p> <ul style="list-style-type: none"> <li>• If a default SQL schema is specified on the URL, it is used. It becomes the default library.</li> <li>• If no default SQL schema is specified on the URL, the first library in the "libraries" property is used. It becomes the default library.</li> <li>• If no default SQL schema is specified on URL and if no "libraries" property is specified, the library with the same name as the signed-on user profile is used.</li> </ul> <p>The job's library list is updated with the libraries in the libraries property. This may affect the behavior of some triggers and stored procedures. It does not affect unqualified names in statements.</p>	<p>The job's library list is updated with the libraries on the libraries property. If a default SQL schema is specified on the URL then that becomes the default library.</p>

<b>Scenario</b>	<b>SQL Naming</b>	<b>System Naming</b>
1. No default SQL schema specified on URL and "libraries" property is not specified	Default SQL schema is the user profile name.	No default SQL schema. Job's library list is searched.
2. Default SQL schema specified on URL and "libraries" property not specified	Default SQL schema is what is specified in the URL.	Default SQL schema is what is specified in the URL. Library list is not searched to resolve unqualified name in SQL statements.
3. Default SQL schema not specified on URL and "libraries" property is specified	Default SQL schema is first library specified in property.	No default SQL schema. All libraries specified in property are searched.
4. Default SQL schema specified on URL and "libraries" property specified	Default SQL schema is what is specified in the URL. Property is ignored.	Default SQL schema is what is specified in the URL. Library list is not searched to resolve unqualified name in SQL statements.
5. No default SQL schema specified on URL, the "libraries" property is specified and a library in the list is not valid	Default SQL schema is first library specified in property.	No default SQL schema. The library list can not be changed because one of the libraries in the list is not found so the job's library list is used.
6. No default SQL schema specified on URL, "libraries" property specified, file found in second library in list	Default SQL schema is first library specified in property, rest of libraries ignored.	If all libraries exist , then no default SQL schema, all libraries on list searched, list replaces job's library list.  If one of the libraries on the list does not exist, the job's library list is not changed.
7. No default SQL schema specified on URL, the "libraries" property is specified, list starts with a comma	Default SQL schema is user profile.	No default SQL schema, all libraries on list searched, list replaces job's library list.
8. No default SQL schema specified on URL, "libraries" property specified, list starts with a *LIBL	Default SQL schema is user profile.	No default SQL schema, all libraries on list searched, libraries specified added to end of list

Scenario	SQL Naming	System Naming
9. No default SQL schema specified on URL, "libraries" property specified, list ends with a *LIBL	Default SQL schema is first library specified in property, rest of libraries ignored.	No default SQL schema, all libraries on list searched, libraries specified added to beginning of job's library list
10. Default SQL schema specified on URL not valid	No default SQL schema, user profile used.	No default SQL schema, job's library list is used

**Note:** When a default SQL schema is specified on the URL and the libraries property is not used, the default SQL schema is appended before the current library list

## JDBC SQL Types

Not all of the SQL types described by the JDBC specification are supported by DB2 for IBM i.

### Unsupported SQL Types

In the cases where a SQL type is not supported, the JDBC driver substitutes a similar SQL type.

The following table lists the SQL types that are not supported and the SQL type that JDBC driver substitutes for each.

Unsupported SQL type	Substituted SQL type
BIT	SMALLINT
TINYINT	SMALLINT
LONGVARCHAR	VARCHAR
LONGVARBINARY	VARBINARY

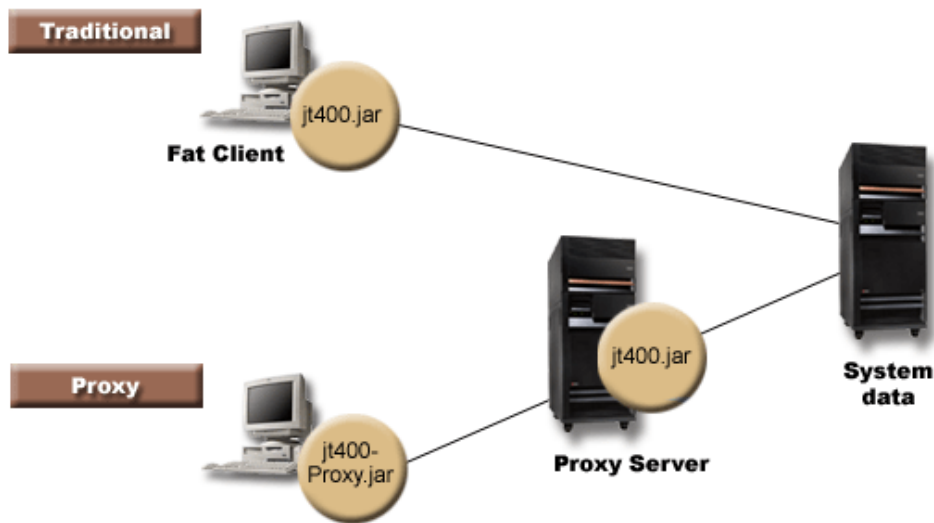
## Proxy Support

IBM Toolbox for Java includes proxy support for some classes. Proxy support is the processing that IBM Toolbox for Java needs to carry out a task on a Java virtual machine (JVM) when the application is on a different JVM.

The proxy classes reside in jt400Proxy.jar, which ships with the rest of the IBM Toolbox for Java. The proxy classes, like the other classes in the IBM Toolbox for Java, comprise a set of platform independent Java classes that can run on any computer with a [Java virtual machine](#). The proxy classes dispatch all method calls to a server application, or proxy server. The full IBM Toolbox for Java classes are on the proxy server. When a client uses a proxy class, the request is transferred to the proxy server which creates and administers the real IBM Toolbox for Java objects.

Figure 1 shows how the standard and proxy client connect to the server. The proxy server can be the IBM i server that contains the data.

### Figure 1: How a standard client and a proxy client connect to a server



An application that uses proxy support performs more slowly than if it uses standard IBM Toolbox for Java classes due to the extra communication needed to support the smaller proxy classes. Applications that make fewer method calls have less performance degradation.

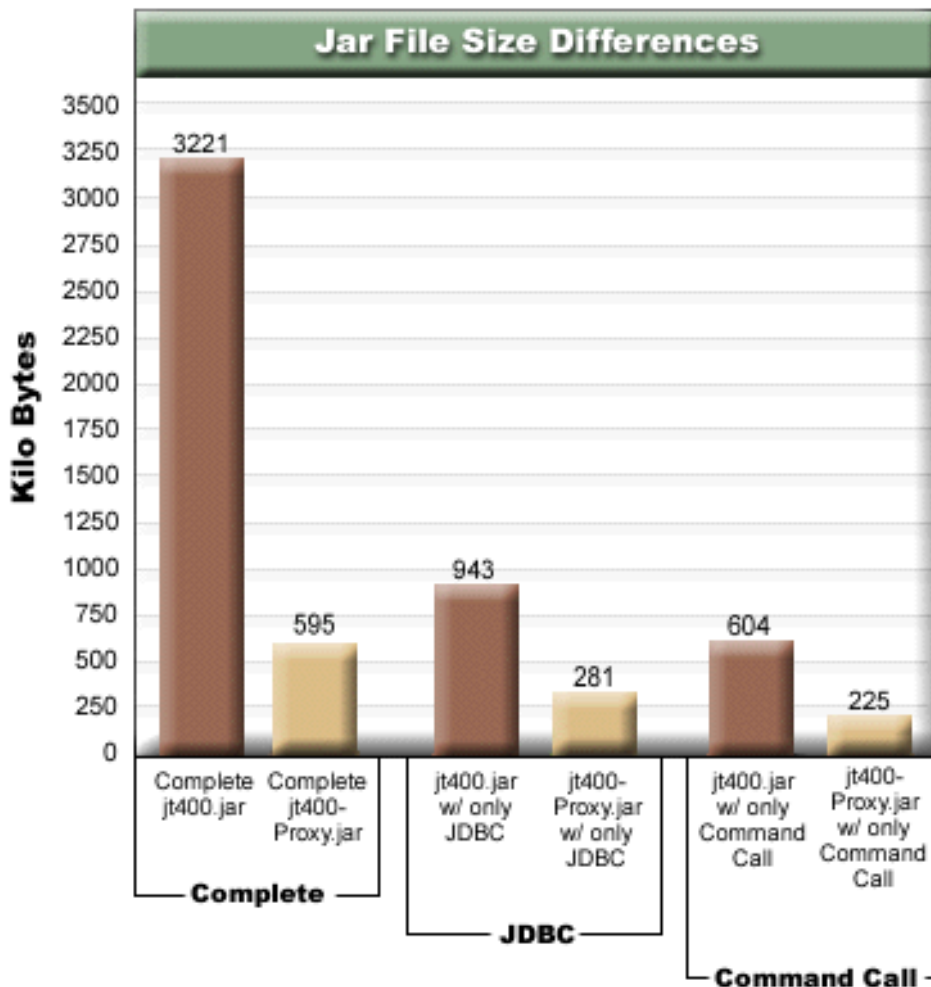
Before proxy support, the classes containing the public interface, all the classes needed to process a request, and the application itself ran on the same JVM. When using proxy support, the public interface must be with the application, but classes for processing requests can run on a different JVM. Proxy support does not change the public interface. The same program can run with either the proxy version of IBM Toolbox for Java or the standard version.

### Using the jt400Proxy.jar file

The goal of the multiple-tier, proxy scenario is to make the public interface JAR file as small as possible, so that downloading it from an applet takes less time. When you use the proxy classes, you don't need to install the entire IBM Toolbox for Java on the client. Instead, use [AS400JarMaker](#) on the jt400Proxy.jar file to include only the required components, which makes the JAR file as small as possible.

Figure 2 compares the size of the proxy JAR files with the standard JAR files:

#### Figure 2: Size comparison of proxy JAR files and standard JAR files



An additional benefit is that proxy support requires you to have fewer ports open through a firewall. With standard IBM Toolbox for Java, you must have multiple ports open. This is because each IBM Toolbox for Java service uses a different port to communicate with the server. For example, Command call uses a different port than JDBC, which uses a different port than print, and so on. You must allow each of these ports through the firewall. However, when using proxy support, all the data flows through the same port.

### Standard proxy and HTTP tunneling

Two options are available for running via a proxy: standard proxy and HTTP tunneling:

- Standard proxy is where the proxy client and proxy server communicate by using a socket over a port. The default port is 3470. Change the default port by using the `setPort()` method on the ProxyServer class, or by using the `-port` option when starting the proxy server. For example:

```
java com.ibm.as400.access.ProxyServer -port 1234
```

- HTTP tunneling is where the proxy client and proxy server communicate by way of the HTTP server. The IBM Toolbox for Java provides a servlet that handles the proxy request. The proxy client calls the servlet by way of the HTTP server. The advantage of tunneling is that you are not required to open an additional port through the firewalls, because communication is by way of the HTTP port. The disadvantage of tunneling is that it is slower than standard proxy.

IBM Toolbox for Java uses the proxy server name to determine if standard proxy or tunneling proxy is being used:

- For standard proxy, just use the server name. For example:

```
com.ibm.as400.access.AS400.proxyServer=myServer
```

- For tunneling, use a URL to force the proxy client to use tunneling. For example:

```
com.ibm.as400.access.AS400.proxyServer=http://myServer
```

When running standard proxy, a socket connection exists between the client and server. If that connection fails, the server cleans up resources associated with that client.

When using HTTP tunneling, using the HTTP protocol makes proxy connectionless. That is, a new connection is made for each data flow. Because the protocol is connectionless, the server does not know if the client application is no longer active. Consequently, the server does not know when to clean up resources. The tunneling server solves this problem by using a thread to clean up resources at a predetermined interval (which is based on a timeout value).

At the end of the predetermined interval, the thread runs and cleans up resources that have not been used lately. Two [system properties](#) govern the thread:

- `com.ibm.as400.access.TunnelProxyServer.clientCleanupInterval` is how often, in seconds, the cleanup thread runs. The default is every two hours.
- `com.ibm.as400.access.TunnelProxyServer.clientLifetime` is how long, in seconds, a resource can be idle before it is cleaned up. The default is 30 minutes.

## Using proxy server

To use the proxy server implementation of the IBM Toolbox for Java classes, complete the following steps:

1. Run AS400ToolboxJarMaker on jt400Proxy.jar to discard classes that you do not need. This step is optional but recommended.
2. Deliver jt400Proxy.jar to the client. For Java applets, you may be able to download the JAR file from the HTML server.
3. Determine what server you will use for the proxy server.
  - For Java applications, the proxy server can be any computer.
  - For Java applets, the proxy server must be running on the same computer as the HTTP server.
4. Ensure that you have put jt400.jar in the CLASSPATH on the server.
5. Start the proxy server or use the proxy servlet:
  - For standard proxy, start the proxy server by using the following command:

```
java com.ibm.as400.access.ProxyServer
```

- For tunneling proxy, configure your HTTP server to use the proxy servlet. The servlet class name is `com.ibm.as400.access.TunnelProxyServer` and it is contained in jt400.jar.
6. On the client, set a [system property](#) to identify the proxy server. IBM Toolbox for Java uses this system property to determine if standard proxy or tunneling proxy is being used.
    - For standard proxy, the property value is the name of the machine that runs the proxy server. For example:

```
com.ibm.as400.access.AS400.proxyServer=myServer
```

- For tunneling proxy, use a URL to force the proxy client to use tunneling. For example:

```
com.ibm.as400.access.AS400.proxyServer=http://myServer
```

7. Run the client program.

When you want to work with both the proxy classes and classes not in jt400Proxy.jar, you can refer to jt400.jar instead of jt400Proxy.jar. jt400Proxy.jar is a subset of the jt400.jar and, therefore, all of the proxy classes are contained in the jt400.jar file.

## Examples: Using proxy servers

The following are three specific examples for using a proxy server with the steps listed above.

- [Running a Java application using proxy support](#)
- [Running a Java applet using proxy support](#)
- [Running a Java application using tunneling proxy support.](#)

## Classes enabled to work with proxy server

Some IBM Toolbox for Java classes are enabled to work with the proxy server application. These include the following:

- [JDBC](#)
- [Record-level access](#)
- [Integrated file system](#)
- [Print](#)
- [Data Queues](#)
- [Command Call](#)
- [Program Call](#)
- [Service Program Call](#)
- [User space](#)
- [Data area](#)
- [AS400 class](#)
- [SecureAS400 class](#)

Other classes are not supported at this time by jt400Proxy. Also, integrated file system permissions are not functional using only the proxy JAR file. However, you can use the [JarMaker](#) class to include these classes from the jt400.jar file.

## Example: Running a Java application using Proxy Support

The following example shows you the steps to run a Java application using proxy support.

1. Choose a machine to act as the proxy server. The Java environment and CLASSPATH on the proxy server machine includes the jt400.jar file. This machine must be able to connect to the system.
2. Start the proxy server on this machine by typing: `java com.ibm.as400.access.ProxyServer -verbose` Specifying verbose allows you to monitor when the client connects and disconnects.
3. Choose a machine to act as the client. The Java environment and CLASSPATH on the client machine includes the jt400Proxy.jar file and your application classes. This machine must be able to connect to the proxy server but does not need a connection to the system.
4. Set the value of the `com.ibm.as400.access.AS400.proxyServer` system property to be the name of your proxy server, and run the application. An easy way to do this is by using the -D option on most Java Virtual Machine invocations: `java -Dcom.ibm.as400.access.AS400.proxyServer=psMachineName YourApplication`
5. As your application runs, you see (if you set verbose in step 2) the application make at least one connection to the proxy server.

## Example: Running a Java applet using proxy support

The following example shows you the steps to run a Java applet using proxy support.

1. Choose a machine to act as the proxy server. Applets can initiate network connections only to the machine from which they were originally downloaded; therefore, it works best to run the proxy server on the same machine as the HTTP server. The Java environment and CLASSPATH on the proxy server machine includes the jt400.jar file.
2. Start the proxy server on this machine by typing: `java com.ibm.as400.access.ProxyServer -verbose` Specifying verbose will allow you to monitor when the client connects and disconnects.
3. Applet code needs to be downloaded before it runs so it is best to reduce the size of the code as much as possible. The `AS400ToolboxJarMaker` can reduce the `jt400Proxy.jar` significantly by including only the code for the components that your applet uses. For instance, if an applet uses only JDBC, reduce the `jt400Proxy.jar` file to include the minimal amount of code by running the following command:

```
java utilities.AS400ToolboxJarMaker -source jt400Proxy.jar -destination
jt400ProxySmall.jar -component JDBC
```

4. The applet must set the value of the `com.ibm.as400.access.AS400.proxyServer` system property to be the name of your proxy server. A convenient way to do this for applets is using a compiled Properties class (Example). Compile this class and place the generated `Properties.class` file in the `com/ibm/as400/access` directory (the same path your html file is coming from). For example, if the html file is `/mystuff/HelloWorld.html`, then `Properties.class` is in `/mystuff/com/ibm/as400/access`.
5. Put the `jt400ProxySmall.jar` in the same directory as the html file (`/mystuff/` in step 4).
6. Refer to the applet like this in your HTML file:

```
<APPLET archive="jt400Proxy.jar, Properties.class" code="YourApplet.class"
width=300 height=100> </APPLET>
```

## Example: Running a Java application using Tunneling Proxy Support

The following example shows you the steps to run a Java application using tunneling proxy support.

1. Choose the HTTP server that you want to run the proxy server, then configure it to run servlet `com.ibm.as400.access.TunnelProxyServer` (in `jt400.jar`). **Note:** Ensure that the HTTP server has a connection to the system that contains the data or resource that the application uses because the servlet connects to that system to carry out requests.
2. Choose a machine to act as the client and ensure that the CLASSPATH on the client machine includes the `jt400Proxy.jar` file and your application classes. The client must be able to connect to the HTTP server but does not need a connection to the system.
3. Set the value of the `com.ibm.as400.access.AS400.proxyServer` property to be the name of your HTTP server in URL format.
4. Run the application, setting the value of the `com.ibm.as400.access.AS400.proxyServer` property to be the name of your HTTP server in URL format. An easy way to do this is by using the `-D` option found on most JVMs:

```
java -Dcom.ibm.as400.access.AS400.proxyServer=http://psMachineName YourApplication
```


**Note:** The proxy client code creates the correct servlet URL by concatenating "servlet" and the servlet name to the server name. In this example, it converts `http://psMachineName` to `http://psMachineName/servlet/TunnelProxyServer`



## Secure Sockets Layer and Java Secure Socket Extension

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IBM Toolbox for Java supports using Java Secure Socket Extension (JSSE) for Java Secure Sockets Layer (SSL) connections. JSSE is integrated into J2SE, version 1.4 and subsequent versions.

For more information about JSSE, see the [Sun JSSE Web site](#) .

JSSE provides the ability to perform server authentication, enable secure communications, and encrypt data. Using JSSE, you can provide for secure data exchange between clients and servers that run any application protocol (for example, HTTP and FTP) over TCP/IP.

If you have previously used `sslight`, you should migrate to JSSE. As of IBM i 5.4, JSSE is the only package supported, and `sslight` is no longer shipped.

## Extensible Markup Language components

---

IBM Toolbox for Java includes several Extensible Markup Language (XML) components, including an XML parser.

The XML components make it easier to perform a variety of tasks:

- Creating graphical user interfaces
- Calling programs on your system and retrieving the results
- Specifying data formats on your system

### Program Call Markup Language

Program Call Markup Language (PCML) is a tag language that helps you call server programs with less Java code.

PCML is based upon the Extensible Markup Language (XML), a tag syntax you use to describe the input and output parameters for server programs. PCML enables you to define tags that fully describe server programs called by your Java application.

**Note:** If you are interested in or are already using PCML, consider using Extensible Program Call Markup Language (XPCML). XPCML enhances the functionality and usability of PCML by offering support for XML schemas. For more information about IBM Toolbox for Java XML components, including XPCML, see [Extensible Markup Language components](#).

A huge benefit of PCML is that it allows you to write less code. Ordinarily, extra code is needed to connect, retrieve, and translate data between a server and IBM Toolbox for Java objects. However, by using PCML, your calls to the server with the IBM Toolbox for Java classes are automatically handled. PCML class objects are generated from the PCML tags and help minimize the amount of code you need to write in order to call server programs from your application.

Although PCML was designed to support distributed program calls to server program objects from a client Java platform, you can also use PCML to make calls to a server program from within the server environment.

### Requirements for using PCML

The PCML component has the same workstation Java virtual machine requirements as the rest of the IBM Toolbox for Java.

In addition, in order to parse PCML at run-time, the CLASSPATH for the application must include an XML parser. The XML parser must extend class `org.apache.xerces.parsers.SAXParser`.

**Note:** If you preserialize the PCML file, you do not need to include an XML parser in the application CLASSPATH to run the application.

#### Related reference

[“Workstation requirements for IBM Toolbox for Java” on page 5](#)

Ensure that your workstation meets the following requirements.

[“XML parser and XSLT processor” on page 311](#)

Some IBM Toolbox for Java packages or functions require that, at run-time, you have an Extensible Markup Language (XML) parser or Extensible Stylesheet Language Transformations (XSLT) processor in your CLASSPATH environment variable.

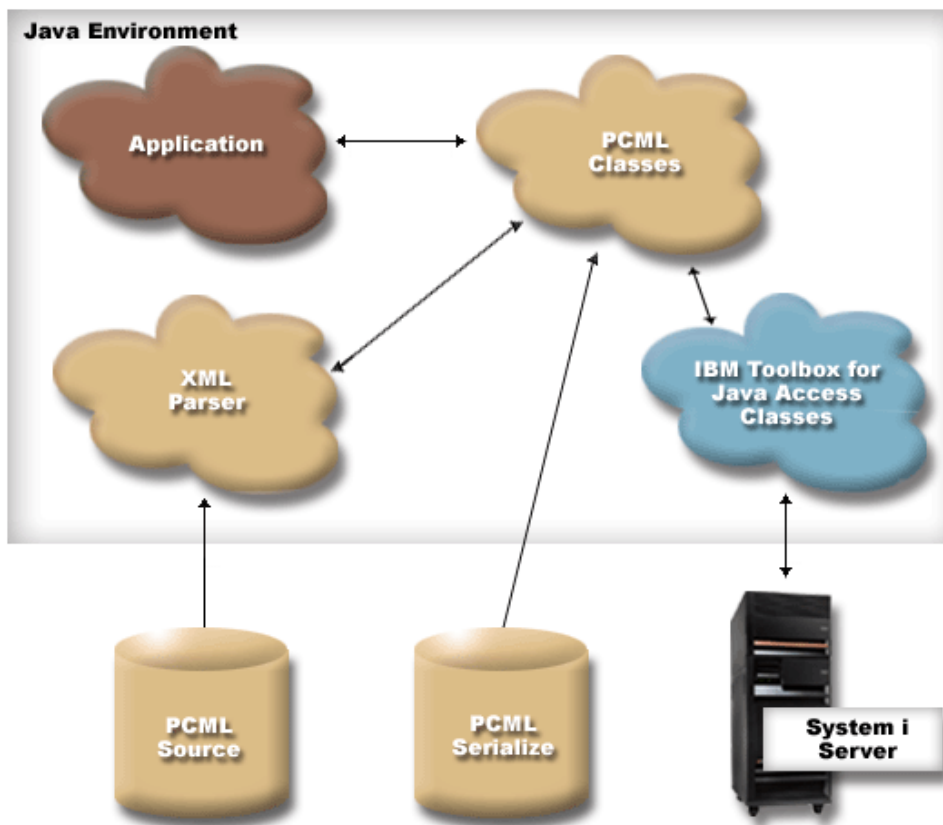
## Building IBM i program calls with PCML

To build IBM i program calls with PCML, you must start by creating a Java application and a PCML source file.

Depending on your design process, you must write one or more PCML source files where you describe the interfaces to the IBM i programs that will be called by your Java application. Refer to [PCML syntax](#) for a detailed description of the language.

Then your Java application interacts with the PCML classes (in this case, the ProgramCallDocument class). The ProgramCallDocument class uses your PCML source file to pass information between your Java application and the IBM i programs. Figure 1 illustrates how Java applications interact with the PCML classes.

**Figure 1. Making program calls to the server using PCML.**



When your application constructs the ProgramCallDocument object, the XML parser reads and parses the PCML source file. For more information about using an XML parser with IBM Toolbox for Java, see [XML parser and XSLT processor](#).

After the ProgramCallDocument class has been created, the application program uses the ProgramCallDocument class's methods to retrieve the necessary information from the server through the IBM i distributed program call (DPC) server.

To improve run-time performance, the ProgramCallDocument class can be serialized during your product build time. The ProgramCallDocument is then constructed using the serialized file. In this case, the XML parser is not used at run-time. Refer to [Using serialized PCML files](#).

## Using PCML source files

Your Java application uses PCML by constructing a `ProgramCallDocument` object with a reference to the PCML source file. The `ProgramCallDocument` object considers the PCML source file to be a Java resource. The Java application finds the PCML source file by using the Java CLASSPATH

The following Java code constructs a `ProgramCallDocument` object:

```
AS400 as400 = new AS400();
ProgramCallDocument pcmlDoc = new ProgramCallDocument(as400, "myPcmlDoc");
```

The `ProgramCallDocument` object will look for your PCML source in a file called `myPcmlDoc.pcml`. Notice that the `.pcml` extension is not specified on the constructor.

If you are developing a Java application in a Java package, you can package-qualify the name of the PCML resource:

```
AS400 as400 = new AS400();
ProgramCallDocument pcmlDoc = new ProgramCallDocument(as400,
"com.company.package.myPcmlDoc");
```

## Using serialized PCML files

To improve run-time performance, you can use a serialized PCML file. A serialized PCML file contains serialized Java objects representing the PCML. The objects that are serialized are the same objects that are created when you construct the `ProgramCallDocument` from a source file as described above.

Using serialized PCML files improves performance because the XML parser is not needed at run-time to process the PCML tags.

The PCML can be serialized using either of the following methods:

- From the command line:

```
java com.ibm.as400.data.ProgramCallDocument -serialize mypcml
```

This method is helpful for having batch processes to build your application.

- From within a Java program:

```
ProgramCallDocument pcmlDoc; // Initialized elsewhere
pcmlDoc.serialize();
```

If your PCML is in a source file named `myDoc.pcml`, the result of serialization is a file named `myDoc.pcml.ser`.

## PCML source files vs. serialized PCML files

Consider the following code to construct a `ProgramCallDocument`:

```
AS400 as400 = new AS400();
ProgramCallDocument pcmlDoc = new ProgramCallDocument(as400,
"com.mycompany.mypackage.myPcmlDoc");
```

The `ProgramCallDocument` constructor will first try to find a serialized PCML file named `myPcmlDoc.pcml.ser` in the `com.mycompany.mypackage` package in the Java CLASSPATH. If a serialized PCML file does not exist, the constructor will then try to find a PCML source file named `myPcmlDoc.pcml` in the `com.mycompany.mypackage` package in the Java CLASSPATH. If a PCML source file does not exist, an exception is thrown.

## Qualified names

Your Java application uses `ProgramCallDocument.setValue()` to set input values for the IBM i program being called. Likewise, your application uses `ProgramCallDocument.getValue()` to retrieve output values from the IBM i program.

When accessing values from the `ProgramCallDocument` class, you must specify the fully qualified name of the document element or `<data>` tag. The qualified name is a concatenation of the names of all the containing tags with each name separated by a period.

For example, given the following PCML source, the qualified name for the **"nbrPolygons"** item is **"polytest.parm1.nbrPolygons"**. The qualified name for accessing the **"x"** value for one of the points in one of the polygons is **"polytest.parm1.polygon.point.x"**.

If any one of the elements needed to make the qualified name is unnamed, all descendants of that element do not have a qualified name. Any elements that do not have a qualified name cannot be accessed from your Java program.

```
<pcml version="1.0">
  <program name="polytest" path="/QSYS.lib/MYLIB.lib/POLYTEST.pgm">
    <!-- Parameter 1 contains a count of polygons along with an array of polygons -->
    <struct name="parm1" usage="inputoutput">
      <data name="nbrPolygons" type="int" length="4" init="5" />
      <!-- Each polygon contains a count of the number of points along with an array of points
    -->
      <struct name="polygon" count="nbrPolygons">
        <data name="nbrPoints" type="int" length="4" init="3" />
        <struct name="point" count="nbrPoints" >
          <data name="x" type="int" length="4" init="100" />
          <data name="y" type="int" length="4" init="200" />
        </struct>
      </struct>
    </struct>
  </program>
</pcml>
```

## Accessing data in arrays

Any `<data>` or `<struct>` element can be defined as an array using the **count** attribute. Or, a `<data>` or `<struct>` element can be contained within another `<struct>` element that is defined as an array.

Furthermore, a `<data>` or `<struct>` element can be in a multidimensional array if more than one containing element has a **count** attribute specified.

In order for your application to set or get values defined as an array or defined within an array, you must specify the array index for each dimension of the array. The array indices are passed as an array of **int** values. Given the source for the array of polygons shown above, the following Java code can be used to retrieve the information about the polygons:

```
ProgramCallDocument polytest; // Initialized elsewhere
Integer nbrPolygons, nbrPoints, pointX, pointY;
nbrPolygons = (Integer) polytest.getValue("polytest.parm1.nbrPolygons");
System.out.println("Number of polygons:" + nbrPolygons);
indices = new int[2];
for (int polygon = 0; polygon < nbrPolygons.intValue(); polygon++)
{
    indices[0] = polygon;
    nbrPoints = (Integer) polytest.getValue("polytest.parm1.polygon.nbrPoints", indices );
    System.out.println(" Number of points:" + nbrPoints);

    for (int point = 0; point < nbrPoints.intValue(); point++)
    {
        indices[1] = point;
        pointX = (Integer) polytest.getValue("polytest.parm1.polygon.point.x", indices );
        pointY = (Integer) polytest.getValue("polytest.parm1.polygon.point.y", indices );
        System.out.println("    X:" + pointX + " Y:" + pointY);
    }
}
```



The above messages can be very helpful in diagnosing cases where the output data coming from the IBM i program does not match the PCML source. This can easily occur when you are using dynamic lengths and offsets.

## PCML syntax

PCML consists of the following tags, each of which has its own attribute tags.

- The `<program>` tag begins and ends code that describes one program
- The `<struct>` tag defines a named structure which can be specified as an argument to a program or as a field within another named structure. A structure tag contains a data or a structure tag for each field in the structure.
- The `<data>` tag defines a field within a program or structure.

In the following example the PCML syntax describes one program with one category of data and some isolated data.

```
<program>
  <struct>
    <data> </data>
  </struct>

  <data> </data>

</program>
```

## PCML program tag

The PCML program tag can be expanded with the following elements.

```
<program name="name"
  [ entrypoint="entry-point-name" ]
  [ epccsid="ccsid" ]
  [ path="path-name" ]
  [ parseorder="name-list" ]
  [ returnvalue="{ void | integer }" ]
  [ threadsafe="{ true | false }" ]>
</program>
```

The following table lists the program tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.

Attribute	Value	Description
<code>entrypoint=</code>	<i>entry-point-name</i>	Specifies the name of the entry point within a service program object that is the target of this program call.  <b>Note:</b> This attribute is only allowed when the PCML version is 2.0 or higher. (For example <code>&lt;pcml version="2.0"&gt;</code> )

Attribute	Value	Description
<b>epccsid=</b>	<i>ccsid</i>	<p>Specifies the CCSID of the entry point within a service program. For more information, see the service program entry notes in the <a href="#">ServiceProgramCall javadoc</a>.</p> <p><b>Note:</b> This attribute is only allowed when the PCML version is 4.0 or higher. (For example &lt;pcml version="4.0"&gt;)</p>
<b>name=</b>	<i>name</i>	Specifies the name of the program.
<b>path=</b>	<i>path-name</i>	<p>Specifies the path to the program object. The default value is to assume the program is in the QSYS library.</p> <p>The path must be a valid integrated file system path name to a *PGM or *SRVPGM object. If a *SRVPGM object is called, the entrypoint attribute must be specified to indicate the name of the entrypoint to be called.</p> <p>If the entrypoint attribute is not specified, the default value for this attribute is assumed to be a *PGM object from the QSYS library. If the entrypoint attribute is specified, the default value for this attribute is assumed to be a *SRVPGM object in the QSYS library.</p> <p>The path name must be specified as all uppercase characters.</p> <p>Do not use the <b>path</b> attribute when the application needs to set the path at run time, for example, when a user specifies what library is used for the install. In this case, use the <a href="#">ProgramCallDocument.setPath()</a> method.</p>

Attribute	Value	Description
<b>parseorder=</b>	<i>name-list</i>	<p>Specifies the order in which output parameters will be processed. The value specified is a blank separated list of parameter names in the order in which the parameters are to be processed. The names in the list must be identical to the names specified on the <b>name</b> attribute of tags belonging to the <b>&lt;program&gt;</b>. The default value is to process output parameters in the order the tags appear in the document.</p> <p>Some programs return information in one parameter that describes information in a previous parameter. For example, assume a program returns an array of structures in the first parameter and the number of entries in the array in the second parameter. In this case, the second parameter must be processed in order for the ProgramCallDocument to determine the number of structures to process in the first parameter.</p>
<b>returnvalue=</b>	<p><i>void</i> The program does not return a value.</p> <p><i>integer</i> The program returns a 4-byte signed integer.</p>	<p>Specifies the type of value, if any, that is returned from a service program call. This attribute is not allowed for *PGM object calls.</p> <p><b>Note:</b> This attribute is only allowed when the PCML version is 2.0 or higher. (For example &lt;pcml version="2.0"&gt;)</p>



Attribute	Value	Description
<b>threadsafe=</b>	<p><i>true</i> The program is considered to be thread-safe.</p> <p><i>false</i> The program is not thread-safe.</p>	<p>When you call a Java program and an IBM i program that are on the same server, use this property to specify whether you want to call the IBM i program in the same job and on the same thread as the Java program. If you know your program is thread-safe, setting the property to <i>true</i> results in better performance.</p> <p>To keep the environment safe, the default is to call programs in separate server jobs. The default value is <i>false</i>.</p> <p><b>Note:</b> This attribute is only allowed when the PCML version is 3.0 or higher. (For example <code>&lt;pcml version="3.0"&gt;</code>)</p>

### PCML struct tag

The PCML struct tag can be expanded with the following elements.

```
<struct name="name"
  [ count="{number | data-name }" ]
  [ maxvrm="version-string" ]
  [ minvrm="version-string" ]
  [ offset="{number | data-name }" ]
  [ offsetfrom="{number | data-name | struct-name }" ]
  [ outputsize="{number | data-name }" ]
  [ usage="{ inherit | input | output | inputoutput }" ]>
</struct>
```

The following table lists the struct tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.

Attribute	Value	Description
<b>name=</b>	<i>name</i>	Specifies the name of the <b>&lt;struct&gt; element</b>

Attribute	Value	Description
<b>count=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing sized array.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the number of elements in the array. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies that the element is an array and identifies the number of entries in the array.</p> <p>If this attribute is omitted, the element is not defined as an array, although it may be contained within another element that is defined as an array.</p>
<b>maxvrm=</b>	<i>version-string</i>	<p>Specifies the highest version of IBM i on which the element exists. If the version of IBM i is greater than the version specified on the attribute, the element and its children, if any exist, will not be processed during a call to a program. The <b>maxvrm</b> element is helpful for defining program interfaces which differ between releases of IBM i.</p> <p>The syntax of the version string must be "VvRrMm," where the capitals letters "V," "R," and "M" are literal characters and "v," "r," and "m" are one or more digits representing the version, release and modification level. The value for "v" must be from 1 to 255 inclusively. The value for "r" and "m" must be from 0 to 255, inclusively.</p>

Attribute	Value	Description
<b>minvrm=</b>	<i>version-string</i>	<p>Specifies the lowest version of IBM i on which this element exists. If the version of IBM i is less than the version specified on this attribute, this element and its children, if any exist, will not be processed during a call to a program. This attribute is helpful for defining program interfaces which differ between releases of IBM i.</p> <p>The syntax of the version string must be "VvRrMm," where the capitals letters "V," "R," and "M" are literal characters and "v," "r," and "m" are one or more digits representing the version, release and modification level. The value for "v" must be from 1 to 255, inclusively. The value for "r" and "m" must be from 0 to 255, inclusively.</p>

Attribute	Value	Description
<b>offset=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing offset.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the offset to the element. The <b>data-name</b> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the offset to the <b>&lt;struct&gt;</b> element within an output parameter.</p> <p>Some programs return information with a fixed structure followed by one or more variable length fields or structures. In this case, the location of a variable length element is typically specified as an offset or displacement within the parameter. The <b>offset</b> attribute is used to describe the offset to this <b>&lt;struct&gt;</b> element.</p> <p><b>Offset</b> is used in conjunction with the <b>offsetfrom</b> attribute. If the <b>offsetfrom</b> attribute is not specified, the base location for the offset specified on the <b>offset</b> attribute is the parent of the element. See <a href="#">Specifying Offsets</a> for more information about how to use the <b>offset</b> and <b>offsetfrom</b> attributes.</p> <p>The <b>offset</b> and <b>offsetfrom</b> attributes are only used to process output data from a program. These attributes do not control the offset or displacement of input data.</p> <p>If the attribute is omitted, the location of the data for the element is immediately following the preceding element in the parameter, if any.</p>

Attribute	Value	Description
<b>offsetfrom=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing base location. A <i>number</i> attribute is most typically used to specify <b>number="0"</b> indicating that the offset is an absolute offset from the beginning of the parameter.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element to be used as a base location for the offset. The element name specified must be the parent or an ancestor of this element. The value from the <b>offset</b> attribute will be relative to the location of the element specified on this attribute. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference an ancestor of this element. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p> <p><i>struct-name</i> where <i>struct-name</i> defines the name of a <b>&lt;struct&gt;</b> element to be used as a base location for the offset. The element name specified must be the parent or an ancestor of this element. The value from the <b>offset</b> attribute will be relative to the location of the element specified on this attribute. The <i>struct-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference an ancestor of this element. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the base location from which the <b>offset</b> attribute is relative.</p> <p>If the <b>offsetfrom</b> attribute is not specified, the base location for the offset specified on the <b>offset</b> attribute is the parent of this element. See <a href="#">Specifying Offsets</a> for more information about how to use the <b>offset</b> and <b>offsetfrom</b> attributes.</p> <p>The <b>offset</b> and <b>offsetfrom</b> attributes are only used to process output data from a program. These attributes do not control the offset or displacement of input data.</p>

Attribute	Value	Description
<b>outputsize=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing number of bytes to reserve.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the number of bytes to reserve for output data. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the number of bytes to reserve for output data for the element. For output parameters which are variable in length, the <b>outputsize</b> attribute is needed to specify how many bytes must be reserved for data to be returned from the server program. <b>Outputsize</b> can be specified on all variable length fields and variable sized arrays, or it can be specified for an entire parameter that contains one or more variable length fields.</p> <p><b>Outputsize</b> is not necessary and must not be specified for fixed-size output parameters.</p> <p>The value specified on the attribute is used as the total size for the element including all children of the element. Therefore, the <b>outputsize</b> attribute is ignored on any children or descendants of the element.</p> <p>If the attribute is omitted, the number of bytes to reserve for output data is determined at runtime by adding the number of bytes to reserve for all of the children of the <b>&lt;struct&gt;</b> element.</p>
<b>usage=</b>	<i>inherit</i>	Usage is inherited from the parent element. If the structure does not have a parent, usage is assumed to be <b>inputoutput</b> .
	<i>input</i>	The structure is an input value to the host program. For character and numeric types, the appropriate conversion is performed.
	<i>output</i>	The structure is an output value from the host program. For character and numeric types, the appropriate conversion is performed.
	<i>inputoutput</i>	The structure is both an input and an output value.

## Specifying offsets

Some programs return information with a fixed structure followed by one or more variable length fields or structures. In this case, the location of a variable length element is typically specified as an offset or displacement within the parameter.

An offset is the distance in bytes from the beginning of the parameters to the beginning of a field or structure. A displacement is the distance in bytes from the beginning of one structure to the beginning of another structure.

For offsets, since the distance is from the beginning of the parameter, specify **offsetfrom="0"**. The following is an example of an offset from the beginning of the parameter:

```
<pcml version="1.0">
  <program name="myprog" path="/QSYS.lib/MYLIB.lib/MYPROG.pgm">
    <!-- receiver variable contains a path -->
    <struct name="receiver" usage="output" outputsize="2048">
      <data name="pathType" type="int" length="4" />
      <data name="offsetToPathName" type="int" length="4" />
      <data name="lengthOfPathName" type="int" length="4" />
      <data name="pathName" type="char" length="lengthOfPathName"
        offset="offsetToPathName" offsetfrom="0"/>
    </struct>
  </program>
</pcml>
```

For displacements, since the distance is from the beginning of another structure, you specify the name of the structure to which the offset is relative. The following is an example of a displacement from the beginning of a named structure:

```
<pcml version="1.0">
  <program name="myprog" path="/QSYS.lib/MYLIB.lib/MYPROG.pgm">
    <!-- receiver variable contains an object -->
    <struct name="receiver" usage="output" >
      <data name="objectName" type="char" length="10" />
      <data name="libraryName" type="char" length="10" />
      <data name="objectType" type="char" length="10" />
      <struct name="pathInfo" usage="output" outputsize="2048" >
        <data name="pathType" type="int" length="4" />
        <data name="offsetToPathName" type="int" length="4" />
        <data name="lengthOfPathName" type="int" length="4" />
        <data name="pathName" type="char" length="lengthOfPathName"
          offset="offsetToPathName" offsetfrom="pathInfo"/>
      </struct>
    </struct>
  </program>
</pcml>
```

## PCML data tag

The PCML data tag can have the following attributes.

Attributes enclosed in brackets, [], indicate that the attribute is optional. If you specify an optional attribute, do not include the brackets in your source. Some attribute values are shown as a list of choices enclosed in braces, {}, with possible choices separated by vertical bars, |. When you specify one of these attributes, do not include the braces in your source and only specify one of the choices shown.

```
<data type="{ char | int | packed | zoned | float | byte | struct | date | time | timestamp }"
  [ bidstringtype="{ ST4 | ST5 | ST6 | ST7 | ST8 | ST9 | ST10 | ST11 | DEFAULT }" ]
  [ ccid="{ number | data-name }" ]
  [ chartype="{ onebyte | twobyte }" ]
  [ count="{ number | data-name }" ]
  [ init="string" ]
  [ length="{ number | data-name }" ]
  [ maxvrm="version-string" ]
  [ minvrm="version-string" ]
  [ name="name" ]
  [ offset="{ number | data-name }" ]
  [ offsetfrom="{ number | data-name | struct-name }" ]
  [ outputsize="{ number | data-name | struct-name }" ]
  [ passby="{ reference | value }" ]
  [ precision="number" ]
  [ struct="struct-name" ]
```

```

[ trim="{ right | left | both | none }" ]
[ usage="{ inherit | input | output | inputoutput }" ]>
[ dateformat="{ MDY | DMY | YMD | JUL | ISO | USA | EUR | JIS | CYMD | CMDY | CDMY | LONGJUL
| MY | YM | MYY | YMM }" ]>
[ dateseparator="{ ampersand, blank | colon | comma | hyphen | period | slash }" ]>
[ timeformat="{ HMS | ISO | USA | EUR | JIS | USA | EUR | JIS }" ]>
[ timeseparator="{ ampersand, blank | colon | comma | hyphen | period | slash }" ]>
</data>

```

The following table lists the data tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.



Attribute	Value	Description
<b>type=</b>	<p><i>char</i> where <i>char</i> indicates a character value. A <i>char</i> data value is returned as a <i>java.lang.String</i>. For more information, see the <a href="#">char values for length</a>.</p> <p><i>int</i> where <i>int</i> is an integer value. An <i>int</i> data value is returned as a <i>java.lang.Long</i>. For more information, see the <a href="#">int values for length and precision</a>.</p> <p><i>packed</i> where <i>packed</i> is a packed decimal value. A <i>packed</i> data value is returned as a <i>java.math.BigDecimal</i>. For more information, see the <a href="#">packed values for length and precision</a>.</p> <p><i>zoned</i> where <i>zoned</i> is a zoned decimal value. A <i>zoned</i> data value is returned as a <i>java.math.BigDecimal</i>. For more information, see the <a href="#">zoned values for length and precision</a>.</p> <p><i>float</i> where <i>float</i> is a floating point value. The <b>length</b> attribute specifies the number of bytes, "4" or "8". A 4-byte integer is returned as a <i>java.lang.Float</i>. An 8-byte integer is returned as a <i>java.lang.Double</i>. For more information, see the <a href="#">float values for length</a>.</p> <p><i>byte</i> where <i>byte</i> is a byte value. No conversion is performed on the data. A <i>byte</i> data value is returned as an array of <i>byte</i> values (<i>byte[]</i>). For more information, see the <a href="#">byte values for length</a>.</p> <p><i>struct</i> where <i>struct</i> specifies the name of the <b>&lt;struct&gt;</b> element. A <i>struct</i> allows you to define a structure once and reuse it multiple times within the document. When you <b>type="struct"</b>, it is as if the structure specified appeared at this location in the document. A <i>struct</i> does not allow for a length value and has no value for precision.</p> <p><i>date</i> where <i>date</i> is a date value.</p> <p><i>time</i> where <i>time</i> is a time value.</p> <p><i>timestamp</i> where <i>timestamp</i> is a timestamp value. 26 bytes value is support with format yyyy-MM-</p>	<p>Indicates the type of data being used (character, integer, packed, zoned, floating point, byte, struct, date, time, or timestamp).</p> <p><b>Note:</b> Types date, time and timestamp are only allowed when the PCML version is 6.0 or higher. (For example &lt;pcml version="6.0"&gt;)</p> <p>Values for the length and precision attributes are different for different data types. For more information, see the <a href="#">Values for length and precision</a>.</p>

Attribute	Value	Description
<b>bidstringtype=</b>	<p><i>DEFAULT</i> where <i>DEFAULT</i> is the default string type for non-bidirectional data (LTR).</p> <p><i>ST4</i> where <i>ST4</i> is <a href="#">String Type 4</a>.</p> <p><i>ST5</i> where <i>ST5</i> is <a href="#">String Type 5</a>.</p> <p><i>ST6</i> where <i>ST6</i> is <a href="#">String Type 6</a>.</p> <p><i>ST7</i> where <i>ST7</i> is <a href="#">String Type 7</a>.</p> <p><i>ST8</i> where <i>ST8</i> is <a href="#">String Type 8</a>.</p> <p><i>ST9</i> where <i>ST9</i> is <a href="#">String Type 9</a>.</p> <p><i>ST10</i> where <i>ST10</i> is <a href="#">String Type 10</a>.</p> <p><i>ST11</i> where <i>ST11</i> is <a href="#">String Type 11</a>.</p>	<p>Specifies the bidirectional string type for <b>&lt;data&gt;</b> elements with <b>type="char"</b>. If this attribute is omitted, string type for this element is implied by the CCSID (whether explicitly specified or the default CCSID of the host environment).</p> <p>String types are defined in the javadoc for the <a href="#">BidiStringType class</a>.</p>
<b>ccsid=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing CCSID.</p> <p><i>data-name</i> where <i>data-name</i> defines the name that will contain, at runtime, the CCSID of the character data. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the host Coded Character Set ID (CCSID) for character data for the <b>&lt;data&gt;</b> element. The <b>ccsid</b> attribute can be specified only for <b>&lt;data&gt;</b> elements with <b>type="char"</b>.</p> <p>If this attribute is omitted, character data for this element is assumed to be in the default CCSID of the host environment.</p>
<b>chartype=</b>	<p><i>onebyte</i> where <i>onebyte</i> specifies the size of each character.</p> <p><i>twobyte</i> where <i>twobyte</i> specifies the size of each character.</p> <p>When using <i>chartype</i>, the <b>length="number"</b> attribute specifies the number of characters, not the number of bytes.</p>	<p>Specifies the size of each character.</p>

Attribute	Value	Description
<b>count=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing number of elements in a sized array.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the number of elements in the array. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies that the element is an array and identifies the number of entries in the array.</p> <p>If the <i>count</i> attribute is omitted, the element is not defined as an array, although it may be contained within another element that is defined as an array.</p>
<b>init=</b>	<i>string</i>	<p>Specifies an initial value for the <b>&lt;data&gt;</b> element. The <i>init</i> value is used if an initial value is not explicitly set by the application program when <b>&lt;data&gt;</b> elements with <b>usage="input"</b> or <b>usage="inputoutput"</b> are used.</p> <p>The initial value specified is used to initialize scalar values. If the element is defined as an array or is contained within a structure defined as an array, the initial value specified is used as an initial value for all entries in the array.</p>

Attribute	Value	Description
<b>length=</b>	<p><i>number</i> where <i>number</i> defines the number of bytes that the data requires. However, when using the <i>chartype</i> attribute, <i>number</i> specifies the number of characters, not the number of bytes.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the length. A <i>data-name</i> can be specified only for <b>&lt;data&gt;</b> elements with <b>type="char"</b> or <b>type="byte"</b>. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the length of the data element. Usage of this attribute varies depending on the data type. For more information, see the <a href="#">Values for length and precision</a>.</p>
<b>maxvrm=</b>	<i>version-string</i>	<p>Specifies the highest version of IBM i on which this element exists. If the IBM i version is greater than the version specified on this attribute, this element and its children, if any exist, will not be processed during a call to a program. This attribute is helpful for defining program interfaces which differ between releases of IBM i.</p> <p>The syntax of the version string must be "VvRrMm", where the capitals letters "V," "R," and "M" are literal characters and "v," "r," and "m" are one or more digits representing the version, release and modification level. The value for "v" must be from 1 to 255 inclusively. The value for "r" and "m" must be from 0 to 255, inclusively.</p>

Attribute	Value	Description
<b>minvrm=</b>	<i>version-string</i>	<p>Specifies the lowest version of IBM i on which this element exists. If the IBM i version is less than the version specified on this attribute, this element and its children, if any exist, will not be processed during a call to a program. This attribute is helpful for defining program interfaces which differ between releases of IBM i.</p> <p>The syntax of the version string must be "VvRrMm," where the capitals letters "V," "R," and "M" are literal characters and "v," "r," and "m" are one or more digits representing the version, release and modification level. The value for "v" must be from 1 to 255 inclusively. The value for "r" and "m" must be from 0 to 255, inclusively.</p>
<b>name=</b>	<i>name</i>	Specifies the name of the <b>&lt;data&gt;</b> element.

Attribute	Value	Description
<b>offset=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing offset.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the offset to this element. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the offset to the <b>&lt;data&gt;</b> element within an output parameter.</p> <p>Some programs return information with a fixed structure followed by one or more variable length fields or structures. In this case, the location of a variable length element is typically specified as an offset or displacement within the parameter.</p> <p>An <b>offset</b> attribute is used in conjunction with the <b>offsetfrom</b> attribute. If the <b>offsetfrom</b> attribute is not specified, the base location for the offset specified on the <b>offset</b> attribute is the parent of this element. See <a href="#">Specifying Offsets</a> for more information on how to use the <b>offset</b> and <b>offsetfrom</b> attributes.</p> <p>The <b>offset</b> and <b>offsetfrom</b> attributes are only used to process output data from a program. These attributes do not control the offset or displacement of input data.</p> <p>If this attribute is omitted, the location of the data for this element is immediately following the preceding element in the parameter, if any.</p>

Attribute	Value	Description
<b>offsetfrom=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing base location. <i>Number</i> is most typically used to specify <b>number="0"</b> indicating that the offset is an absolute offset from the beginning of the parameter.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element used as a base location for the offset. The element name specified must be the parent or an ancestor of this element. The value from the <b>offset</b> attribute will be relative to the location of the element specified on this attribute. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference an ancestor of this element. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p> <p><i>struct-name</i> where <i>struct-name</i> defines the name of a <b>&lt;struct&gt;</b> element used as a base location for the offset. The element name specified must be the parent or an ancestor of this element. The value from the <b>offset</b> attribute will be relative to the location of the element specified on this attribute. The <i>struct-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference an ancestor of this element. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the base location from which the <b>offset</b> attribute is relative.</p> <p>If the <b>offsetfrom</b> attribute is not specified, the base location for the offset specified on the <b>offset</b> attribute is the parent of this element. See <a href="#">Specifying Offsets</a> for more information about how to use the <b>offset</b> and <b>offsetfrom</b> attributes.</p> <p>The <b>offset</b> and <b>offsetfrom</b> attributes are only used to process output data from a program. These attributes do not control the offset or displacement of input data.</p>

Attribute	Value	Description
<b>outputsize=</b>	<p><i>number</i> where a <i>number</i> defines a fixed, never-changing number of bytes to reserve.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the PCML document that will contain, at runtime, the number of bytes to reserve for output data. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the number of bytes to reserve for output data for the element. For output parameters which are variable in length, the <b>outputsize</b> attribute is needed to specify how many bytes must be reserved for data to be returned from the IBM i program. An <b>outputsize</b> attribute can be specified on all variable length fields and variable sized arrays, or it can be specified for an entire parameter that contains one or more variable length fields.</p> <p><b>Outputsize</b> is not necessary and must not be specified for fixed-size output parameters.</p> <p>The value specified on this attribute is used as the total size for the element including all the children of the element. Therefore, the <b>outputsize</b> attribute is ignored on any children or descendants of the element.</p> <p>If <b>outputsize</b> is omitted, the number of bytes to reserve for output data is determined at runtime by adding the number of bytes to reserve for all of the children of the <b>&lt;struct&gt;</b> element.</p>
<b>passby=</b>	<p><i>reference</i> where <i>reference</i> indicates that the parameter will be passed by reference. When the program is called, the program will be passed a pointer to the parameter value.</p> <p><i>value</i> where <i>value</i> indicates an integer value. This value is allowed only when <b>type="int"</b> and <b>length="4"</b> is specified.</p>	<p>Specifies whether the parameter is passed by reference or passed by value. This attribute is allowed only when this element is a child of a <b>&lt;program&gt;</b> element defining a service program call.</p>
<b>precision=</b>	<i>number</i>	<p>Specifies the number of bytes of precision for some numeric data types. For more information, see the <a href="#">Values for length and precision</a>.</p>
<b>struct=</b>	<i>name</i>	<p>Specifies the name of a <b>&lt;struct&gt;</b> element for the <b>&lt;data&gt;</b> element. A <b>struct</b> attribute can be specified only for <b>&lt;data&gt;</b> elements with <b>type="struct"</b>.</p>



Attribute	Value	Description
<b>trim=</b>	<p><i>right</i> where <i>right</i> is the default behavior that means to trim trailing white spaces.</p> <p><i>left</i> where <i>left</i> means to trim preceding white spaces.</p> <p><i>both</i> where <i>both</i> means to trim both preceding and trailing white spaces.</p> <p><i>none</i> where <i>none</i> means that white spaces are not trimmed.</p>	Specifies how to trim white space from character data.
<b>usage=</b>	<i>inherit</i>	Usage is inherited from the parent element. If the structure does not have a parent, usage is assumed to be <i>inputoutput</i> .
	<i>input</i>	Defines an input value to the host program. For character and numeric types, the appropriate conversion is performed.
	<i>output</i>	Defines an output value from the host program. For character and numeric types, the appropriate conversion is performed.
	<i>inputoutput</i>	Defines both an input and an output value.

Attribute	Value	Description
<b>dateformat</b>	<p><i>MDY</i> (mm/dd/yy), Default separator: '/'</p> <p><i>DMY</i> (dd/mm/yy), Default separator: '/'</p> <p><i>YMD</i> (yy/mm/dd), Default separator: '/'</p> <p><i>JUL</i> (yy/ddd), Default separator: '/'</p> <p><i>ISO</i> (yyyy-mm-dd), Default separator: '-'</p> <p><i>USA</i> (mm/dd/yyyy), Default separator: '/'</p> <p><i>EUR</i> (dd.mm.yyyy), Default separator: '.'</p> <p><i>JIS</i> (yyyy-mm-dd), Default separator: '-'</p> <p><i>CYMD</i> (cyy/mm/dd), Default separator: '/'</p> <p><i>CMDY</i> (cmm/dd/yy), Default separator: '/'</p> <p><i>CDMY</i> (cdd/mm/yy), Default separator: '/'</p> <p><i>LONGJUL</i> (yyyy/ddd), Default separator: '/'</p> <p><i>MY</i> (mm/yy), Default separator: '/'</p> <p><i>YM</i> (yy/mm), Default separator: '/'</p> <p><i>MYY</i> (mm/yyyy), Default separator: '/'</p> <p><i>YMM</i> (yyyy/mm), Default separator: '/'</p>	<p>Specify the date format for &lt;data&gt; elements with <code>type="date"</code> .</p> <p>If this attribute is omitted, date format ISO is used by default.</p> <p><b>Note:</b> Note: This attribute is only allowed when the PCML version is 6.0 or higher. (For example &lt;pcml version="6.0"&gt;)</p>
<b>dateseparator</b>	<p><i>ampersand</i> separate with '&amp;'</p> <p><i>blank</i> separate with ''</p> <p><i>colon</i> separate with ':'</p> <p><i>comma</i> separate with ','</p> <p><i>hyphen</i> separate with '-'</p> <p><i>period</i> separate with '.'</p> <p><i>slash</i> separate with '/'</p>	<p>Specify the date separator for &lt;data&gt; elements with <code>type="date"</code> .</p> <p>If this attribute is omitted, the default date separate for each dateFormat is used.</p> <p><b>Note:</b> This attribute is only allowed when the PCML version is 6.0 or higher. (For example &lt;pcml version="6.0"&gt;)</p>

Attribute	Value	Description
<b>timeformat</b>	<p><i>HMS</i> (hh:mm:ss), Default separator: ':'</p> <p><i>ISO</i> (hh.mm.ss), Default separator: '.'</p> <p><i>USA</i> (hh:mm AM), Default separator: ':'</p> <p><i>EUR</i> (hh.mm.ss), Default separator: '.'</p> <p><i>JIS</i> (hh:mm:ss), Default separator: ':'</p>	<p>Specify the time format for <b>&lt;data&gt;</b> elements with <b>type="time"</b>.</p> <p>If this attribute is omitted, time format ISO is used by default.</p> <p><b>Note:</b> This attribute is only allowed when the PCML version is 6.0 or higher. (For example <code>&lt;pcml version="6.0"&gt;</code>)</p>
<b>timeseparator</b>	<p><i>ampersand</i> separate with '&amp;'</p> <p><i>blank</i> separate with ' '</p> <p><i>colon</i> separate with ':'</p> <p><i>comma</i> separate with ','</p> <p><i>hyphen</i> separate with '-'</p> <p><i>period</i> separate with '.'</p> <p><i>slash</i> separate with '/'</p>	<p>Specify the time format for <b>&lt;data&gt;</b> elements with <b>type="time"</b>.</p> <p>If this attribute is omitted, the default time separate for each timeFormat is used.</p> <p><b>Note:</b> This attribute is only allowed when the PCML version is 6.0 or higher. (For example <code>&lt;pcml version="6.0"&gt;</code>)</p>

## Specifying offsets

Some programs return information with a fixed structure followed by one or more variable length fields or structures. In this case, the location of a variable length element is typically specified as an offset or displacement within the parameter.

An offset is the distance in bytes from the beginning of the parameters to the beginnings of a field or structure. A displacement is the distance in bytes from the beginning of one structure to the beginning of another structure.

For offsets, since the distance is from the beginning of the parameter, you must specify **offsetfrom="0"**. The following is an example of an offset from the beginning of the parameter:

```
<pcml version="1.0">
  <program name="myprog" path="/QSYS.lib/MYLIB.lib/MYPROG.pgm">
    <!-- receiver variable contains a path -->
    <struct name="receiver" usage="output" outputsize="2048">
      <data name="pathType" type="int" length="4" />
      <data name="offsetToPathName" type="int" length="4" />
      <data name="lengthOfPathName" type="int" length="4" />
      <data name="pathName" type="char" length="lengthOfPathName"
        offset="offsetToPathName" offsetfrom="0"/>
    </struct>
  </program>
</pcml>
```

For displacements, since the distance is from the beginning of another structure, you specify the name of the structure to which the offset is relative. The following is an example of an displacement from the beginning of a named structure:

```
<pcml version="1.0">
  <program name="myprog" path="/QSYS.lib/MYLIB.lib/MYPROG.pgm">
    <!-- receiver variable contains an object -->
    <struct name="receiver" usage="output" >
      <data name="objectName" type="char" length="10" />
      <data name="libraryName" type="char" length="10" />
    </struct>
  </program>
</pcml>
```

```

<data name="objectType" type="char" length="10" />
<struct name="pathInfo" usage="output" outputsize="2048" >
  <data name="pathType" type="int" length="4" />
  <data name="offsetToPathName" type="int" length="4" />
  <data name="lengthOfPathName" type="int" length="4" />
  <data name="pathName" type="char" length="lengthOfPathName"
    offset="offsetToPathName" offsetfrom="pathInfo"/>
</struct>
</struct>
</program>
</pcml>

```

### Values for length and precision

Values for the length and precision attributes are different for different data types.

The following table lists each data type with a description of the possible values for length and precision.

Data type	Length	Precision
<b>type="char"</b>	The number of bytes of data for this element, which is not necessarily the number of characters. You must specify either a literal <i>number</i> or a <i>data-name</i> .	Not applicable
<b>type="int"</b>	The number of bytes of data for this element: 2, 4, or 8. You must specify a literal <i>number</i> .	Indicates the number of bits of precision and whether the integer is signed or unsigned: <ul style="list-style-type: none"> <li>• For <b>length="2"</b> <ul style="list-style-type: none"> <li>– Use <b>precision="15"</b> for a signed 2-byte integer. This is the default value</li> <li>– Use <b>precision="16"</b> for an unsigned 2-byte integer</li> </ul> </li> <li>• For <b>length="4"</b> <ul style="list-style-type: none"> <li>– Use <b>precision="31"</b> for a signed 4-byte integer</li> <li>– Use <b>precision="32"</b> for an unsigned 4-byte integer</li> </ul> </li> <li>• For <b>length="8"</b> <ul style="list-style-type: none"> <li>– Use <b>precision="63"</b> for a signed 8-byte integer</li> <li>– Use <b>precision="64"</b> for an unsigned 8-byte integer</li> </ul> </li> </ul>
<b>type="packed" or "zoned"</b>	The number of numeric digits of data for this element. You must specify a literal <i>number</i> .	The number of decimal digits for the element. This number must be greater than or equal to zero and less than or equal to the total number of digits specified on the <b>length</b> attribute.
<b>type="float"</b>	The number of bytes, 4 or 8, of data for this element. You must specify a literal <i>number</i> .	Not applicable

Data type	Length	Precision
<b>type</b> ="byte"	The number of bytes of data for this element. You must specify either a literal <i>number</i> or <i>data-name</i> .	Not applicable
<b>type</b> ="struct" or "date" or "time" or "timestamp"	Not allowed.	Not applicable

## Resolving relative names

Several attributes allow you to specify the name of another element, or tag, within the document as the attribute value. The name specified can be a name that is relative to the current tag.

Names are resolved by seeing if the name can be resolved as a child or descendent of the tag containing the current tag. If the name cannot be resolved at this level, the search continues with the next highest containing tag. This resolution must eventually result in a match of a tag that is contained by either the **<pcml>** tag or the **<rfml>** tag, in which case the name is considered to be an absolute name, not a relative name.

Here is an example using PCML:

```
<pcml version="1.0">
  <program name="polytest" path="/QSYS.lib/MYLIB.lib/POLYTEST.pgm">
    <!-- Parameter 1 contains a count of polygons along with an array of polygons -->
    <struct name="parm1" usage="inputoutput">
      <data name="nbrPolygons" type="int" length="4" init="5" />
      <!-- Each polygon contains a count of the number of points along with an array of points -->
    -->
      <struct name="polygon" count="nbrPolygons">
        <data name="nbrPoints" type="int" length="4" init="3" />
        <struct name="point" count="nbrPoints" >
          <data name="x" type="int" length="4" init="100" />
          <data name="y" type="int" length="4" init="200" />
        </struct>
      </struct>
    </struct>
  </program>
</pcml>
```

Here is an example using RFML:

```
<rfml version="4.0">
  <struct name="polygon">
    <!-- Each polygon contains a count of the number of points along with an array of points. -->
  -->
    <data name="nbrPoints" type="int" length="4" init="3" />
    <data name="point" type="struct" struct="point" count="nbrPoints" />
  </struct>
  <struct name="point" >
    <data name="x" type="int" length="4" init="100" />
    <data name="y" type="int" length="4" init="200" />
  </struct>
  <recordformat name="polytest">
    <!-- This format contains a count of polygons along with an array of polygons -->
    <data name="nbrPolygons" type="int" length="4" init="5" />
    <data name="polygon" type="struct" struct="polygon" count="nbrPolygons" />
  </recordformat>
</rfml>
```

## Record Format Markup Language

The Record Format Markup Language (RFML) is an XML extension for specifying record formats.

The IBM Toolbox for Java RFML component enables your Java applications to use RFML documents to specify and manipulate fields within certain kinds of records.

RFML documents, called RFML source files, represent a useful subset of the data description specification (DDS) data types defined for IBM i physical and logical files. You can use RFML documents to manage the information in the following:

- File records
- Data queue entries
- User spaces
- Arbitrary data buffers

**Note:** For more information about using DDS to describe data attributes, see the [DDS Reference](#).

RFML closely resembles [Program Call Markup Language \(PCML\)](#), another XML extension that is supported by IBM Toolbox for Java. RFML is neither a subset nor a superset of PCML, but rather a kind of sibling language that adds a few new elements and attributes and omits others.

PCML provides an XML-oriented alternative to using the `ProgramCall` and `ProgramParameter` classes. Similarly, RFML provides a user-friendly, easily maintainable alternative to the `Record`, `RecordFormat`, and `FieldDescription` classes.

### Related information

[Data description specifications](#)

## Requirements for using RFML

The RFML component has the same workstation Java virtual machine requirements as the rest of the IBM Toolbox for Java.

In addition, in order to parse RFML at run time, the CLASSPATH for the application must include an XML parser. The XML parser must extend class `org.apache.xerces.parsers.SAXParser`. For more information, see [“XML parser and XSLT processor”](#) on page 311.

**Note:** RFML has the same parser requirements as PCML. As with PCML, if you preserialize the RFML file, you do not need to include an XML parser in the application CLASSPATH to run the application.

### Related reference

[“Workstation requirements for IBM Toolbox for Java”](#) on page 5  
Ensure that your workstation meets the following requirements.

## Example: Using RFML compared to using IBM Toolbox for Java Record classes

This example illustrates the differences between using RFML and using the IBM Toolbox for Java Record classes.

Using the traditional Record classes, you interweave the data format specifications with the business logic of your application. Adding, changing, or deleting a field means that you must edit and recompile your Java code. However, using RFML isolates the data format specifications into RFML source files that are entirely separate from the business logic. Accommodating field changes means modifying the RFML file, often without having to change or recompile your Java application.

The example assumes that your application deals with customer records, which you have defined in an [RFML source file](#) and named `qcustcdt.rfml`. The source file represents the fields that compose each customer record.

The listing below shows how a Java application might interpret a customer record using the IBM Toolbox for Java `Record`, `RecordFormat`, and `FieldDescription` classes:

```
// Buffer containing the binary representation of one record of information.
byte[] bytes;

// ... Read the record data into the buffer ...

// Set up a RecordFormat object to represent one customer record.
RecordFormat recFmt1 = new RecordFormat("cusrec");
recFmt1.addFieldDescription(new ZonedDecimalFieldDescription(new AS400ZonedDecimal(6, 0),
"cusnum"));
```

```

recFmt1.addFieldDescription(new CharacterFieldDescription(new AS400Text(8, 37), "lstnam"));
recFmt1.addFieldDescription(new CharacterFieldDescription(new AS400Text(3, 37), "init"));
recFmt1.addFieldDescription(new CharacterFieldDescription(new AS400Text(13, 37), "street"));
recFmt1.addFieldDescription(new CharacterFieldDescription(new AS400Text(6, 37), "city"));
recFmt1.addFieldDescription(new CharacterFieldDescription(new AS400Text(2, 37), "state"));
recFmt1.addFieldDescription(new ZonedDecimalFieldDescription(new AS400ZonedDecimal(5, 0),
"zipcod"));
recFmt1.addFieldDescription(new ZonedDecimalFieldDescription(new AS400ZonedDecimal(4, 0),
"cdtlmt"));
recFmt1.addFieldDescription(new ZonedDecimalFieldDescription(new AS400ZonedDecimal(1, 0),
"chgcod"));
recFmt1.addFieldDescription(new ZonedDecimalFieldDescription(new AS400ZonedDecimal(6, 2),
"baldue"));
recFmt1.addFieldDescription(new ZonedDecimalFieldDescription(new AS400ZonedDecimal(6, 2),
"cdtdue"));

// Read the byte buffer into the RecordFormatDocument object.
Record rec1 = new Record(recFmt1, bytes);

// Get the field values.
System.out.println("cusnum: " + rec1.getField("cusnum"));
System.out.println("lstnam: " + rec1.getField("lstnam"));
System.out.println("init: " + rec1.getField("init"));
System.out.println("street: " + rec1.getField("street"));
System.out.println("city: " + rec1.getField("city"));
System.out.println("state: " + rec1.getField("state"));
System.out.println("zipcod: " + rec1.getField("zipcod"));
System.out.println("cdtlmt: " + rec1.getField("cdtlmt"));
System.out.println("chgcod: " + rec1.getField("chgcod"));
System.out.println("baldue: " + rec1.getField("baldue"));
System.out.println("cdtdue: " + rec1.getField("cdtdue"));

```

By comparison, here is how the same record might be interpreted using RFML.

The Java code to interpret the contents of the customer data record using RFML might look like this:

```

// Buffer containing the binary representation of one record of
information.
byte[] bytes;

// ... Read the record data into the buffer ...

// Parse the RFML file into a RecordFormatDocument object.
// The RFML source file is called qcustcdt.rfml.
RecordFormatDocument rfml1 = new RecordFormatDocument("qcustcdt");

// Read the byte buffer into the RecordFormatDocument object.
rfml1.setValues("cusrec", bytes);

// Get the field values.
System.out.println("cusnum: " + rfml1.getValue("cusrec.cusnum"));
System.out.println("lstnam: " + rfml1.getValue("cusrec.lstnam"));
System.out.println("init: " + rfml1.getValue("cusrec.init"));
System.out.println("street: " + rfml1.getValue("cusrec.street"));
System.out.println("city: " + rfml1.getValue("cusrec.city"));
System.out.println("state: " + rfml1.getValue("cusrec.state"));
System.out.println("zipcod: " + rfml1.getValue("cusrec.zipcod"));
System.out.println("cdtlmt: " + rfml1.getValue("cusrec.cdtlmt"));
System.out.println("chgcod: " + rfml1.getValue("cusrec.chgcod"));
System.out.println("baldue: " + rfml1.getValue("cusrec.baldue"));
System.out.println("cdtdue: " + rfml1.getValue("cusrec.cdtdue"));

```

## RecordFormatDocument class

The RecordFormatDocument class enables your Java programs to convert between RFML representations of data and Record and RecordFormat objects for use with other IBM Toolbox for Java components.

[RecordFormatDocument class](#)

The RecordFormatDocument class represents an RFML source file, and it provides methods that allow your Java program to perform the following actions:

- Compose RFML source files from Record objects, RecordFormat objects, and byte arrays
- Generate Record objects, RecordFormat objects, and byte arrays that represent the information that the RecordFormatDocument object contains
- Get and set the values of different objects and data types
- Generate XML (RFML) that represents the data that the RecordFormatDocument object contains
- Serialize the RFML source file that the RecordFormatDocument object represents

For more information about the available methods, see the Javadoc method summary for the RecordFormatDocument class.

### Using the RecordFormatDocument class with other IBM Toolbox for Java classes

Use the RecordFormatDocument class with the following IBM Toolbox for Java classes:

- Record-oriented classes, which include the record-level access file classes (AS400File, SequentialFile, and KeyedFile) that read, manipulate, and write Record objects. This category also includes the LineDataRecordWriter class.
- Byte-oriented classes, which include certain DataQueue, UserSpace, and IFSFile classes that read and write a byte-array of data at a time.

Do not use RecordFormatDocument class with the following IBM Toolbox for Java classes, which read and write data in forms that RecordFormatDocument does not handle:

- The DataArea classes because the read and write methods deal only with String, boolean, and BigDecimal data types.
- IFSTextFileInputStream and IFSTextFileOutputStream because these read and write methods deal only with String.
- JDBC classes because RFML focuses only on data described by the [IBM i data description specification \(DDS\)](#).

### Related information

[RecordFormatDocument Javadoc](#)

## Record format documents and RFML syntax

RFML documents, called RFML source files, contain tags that define the specification for a particular data format.

Because RFML is based on PCML, the syntax is familiar to PCML users. Because RFML is an XML extension, RFML source files are easy to read and simple to create. For example, you can create an RFML source file by using a simple text editor. Also, RFML source files reveal the structure of the data in a way that is easier to understand than in a programming language like Java.

The RFML example [Using RFML compared to using IBM Toolbox for Java Record classes](#) includes an example [RFML source file](#).

### RFML DTD

The [RFML document type definition \(DTD\)](#) defines valid RFML elements and syntax. To ensure that an XML parser can validate your RFML source file at runtime, declare the RFML DTD in the source file:

```
<!DOCTYPE rfml SYSTEM "rfml.dtd">
```

The RFML DTD resides in the jt400.jar file (com/ibm/as400/data/rfml.dtd).

### RFML syntax

The RFML DTD defines tags, each of which has its own attribute tags. You use the RFML tags to declare and define the elements in your RFML files.



In the following example, RFML syntax describes one record format and one structure:

```
<rfml>
  <recordformat>
    <data> </data>
  </recordformat>

  <struct>
    <data> </data>
  </struct>
</rfml>
```

### **RFML document type definition (DTD)**

This is the RFML DTD. Note that the version is 4.0. The RFML DTD resides in the jt400.jar file (com/ibm/as400/data/rfml.dtd).

```
<!--
Record Format Markup Language (RFML) Document Type Definition.

RFML is an XML language. Typical usage:
  <?xml version="1.0"?>
  <!DOCTYPE rfml SYSTEM "rfml.dtd">
  <rfml version="4.0">
  ...
  </rfml>

(C) Copyright IBM Corporation, 2001,2002
All rights reserved. Licensed Materials Property of IBM
US Government Users Restricted Rights
Use, duplication or disclosure restricted by
GSA ADP Schedule Contract with IBM Corp.
-->

<!-- Convenience entities -->
<!ENTITY % string "CDATA" <!-- a string of length 0 or greater -->
<!ENTITY % nonNegativeInteger "CDATA" <!-- a non-negative integer -->
<!ENTITY % binary2 "CDATA" <!-- an integer in range 0-65535 -->
<!ENTITY % boolean "(true|false)"
<!ENTITY % datatype "(char | int | packed | zoned | float | byte | struct)"
<!ENTITY % biditype "(ST4 | ST5 | ST6 | ST7 | ST8 | ST9 | ST10 | ST11 | DEFAULT)"

<!-- The document root element -->
<!ELEMENT rfml (struct | recordformat)+
<ATTLIST rfml
  version %string; #FIXED "4.0"
  ccsid %binary2; #IMPLIED
>
<!-- Note: The ccsid is the default value that will be used for -->
<!-- any contained <data type="char"> elements that do not specify a ccsid. -->

<!-- Note: RFML does not support nested struct declarations. -->
<!-- All struct elements are direct children of the root node. -->
<!ELEMENT struct (data)+
<ATTLIST struct
  name ID #REQUIRED
>

<!-- <!ELEMENT recordformat (data | struct)*> -->
<!ELEMENT recordformat (data)*
<ATTLIST recordformat
  name ID #REQUIRED
  description %string; #IMPLIED
>
<!-- Note: On the server, the Record "text description" field is limited to 50 bytes. -->

<!ELEMENT data EMPTY>
<ATTLIST data
  name %string; #REQUIRED
  count %nonNegativeInteger; #IMPLIED
  type %datatype; #REQUIRED
```

```

length          %nonNegativeInteger; #IMPLIED
precision       %nonNegativeInteger; #IMPLIED
ccsid           %binary2;           #IMPLIED
init            CDATA                #IMPLIED
struct         IDREF                 #IMPLIED

    bidistringtype %biditype;        #IMPLIED
>
<!-- Note: The 'name' attribute must be unique within a given recordformat. -->
<!-- Note: On the server, the length of Record field names is limited to 10 bytes. -->
<!-- Note: The 'length' attribute is required, except when type="struct". -->
<!-- Note: If type="struct", then the 'struct' attribute is required. -->
<!-- Note: The 'ccsid' and 'bidistringtype' attributes are valid only when type="char". -->
<!-- Note: The 'precision' attribute is valid only for types "int", "packed", and "zoned". -->

<!-- The standard predefined character entities -->
<!ENTITY quot "&#34;"> <!-- quotation mark -->
<!ENTITY amp "&#38;#38;"> <!-- ampersand -->
<!ENTITY apos "&#39;"> <!-- apostrophe -->
<!ENTITY lt "&#38;#60;"> <!-- less than -->
<!ENTITY gt "&#62;"> <!-- greater than -->
<!ENTITY nbsp "&#160;"> <!-- non-breaking space -->
<!ENTITY shy "&#173;"> <!-- soft hyphen (discretionary hyphen) -->
<!ENTITY mdash "&#38;#x2014;">
<!ENTITY ldquo "&#38;#x201C;">
<!ENTITY rdquo "&#38;#x201D;">

```

## The RFML data tag

The RFML data tag defines a field within a record format or structure.

Listed below are the attributes for the data tag. Attributes enclosed in brackets, [], indicate that the attribute is optional. If you specify an optional attribute, do not include the brackets in your source. Some attribute values are shown as a list of choices enclosed in braces, {}, with possible choices separated by vertical bars, |. When you specify one of these attributes, do not include the braces in your source and only specify one of the choices shown.

```

<data type="{ char | int | packed | zoned | float | byte | struct }" ]
  [ bidistringtype="{ ST4 | ST5 | ST6 | ST7 | ST8 | ST9 | ST10 | ST11 | DEFAULT }" ]
  [ ccsid="{ number | data-name }" ]
  [ count="{ number | data-name }" ]
  [ init="{ string }" ]
  [ length="{ number | data-name }" ]
  [ name="{ name }" ]
  [ precision="{ number }" ]
  [ struct="{ struct-name } ]>
</data>

```

The following table lists the data tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.

Attribute	Value	Description
<b>type=</b>	<p><i>char</i> A character value. A <i>char</i> data value is returned as a <i>java.lang.String</i>. For more information, see the <a href="#">char</a> values for length.</p> <p><i>int</i> An integer value. An <i>int</i> data value is returned as a <i>java.lang.Long</i>. For more information, see the <a href="#">int</a> values for length and precision.</p> <p><i>packed</i> A packed decimal value. A <i>packed</i> data value is returned as a <i>java.math.BigDecimal</i>. For more information, see the <a href="#">packed</a> values for length and precision.</p> <p><i>zoned</i> A zoned decimal value. A <i>zoned</i> data value is returned as a <i>java.math.BigDecimal</i>. For more information, see the <a href="#">zoned</a> values for length and precision.</p> <p><i>float</i> A floating point value. The <b>length</b> attribute specifies the number of bytes: either 4 or 8. A 4-byte integer is returned as a <i>java.lang.Float</i>. An 8-byte integer is returned as a <i>java.lang.Double</i>. For more information, see the <a href="#">float</a> values for length.</p> <p><i>byte</i> A byte value. No conversion is performed on the data. A <i>byte</i> data value is returned as an array of <i>byte</i> values (<i>byte[]</i>). For more information, see the <a href="#">byte</a> values for length.</p> <p><i>struct</i> The name of the <b>&lt;struct&gt;</b> element. A <i>struct</i> allows you to define a structure once and reuse it multiple times within the document. When you use <b>type="struct"</b>, it is as if the structure specified appears at this location in the document. A <i>struct</i> does not allow for a length value and has no value for precision.</p>	<p>Indicates the type of data being used (character, integer, packed, zoned, floating point, byte, or struct).</p> <p>Values for the length and precision attributes are different for different data types. For more information, see the <a href="#">Values for length and precision</a>.</p>

Attribute	Value	Description
<b>bidistringtype=</b>	<p><i>DEFAULT</i> where <i>DEFAULT</i> is the default string type for non-bidirectional data (LTR).</p> <p><i>ST4</i> where <i>ST4</i> is String Type 4.</p> <p><i>ST5</i> where <i>ST5</i> is String Type 5.</p> <p><i>ST6</i> where <i>ST6</i> is String Type 6.</p> <p><i>ST7</i> where <i>ST7</i> is String Type 7.</p> <p><i>ST8</i> where <i>ST8</i> is String Type 8.</p> <p><i>ST9</i> where <i>ST9</i> is String Type 9.</p> <p><i>ST10</i> where <i>ST10</i> is String Type 10.</p> <p><i>ST11</i> where <i>ST11</i> is String Type 11.</p>	<p>Specifies the bidirectional string type for <b>&lt;data&gt;</b> elements with <b>type="char"</b>. If this attribute is omitted, string type for this element is implied by the CCSID (whether explicitly specified or the default CCSID of the host environment).</p> <p>String types are defined in the Javadoc for the <code>BidiStringType</code> class.</p>
<b>ccsid=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing CCSID.</p> <p><i>data-name</i> where <i>data-name</i> defines the name that will contain, at runtime, the CCSID of the character data. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the host coded character set identifier (CCSID) for character data for the <b>&lt;data&gt;</b> element. The <b>ccsid</b> attribute can be specified only for <b>&lt;data&gt;</b> elements with <b>type="char"</b>.</p> <p>If this attribute is omitted, character data for this element is assumed to be in the default CCSID of the host environment.</p>

Attribute	Value	Description
<b>count=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing number of elements in a sized array.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the RFML document that will contain, at runtime, the number of elements in the array. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies that the element is an array and identifies the number of entries in the array.</p> <p>If the count attribute is omitted, the element is not defined as an array, although it may be contained within another element that is defined as an array.</p>
<b>init=</b>	<i>string</i>	<p>Specifies an initial value for the <b>&lt;data&gt;</b> element.</p> <p>The initial value specified is used to initialize scalar values. If the element is defined as an array or is contained within a structure defined as an array, the initial value specified is used as an initial value for all entries in the array.</p>
<b>length=</b>	<p><i>number</i> where <i>number</i> defines a fixed, never-changing length.</p> <p><i>data-name</i> where <i>data-name</i> defines the name of a <b>&lt;data&gt;</b> element within the RFML document that will contain, at runtime, the length. A <i>data-name</i> can be specified only for <b>&lt;data&gt;</b> elements with <b>type="char"</b> or <b>type="byte"</b>. The <i>data-name</i> specified can be a fully qualified name or a name that is relative to the current element. In either case, the name must reference a <b>&lt;data&gt;</b> element that is defined with <b>type="int"</b>. See <a href="#">Resolving Relative Names</a> for more information about how relative names are resolved.</p>	<p>Specifies the length of the data element. Usage of this attribute varies depending on the data type. For more information, see the <a href="#">Values for length and precision</a>.</p>
<b>name=</b>	<i>name</i>	<p>Specifies the name of the <b>&lt;data&gt;</b> element.</p>

Attribute	Value	Description
<b>precision=</b>	<i>number</i>	Specifies the number of bytes of precision for some numeric data types. For more information, see the <a href="#">Values for length and precision</a> .
<b>struct=</b>	<i>name</i>	Specifies the name of a <b>&lt;struct&gt;</b> element for the <b>&lt;data&gt;</b> element. A <b>struct</b> attribute can be specified only for <b>&lt;data&gt;</b> elements with <b>type="struct"</b> .

### Related information

[BidiStringType Javadoc](#)

### The RFML rfml tag

The rfml tag begins and ends the RFML source file that describes the data format.

Listed below are the attributes for the rfml tag. Attributes enclosed in brackets, [], indicate that the attribute is optional. If you specify an optional attribute, do not include the brackets in your source.

```
<rfml version="version-string"
      [ ccsid="number" ]>
</rfml>
```

The following table lists the rfml tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.

Attribute	Value	Description
<b>version=</b>	<i>version-string</i> A fixed version of the RFML DTD. For V5R3, 4.0 is the only valid value.	Specifies the version of the RFML DTD, which you can use to verify the correct value.
<b>ccsid=</b>	<i>number</i> A fixed, never-changing coded character set identifier (CCSID).	Specifies the host CCSID, which applies to all enclosed <b>&lt;data type="char"&gt;</b> elements that do not specify a CCSID. For more information, see the RFML <b>&lt;data&gt;</b> tag. When you omit this attribute, the default CCSID of the host environment is used.

### The RFML recordformat tag

The RFML recordformat tag defines a record format, which contains either data elements or references to structure elements.

Listed below are the attributes for the recordformat tag. Attributes enclosed in brackets, [], indicate that the attribute is optional. If you specify an optional attribute, do not include the brackets in your source.

```
<recordformat name="name"
              [ description="description" ]>
</recordformat>
```

The following table lists the recordformat tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.

Attribute	Value	Description
<b>name=</b>	<i>name</i>	Specifies the name of the recordformat.
<b>description=</b>	<i>description</i>	Specifies the description of the recordformat.

### **The RFML struct tag**

The RFML struct tag defines a named structure that you can reuse within the RFML source file. The structure contains a data tag for each field in the structure.

Listed below are the attributes for the struct tag. Attributes enclosed in brackets, [], indicate that the attribute is optional. If you specify an optional attribute, do not include the brackets in your source.

```
<struct name="name">
</struct>
```

The following table lists the struct tag attributes. Each entry includes the attribute name, the possible valid values, and a description of the attribute.

Attribute	Value	Description
<b>name=</b>	<i>name</i>	Specifies the name of the <b>&lt;struct&gt;</b> element.

## **XML parser and XSLT processor**

Some IBM Toolbox for Java packages or functions require that, at run-time, you have an Extensible Markup Language (XML) parser or Extensible Stylesheet Language Transformations (XSLT) processor in your CLASSPATH environment variable.

Refer to the following information to determine which parser and processor you want to use.

For more information about which IBM Toolbox for Java packages and functions require an XML parser or XSLT processor, see the following page:

[“JAR files” on page 7](#)


### **XML parser**

If the package or function requires an XML parser, you must include an XML parser in the CLASSPATH at run-time. The XML parser must meet the following requirements:

- Be JAXP-compliant
- Extend class org.apache.xerces.parsers.SAXParser
- Support full schema validation

**Note:** The parser only needs to support full schema validation if use intend to use XPCML. If you are only using PCML, full schema validation is not necessary.

The Java 2 Software Developer Kit (J2SDK), version 1.4, includes a suitable XML parser. If you use a previous version of J2SDK, use any of the following methods to access a suitable XML parser:

- Use x4j400.jar (an IBM version of the Xerces XML parser from Apache)
- Download the Xerces XML parser from the [Apache Web site](#) 
- Use any compatible XML parser in the /QIBM/ProdData/OS400/xml/lib directory on your system

**Note:** Consider using the latest versions of the parsers that reside in /QIBM/ProdData/OS400/xml/lib. For example, xmlapis11.jar and xerces411.jar are both fully validating parsers.

You can use these parsers on your server or copy them to a workstation.


**Note:** Any XML parser that meets the requirements for running XPCML can run PCML and RFML. Keep in mind that XPCML does not support serialization.

## XSLT processor

If the package or function requires an XSLT processor, you must include an XSLT processor in the CLASSPATH at run-time. The XSLT processor must meet the following requirements:

- Be JAXP-compliant
- Contain the class `javax.xml.transform.Transformer`

The Java 2 Software Developer Kit (J2SDK), version 1.4, includes a suitable XSLT processor. If you use a previous version of J2SDK, use any of the following methods to access a suitable XSLT processor:

- Use `xslparser.jar` (an IBM version of the Xalan XSLT processor from Apache)
- Download the Xalan XSLT processor from the [Apache Web site](#) 
- Use any compatible XSLT processor in the `/QIBM/ProdData/OS400/xml/lib` directory on your system

You can use these processors on your system or copy them to a workstation.

## Extensible Program Call Markup Language

Extensible Program Call Markup Language (XPCML) enhances the functionality and usability of the Program Call Markup Language (PCML) by offering support for XML schemas. XPCML does not support serialization, so unlike PCML, you cannot serialize an XPCML document.

However, XPCML offers several valuable enhancements when compared to PCML:

- Specify and pass values for program parameters
- Retrieve the results of a program call to your server in XPCML
- Transform an existing PCML document into the equivalent XPCML document
- Extend and customize the XPCML schema to define new simple and complex elements and attributes

For more information about XPCML, see the following pages:

### Related reference

[“Extensible Markup Language components” on page 273](#)

IBM Toolbox for Java includes several Extensible Markup Language (XML) components, including an XML parser.

### Related information

[XML Toolkit](#)

[W3C Architecture domain: XML Schema](#)

## Advantages of XPCML over PCML

Extensible Program Call Markup Language (XPCML) offers several valuable enhancements over PCML.

- Specify and pass values for program parameters
- Retrieve the results of a program call to your IBM i server in XPCML
- Transform an existing PCML document into the equivalent XPCML document
- Extend and customize the XPCML schema to define new simple and complex elements and attributes

## Specify and pass values for program parameters

XPCML uses an XML schema to define program parameter types; PCML uses a data type definition (DTD). At parse time, the XML parser validates data values entered as parameters against the appropriate parameters as defined in the schema. Data types exist for parameters of many types: strings, integers,



longs, and so on. This ability to specify and pass values for program parameters is a significant improvement over PCML. In PCML, you can verify values for parameters only after parsing the PCML document. Additionally, verifying parameter values in PCML often requires coding your application to perform the validation.

## Retrieve results of a program call in XPCML

XPCML also provides the capability to retrieve program call results as XPCML. In PCML, you obtain program call results by calling one of the `getValue` methods of the `ProgramCallDocument` class after you make the call to the program. In XPCML, you can use the `getValue` methods, but you can also have your XPCML call a `generateXPCML` method, which returns the results of a program call as XPCML.

## Transform existing PCML documents into XPCML

A new method of the `ProgramCallDocument` class, `transformPCMLToXPCML`, enables you to transform existing PCML documents to equivalent XPCML documents. This allows you to take advantage of new XPCML function without writing XPCML source for your existing IBM i program call documents.

## Extend and customize the XPCML schema

XPCML is extensible which means you can define new parameter types that extend those specified by the XPCML schema. Condensing XPCML extends the XPCML schema to create new data type definitions that simplify and improve the readability and usability of your XPCML documents.

## Requirements for using XPCML

The Extensible Program Call Markup Language (XPCML) has the same workstation Java virtual machine requirements as the rest of the IBM Toolbox for Java.

For more information, see the following page:

[“Workstation requirements for running IBM Toolbox for Java applications” on page 5](#)

In addition, using XPCML includes requirements for the XML schema file, XML parser, and Extensible Stylesheet Language Transformation (XSLT) processor:

### XML schema file

Your XPCML documents must know the location of the file that contains the schema. The default schema for IBM Toolbox for Java is `xpcml.xsd`, which resides within the `jt400.jar` file.

To use the default schema, extract `xpcml.xsd` from `jt400.jar`, then place the file in a suitable location. The following procedure shows one way that you can extract the `.xsd` file on a workstation.

#### Extract the `xpcml.xsd` schema file

- Start a command line session in the directory that contains `jt400.jar`
- Use the following command to extract the `.xsd` file:

```
jar xvf jt400.jar com/ibm/as400/data/xpcml.xsd
```

**Note:** If you do not run the previous command from the directory that contains `jt400.jar`, you can specify a fully qualified path to `jt400.jar`.

You can place the default schema file (or any schema file) in any directory. The only requirement is that you specify the location of the schema file by using the `xsi:noNamespaceSchemaLocation` attribute in the `<xpcml>` tag.

You can specify the location of the schema as a file path or as a URL.

**Note:** Although the following examples use `xpcml.xsd` as the schema file, you can specify any schema that extends `xpcml.xsd`.

- To specify the same directory as the XPCML file, use `xsi:noNamespaceSchemaLocation='xpcml.xsd'`

- To specify a fully qualified path: `xsi:noNamespaceSchemaLocation='c:\myDir\xpctl.xsd'`
- To specify a URL: `xsi:noNamespaceSchemaLocation='http://myServer/xpctl.xsd'`

To see an HTML version of the xpctl.xsd file, see the following page:

[“Schema xpctl.xsd file” on page 315](#)

## XML parser and XSLT processor

At run-time, you must include an XML parser and an XSLT processor in your CLASSPATH environment variable. For more information, see the following page:

[“XML parser and XSLT processor” on page 311](#)

## XPCML schema and syntax

XPCML documents, called XPCML source files, contain tags and data that fully define calls to programs on your system.

Because XPCML uses XML schemas instead of a document type definition (DTD), you can use XPCML in ways that you cannot use PCML:

- Pass values for input parameters to your program as XML elements
- Receive values for output parameters from your program as XML elements
- Have the XML parser automatically validate the values passed to your program
- Extend the schema to define new simple and complex elements

For more information about the XPCML schema and syntax, see the following pages:

### ***Comparison of XPCML source to PCML source***

XPCML differs from PCML in several ways, but one major difference is that XPCML allows you to specify the values of input parameters within the XPCML source file.

PCML allows you to use the `init` attribute of the `<data>` tag to specify the initial value for a data element in the PCML source. However, using PCML to specify values has the following limitations:

- You cannot use the `init` attribute to set array values
- Validation of the `init` value occurs only after parsing the PCML document

To specify array values in PCML, you must first read in and parse the PCML document, then perform a series of calls to `ProgramCallDocument.setValue()`.

Using XPCML makes it easier to specify values of single elements and arrays:

- Specify values for both scalar and array elements in the XPCML source file
- Validate the specified array values at parse time

The following simple comparisons indicate ways in which XPCML differs from PCML. Each example defines a program call for an IBM i program.

### **Example: Calling an IBM i program**

The following examples call an IBM i program called `prog1`.

#### **XPCML source code**

```
<?xml version="1.0" encoding="UTF-8"?>
<xpctl xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation='xpctl.xsd' version="4.0">
  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <stringParm name="parm1" passDirection="in" length="10">Parm1</stringParm>
      <intParm name="parm2" passDirection="in">5</intParm>
      <shortParm name="parm3" passDirection="in">3</shortParm>
    </parameterList>
```

```
</program>
</xpcml>
```

## PCML source code

```
<pcml version="4.0">
  <program name="prog1" path="QSYS.LIB/MYLIB.LIB/PROG1.PGM">
    <data name="parm1" type="char" usage="input" length="10" init="Parm1"/>
    <data name="parm2" type="int" usage="input" length="4" init="5"/>
    <data name="parm3" type="int" usage="input" length="2" precision="16" init="3"/>
  </program>
</pcml>
```

## Example: Calling an IBM i program using an array of string parameters

The following examples call an IBM i program called prog2 and define parm1 as an array of string parameters. Note the functionality of XPCML:

- Initializes the value of each element in the array
- Specifies the input values as element content that a fully validating XML parser can verify

You can take advantage of this XPCML functionality without writing any Java code.

PCML cannot match the XPCML performance. PCML cannot initialize the value of each element in the array. PCML cannot validate the init values at parse time. To match the functionality of XPCML, you would have to read in and parse the PCML document, then code your Java application to set the value for each array element. You would also have to write code to validate the parameters.

## XPCML source code

```
<?xml version="1.0" encoding="UTF-8"?>
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">

  <program name="prog2" path="/QSYS.LIB/W95LIB.LIB/PROG2.PGM">
    <parameterList>
      <arrayOfStringParm name="parm1" passDirection="in"
        length="10" count="3">
        <i>Parm1-First value</i>
        <i>Parm1-Second value</i>
        <i>Parm1-Third value</i>
      </arrayOfStringParm>
      <longParm name="parm2" passDirection="in">5</longParm>
      <zonedDecimalParm name="parm3" passDirection="in"
        totalDigits="5" fractionDigits="2">32.56</zonedDecimalParm>
    </parameterList>
  </program>
</xpcml>
```

## PCML source code

```
<pcml version="4.0">
  <program name="prog2" path="QSYS.LIB/MYLIB.LIB/PROG2.PGM">
    <data name="parm1" type="char" usage="input" length="20" count="3"/>
    <data name="parm2" type="int" usage="input" length="8" init="5"/>
    <data name="parm3" type="zoned" usage="input" length="5" precision="2" init="32.56"/>
  </program>
</pcml>
```

## Schema xpcml.xsd file

To make it easier to display and print, some lines of this HTML version of xpcml.xsd wrap to a second line. The same lines in the source xsd file appear on a single line.

For more information about using the xpcml.xsd file, see [Requirements for using XPCML](#).

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--////////////////////////////////////
```

```

//
// JTOpen (IBM Toolbox for Java - OSS version)
//
// Filename: xpcml.xsd
//
// The source code contained herein is licensed under the IBM Public License
// Version 1.0, which has been approved by the Open Source Initiative.
// Copyright (C) 1997-2008 International Business Machines Corporation and
// others. All rights reserved.
//
//////////////////////////////////////-->

<xs:schema xmlns:xs='http://www.w3.org/2001/XMLSchema'>

<xs:annotation>
  <xs:documentation>
    Schema for xpcml (eXtended Program Call Markup Language).
  </xs:documentation>
</xs:annotation>

<xs:element name="xpcml">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="structOrProgram" minOccurs="1" maxOccurs="unbounded" />
    </xs:sequence>
    <xs:attribute name="version" use="required">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="4.0"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:attribute>
  </xs:complexType>

  <!-- Define key/keyref link between the name of a struct -->
  <!-- and the struct attribute of a parameter field. -->
  <xs:key name="StructKey">
    <xs:selector xpath="struct"/>
    <xs:field xpath="@name"/>
  </xs:key>
  <xs:keyref name="spRef" refer="StructKey">
    <xs:selector xpath="structParm" />
    <xs:field xpath="@struct" />
  </xs:keyref>
</xs:element>

<!-- Program tag and attributes -->
<xs:element name="program" substitutionGroup="structOrProgram">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="parameterList" minOccurs="1" maxOccurs="1"/>
      <!-- Used as a wrapper tag around the parameter list for the program. -->
    </xs:sequence>
    <!-- Name of the program to call. -->
    <xs:attribute name="name" type="string50" use="required" />
    <!-- Path to the program object. Default is to assume in library QSYS. -->
    <xs:attribute name="path" type="xs:string"/>
    <!-- Specifies the order in which parameters should be parsed. -->
    <!-- Value is a blank-separated list of parameter names. -->
    <xs:attribute name="parseOrder" type="xs:string"/>
    <!-- The entry point name within a service program. -->
    <xs:attribute name="entryPoint" type="xs:string"/>
    <!-- The type of value, if any, returned from a service program call. -->
    <xs:attribute name="returnValue" type="returnValueType"/>
    <!-- When calling a Java program and System i -->
    <!-- program is on same server -->
    <!-- and is thread-safe, set to true to call the -->
    <!-- System i program in same job -->
    <!-- and on same thread as the Java program. -->
    <xs:attribute name="threadSafe" type="xs:boolean" />
    <!-- The CCSID of the entry point name within a service program. -->
    <xs:attribute name="epccsid" type="ccsidType"/>
  </xs:complexType>
</xs:element>

<!-- A parameter list is made up of one or more parameters. -->
<xs:element name="parameterList">
  <xs:complexType>
    <xs:group ref="programParameter" minOccurs="1" maxOccurs="unbounded"/>
  </xs:complexType>
</xs:element>

```

```

<!-- All the different kinds of program parameters that we understand. -->
<xs:group name="programParameter">
  <xs:choice>
    <xs:element ref="stringParmGroup"/>
    <xs:element ref="stringParmArrayGroup"/>
    <xs:element ref="intParmGroup"/>
    <xs:element ref="intParmArrayGroup"/>
    <xs:element ref="unsignedIntParmGroup"/>
    <xs:element ref="unsignedIntParmArrayGroup"/>
    <xs:element ref="shortParmGroup"/>
    <xs:element ref="shortParmArrayGroup"/>
    <xs:element ref="unsignedShortParmGroup"/>
    <xs:element ref="unsignedShortParmArrayGroup"/>
    <xs:element ref="longParmGroup"/>
    <xs:element ref="longParmArrayGroup"/>
    <xs:element ref="zonedDecimalParmGroup"/>
    <xs:element ref="zonedDecimalParmArrayGroup"/>
    <xs:element ref="packedDecimalParmGroup"/>
    <xs:element ref="packedDecimalParmArrayGroup"/>
    <xs:element ref="floatParmGroup"/>
    <xs:element ref="floatParmArrayGroup"/>
    <xs:element ref="doubleParmGroup"/>
    <xs:element ref="doubleParmArrayGroup"/>
    <xs:element ref="hexBinaryParmGroup"/>
    <xs:element ref="hexBinaryParmArrayGroup"/>
    <xs:element ref="structParmGroup"/>
    <xs:element ref="structParmArrayGroup"/>
    <xs:element ref="structArrayGroup"/>
    <xs:element ref="struct"/>
  </xs:choice>
</xs:group>

<!-- Abstract type for all data parameter types. -->
<xs:element name="stringParmGroup" type="stringParmType" abstract="true" />
<xs:element name="stringParmArrayGroup" type="stringParmArrayType" abstract="true" />
<xs:element name="intParmGroup" type="intParmType" abstract="true" />
<xs:element name="intParmArrayGroup" type="intParmArrayType" abstract="true" />
<xs:element name="unsignedIntParmGroup" type="unsignedIntParmType" abstract="true" />
<xs:element name="unsignedIntParmArrayGroup" type="unsignedIntParmArrayType" abstract="true" />
<xs:element name="shortParmGroup" type="shortParmType" abstract="true" />
<xs:element name="shortParmArrayGroup" type="shortParmArrayType" abstract="true" />
<xs:element name="unsignedShortParmGroup" type="unsignedShortParmType" abstract="true" />
<xs:element name="unsignedShortParmArrayGroup" type="unsignedShortParmArrayType"
abstract="true" />
<xs:element name="longParmGroup" type="longParmType" abstract="true" />
<xs:element name="longParmArrayGroup" type="longParmArrayType" abstract="true" />
<xs:element name="zonedDecimalParmGroup" type="zonedDecimalParmType" abstract="true" />
<xs:element name="zonedDecimalParmArrayGroup" type="zonedDecimalParmArrayType"
abstract="true" />
<xs:element name="packedDecimalParmGroup" type="packedDecimalParmType" abstract="true" />
<xs:element name="packedDecimalParmArrayGroup" type="packedDecimalParmArrayType"
abstract="true" />
<xs:element name="floatParmGroup" type="floatParmType" abstract="true" />
<xs:element name="floatParmArrayGroup" type="floatParmArrayType" abstract="true" />
<xs:element name="doubleParmGroup" type="doubleParmType" abstract="true" />
<xs:element name="doubleParmArrayGroup" type="doubleParmArrayType" abstract="true" />
<xs:element name="hexBinaryParmGroup" type="hexBinaryParmType" abstract="true" />
<xs:element name="hexBinaryParmArrayGroup" type="hexBinaryParmArrayType" abstract="true" />
<xs:element name="structParmGroup" type="structParmType" abstract="true" />
<xs:element name="structParmArrayGroup" type="structParmArrayType" abstract="true" />
<xs:element name="structArrayGroup" type="structArrayType" abstract="true"
substitutionGroup="structOrProgram" />

<!-- String parameter -->
<xs:element name="stringParm" type="stringParmType" substitutionGroup="stringParmGroup"
nillable="true"/>
<xs:complexType name="stringParmType">
  <xs:simpleContent>
    <xs:extension base="stringFieldType">
      <xs:attributeGroup ref="commonParmAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- Array of string parameters -->
<xs:element name="arrayOfStringParm" type="stringParmArrayType"
substitutionGroup="stringParmArrayGroup" nillable="true" />
<xs:complexType name="stringParmArrayType">
  <xs:sequence>
    <xs:element name="i" type="stringElementType" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>

```

```

<xs:attributeGroup ref="commonParmAttrs"/>
<xs:attributeGroup ref="commonFieldAttrs"/>
<!-- The number of elements in the array. -->
<!-- 'count' is required if you want to input and/or output array data as XPCML. -->
<xs:attribute name="count" type="xs:string" />
<!-- The number of characters in each string. -->
<xs:attribute name="length" type="xs:string"/>
<!-- The host CCSID for each string. -->
<xs:attribute name="ccsid" type="xs:string"/>
<!-- Specifies how to trim whitespace (left, right, both, none). -->
<xs:attribute name="trim" type="trimType" />
<!-- The size of each character ('charType' in PCML). -->
<xs:attribute name="bytesPerChar" type="charType" />
<!-- The bidirectional string type. -->
<xs:attribute name="bidiStringType" type="bidiStringTypeType" />
</xs:complexType>

  <xs:complexType name="stringElementType">
    <xs:simpleContent>
      <xs:extension base="xs:string">
        <!-- The index into the array. -->
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- Integer parameter (4 bytes on server) -->
<xs:element name="intParm" type="intParmType" nillable="true"
substitutionGroup="intParmGroup" />
  <xs:complexType name="intParmType" >
    <xs:simpleContent>
      <xs:extension base="intFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- intParm array type -->
<xs:element name="arrayOfIntParm" type="intParmArrayType"
substitutionGroup="intParmArrayGroup"
  nillable="true" />
  <xs:complexType name="intParmArrayType">
    <xs:sequence>
      <!-- 'i' is the tag used for non-struct array elements. -->
      <xs:element name="i" type="intElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
  </xs:complexType>

  <xs:complexType name="intElementType">
    <xs:simpleContent>
      <xs:extension base="xs:int">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- Unsigned Integer parameter (4 bytes on server) -->
<xs:element name="unsignedIntParm" type="unsignedIntParmType" nillable="true"
substitutionGroup="unsignedIntParmGroup" />
  <xs:complexType name="unsignedIntParmType">
    <xs:simpleContent>
      <xs:extension base="unsignedIntFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- unsigned intParm array type -->
<xs:element name="arrayOfUnsignedIntParm" type="unsignedIntParmArrayType"
substitutionGroup="unsignedIntParmArrayGroup" nillable="true" />
  <xs:complexType name="unsignedIntParmArrayType">
    <xs:sequence>
      <xs:element name="i" type="unsignedIntElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />

```

```

    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
</xs:complexType>

<xs:complexType name="unsignedIntElementType">
  <xs:simpleContent>
    <xs:extension base="xs:unsignedInt">
      <xs:attribute name="index" type="xs:nonNegativeInteger" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- Short integer parameter (2 bytes on server) -->
<xs:element name="shortParm" type="shortParmType" nillable="true"
substitutionGroup="shortParmGroup"/>
  <xs:complexType name="shortParmType">
    <xs:simpleContent>
      <xs:extension base="shortFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- shortParm array type -->
<xs:element name="arrayOfShortParm" type="shortParmArrayType"
substitutionGroup="shortParmArrayGroup"
  nillable="true" />
  <xs:complexType name="shortParmArrayType">
    <xs:sequence>
      <xs:element name="i" type="shortElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
  </xs:complexType>

  <xs:complexType name="shortElementType">
    <xs:simpleContent>
      <xs:extension base="xs:short">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- Unsigned Short integer parameter (2 bytes on server) -->
<xs:element name="unsignedShortParm" type="unsignedShortParmType" nillable="true"
substitutionGroup="unsignedShortParmGroup" />
  <xs:complexType name="unsignedShortParmType">
    <xs:simpleContent>
      <xs:extension base="unsignedShortFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- unsignedShortParm array type -->
<xs:element name="arrayOfUnsignedShortParm" type="unsignedShortParmArrayType"
substitutionGroup="unsignedShortParmArrayGroup" nillable="true" />
  <xs:complexType name="unsignedShortParmArrayType">
    <xs:sequence>
      <xs:element name="i" type="unsignedShortElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
  </xs:complexType>

  <xs:complexType name="unsignedShortElementType">
    <xs:simpleContent>
      <xs:extension base="xs:unsignedShort">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- Long integer parameter (8 bytes on server) -->
  <xs:element name="longParm" type="longParmType" nillable="true"

```

```

substitutionGroup="longParmGroup" />
  <xs:complexType name="longParmType">
    <xs:simpleContent>
      <xs:extension base="longFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- longParm array type -->
<xs:element name="arrayOfLongParm" type="longParmArrayType"
substitutionGroup="longParmArrayGroup"
  nillable="true" />
<xs:complexType name="longParmArrayType">
  <xs:sequence>
    <xs:element name="i" type="longElementType" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
  <xs:attribute name="count" type="xs:string" />
  <xs:attributeGroup ref="commonParmAttrs"/>
  <xs:attributeGroup ref="commonFieldAttrs"/>
</xs:complexType>

<xs:complexType name="longElementType">
  <xs:simpleContent>
    <xs:extension base="xs:long">
      <xs:attribute name="index" type="xs:nonNegativeInteger" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- ZonedDecimal parameter -->
<xs:element name="zonedDecimalParm" type="zonedDecimalParmType" nillable="true"
  substitutionGroup="zonedDecimalParmGroup" />
<xs:complexType name="zonedDecimalParmType">
  <xs:simpleContent>
    <xs:extension base="zonedDecimalFieldType">
      <xs:attributeGroup ref="commonParmAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- zonedDecimalParm array type -->
<xs:element name="arrayOfZonedDecimalParm" type="zonedDecimalParmArrayType"
  substitutionGroup="zonedDecimalParmArrayGroup" nillable="true" />
<xs:complexType name="zonedDecimalParmArrayType">
  <xs:sequence>
    <xs:element name="i" type="zonedDecimalElementType" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attributeGroup ref="commonParmAttrs"/>
  <xs:attributeGroup ref="commonFieldAttrs"/>
  <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
  <xs:attribute name="count" type="xs:string" />
  <!-- The total number of digits in the field ('length' in PCML). -->
  <xs:attribute name="totalDigits" type="xs:positiveInteger"/>
  <!-- The number of fractional digits ('precision' in PCML). -->
  <xs:attribute name="fractionDigits" type="xs:nonNegativeInteger"/>
</xs:complexType>

<xs:complexType name="zonedDecimalElementType">
  <xs:simpleContent>
    <xs:extension base="xs:decimal">
      <xs:attribute name="index" type="xs:nonNegativeInteger" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- packedDecimal parameter -->
<xs:element name="packedDecimalParm" type="packedDecimalParmType" nillable="true"
  substitutionGroup="packedDecimalParmGroup" />
<xs:complexType name="packedDecimalParmType">
  <xs:simpleContent>
    <xs:extension base="packedDecimalFieldType">
      <xs:attributeGroup ref="commonParmAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- packedDecimalParm array type -->
<xs:element name="arrayOfPackedDecimalParm" type="packedDecimalParmArrayType"
  substitutionGroup="packedDecimalParmArrayGroup" nillable="true" />

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<xs:complexType name="packedDecimalParmArrayType">
  <xs:sequence>
    <xs:element name="i" type="packedDecimalElementType" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attributeGroup ref="commonParmAttrs"/>
  <xs:attributeGroup ref="commonFieldAttrs"/>
  <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
  <xs:attribute name="count" type="xs:string" />
  <xs:attribute name="totalDigits" type="xs:positiveInteger"/>
  <xs:attribute name="fractionDigits" type="xs:nonNegativeInteger"/>
</xs:complexType>

<xs:complexType name="packedDecimalElementType">
  <xs:simpleContent>
    <xs:extension base="xs:decimal">
      <xs:attribute name="index" type="xs:nonNegativeInteger" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- Float parameter (4 bytes on server) -->
<xs:element name="floatParm" type="floatParmType" nillable="true"
substitutionGroup="floatParmGroup"/>
  <xs:complexType name="floatParmType">
    <xs:simpleContent>
      <xs:extension base="floatFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- floatParm array type -->
<xs:element name="arrayOfFloatParm" type="floatParmArrayType"
substitutionGroup="floatParmArrayGroup"
nillable="true" />
  <xs:complexType name="floatParmArrayType">
    <xs:sequence>
      <xs:element name="i" type="floatElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
  </xs:complexType>

  <xs:complexType name="floatElementType">
    <xs:simpleContent>
      <xs:extension base="xs:float">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- Double parameter (8 bytes on server) -->
<xs:element name="doubleParm" type="doubleParmType" nillable="true"
substitutionGroup="doubleParmGroup" />
  <xs:complexType name="doubleParmType">
    <xs:simpleContent>
      <xs:extension base="doubleFieldType">
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- doubleParm array type -->
<xs:element name="arrayOfDoubleParm" type="doubleParmArrayType"
substitutionGroup="doubleParmArrayGroup" nillable="true" />
  <xs:complexType name="doubleParmArrayType">
    <xs:sequence>
      <xs:element name="i" type="doubleElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
  </xs:complexType>

  <xs:complexType name="doubleElementType">
    <xs:simpleContent>
      <xs:extension base="xs:double">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

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    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- Hex binary parameter (any number of bytes; unsigned) -->
  <xs:element name="hexBinaryParm" type="hexBinaryParmType"
substitutionGroup="hexBinaryParmGroup" />
  <xs:complexType name="hexBinaryParmType">
    <xs:simpleContent>
      <xs:extension base="hexBinaryFieldType">
        <!-- The field length in bytes ('length' in PCML). -->
        <xs:attribute name="totalBytes" type="xs:string"/>
        <xs:attributeGroup ref="commonParmAttrs"/>
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- hexBinaryParm array type -->
  <xs:element name="arrayOfHexBinaryParm" type="hexBinaryParmArrayType"
    substitutionGroup="hexBinaryParmArrayGroup" nillable="true" />
  <xs:complexType name="hexBinaryParmArrayType">
    <xs:sequence>
      <xs:element name="i" type="hexBinaryElementType" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="totalBytes" type="xs:string"/>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
  </xs:complexType>

  <xs:complexType name="hexBinaryElementType">
    <xs:simpleContent>
      <xs:extension base="xs:hexBinary">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>

<!-- Structure parm type -->
  <xs:element name="structParm" type="structParmType" substitutionGroup="structParmGroup" />
  <xs:complexType name="structParmType">
    <xs:complexContent>
      <xs:extension base="structureParmArray">
        <xs:attribute name="struct" type="string50"/>
        <!-- Specifies whether the parameter is passed by value or reference ('passby' in
PCML).-->
        <!-- Value only allowed for integer parameters. -->
        <xs:attribute name="passMode" type="passModeType"/>
        <!-- 'count' is required if you want to input and/or output array data as XPCML.
-->
        <xs:attribute name="count" type="xs:string"/>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

<!-- Structure parm array type -->
  <xs:element name="arrayOfStructParm" type="structParmArrayType"
    substitutionGroup="structParmArrayGroup" nillable="true" />
  <xs:complexType name="structParmArrayType">
    <xs:sequence>
      <!-- struct_i tag represents struct or struct parm array elements. -->
      <xs:element name="struct_i" type="structElementType" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
    <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
    <xs:attribute name="count" type="xs:string" />
    <xs:attributeGroup ref="commonParmAttrs"/>
    <xs:attributeGroup ref="commonFieldAttrs"/>
    <xs:attribute name="struct" type="string50"/>
  </xs:complexType>

  <xs:complexType name="structElementType">
    <xs:complexContent>
      <xs:extension base="structureParmArray">
        <xs:attribute name="index" type="xs:nonNegativeInteger" />
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

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<!-- Struct element -->
<xs:element name="struct" type="structureParmArray" substitutionGroup="structOrProgram" />

<!-- Struct array type -->
<xs:element name="arrayOfStruct" type="structArrayType" substitutionGroup="structArrayGroup"
  nillable="true" />
<xs:complexType name="structArrayType">
  <xs:sequence>
    <!-- struct_i tag represents struct elements in an array. -->
    <xs:element name="struct_i" type="structElementType" minOccurs="0"
maxOccurs="unbounded"/>
  </xs:sequence>
  <!-- The name of the struct. -->
  <xs:attribute name="name" type="string50"/>
  <!-- Number of elements in the array. -->
  <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
  <xs:attribute name="count" type="xs:string" />
  <!-- Specifies whether this is an input, output, or input-output struct ('usage' in PCML).
-->
  <xs:attribute name="passDirection" type="passDirectionType"/>
  <!-- The offset to the struct within an output parameter. -->
  <xs:attribute name="offset" type="xs:string" />
  <!-- The base location from which the 'offset' attribute is relative. -->
  <xs:attribute name="offsetFrom" type="xs:string" />
  <!-- The number of bytes to reserve for output data for the element. -->
  <xs:attribute name="outputSize" type="xs:string" />
  <!-- The lowest version of IBM i on which this element exists. -->
  <xs:attribute name="minvrm" type="string10" />
  <!-- The highest version of IBM i on which this element exists. -->
  <xs:attribute name="maxvrm" type="string10" />
</xs:complexType>

<!-- Attributes that are common to all data field types. -->
<xs:attributeGroup name="commonParmAttrs">
  <!-- Specifies whether this is an input, output, or input-output parameter ('usage' in
PCML). -->
  <!-- The default value if none is specified is 'inherit'. -->
  <xs:attribute name="passDirection" type="passDirectionType"/>
  <!-- Specifies whether the parameter is passed by reference or value ('passby' in PCML).
-->
  <!-- The default value if none is specified is 'reference'. -->
  <xs:attribute name="passMode" type="passModeType" />
  <!-- The offset to the element within an output parameter. -->
  <!-- The default value if none is specified is 0. -->
  <xs:attribute name="offset" type="xs:string" />
  <!-- The base location from which the 'offset' attribute is relative. -->
  <xs:attribute name="offsetFrom" type="xs:string" />
  <!-- The number of bytes to reserve for output data for the element. -->
  <xs:attribute name="outputSize" type="xs:string" />
  <!-- The lowest version of IBM i to which this field applies. -->
  <!-- If not specified, we assume this field applies to all versions. -->
  <xs:attribute name="minvrm" type="string10" />
  <!-- The highest version of IBM i to which this field applies. -->
  <!-- If not specified, we assume this field applies to all versions. -->
  <xs:attribute name="maxvrm" type="string10" />
</xs:attributeGroup>

<xs:simpleType name="passDirectionType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="in"/>
    <xs:enumeration value="inout"/>
    <xs:enumeration value="out"/>
    <xs:enumeration value="inherit"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="passModeType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="value"/>
    <xs:enumeration value="reference"/>
  </xs:restriction>
</xs:simpleType>

<!-- Following types are to maintain compatibility with PCML -->
<xs:simpleType name="bidiStringType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="ST4"/>
    <xs:enumeration value="ST5"/>
    <xs:enumeration value="ST6"/>
    <xs:enumeration value="ST7"/>
    <xs:enumeration value="ST8"/>
  </xs:restriction>
</xs:simpleType>

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        <xs:enumeration value="ST9"/>
        <xs:enumeration value="ST10"/>
        <xs:enumeration value="ST11"/>
        <xs:enumeration value="DEFAULT"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="charType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="onebyte"/>
        <xs:enumeration value="twobyte"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="trimType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="none"/>
        <xs:enumeration value="left"/>
        <xs:enumeration value="right"/>
        <xs:enumeration value="both"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="returnValueType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="void"/>
        <xs:enumeration value="integer"/>
    </xs:restriction>
</xs:simpleType>

<xs:complexType name="structureParmArray">
    <xs:sequence>
        <xs:group ref="structureParm" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="name" type="string50"/>
    <xs:attribute name="passDirection" type="passDirectionType"/>
    <xs:attribute name="offset" type="xs:string" />
    <xs:attribute name="offsetFrom" type="xs:string" />
    <xs:attribute name="outputSize" type="xs:string" />
    <xs:attribute name="minvrm" type="string10" />
    <xs:attribute name="maxvrm" type="string10" />
</xs:complexType>

<!-- A structureParm is exactly one of the following: stringParm, intParm,
shortParm, longParm, zonedDecimalParm, packedDecimalParm, floatParm,
doubleParm, or hexBinaryParm. -->
    <xs:group name="structureParm">
        <xs:choice>
            <xs:element ref="stringParmGroup" />
            <xs:element ref="stringParmArrayGroup" />
            <xs:element ref="intParmGroup" />
            <xs:element ref="intParmArrayGroup" />
            <xs:element ref="unsignedIntParmGroup" />
            <xs:element ref="unsignedIntParmArrayGroup" />
            <xs:element ref="shortParmGroup" />
            <xs:element ref="shortParmArrayGroup" />
            <xs:element ref="unsignedShortParmGroup" />
            <xs:element ref="unsignedShortParmArrayGroup" />
            <xs:element ref="longParmGroup" />
            <xs:element ref="longParmArrayGroup" />
            <xs:element ref="zonedDecimalParmGroup" />
            <xs:element ref="zonedDecimalParmArrayGroup" />
            <xs:element ref="packedDecimalParmGroup" />
            <xs:element ref="packedDecimalParmArrayGroup" />
            <xs:element ref="floatParmGroup" />
            <xs:element ref="floatParmArrayGroup" />
            <xs:element ref="doubleParmGroup" />
            <xs:element ref="doubleParmArrayGroup" />
            <xs:element ref="hexBinaryParmGroup" />
            <xs:element ref="hexBinaryParmArrayGroup" />
            <xs:element ref="structParmGroup" />
            <xs:element ref="structParmArrayGroup" />
            <xs:element ref="structArrayGroup" />
            <xs:element ref="struct" />
        </xs:choice>
    </xs:group>

<!-- Field Definition schema. -->

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<!-- Define basic IBM i native data types. -->

<xs:complexType name="zonedDecimal">
  <xs:simpleContent>
    <xs:extension base="xs:decimal">
      <xs:attribute name="totalDigits" type="xs:positiveInteger" />
      <xs:attribute name="fractionDigits" type="xs:nonNegativeInteger" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<xs:complexType name="packedDecimal">
  <xs:simpleContent>
    <xs:extension base="xs:decimal">
      <xs:attribute name="totalDigits" type="xs:positiveInteger" />
      <xs:attribute name="fractionDigits" type="xs:nonNegativeInteger" />
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<xs:complexType name="structureFieldArray">
  <xs:sequence>
    <xs:group ref="structureField" minOccurs="1" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="name" type="string50"/>
  <!-- 'count' is required if you want to input and/or output array data as XPCML. -->
  <xs:attribute name="count" type="xs:string"/>
</xs:complexType>

<!-- Abstract type for "struct or program". -->
<xs:element name="structOrProgram" abstract="true" />

<!-- Abstract type for all data field types. -->
<xs:element name="stringFieldGroup" type="stringFieldType" abstract="true" />
<xs:element name="intFieldGroup" type="intFieldType" abstract="true" />
<xs:element name="unsignedIntFieldGroup" type="unsignedIntFieldType" abstract="true" />
<xs:element name="shortFieldGroup" type="shortFieldType" abstract="true" />
<xs:element name="unsignedShortFieldGroup" type="unsignedShortFieldType" abstract="true" />
<xs:element name="longFieldGroup" type="longFieldType" abstract="true" />
<xs:element name="zonedDecimalFieldGroup" type="zonedDecimalFieldType" abstract="true" />
<xs:element name="packedDecimalFieldGroup" type="packedDecimalFieldType" abstract="true" />
<xs:element name="floatFieldGroup" type="floatFieldType" abstract="true" />
<xs:element name="doubleFieldGroup" type="doubleFieldType" abstract="true" />
<xs:element name="hexBinaryFieldGroup" type="hexBinaryFieldType" abstract="true" />
<xs:element name="structFieldGroup" type="structFieldType" abstract="true" />

<!-- Declare each field element to be a specific field type. -->
<xs:element name="stringField" type="stringFieldType" substitutionGroup="stringFieldGroup"
  nillable="true"/>
<xs:element name="intField" type="intFieldType" nillable="true"
  substitutionGroup="intFieldGroup" />
<xs:element name="unsignedIntField" type="unsignedIntFieldType"
  substitutionGroup="unsignedIntFieldGroup" nillable="true"/>
<xs:element name="shortField" type="shortFieldType" nillable="true"
  substitutionGroup="shortFieldGroup" />
<xs:element name="unsignedShortField" type="unsignedShortFieldType" nillable="true"
  substitutionGroup="unsignedShortFieldGroup" />
<xs:element name="longField" type="longFieldType" nillable="true"
  substitutionGroup="longFieldGroup" />
<xs:element name="hexBinaryField" type="hexBinaryFieldType" nillable="true"
  substitutionGroup="hexBinaryFieldGroup" />
<xs:element name="zonedDecimalField" type="zonedDecimalFieldType" nillable="true"
  substitutionGroup="zonedDecimalFieldGroup" />
<xs:element name="packedDecimalField" type="packedDecimalFieldType" nillable="true"
  substitutionGroup="packedDecimalFieldGroup" />
<xs:element name="doubleField" type="doubleFieldType" nillable="true"
  substitutionGroup="doubleFieldGroup" />
<xs:element name="floatField" type="floatFieldType" nillable="true"
  substitutionGroup="floatFieldGroup" />

<xs:element name="structField" type="structFieldType" nillable="true"
  substitutionGroup="structFieldGroup" />

<!-- A StructureField is exactly one of the following: stringField, intField,

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shortField, longField, zonedDecimalField, packedDecimalField, floatField,
doubleField, or hexBinaryField. -->
<xs:group name="structureField">
  <xs:choice>
    <xs:element ref="stringFieldGroup"/>
    <xs:element ref="intFieldGroup"/>
    <xs:element ref="unsignedIntFieldGroup"/>
    <xs:element ref="shortFieldGroup"/>
    <xs:element ref="unsignedShortFieldGroup"/>
    <xs:element ref="longFieldGroup"/>
    <xs:element ref="zonedDecimalFieldGroup"/>
    <xs:element ref="packedDecimalFieldGroup"/>
    <xs:element ref="floatFieldGroup"/>
    <xs:element ref="doubleFieldGroup"/>
    <xs:element ref="hexBinaryFieldGroup"/>
    <xs:element ref="structParmGroup"/>
    <xs:element ref="struct"/>
  </xs:choice>
</xs:group>

<!-- Character field -->
<!-- Maps to AS400Text. -->
<xs:complexType name="stringFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:string">
      <!-- Number of characters. -->
      <xs:attribute name="length" type="xs:string"/>
      <!-- Indicates the field's encoding (CCSID) on the server. -->
      <xs:attribute name="ccsid" type="xs:string"/>
      <xs:attribute name="trim" type="trimType" />
      <xs:attribute name="bytesPerChar" type="charType" />
      <xs:attribute name="bidiStringType" type="bidiStringTypeType" />
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- hexBinary field -->
<!-- Maps to AS400ByteArray. -->
<xs:complexType name="hexBinaryFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:hexBinary">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- Float field -->
<!-- Maps to AS400Float4. -->
<xs:complexType name="floatFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:float">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- zonedDecimal field -->
<!-- Maps to AS400ZonedDecimal. -->
<xs:complexType name="zonedDecimalFieldType">
  <xs:simpleContent>
    <xs:extension base="zonedDecimal">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- packedDecimal field -->
<!-- Maps to AS400PackedDecimal. -->
<xs:complexType name="packedDecimalFieldType">
  <xs:simpleContent>
    <!-- In DDS, "binary" values are 1-18 digits; if field length is
         greater than 9, then decimal positions value must be 0. -->
    <xs:extension base="packedDecimal">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- int field -->

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<!-- Maps to AS400Bin4. -->
<xs:complexType name="intFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:int">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- unsigned int field -->
<!-- Maps to AS400Bin4. -->
<xs:complexType name="unsignedIntFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:unsignedInt">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- short field -->
<!-- Maps to AS400Bin2. -->
<xs:complexType name="shortFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:short">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- unsigned short field -->
<!-- Maps to AS400Bin2. -->
<xs:complexType name="unsignedShortFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:unsignedShort">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- long field -->
<!-- Maps to AS400Bin8. -->
<xs:complexType name="longFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:long">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- double field -->
<!-- Maps to AS400Float8. -->
<xs:complexType name="doubleFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:double">
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- struct Field -->
<xs:complexType name="structFieldType">
  <xs:simpleContent>
    <xs:extension base="xs:string">
      <xs:attribute name="struct" type="string50"/>
      <xs:attributeGroup ref="commonFieldAttrs"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>

<!-- Attributes that are common to all data field types. -->
<xs:attributeGroup name="commonFieldAttrs">
  <xs:attribute name="name" type="string50"/>
  <xs:attribute name="columnHeading1" type="string20"/>
  <xs:attribute name="columnHeading2" type="string20"/>
  <xs:attribute name="columnHeading3" type="string20"/>
  <xs:attribute name="description" type="string50"/>
  <xs:attribute name="defaultValue" type="xs:string"/><!-- Max length of string is 65535
characters. -->

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    <xs:attribute name="nullable" type="xs:boolean"/>
    <xs:attribute name="isEmptyString" type="xs:boolean"/><!-- Indicate this is an empty string.
-->
</xs:attributeGroup>

<!-- Utility types. -->

<xs:simpleType name="ccsidType">
  <xs:restriction base="xs:nonNegativeInteger">
    <xs:maxInclusive value="65535"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="string10">
  <xs:restriction base="xs:string">
    <xs:maxLength value="10"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="string20">
  <xs:restriction base="xs:string">
    <xs:maxLength value="20"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="string50">
  <xs:restriction base="xs:string">
    <xs:maxLength value="50"/>
  </xs:restriction>
</xs:simpleType>

</xs:schema>

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## XPCML syntax

The XPCML schema defines several element tags, and each element tag contains attribute tags.

The following table lists the different elements that you can declare and define in your XPCML source files. Each entry in the first column links to the appropriate section of the XPCML schema.

XPCML tag	Description	Equivalent PCML tag
<a href="#">doubleParm</a>	Defines a double parameter	data (type=float, length=8)
<a href="#">arrayOfDoubleParm</a>	Defines a parameter that is an array of doubles	
<a href="#">floatParm</a>	Defines a float parameter	data (type=float, length=4)
<a href="#">arrayOfFloatParm</a>	Defines a parameter that is an array of floats	
<a href="#">hexBinaryParm</a>	Defines a byte parameter represented in hex	byte (rough equivalent, represented in hex)
<a href="#">arrayOfHexBinaryParm</a>	Defines a parameter that is an array of hexBinaries	
<a href="#">intParm</a>	Defines an integer parameter	data (type=int, length=4)
<a href="#">arrayOfIntParm</a>	Defines a parameter that is an array of integers	
<a href="#">longParm</a>	Defines a long parameter	data (type=int, length=8)
<a href="#">arrayOfLongParm</a>	Defines a parameter that is an array of longs	
<a href="#">packedDecimalParm</a>	Defines a packed decimal parameter	data (type=packed)
<a href="#">arrayOfPackedDecimalParm</a>	Defines a parameter that is an array of packed decimals	



<b>XPCML tag</b>	<b>Description</b>	<b>Equivalent PCML tag</b>
<a href="#">parameterList</a>	Signals that the enclosing tag represents all of the parameter definitions for the program	
<a href="#">program</a>	Begins and ends the XML that describes one program call	program
<a href="#">shortParm</a>	Defines a short parameter	data (type int, length 2)
<a href="#">arrayOfShortParm</a>	Defines a parameter that is an array of shorts	
<a href="#">stringParm</a>	Defines a string parameter	
<a href="#">arrayOfStringParm</a>	Defines a parameter that is an array of strings	
<a href="#">struct</a>	Defines a named structure that you can specify as an argument to a program or as a field within another named structure	struct
<a href="#">arrayOfStruct</a>	Defines an array of structs	
<a href="#">structParm</a>	Represents a reference to a struct tag found elsewhere in the XPCML document that you want to included at a specific location in the document	data (type=struct)
<a href="#">arrayOfStructParm</a>	Defines a parameter that is an array of struct parameters	
<a href="#">unsignedIntParm</a>	Defines an unsigned integer parameter	data (type=int, length=4, precision=32)
<a href="#">arrayOfUnsignedIntParm</a>	Defines a parameter that is an array of unsigned integers	
<a href="#">unsignedShortParm</a>	Defines an unsigned short parameter	data (type=int, length=2, precision=16)
<a href="#">arrayOfUnsignedShortParm</a>	Defines a parameter that is an array of unsigned shorts	
<a href="#">xpcml</a>	Begins and ends the XPCML source file that describes the program call format	
<a href="#">zonedDecimalParm</a>	Defines a zoned decimal parameter	data (type zoned)
<a href="#">arrayOfZonedDecimalParm</a>	Defines a parameter that is an array of zoned decimals	

### ***XPCML tag attributes***

The XPCML schema defines several element tags, and each element tag contains attribute tags. The following table lists and describes the different attributes for each element.

For more specific and detailed information about XPCML tags and their attributes, see [XPCML schema](#).

<b>XPCML tag</b>	<b>Attribute</b>	<b>Description</b>
hexBinaryParm	fill last 2 columns with data and decide format	
arrayOfHexBinaryParm		
doubleParm	Defines a double parameter	float (length 8)
arrayOfDoubleParm	Defines a parameter that is an array of doubles	
floatParm	Defines a float parameter	data (type float, length 4)
arrayOfFloatParm	Defines a parameter that is an array of floats	
intParm	Defines an integer parameter	data (type int, length 4)
arrayOfIntParm	Defines a parameter that is an array of integers	
longParm	Defines a long parameter	data (type int, length 8)
arrayOfLongParm	Defines a parameter that is an array of longs	
packedDecimalParm	Defines a packed decimal parameter	data (type packed)
arrayOfPackedDecimalParm	Defines a parameter that is an array of packed decimals	
parameterList	Signals that the enclosing tag represents all of the parameter definitions for the program	
program	Begins and ends the XML that describes one program call	
shortParm	Defines a short parameter	data (type int, length 2)
arrayOfShortParm	Defines a parameter that is an array of shorts	
stringParm	Defines a string parameter	
arrayOfStringParm	Defines a parameter that is an array of strings	
struct	Defines a named structure that you can specify as an argument to a program or as a field within another named structure	
arrayOfStruct	Defines an array of structs	
structParm	Represents a reference to a struct tag found elsewhere in the XPCML document that you want to included at a specific location in the document	data (type struct)
arrayOfStructParm	Defines a parameter that is an array of struct parms	

<b>XPCML tag</b>	<b>Attribute</b>	<b>Description</b>
unsignedIntParm	Defines an unsigned integer parameter	data (type int, length 4, precision 32)
arrayOfUnsignedIntParm	Defines a parameter that is an array of unsigned integers	
unsignedShortParm	Defines an unsigned short parameter	data (type int, length 2, precision 16)
arrayOfUnsignedShortParm	Defines a parameter that is an array of unsigned shorts	
xpcml	Begins and ends the XPCML source file that describes the program call format	
zonedDecimalParm	Defines a zoned decimal parameter	data (type zoned)
arrayOfZonedDecimalParm	Defines a parameter that is an array of zoned decimals	

## Using XPCML

Using XPCML is similar to using PCML. The following steps serve as a general outline for the actions that you need to perform to use XPCML.

1. Use XPCML to describe the specification for the program call
2. Create a ProgramCallDocument object
3. Use ProgramCallDocument.callProgram() to run the program

Despite the similarities to using PCML, using XPCML offers enhanced functionality:

- Have the parser automatically validate parameter values
- Specify and pass values for program parameters
- Retrieve the results of a program call to your server in XPCML
- Transform an existing PCML document into the equivalent XPCML document
- Extend the XPCML schema to define new simple and complex elements and attributes

For example, IBM Toolbox for Java enables you to extend the XPCML schema to create new parameter and data types. You can use this XPCML capability to condense your XPCML source files, which makes the files easier to read and code easier to use.

For more information about using XPCML, see the following pages:

### ***Converting existing PCML to XPCML***

The ProgramCallDocument class contains the transformPCMLToXPCML method that enables you to transform existing PCML documents to equivalent XPCML documents.

XPCML has comparable definitions for all of the elements and attributes that you can define in PCML. Using transformPCMLToXPCML() converts the PCML representation of the elements and attributes to the equivalent XPCML.

Note that in some cases, equivalent XPCML attributes have a different name than in PCML. For example, the attribute "usage" in PCML is the attribute "passDirection" in XPCML. For more information about how to use XPCML compared to PCML, see [XPCML schema and syntax](#).

The method takes the existing PCML document, which you pass to it as an InputStream object, and generates the equivalent XPCML as an OutputStream object. Because transformPCMLToXPCML() is a static method, you can call it without first creating a ProgramCallDocument object.

## Example: Converting a PCML document to an XPCML document

The following example shows how to convert a PCML document (named myPCML.pcml) to an XPCML document (named myXPCML.xpcml).

**Note:** You must specify .xpcml as the file extension for XPCML files. Using .xpcml as the file extension ensures that the ProgramCallDocument class recognizes the file as XPCML. If you do not specify an extension, ProgramCallDocument assumes that the file is PCML.

### PCML document myPCML.pcml

```
<!-- myPCML.pcml -->
<pcml version="4.0">
  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <data type="char" name="parm1" usage="in" passby="reference"
      minvrm="V5R2M0" ccsid="37" length="10" init="Value 1"/>
  </program>
</pcml>
```

### Java code to convert myPCML.pcml to myXPCML.xpcml

```
try {
  InputStream pcmlStream = new FileInputStream("myPCML.pcml");
  OutputStream xpcmlStream = new FileOutputStream("myXPCML.xpcml");
  ProgramCallDocument.transformPCMLToXPCML(pcmlStream, xpcmlStream);
}
catch (Exception e) {
  System.out.println("error: - "+e.getMessage());
  e.printStackTrace();
}
```

### Resulting XPCML document myXPCML.xpcml

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- myXPCML.xpcml -->
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">
  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <stringParm name="parm1" passDirection="in" passMode="reference"
        minvrm="V5R2M0" ccsid="37" length="10">Value 1
      </stringParm>
    </parameterList>
  </program>
</xpcml>
```

For more information about transformPCMLToXPCML() and the ProgramCallDocument class, see the following page:

[ProgramCallDocument javadoc information](#)

### ***Using XPCML to call a program on your server***

After you create your XPCML file, you need to create a ProgramCallDocument object that can use the XPCML specifications and data values to call a program on your IBM i server.

Create an XPCML ProgramCallDocument by passing in the name of your XPCML file on the ProgramCallDocument constructor. Creating an XPCML ProgramCallDocument in this way first parses and validates your XPCML document, then creates the ProgramCallDocument object.

In order to parse and validate the XPCML document, make sure that your CLASSPATH includes a fully validating XML parser. For more information about requirements to run XPCML, see the following page:

[“Requirements for using XPCML” on page 313](#)

The following example shows how to create a ProgramCallDocument object for the XPCML file, myXPCML.xpcml.

```
system = new AS400();
// Create a ProgramCallDocument into which to parse the file.
```

```
ProgramCallDocument xpcmlDoc =
    new ProgramCallDocument(system, "myXPCML.xpcml");
```

The only difference between creating an XPCML ProgramCallDocument and a PCML ProgramCallDocument is that you pass the constructor an XPCML document instead of a PCML document.

**Note:** You must specify .xpcml as the file extension for XPCML files. Using .xpcml as the file extension ensures that the ProgramCallDocument class recognizes the file as XPCML. If you do not specify an extension, ProgramCallDocument assumes that the file is PCML.

## Using XPCML to call a program on your server

After you create the ProgramCallDocument object, use any of the methods of the ProgramCallDocument class to work with your XPCML document. For example, call an IBM i program by using ProgramCallDocument.callProgram() or change the value for an XPCML input parameter before calling the server program by using the appropriate ProgramCallDocument.setValue method.

The following example shows how to create a ProgramCallDocument object for an XPCML file (named myXPCML.xpcml). After creating the ProgramCallDocument object, the example calls a program (PROG1) that is specified in the XPCML document. In this case, the only difference between using XPCML and PCML is that the example passes an XPCML file to the ProgramCallDocument constructor.

After your application reads and parses an XPCML document, the XPCML document functions just like a PCML document. At this point, XPCML can use any of the existing methods that PCML uses.

```
system = new AS400();

// Create a ProgramCallDocument into which to parse the file.
ProgramCallDocument xpcmlDoc = new ProgramCallDocument(system, "myXPCML.xpcml");

// Call PROG1
boolean rc = xpcmlDoc.callProgram("PROG1");
```

## Obtaining program call results as XPCML

After you call a server program, you can use ProgramCallDocument.getValue methods to retrieve the Java objects that represent program parameter values.

Additionally, the following generateXPCML methods enable ProgramCallDocument to return the results of a program call as XPCML:

- generateXPCML(String fileName): Generates results in XPCML for the entire XPCML source file that you used to construct the ProgramCallDocument object. Stores the XPCML in a file with the specified file name.
- generateXPCML(String pgmName, String fileName): Generates results in XPCML for only the specified program and its parameters. Stores the XPCML in a file with the specified file name.
- generateXPCML(java.io.OutputStream outputStream): Generates results in XPCML for the entire XPCML source file. Stores the XPCML in the specified OutputStream object.
- generateXPCML(String pgmName, java.io.OutputStream outputStream): Generates results in XPCML for only the specified program and its parameters. Stores the XPCML in the specified OutputStream object.

For more information about the ProgramCallDocument class, see the ProgramCallDocument Javadoc information.

The following example shows how you can construct an XPCML ProgramCallDocument, call an IBM i program, and retrieve the results of the program call as XPCML.

[“Example: Retrieving program call results as XPCML ” on page 523](#)

## Related information

[ProgramCallDocument Javadoc](#)

## ***Passing in parameter values as XPCML***

You can set the values for program parameters in the XPCML source file and pass in the parameter values as XPCML.

When the ProgramCallDocument object reads in and parses the XPCML document, it automatically calls the appropriate setValue method for each parameter specified in the XPCML.

Using XPCML to pass in parameter values relieves you from writing Java code that sets the values of complicated structures and arrays.

The following examples show different ways to construct arrays and pass in parameter values as XPCML:

[“Example: Passing in parameter values as XPCML” on page 525](#)

[“Examples: Passing in arrays of parameter values as XPCML” on page 526](#)

## ***Using condensed XPCML***

Because XPCML is extensible, you can define new parameter types that extend those specified by the XPCML schema. Condensing XPCML extends the XPCML schema to create new data type definitions that simplify and improve the readability and usability of your XPCML documents.

The following discussion assumes that you understand the XPCML schema. For more information about the XPCML schema, see the following page:

[“XPCML schema and syntax” on page 314](#)

To condense existing XPCML source, you use the ProgramCallDocument.condenseXPCML method, which generates the following:

- An extended schema that contains new type definitions for each parameter in the existing XPCML source
- New XPCML source that uses the type definitions provided in the extended schema

For more information about condensing your XPCML, see the following pages:

[“Condensing existing XPCML documents” on page 334](#)

[“Example: Using condensed XPCML to create a ProgramCallDocument object” on page 531](#)

[“Example: Obtaining program call results as condensed XPCML ” on page 531](#)

### *Condensing existing XPCML documents*

Condensing existing XPCML documents results in more readable and usable XPCML source. To create condensed XPCML, use the ProgramCallDocument.condenseXPCML method.

To call condenseXPCML(), provide the following parameters to the method:

- An input stream that represents the existing XPCML
- An output stream that represents the condensed XPCML
- An output stream that represents the new, extended schema
- A name for the new schema in the appropriate format (for example, mySchema.xsd)

For more information about condenseXPCML() and the ProgramCallDocument class, see the ProgramCallDocument Javadoc information.

ProgramCallDocument.condenseXPCML() is a static method, which means that you do not have to instantiate a ProgramCallDocument object in order to call the method.

## **Examples**

The following examples illustrate how to condense an existing XPCML document.

The first example is simple and includes original XPCML source, the resulting condensed XPCML, and the extended schema. The second example is longer and more complex, so it includes the Java code that calls condenseXPCML() and only a few of the newly generated type definitions in the extended schema:

[“Example: Condensing an existing XPCML document” on page 528](#)

[“Example: Condensing an existing XPCML document, including Java code” on page 528](#)

## Related information

[ProgramCallDocument Javadoc](#)

### **Identifying parse errors in XPCML**

When validating XPCML schema documents, a fully validating XML parser may generate warnings, non-fatal parse errors, and fatal parse errors.

Warnings and non-fatal parse errors do not cause the parse to fail. You might want to examine warnings and non-fatal errors to help you determine problems with your XPCML source. Fatal parse errors cause the parse to terminate with an exception.

To display warnings and non-fatal parser errors when parsing an XPCML document, turn tracing on in your application and set the trace category to PCML.

### **Example**

A fully validating XML parser generates an error for any numeric parameter type that does not have a value. The following example shows sample XPCML source and the resulting non-fatal parse error:

#### **XPCML source**

```
<program name="prog1"/>
  <parameterList>
    <intParm name="parm1"/>
  </parameterList>
</program>
```

#### **Resulting error**


```
Tue Mar 25 15:21:44 CST 2003 [Error]: cvc-complex-type.2.2: Element
'intParm' must have no element [children], and the value must be valid.
```

To prevent logging this kind of error, add the `nil=true` attribute to the `intParm` element. The `nil=true` attribute signals to the parser that you have deliberately left the element empty. Here is the previous XPCML source with the `nil=true` attribute added:

```
<program name="prog1"/>
  <parameterList>
    <intParm xsi:nil="true" name="parm1"/>
  </parameterList>
</program>
```

## Frequently asked questions (FAQ)

IBM Toolbox for Java frequently asked questions (FAQs) provide answers to questions about optimizing your IBM Toolbox for Java performance, performing troubleshooting, using JDBC, and more.

- [IBM Toolbox for Java FAQ](#) 

## Tips for programming

This section features a variety of tips that can help you use IBM Toolbox for Java.

### **Shutting down your Java program**

To ensure that your program shuts down properly, issue `System.exit(0)` as the last instruction before your Java program ends.

**Note:** Avoid using `System.exit(0)` with servlets because doing so shuts down the entire Java virtual machine.

IBM Toolbox for Java connects to the server with user threads. Because of this, a failure to issue `System.exit(0)` may keep your Java program from properly shutting down.

Using `System.exit(0)` is not a requirement, but a precaution. There are times that you must use this command to exit a Java program and it is not problematic to use `System.exit(0)` when it is not necessary.

## Integrated file system path names for server objects

Your Java program must use integrated file system names to refer to server objects, such as programs, libraries, commands, or spooled files. The integrated file system name is the name of a server object as it might be accessed in the library file system of the IBM i integrated file system.

The path name may consist of the following components:

Path name component	Description
library	The library in which the object resides. The library is a <b>required</b> portion of an integrated file system path name. The library name must be 10 or fewer characters and be followed by <b>.lib</b> .
object	The name of the object that the integrated file system path name represents. The object is a <b>required</b> portion of an integrated file system path name. The object name must be 10 or fewer characters and be followed by <b>.type</b> , where <b>type</b> is the type of the object. Types can be found by prompting for the OBJTYPE parameter on control language (CL) commands, such as the Work with Objects (WRKOBJ) command.
type	The type of the object. The type of the object must be specified when specifying the <b>object</b> . (See <b>object</b> above.) The type name must be 6 or fewer characters.
member	The name of the member that this integrated file system path name represents. The member is an <b>optional</b> portion of an integrated file system path name. It can be specified only when the <b>object type</b> is <b>FILE</b> . The member name must be 10 or fewer characters and followed by <b>.mbr</b> .

Follow these conditions when determining and specifying the integrated file system name:

- The forward slash (/) is the path separator character.
- The root-level directory, called QSYS.LIB, contains the server library structure.
- Objects that reside in the server library QSYS have the following format:

```
/QSYS.LIB/object.type
```

- Objects that reside in other libraries have the following format:

```
/QSYS.LIB/library.LIB/object.type
```

- The object type extension is the server abbreviation used for that type of object.

To see a list of these types, enter a CL command that has object type as a parameter and press **F4** (Prompt) for the type. For example, the Work with Objects (WRKOBJ) command has an object type parameter.

The following table is a list of some commonly used object types and the abbreviation for each type:



Object type	Abbreviation
command	.CMD
data queue	.DTAQ
file	.FILE
font resource	.FNTRSC
form definition	.FORMDF
library	.LIB
member	.MBR
overlay	.OVL
page definition	.PAGDFN
page segment	.PAGSET
program	.PGM
output queue	.OUTQ
spooled file	.SPLF

Use the following descriptions to help you determine how to specify integrated file system path names:

Integrated file system name	Description
/QSYS.LIB/MY_LIB.LIB/MY_PROG.PGM	Program MY_PROG in library MY_LIB on the server
/QSYS.LIB/MY_LIB.LIB/MY_QUEUE.DTAQ	Data queue MY_QUEUE in library MY_LIB on the server
/QSYS.LIB/YEAR1998.LIB/MONTH.FILE/JULY.MBR	Member JULY in file MONTH in library YEAR1998 on the server

## Integrated file system special values

Various IBM Toolbox for Java classes recognize special values in integrated file system path names. The traditional format for these special values (as used on an IBM i command line) begins with an asterisk (**\*ALL**). However, in a Java program that uses IBM Toolbox for Java classes, the format for these special values begins and ends with percent signs (**%ALL%**).

**Note:** In the integrated file system, an asterisk is a wildcard character.

The following table shows which of these special values the IBM Toolbox for Java classes recognize for particular path name components. The table also shows how the traditional format for these special values differ from the format used in IBM Toolbox for Java classes.

Path name component	Traditional format	IBM Toolbox for Java format
Library name	*ALL	%ALL%
	*ALLUSR	%ALLUSR%
	*CURLIB	%CURLIB%
	*LIBL	%LIBL%
	*USRLIBL	%USRLIBL%
Object name	*ALL	%ALL%

Path name component	Traditional format	IBM Toolbox for Java format
Member name	*ALL	%ALL%
	*FILE	%FILE%
	*FIRST	%FIRST%
	*LAST	%LAST%

See the [QSYSObjectPathName](#) class for information about building and parsing integrated file system names.

For more information about integrated file system concepts, see [Integrated file system concepts](#).

## Managing connections in Java programs

It is important to be able to create, start, and end connections to your server. The following discussion explains concepts central to managing connections to your server and also offers some code examples.

To connect to an IBM i server, your Java program must create an AS400 object. The AS400 object contains up to one socket connection for each IBM i server type. A service corresponds to a job on the server and is the interface to the data on the server.

**Note:** When you create Enterprise JavaBeans (EJB), comply with the EJB specification that does not allow threads during your connection. Although turning off IBM Toolbox for Java thread support may slow your application, it is required to comply with the EJB specification.

Every connection to each server has its own job on the system. A different server supports each of the following:

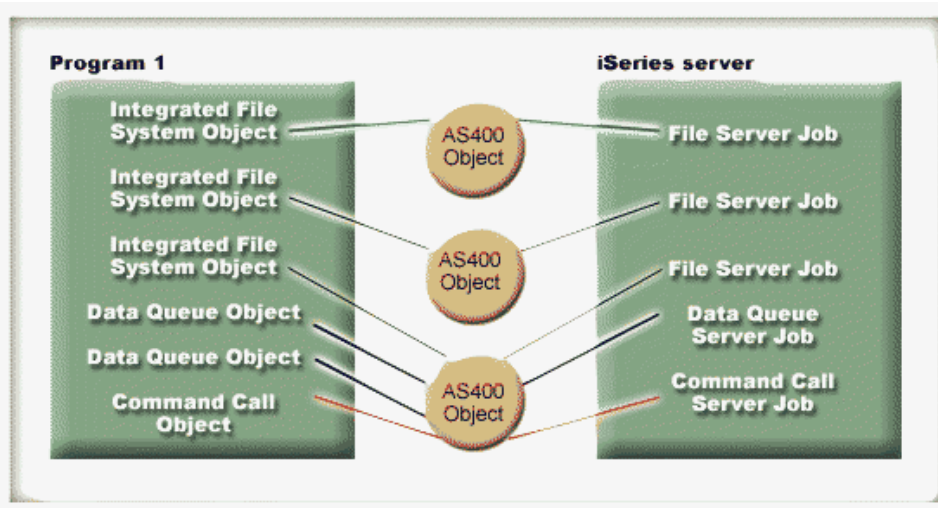
- JDBC
- Program call and command call
- Integrated file system
- Print
- Data queue
- Record-level access

**Note:**

- The [print](#) classes use one socket connection per AS400 object if the application does not try to do two things that require the network print server at the same time.
- A [print](#) class creates additional socket connections to the network print server if needed. The extra conversations are disconnected if they are not used for 5 minutes.

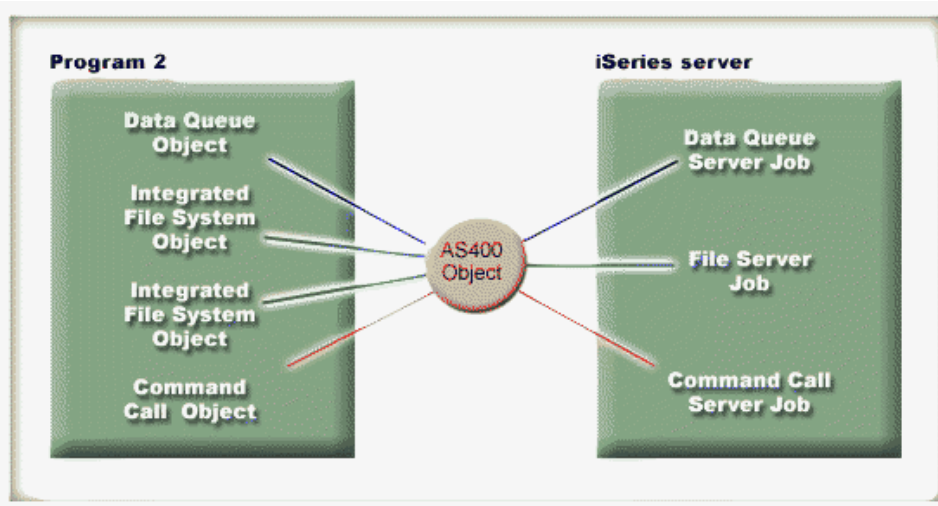
The Java program can control the number of connections to the system. To optimize communications performance, a Java program can create multiple AS400 objects for the same server as shown in Figure 1. This creates multiple socket connections to the system.

**Figure 1: Java program creating multiple AS400 objects and socket connections for the same system**



To conserve server resources, create only one AS400 object as shown in Figure 2. This approach reduces the number of connections, which reduces the amount of resource used on the server.

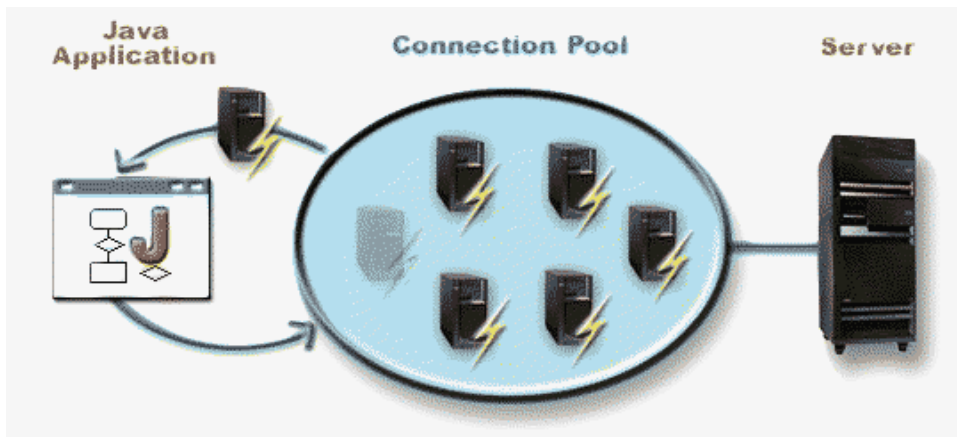
**Figure 2: Java program creating a single AS400 object and socket connection for the same system**



**Note:** Although creating more connections increases the amount of resource used on the server, creating more connections can have a benefit. Having more connections enables your Java program to process things in parallel, which can give better throughput (transactions-per-second) and speed up your application.

You can also choose to use a connection pool to manage connections as shown in Figure 3. This approach reduces the amount of time it takes to connect by reusing a connection previously established for the user.

**Figure 3: Java program getting a connection from an AS400ConnectionPool to a server**



The following examples show how to create and use AS400 objects:

**Example 1:** In the following example, two `CommandCall` objects are created that send commands to the same server. Because the `CommandCall` objects use the same `AS400` object, only one connection to the server is created.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create two command call objects that use
// the same AS400 object.
CommandCall cmd1 = new CommandCall(sys,"myCommand1");
CommandCall cmd2 = new CommandCall(sys,"myCommand2");

// Run the commands. A connection is made when the
// first command is run. Since they use the same
// AS400 object the second command object will use
// the connection established by the first command.
cmd1.run();
cmd2.run();
```

**Example 2:** In the following example, two `CommandCall` objects are created that send commands to the same system. Because the `CommandCall` objects use different `AS400` objects, two connections to the server are created.

```
// Create two AS400 objects to the same server.
AS400 sys1 = new AS400("mySystem.myCompany.com");
AS400 sys2 = new AS400("mySystem.myCompany.com");

// Create two command call objects. They use
// different AS400 objects.
CommandCall cmd1 = new CommandCall(sys1,"myCommand1");
CommandCall cmd2 = new CommandCall(sys2,"myCommand2");

// Run the commands. A connection is made when the
// first command is run. Since the second command
// object uses a different AS400 object, a second
// connection is made when the second command is run.
cmd1.run();
cmd2.run();
```

**Example 3:** In the following example, a `CommandCall` object and an `IFSFileInputStream` object are created using the same `AS400` object. Because the `CommandCall` object and the `IFSFileInput Stream` object use different services on the server, two connections are created.

```
// Create an AS400 object.
AS400 newConn1 = new AS400("mySystem.myCompany.com");

// Create a command call object.
CommandCall cmd = new CommandCall(newConn1,"myCommand1");

// Create the file object. Creating it causes the
// AS400 object to connect to the file service.
IFSFileInputStream file = new IFSFileInputStream(newConn1,"/myfile");
```

```
// Run the command. A connection is made to the
// command service when the command is run.
cmd.run();
```

**Example 4:** In the following example, an `AS400ConnectionPool` is used to get an IBM i connection. This example (like Example 3 above) does not specify a service, so the connection to the command service is made when the command is run.

```
// Create an AS400ConnectionPool.
AS400ConnectionPool testPool1 = new AS400ConnectionPool();

// Create a connection.
AS400 newConn1 = testPool1.getConnection("myAS400", "myUserID", "myPassword");

// Create a command call object that uses the AS400 object.
CommandCall cmd = new CommandCall(newConn1,"myCommand1");

// Run the command. A connection is made to the
// command service when the command is run.
cmd.run();

// Return connection to pool.
testPool1.returnConnectionToPool(newConn1);
```

**Example 5:** The following example uses `AS400ConnectionPool` to connect to a particular service when requesting the connection from the pool. This eliminates the time required to connect to the service when the command is run (see Example 4 above). If the connection is returned to the pool, the next call to get a connection can return the same connection object. This means that no extra connection time is needed, either on creation or use.

```
// Create an AS400ConnectionPool.
AS400ConnectionPool testPool1 = new AS400ConnectionPool();

// Create a connection to the AS400.COMMAND service. (Use the service number constants
// defined in the AS400 class (FILE, PRINT, COMMAND, DATAQUEUE, and so on.))
AS400 newConn1 = testPool1.getConnection("myAS400", "myUserID", "myPassword",
AS400.COMMAND);

// Create a command call object that uses the AS400 object.
CommandCall cmd = new CommandCall(newConn1,"myCommand1");

// Run the command. A connection has already been made
// to the command service.
cmd.run();

// Return connection to pool.
testPool1.returnConnectionToPool(newConn1);

// Get another connection to command service. In this case, it will return the same
// connection as above, meaning no extra connection time will be needed either now or
// when the command service is used.
AS400 newConn2 = testPool1.getConnection("myAS400", "myUserID", "myPassword",
AS400.COMMAND);
```

## Starting and ending connections

The Java program can control when a connection is started and ended. By default, a connection is started when information is needed from the server. You can control exactly when the connection is made by calling the `connectService()` method on the `AS400` object to preconnect to the server.

Using an `AS400ConnectionPool`, you can create a connection preconnected to a service without calling the `connectService()` method, as in Example 5 above.

The following examples show Java programs connecting to and disconnecting from the system.

**Example 1:** This example shows how to preconnect to the system:

```
// Create an AS400 object.
AS400 system1 = new AS400("mySystem.myCompany.com");

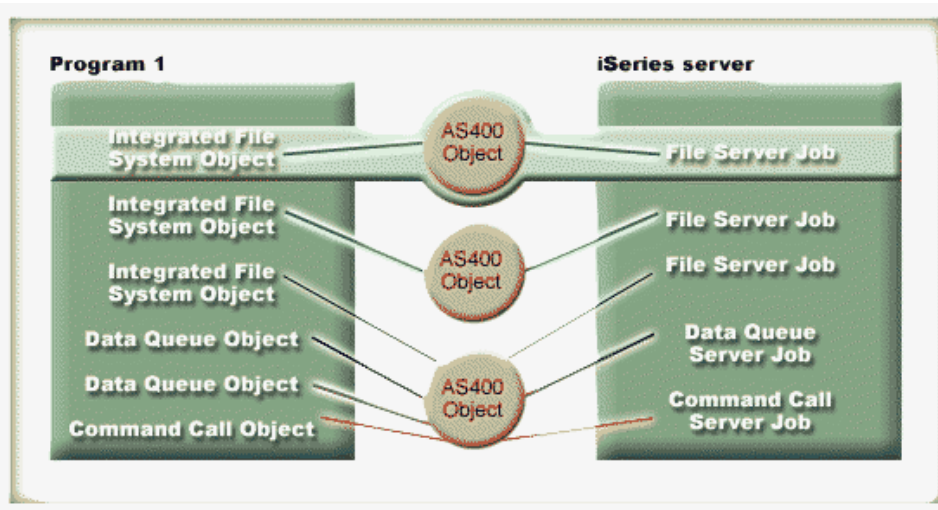
// Connect to the command service. Do it now
// instead of when data is first sent to the
```

```
// command service. This is optional since the
// AS400 object will connect when necessary.
system1.connectService(AS400.COMMAND);
```

**Example 2:** Once a connection is started, the Java program is responsible for disconnecting, which is done either implicitly by the AS400 object, or explicitly by the Java program. A Java program disconnects by calling the `disconnectService()` method on the AS400 object. To improve performance, the Java program must disconnect only when the program is finished with a service. If the Java program disconnects before it is finished with a service, the AS400 object reconnects, if it is possible to reconnect, when data is needed from the service.

Figure 4 shows how disconnecting the connection for the first integrated file system object connection ends only that single instance of the AS400 object connection, not all of the integrated file system object connections.

**Figure 4: Single object using its own service for an instance of an AS400 object is disconnected**



This example shows how the Java program disconnects a connection:

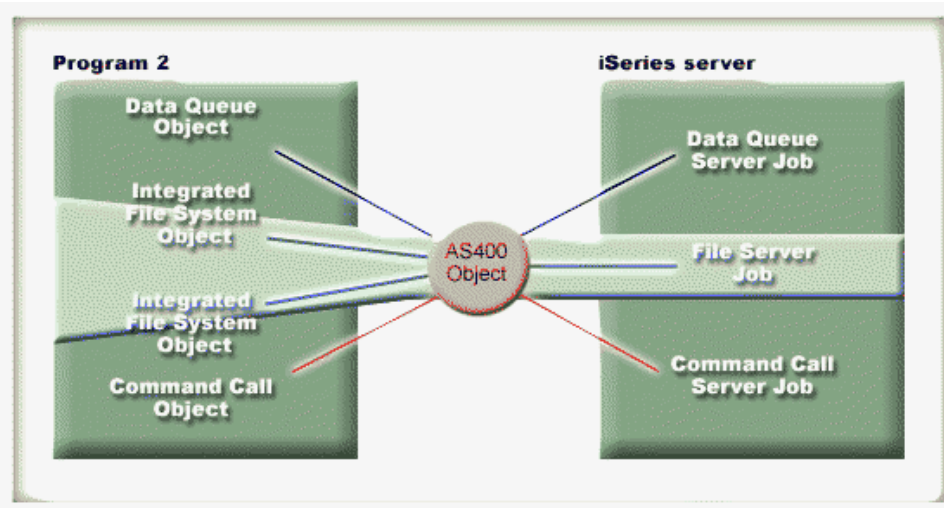
```
// Create an AS400 object.
AS400 system1 = new AS400("mySystem.myCompany.com");

// ... use command call to send several commands
// to the server. Since connectService() was not
// called, the AS400 object automatically
// connects when the first command is run.

// All done sending commands so disconnect the
// connection.
system1.disconnectService(AS400.COMMAND);
```

**Example 3:** Multiple objects that use the same service and share the same AS400 object share a connection. Disconnecting ends the connection for all objects that are using the same service for each instance of an AS400 object as is shown in Figure 5.

**Figure 5: All objects using the same service for an instance of an AS400 object are disconnected**



For example, two CommandCall objects use the same AS400 object. When `disconnectService()` is called, the connection is ended for both CommandCall objects. When the `run()` method for the second CommandCall object is called, the AS400 object must reconnect to the service:

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create two command call objects.
CommandCall cmd1 = new CommandCall(sys,"myCommand1");
CommandCall cmd2 = new CommandCall(sys,"myCommand2");

// Run the first command
cmd1.run();

// Disconnect from the command service.
sys.disconnectService(AS400.COMMAND);

// Run the second command. The AS400 object
// must reconnect to the server.
cmd2.run();

// Disconnect from the command service. This
// is the correct place to disconnect.
sys.disconnectService(AS400.COMMAND);
```

**Example 4:** Not all IBM Toolbox for Java classes automatically reconnect. Some method calls in the integrated file system classes do not reconnect because the file may have changed. While the file was disconnected, some other process may have deleted the file or changed its contents. In the following example, two file objects use the same AS400 object. When `disconnectService()` is called, the connection is ended for both file objects. The `read()` for the second `IFSFileInputStream` object fails because it no longer has a connection to the server.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create two file objects. A connection to the
// server is created when the first object is
// created. The second object uses the connection
// created by the first object.
IFSFileInputStream file1 = new IFSFileInputStream(sys,"/file1");
IFSFileInputStream file2 = new IFSFileInputStream(sys,"/file2");

// Read from the first file, then close it.
int i1 = file1.read();
file1.close();

// Disconnect from the file service.
sys.disconnectService(AS400.FILE);

// Attempt to read from the second file. This
// fails because the connection to the file service
// no longer exists. The program must either
// disconnect later or have the second file use a
```

```
// different AS400 object (which causes it to
// have its own connection).
int i2 = file2.read();

// Close the second file.
file2.close();

// Disconnect from the file service. This
// is the correct place to disconnect.
sys.disconnectService(AS400.FILE);
```

## IBM i Java virtual machine

The IBM Toolbox for Java classes run on the IBM Developer Kit for Java (IBM i) Java virtual machine (JVM).

In fact, the classes run on any platform that supports the Java 2 Software Development Kit (J2SDK) specifications.

For more information about IBM i support for different Java platforms, see [Support for multiple JDKs](#).

### Comparing the IBM i Java virtual machine and the IBM Toolbox for Java classes

You always have at least two ways to access a server resource when your Java program is running on the IBM Developer Kit for Java (IBM i) Java virtual machine (JVM).

You can use either of the following interfaces:

- Facilities built into Java
- An IBM Toolbox for Java class

When deciding which interface to use, consider the following factors:

- **Location** - Where a program runs is the most important factor in deciding which interface set to use. Does the program do the following:
  - Run only on the client?
  - Run only on the server?
  - Run on both client and server, but in both cases the resource is an IBM i resource?
  - Run on one IBM i JVM and access resources on another IBM i server?
  - Run on different kinds of servers?

If the program runs on both client and server (including an IBM i server as a client to a second IBM i server) and accesses only IBM i resources, it may be best to use the IBM Toolbox for Java interfaces.

If the program must access data on many types of servers, it may be best to use Java native interfaces.

- **Consistency / Portability** - The ability to run IBM Toolbox for Java classes on the IBM i server means that the same interfaces can be used for both client programs and server programs. When you have only one interface to learn for both client programs and server programs, you can be more productive.

Writing to IBM Toolbox for Java interfaces makes your program less **server** portable, however.

If your program must connect to an IBM i server as well as other servers, you may find it better to use the facilities that are built into Java.

- **Complexity** - The IBM Toolbox for Java interface is built especially for easy access to an IBM i resource. Often, the only alternative to using the IBM Toolbox for Java interface is to write a program that accesses the resource and communicates with that program through Java Native Interface (JNI).

You must decide whether it is more important to have better Java neutrality and write a program to access the resource, or to use the IBM Toolbox for Java interface, which is less portable.

- **Function** - The IBM Toolbox for Java interface often provides more function than the Java interface. For example, the IBM Toolbox for Java `IFSFileOutputStream` class has more function than the



FileOutputStream class of java.io. However, you lose **server** portability by using the IBM Toolbox for Java class.

You must decide whether portability is more important or whether you want to take advantage of the additional function.

- **Resource** - When running on the IBM i JVM, many of the IBM Toolbox for Java classes still make requests through the host servers. Therefore, a second job (the server job) carries out the request to access a resource.

This request may take more resource than a Java native interface that runs under the job of the Java program.

- **IBM i server as a client** - If your program runs on one IBM i server and accesses data on a second IBM i server, your best choice may be to use IBM Toolbox for Java classes. These classes provide easy access to the resource on the second IBM i server.

An example of this is Data Queue access. The IBM Toolbox for Java Data Queue interfaces provide easy access to the data queue resource.

## Running IBM Toolbox for Java classes on the IBM i Java virtual machine

There are some special considerations for running the IBM Toolbox for Java classes on the IBM Developer Kit for Java (IBM i) Java virtual machine (JVM).

### Command call

Two common ways to call a command are to use one of the following:

- The IBM Toolbox for Java CommandCall class
- The java.lang.Runtime.exec method

The `CommandCall` class generates a list of messages that are available to the Java program once the command completes. This list of messages is not available through `java.lang.Runtime.exec()`.

The `java.lang.Runtime.exec` method is portable across many platforms, so if your program must access files on different types of servers, `java.lang.Runtime.exec()` is a better solution.

### Integrated file system

Common ways to access a file in the IBM i integrated file system:

- The IBM Toolbox for Java IFSFile classes
- The file classes that are a part of java.io

The IBM Toolbox for Java integrated file system classes have the advantage of providing more function than the java.io classes. The IBM Toolbox for Java classes also work in applets, and they do not need a method of redirection (such as IBM i Access for Windows) to get from a workstation to the server.

The java.io classes are portable across many platforms, which is an advantage. If your program must access files on different types of servers, java.io is a better solution.

If you use java.io classes on a client, you need a method of redirection (such as the IBM i Access for Windows) to get to the server file system.

### JDBC

Two IBM-supplied JDBC drivers are available to programs running on the IBM i JVM:

- The IBM Toolbox for Java JDBC driver
- The IBM Developer Kit for Java JDBC driver

The IBM Toolbox for Java JDBC driver is best to use when the program is running in a client/server environment.

The IBM Developer Kit for Java JDBC driver is best to use when the program is running on the server.

If the same program runs on both the workstation and the server, you should load the correct driver through a system property instead of coding the driver name into your program.

## Program call

Two common ways to call a program are as follows:

- The ProgramCall class of the IBM Toolbox for Java
- Through a Java Native Interface (JNI) call

The IBM Toolbox for Java [ProgramCall](#) class has the advantage that it can call any server program.

You may not be able to call your server program through JNI. An advantage of JNI is that it is more portable across server platforms.

## Setting system name, user ID, and password with an AS400 object in the IBM i Java virtual machine

The AS400 object allows special values for system name, user ID, and password when the Java program is running on the IBM Toolbox for Java (IBM i) Java virtual machine (JVM).

When you run a program on the IBM i JVM, be aware of some special values and other considerations:

- User ID and password prompting is disabled when the program runs on the server. For more information about user ID and password values in the server environment, see [Summary of user ID and password values on an AS400 object](#).
- If system name, user ID, or password is not set on the AS400 object, the AS400 object connects to the current server by using the user ID and password of the job that started the Java program. When connecting to a v4r4 or later machine, it can extend the signed-on user's password like the rest of the IBM Toolbox for Java components.
- The special value, **localhost**, can be used as the system name. In this case, the AS400 object connects to the current server.
- The special value, **\*current**, can be used as the user ID or password on the AS400 object. In this case, the user ID or password (or both) of the job that started the Java program is used.
- The special value, **\*current**, can be used as the user ID or password on the AS400 object when the Java program is running on the IBM i JVM of one server, and the program is accessing resources on another IBM i server. In this case, the user ID and password of the job that started the Java program on the source system are used when connecting to the target system.

## Examples

The following examples show how to use the AS400 object with the IBM i JVM.

### Example: Creating an AS400 object when the IBM i JVM is running a Java program

When a Java program is running in the IBM i JVM, the program does not need to supply a system name, user ID, or password.

**Note:** You **must** supply a password when using record-level access.

If these values are not supplied, the AS400 object connects to the local system by using the user ID and password of the job that started the Java program.

When the program is running on the IBM i JVM, setting the system name to **localhost** is the same as not setting the system name. The following example shows how to connect to the current server:

```
// Create two AS400 objects. If the Java program is running in the
// IBM i JVM, the behavior of the two objects is the same.
// They will connect to the current server using the user ID and
// password of the job that started the Java program.
```

```
AS400 sys = new AS400()
AS400 sys2 = new AS400("localhost")
```

**Example: Connecting to the current server with a different user ID and password from the program that started the job** The Java program can set a user ID and password even when the program is running on the IBM i JVM. These values override the user ID and password of the job that started the Java program.

In the following example, the Java program connects to the current server, but the program uses a user ID and password that differs from those of the job that started the Java program.

```
// Create an AS400 object. Connect to the current server but do
// not use the user ID and password of the job that started the
// program. The supplied values are used.
AS400 sys = new AS400("localhost", "USR2", "PSWRD2")
```

**Example: Connecting to a different server by using the user ID and password of the job that started the Java program**

A Java program that is running on one server can connect to and use the resources of other systems.

If **\*current** is used for user ID and password, the user ID and password of the job that started the Java program is used when the Java program connects to the target server.

In the following example, the Java program is running on one server, but uses resources from another server. The user ID and password of the job that started the Java program are used when the program connects to the second server.

```
// Create an AS400 object. This program will run on one server
// but will connect to a second server (called "target").
// Because *current is used for user ID and password, the user
// ID and password of the job that started the program will be
// used when connecting to the second server.
AS400 target = new AS400("target", "*current", "*current")
```

### Summary of user ID and password values on an AS400 object

The following table summarizes how the user ID and password values on an AS400 object are handled by a Java program running on a server compared to a Java program running on a client.

Values on AS400 object	Java program running on a server	Java program running on a client
System name, user ID, and password not set	Connect to the current server using the user ID and password of the job that started the program	Prompt for system, user ID, and password
System name = localhost	Connect to the current server using the user ID and password of the job that started the program	<b>Error:</b> localhost is not valid when the Java program is running on a client
System name = localhost User ID = *current		
System name = localhost User ID = *current Password ID = *current		
System name = "sys"	Connect to server "sys" using the user ID and password of the job that started the program. "sys" can be the current server or another server	Prompt for user ID and password

Values on AS400 object	Java program running on a server	Java program running on a client
System name = localhost User ID = "UID" Password ID = "PWD"	Connect to the current server using the user ID and password specified by the Java program instead of the user ID and password of the job that started the program	<b>Error:</b> localhost is not valid when the Java program is not running on a client

## Independent auxiliary storage pool (ASP)

An independent auxiliary storage pool (ASP) is a collection of disk units that you can bring online or take offline independent of the rest of the storage on a system.

Independent ASPs contain any of the following:

- one or more user-defined file systems
- one or more external libraries

Each Independent ASP contains all of the necessary system information associated with the data it contains. So, while the system is active, you can take the Independent ASP offline, bring it online, or switch between systems.

For more information, see [Independent ASPs](#) and [User ASPs](#).

You can use the "database name" [JDBC property](#) or the [setDatabaseName\(\)](#) method from the AS400JDBCDataSource class to specify the ASP to which you want to connect.

All other IBM Toolbox for Java classes (IFSFile, Print, DataQueues, and so on) use the Independent ASP specified by the job description of the user profile that connects to the server.

## Exceptions

The IBM Toolbox for Java access classes throw exceptions when device errors, physical limitations, programming errors, or user input errors occur. The exception classes are based upon the type of error that occurs instead of the location where the error originates.

Most exceptions contain the following information:

- **Error type:** The exception object that is thrown indicates the type of error that occurred. Errors of the same type are grouped together in an exception class.
- **Error details:** The exception contains a return code to further identify the cause of the error that occurred. The return code values are constants within the exception class.
- **Error text:** The exception contains a text string that describes the error that occurred. The string is translated in the locale of the client Java virtual machine.

### Example: Catching a thrown exception

The following example shows how to catch a thrown exception, retrieve the return code, and display the exception text:

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
// All the setup work to delete a file on the server through the
// IFSFile class is done. Now try deleting the file.
try
{
    aFile.delete();
}

// The delete failed.
catch (ExtendedIOException e)
```

```

{
    // Display the translated string containing the reason that the
    // delete failed.
    System.out.println(e);

    // Get the return code out of the exception and display additional
    // information based on the return code.
    int rc = e.getReturnCode()

    switch (rc)
    {
        case ExtendedIOException.FILE_IN_USE:
            System.out.println("Delete failed, file is in use ");
            break;

        case ExtendedIOException.PATH_NOT_FOUND:
            System.out.println("Delete failed, path not found ");
            break;

        // For every specific error that you want to track...

        default:
            System.out.println("Delete failed, rc = ");
            System.out.println(rc);
    }
}
}

```

## Trace class

The Trace class allows the Java program to log trace points and diagnostic messages. This information helps reproduce and diagnose problems.

**Note:** You can also set tracing by using the [trace system properties](#).

The Trace class logs the following categories of information:

Information category	Description
Conversion	Logs character set conversions between Unicode and code pages. This category is used only by the IBM Toolbox for Java classes.
Datastream	Logs the data that flows between the system and the Java program. This category is used only by the IBM Toolbox for Java classes.
Diagnostic	Logs state information.
Error	Logs additional errors that cause an exception.
Information	Traces the flow through a program.
PCML	This category is used to determine how PCML interprets the data that is sent to and from the server.
Proxy	This category is used by IBM Toolbox for Java classes to log data flow between the client and the proxy server.
Warning	Logs information about errors the program was able to recover from.
All	This category is used to enable or disable tracing for all of the above categories at once. Trace information cannot be directly logged to this category.

The IBM Toolbox for Java classes also use the trace categories. When a Java program enables logging, IBM Toolbox for Java information is included with the information that is recorded by the application.

**You can enable the trace for a single category or a set of categories.** Once the categories are selected, use the `setTraceOn` method to turn tracing on and off. Data is written to the log using the `log` method.

**You can send trace data for different components to separate logs.** Trace data, by default, is written to the default log. Use component tracing to write application-specific trace data to a separate log or standard output. By using component tracing, you can easily separate trace data for a specific application from other data.

**Excessive logging can impact performance.** Use the `isTraceOn` method to query the current state of the trace. Your Java program can use this method to determine whether it builds the trace record before it calls the `log` method. Calling the `log` method when logging is off is not an error, but it takes more time.

**The default is to write log information to standard out.** To redirect the log to a file, call the `setFileName()` method from your Java application. In general, this works only for Java applications because most browsers do not give applets access to write to the local file system.

**Logging is off by default.** Java programs provide a way for the user to turn on logging so that it is easy to enable logging. For example, the application can parse for a command line parameter that indicates which category of data is logged. The user can set this parameter when log information is needed.

## Examples

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following examples show how to use the `Trace` class.

### Example Using `setTraceOn()` and writing data to a log by using the `log` method

```
// Enable diagnostic, information, and warning logging.
Trace.setTraceDiagnosticOn(true);
Trace.setTraceInformationOn(true);
Trace.setTraceWarningOn(true);

// Turn tracing on.
Trace.setTraceOn(true);

// ... At this point in the Java program, write to the log.
Trace.log(Trace.INFORMATION, "Just entered class xxx, method xxx");

// Turning tracing off.
Trace.setTraceOn(false);
```

### Example: Using `Trace`

In the following code, Method 2 is the preferable way to use `Trace`.

```
// Method 1 - build a trace record
// then call the log method and let the trace class determine if the
// data should be logged. This will work but will be slower than the
// following code.
String traceData = new String("Just entered class xxx, data = ");
traceData = traceData + data + "state = " + state;
Trace.log(Trace.INFORMATION, traceData);

// Method 2 - check the log status before building the information to
// log. This is faster when tracing is not active.
if (Trace.isTraceOn() && Trace.isTraceInformationOn())
{
    String traceData = new String("just entered class xxx, data = ");
    traceData = traceData + data + "state = " + state;
    Trace.log(Trace.INFORMATION, traceData);
}
```

### Example: Using component tracing

```
// Create a component string. It is more efficient to create an
// object than many String literals.
String myComponent1 = "com.myCompany.xyzComponent";
String myComponent2 = "com.myCompany.abcComponent";

// Send IBM Toolbox for Java and the component trace data each to separate files.
// The trace will contain all trace information, while each
```

```

// component log file will only contain trace information specific to
// that component. If a Trace file is not specified, all trace data
// will go to standard out with the component specified in front of
// each trace message.

// Trace.setFileName("c:\\bit.bucket");
// Trace.setFileName(myComponent1, "c:\\Component1.log");
// Trace.setFileName(myComponent2, "c:\\Component2.log");

Trace.setTraceOn(true); // Turn trace on.
Trace.setTraceInformationOn(true); // Enable information messages.

// Log component specific trace data or general IBM Toolbox for Java
// trace data.

Trace.setFileName("c:\\bit.bucket");
Trace.setFileName(myComponent1, "c:\\Component1.log");

```

## Related information

[Trace Javadoc](#)

## IBM i optimization

There exists two versions of the IBM Toolbox for Java software, one that is optimized when running on the IBM i JVM, and another that runs the same way no matter where the IBM Toolbox for Java is run.

Sign-on behavior and performance are improved when using the optimized version of the IBM Toolbox for Java software and running on the IBM i JVM and connecting to the same server.

### Enabling the optimizations

IBM Toolbox for Java is shipped as part of Licensed Program 5770-SS1 (option 3) in two directories:

- The /QIBM/ProdData/http/public/jt400/lib contains the version of the IBM Toolbox for Java that does not include IBM i optimizations. Use these files if you want behavior consistent with running the IBM Toolbox for Java on a client.
- The /QIBM/ProdData/OS400/jt400/lib contains the version of the IBM Toolbox for Java that does include IBM i optimizations when running on the IBM i JVM.

**Note:** As of IBM i 7.1, directory /QIBM/ProdData/http/public/jt400 is actually a symbolic link to /QIBM/ProdData/OS400/jt400. The /QIBM/ProdData/http/public/jt400 link is retained in order to maintain compatibility with earlier versions of IBM i.

For more information see [Note 1](#) in the information about [JAR files](#).

### Sign-on considerations

The version of the IBM Toolbox for Java that contains optimizations adds additional options for providing server (system) name, user ID and password information to the IBM Toolbox for Java.

When accessing an IBM i resource, the IBM Toolbox for Java classes must have a system name, user ID and password.

- **When running on a client**, the system name, user ID and password are provided by the Java program, or the IBM Toolbox for Java retrieves these values from the user through a sign-on dialog.
- **When running within the IBM i Java virtual machine**, the IBM Toolbox for Java has one more option. It can send requests to the current (local) server using the user ID and password of the job that started the Java program.

With the IBM Toolbox for Java that contains optimizations, the user ID and password of the current job also can be used when a Java program that is running on one IBM i server accesses the resources on another IBM i server. In this case, the Java program sets the system name, then uses the special value "\*current" for the user ID and password.

The Java program can only set the password to `"*current"` if you are using record-level access V4R4 or later. Otherwise, when you use record-level access, `"localhost"` is valid for system name and `"*current"` is valid for user ID; however, the Java program must supply the password.

A Java program sets system name, user ID, and password values in the `AS400` object.

To use the user ID and password of the job, the Java program can use `"*current"` as user ID and password, or it can use the constructor that does not have user ID and password parameters.

To use the current server, the Java program can use `"localhost"` as the system name or use the default constructor. That is,

```
AS400 system = new AS400();
```

is the same as

```
AS400 system = new AS400("localhost", "*current", "*current");
```

## Examples

The following examples show how to sign on to a server by using optimized classes.

### Example: Signing on when using different AS400 constructors

Two `AS400` objects are created in the following example. The two objects have the same behavior: they both run a command to the current server using the user ID and password of the job. One object uses the special value for the user ID and password, while the other uses the default constructor and does not set user ID or password.

```
// Create an AS400 object. Since the default
// constructor is used and system, user ID and
// password are never set, the AS400 object sends
// requests to the local server using the job's
// user ID and password. If this program were run
// on a client, the user would be prompted for
// system, user ID and password.
AS400 sys1 = new AS400();

// Create an AS400 object. This object sends
// requests to the local system using the job's
// user ID and password. This object will not work on a client.
AS400 sys2 = new AS400("localhost", "*current", "*current");

// Create two command call objects that use the AS400 objects.
CommandCall cmd1 = new CommandCall(sys1,"myCommand1");
CommandCall cmd2 = new CommandCall(sys2,"myCommand2");

// Run the commands.
cmd1.run();
cmd2.run();
```

### Example: Signing on by using the user ID and password of the current job

In the following example an `AS400` object is created that represents a second IBM i server. Since `"*current"` is used, the job's user ID and password from the server running the Java program are used on the second (target) server.

```
// Create an AS400 object. This object sends
// requests to a second system using the user ID
// and password from the job on the current server.
AS400 sys = new AS400("mySystem.myCompany.com", "*current", "*current");

// Create a command call object to run a command
// on the target server.
CommandCall cmd = new CommandCall(sys,"myCommand1");

// Run the command.
cmd.run();
```



## Performance improvements

With the additional classes provided by IBM i, Java programs running on the Java virtual machine for IBM i experience improved performance. Performance is improved in some cases because less communication function is used, and in other cases, an API is used instead of calling the server program.

### Shorter download time

In order to download the minimum number of IBM Toolbox for Java class files, use the [proxy server](#) in combination with the [AS400ToolboxJarMaker](#) tool.

### Faster communication

For all IBM Toolbox for Java functions except JDBC and integrated file system access, Java programs running on the Java virtual machine for IBM i will run faster. The programs run faster because less communication code is used when communicating between the Java program and the server program on the server that does the request.

JDBC and integrated file system access were not optimized because facilities already exist that make these functions run faster. When running on the IBM i server, you can use the JDBC driver for IBM i instead of the JDBC driver that comes with the IBM Toolbox for Java. To access files on the server, you can use `java.io` instead of the integrated file system access classes that come with the IBM Toolbox for Java.

### Directly calling IBM i APIs

Performance of the following classes of the IBM Toolbox for Java is improved because these classes directly call IBM i APIs instead of calling a server program to carry out the request:

- AS400Certificate classes
- CommandCall
- DataQueue
- ProgramCall
- Record-level database access classes
- ServiceProgramCall
- UserSpace

APIs are directly called only if the user ID and password match the user ID and password of the job running the Java program. To get the performance improvement, the user ID and password must match the user ID and password of the job that starts the Java program. For best results, use "localhost" for system name, "\*current" for user ID, and "\*current" for password.

### Port mapping changes

The port mapping system has been changed, which makes accessing a port faster. Before this change, a request for a port would be sent to the port mapper. From there, the server would determine which port was available and return that port to the user to be accepted. Now, you can either tell the server which port to use or specify that the default ports be used. This option eliminates the wasted time of the server determining the port for you. Use the `WRKSRVTBLE` command to view or change the list of ports for the server.

For the port mapping improvement, a few methods have been added to [AS400 class](#):

- `getServicePort`
- `setServicePort`
- `setServicePortsToDefault`

## Language specific strings changes

Language-specific string files are now shipped within the IBM Toolbox for Java program as class files instead of property files. The server finds messages in class files faster than in property files. `ResourceBundle.getString()` now runs faster because the files are stored in the first place that the computer searches. Another advantage of changing to class files is that the server can find the translated version of a string faster.

## Converters

Two classes allow faster, more efficient conversion between Java and the system:

- Binary Converter: Converts between Java byte arrays and Java simple types.
- Character Converter: Converts between Java String objects and IBM i code pages.

Also, the IBM Toolbox for Java now incorporates its own conversion tables for over 100 commonly used CCSIDs. Previously, the IBM Toolbox for Java either deferred to Java for nearly all text conversion. If Java did not possess the correct conversion table, IBM Toolbox for Java downloaded the conversion table from the server.

The IBM Toolbox for Java performs all text conversion for any CCSID of which it is aware. When it encounters an unknown CCSID, it attempts to let Java handle the conversion. At no point does the IBM Toolbox for Java attempt to download a conversion table from the server. This technique greatly reduces the amount of time it takes for an IBM Toolbox for Java application to perform text conversion. No action is required by the user to take advantage of this new text conversion; the performance gains all occur in the underlying converter tables.

### Related information

[AS400 Javadoc](#)

[BinaryConverter Javadoc](#)

[Character Converter Javadoc](#)

## Client installation and update classes

For most installation and update purposes, the IBM Toolbox for Java classes can be referenced at their location in the integrated file system on the server.

Because program temporary fixes (PTFs) are applied to this location, Java programs that access these classes directly on the server automatically receive these updates. But, accessing the classes from the server does not always work, specifically for the following situations:

- If a low-speed communication link connects server and the client, the performance of loading the classes from the server may be unacceptable.
- If Java applications use the CLASSPATH environment variable to access the classes on the client file system, you need IBM i Access for Windows to redirect file system calls to the server. It may not be possible for IBM i Access for Windows to reside on the client.

In these cases, installing the classes on the client is a better solution.

## AS400ToolboxJarMaker

While the JAR file format was designed to speed up the downloading of Java program files, the AS400ToolboxJarMaker generates an even faster loading IBM Toolbox for Java JAR file through its ability to create a smaller JAR file from a larger one.

Also, the AS400ToolboxJarMaker class can unzip a JAR file for you to gain access to the individual content files for basic use.

## Flexibility of AS400ToolboxJarMaker

All of the AS400ToolboxJarMaker functions are performed with the JarMaker class and the AS400ToolboxJarMaker subclass:

- The generic `JarMaker` tool operates on any JAR or Zip file; it splits a JAR file or reduces the size of a JAR file by removing classes that are not used.
- The `AS400ToolboxJarMaker` customizes and extends JarMaker functions for easier use with IBM Toolbox for Java JAR files.

According to your needs, you can invoke the AS400ToolboxJarMaker methods from within your own Java program or from a command line. Call AS400ToolboxJarMaker from the command line by using the following syntax:

```
java utilities.JarMaker [options]
```

where

- options = one or more of the available options

For a complete set of options available to run at a command line prompt, see the following in the Javadoc:

- Options for the JarMaker base class
- Extended options for the AS00ToolboxJarMaker subclass

## Using AS400ToolboxJarMaker

You can use AS400ToolboxJarMaker to work with JAR files in several ways:

- Uncompress one file bundled within a JAR file
- Split a large JAR file into smaller JAR files
- Exclude any IBM Toolbox for Java files that your application does not need to run

### Uncompressing a JAR file

Suppose you wanted to uncompress just one file bundled within a JAR file. AS400ToolboxJarMaker allows you to expand the file into one of the following:

- Current directory (`extract(jarFile)`)
- Another directory (`extract(jarFile, outputDirectory)`)

For example, with the following code, you are extracting AS400.class and all of its dependent classes from jt400.jar:

```
java utilities.AS400ToolboxJarMaker -source jt400.jar
    -extract outputDir
    -requiredFile com/ibm/as400/access/AS400.class
```

### Splitting up a single JAR file into multiple, smaller JAR files

Suppose you wanted to split up a large JAR file into smaller JAR files, according to your preference for maximum JAR file size. AS400ToolboxJarMaker, accordingly, provides you with the `split(jarFile, splitSize)` function.

In the following code, jt400.jar is split into a set of smaller JAR files, none larger than 300KB:

```
java utilities.AS400ToolboxJarMaker -split 300
```

### Removing unused files from a JAR file

With AS400ToolboxJarMaker, you can exclude any IBM Toolbox for Java files not needed by your application by selecting only the IBM Toolbox for Java [components](#), [languages](#), and [CCSIDs](#) that you need to make your application run. AS400ToolboxJarMaker also provides you with the option of including or excluding the JavaBean files associated with the components you select.

For example, the following command creates a JAR file that contains only those IBM Toolbox for Java classes needed to make the CommandCall and ProgramCall components of the IBM Toolbox for Java work:

```
java utilities.AS400ToolboxJarMaker -component CommandCall,ProgramCall
```

Additionally, if it is unnecessary to convert text strings between Unicode and the double byte character set (DBCS) conversion tables, you can create a 400KB byte smaller JAR file by omitting the unneeded conversion tables with the `-ccsid` option:

```
java utilities.AS400ToolboxJarMaker -component CommandCall,ProgramCall -ccsid 61952
```

**Note:** Conversion classes are not included with the program call classes. When including program call classes, you must also explicitly include the conversion classes used by your program by using the `-ccsid` option.

[JarMaker Javadoc](#)

[AS400ToolboxJarMaker Javadoc](#)

## Java national language support


Java supports a set of national languages, but it is a subset of the languages that the server supports.


When a mismatch between languages occurs, for example, if you are running on a local workstation that is using a language that is not supported by Java, the IBM Toolbox for Java licensed program **may issue some error messages in English**.


## Service and support for the IBM Toolbox for Java

Use the following resources for service and support.

**[IBM Toolbox for Java troubleshooting information](#)**  Use this information to help you resolve problems when using IBM Toolbox for Java.

**[JTOpen/IBM Toolbox for Java forum](#)**  Join the community of Java programmers who use IBM Toolbox for Java. This forum is an effective way to get assistance and advice from other Java programmers and sometimes from the IBM Toolbox for Java developers themselves

**[Server support](#)**  Use the IBM Server support Web site to find out about the tools and resources that help you streamline the technical planning and support for your system.


**[Software support](#)**  Use the IBM Software Support Services Web site to find out about the wide array of software support services offered by IBM.

Support services for the IBM Toolbox for Java are provided under the usual terms and conditions for software products. Support services include program services, voice support, and consulting services. Contact your local IBM representative for more information.

Resolving IBM Toolbox for Java program defects is supported under program services and voice support, while resolving application programming and debugging issues is supported under consulting services.

IBM Toolbox for Java application program interface (API) calls are supported under consulting services unless any of the following are true:

- It is clearly a Java API defect, as demonstrated by re-creation in a relatively simple program.
- It is a question asking for documentation clarification.
- It is a question about the location of samples or documentation.

All programming assistance is supported under consulting services including those program samples provided in the IBM Toolbox for Java licensed program. Additional samples may be made available on the Internet at the [IBM i home page](#)  on an unsupported basis.

Problem solving information is provided with the IBM Toolbox for Java Licensed Program Product. If you believe there is a potential defect in the IBM Toolbox for Java API, a simple program that demonstrates the error will be required.

## Code examples

---

The following list provides links to entry points for many of the examples used throughout the IBM Toolbox for Java information.

[Access classes](#)

[Beans](#)

[Commtrace classes](#)

[HTML classes](#)

[PCML](#)

[ReportWriter classes](#)

[RFML](#)

[Security classes](#)

[Servlet classes](#)

[Simple examples](#)

[Tips for programming](#)

[Utility classes](#)

[XPCML](#)

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### Examples: Access classes

This section lists the code examples that are provided throughout the documentation of the IBM Toolbox for Java access classes.

#### AS400JPing

- [Example: Using AS400JPing within a Java program](#)

#### BidiTransform

- [Example: Using the AS400BidiTransform class to transform bidirectional text](#)

#### CommandCall

- [Example: Using CommandCall to run a command on the server](#)
- [Example: Using CommandCall to prompt for the name of the server, command to run, and print the result](#)

## ConnectionPool

- [Example: Using AS400ConnectionPool to create connections to the server](#)

## DataArea

- [Example: Creating and writing to a decimal data area](#)

## Data conversion and description

- [Examples: Using the FieldDescription, RecordFormat, and Record classes](#)
- [Example: Putting data on a queue](#)
- [Example: Reading data from a queue](#)
- [Example: Using AS400DataType classes with ProgramCall](#)

## DataQueue

- [Example: How to create a DataQueue object, read data, and disconnect](#)
- [Example: Putting data on a queue](#)
- [Example: Reading data from a queue](#)
- [Example: Using KeyedDataQueue to put items on a queue](#)
- [Example: Using KeyedDataQueue to take items off a queue](#)

## Digital certificate

- [Example: Listing digital certificates that belong to a user](#)

## EnvironmentVariable

- [Example: Creating, setting, and getting environment variables](#)

## Exceptions

- [Example: Catching a thrown exception, retrieving the return code, and displaying the exception text](#)

## FTP

- [Example: Using the FTP class to Copy a set of files from a server directory](#)
- [Example: Using the AS400FTP class to copy a set of files from a directory](#)

## Integrated file system

- [Examples: Using IFSFile](#)
- [Example: Using the IFSFile.listFiles\(\) method to list the contents of a directory](#)
- [Example: Using IFSFile classes to copy files](#)
- [Example: Using IFSFile classes to list the contents of a directory](#)
- [Example: How to use IFSJavaFile instead of java.io.File](#)
- [Example: Using the IFSFile classes to list the contents of a directory on the server](#)

## JavaApplicationCall

- [Example: Running a program on the server from the client that outputs "Hello World!"](#)

## JDBC

- [Example: Using the JDBC driver to create and populate a table](#)
- [Example: Using the JDBC driver to query a table and output its contents](#)

## Jobs

- [Example: Retrieving and changing job information using the cache](#)
- [Example: Listing all active jobs](#)
- [Example: Printing all of the messages in the job log for a specific user](#)
- [Example: Listing the job identification information for a specific user](#)
- [Example: Getting a list of jobs on the server and listing the job status and the job identifier](#)
- [Example: Displaying messages in the job log for a job that belongs to the current user](#)

## Message queue

- [Example: How to use the message queue object](#)
- [Example: Printing the contents of the message queue](#)
- [Example: Retrieving and printing a message](#)
- [Example: Listing the contents of the message queue](#)
- [Example: Using AS400Message with CommandCall](#)
- [Example: Using AS400Message with ProgramCall](#)

## NetServer

- [Example: Using a NetServer object to change the name of the NetServer](#)

## Print

- [Example: Asynchronously listing all spooled files using the PrintObjectListListener interface](#)
- [Example: Asynchronously listing all spooled files \*without\* using the PrintObjectListListener interface](#)
- [Example: Copying a spooled file using SpooledFile.copy\(\)](#)
- [Example: Creating a spooled file from an input stream](#)
- [Example: Generating an SCS data stream using the SCS3812Writer class](#)
- [Example: Reading an existing spooled file](#)
- [Example: Reading and transforming spooled files](#)
- [Example: Synchronously listing all spooled files](#)

## Permission

- [Example: Set the authority of an AS400 object](#)

## Program call

- [Example: Using ProgramCall](#)
- [Example: Using ProgramCall to retrieve system status](#)
- [Example: Passing parameter data with a Program parameter object](#)

## QSYSObjectPathName

- [Example: Building an integrated file system name](#)

- [Example: Using QSYSObjectPathName.toPath\(\) to build an AS400 object name](#)
- [Example: Using QSYSObjectPathName to parse the integrated file system path name](#)

## Record-level access

- [Example: Sequentially accessing a file](#)
- [Example: Using the record-level access classes to read a file](#)
- [Example: Using the record-level access classes to read records by key](#)
- [Example: Using the LineDataRecordWriter class](#)

## Service program call

- [Example: Using ServiceProgramCall to call a procedure](#)

## SystemStatus

- [Example: Use caching with the SystemStatus class](#)

## SystemPool

- [Example: Setting the maximum faults size for SystemPool](#)

## SystemValue

- [Example: Using SystemValue and SystemValueList](#)

## Trace

- [Example: Using the Trace.setTraceOn\(\) method](#)
- [Example: Preferred way to use Trace](#)
- [Example: Using component tracing](#)

## UserGroup

- [Example: Retrieving a list of users](#)
- [Example: Listing all the users of a group](#)

## UserSpace

- [Example: How to create a user space](#)

The following disclaimer applies to all of the IBM Toolbox for Java examples:

### Code example disclaimer

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## Example: Using CommandCall

This IBM Toolbox for Java example program prompts the user for the name of the server and the command to run, then prints the result of the command.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// Command call example. This program prompts the user
// for the name of the server and the command to run, then
// prints the result of the command.
//
// This source is an example of "CommandCall"
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class CommandCallExample extends Object
{
    public static void main(String[] parameters)
    {

        // Created a reader to get input from the user
        BufferedReader inputStream = new BufferedReader(new InputStreamReader(System.in),1);

        // Declare variables to hold the system name and the command to run
        String systemString = null;
        String commandString = null;

        System.out.println( " " );

        // Get the system name and the command to run from the user
        try
        {
            System.out.print("System name: ");
            systemString = inputStream.readLine();

            System.out.print("Command: ");
            commandString = inputStream.readLine();
        }
        catch (Exception e) {};

        System.out.println( " " );

        // Create an AS400 object. This is the system we send the command to
        AS400 as400 = new AS400(systemString);

        // Create a command call object specifying the server that will
        // receive the command.
        CommandCall command = new CommandCall( as400 );

        try
        {
            // Run the command.
            if (command.run(commandString))
                System.out.print( "Command successful" );
            else
                System.out.print( "Command failed" );

            // If messages were produced from the command, print them
            AS400Message[] messageList = command.getMessageList();
        }
    }
}
```

```

        if (messagelist.length > 0)
        {
            System.out.println( ", messages from the command:" );
            System.out.println( " " );
        }

        for (int i=0; i < messagelist.length; i++)
        {
            System.out.print ( messagelist[i].getID() );
            System.out.print ( ": " );
            System.out.println( messagelist[i].getText() );
        }
    }
    catch (Exception e)
    {
        System.out.println( "Command " + command.getCommand() + " did not run" );
    }

    System.exit(0);
}
}
}

```

## Example: Using AS400ConnectionPool

This IBM Toolbox for Java example program uses an AS400ConnectionPool to create connections to a system.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// AS400ConnectionPooling example. This program uses an
// AS400ConnectionPool to create connections to an
// IBM i system.
// Command syntax:
//   AS400ConnectionPooling system myUserId myPassword
//
// For example,
//   AS400ConnectionPooling MySystem MyUserId MyPassword
//
////////////////////////////////////

import com.ibm.as400.access.*;

public class AS400ConnectionPooling
{
    public static void main (String[] parameters)
    {
        // Check the input parameters.
        if (parameters.length != 3)
        {
            System.out.println("");
            System.out.println("Usage:");
            System.out.println("");
            System.out.println("  AS400ConnectionPooling system userId password");
            System.out.println("");
            System.out.println("For example:");
            System.out.println("");
            System.out.println("  AS400ConnectionPooling MySystem MyUserId MyPassword");
            System.out.println("");
            return;
        }

        String system   = parameters[0];
        String userId   = parameters[1];
        String password  = parameters[2];

        try
        {
            // Create an AS400ConnectionPool.
            AS400ConnectionPool testPool = new AS400ConnectionPool();

            // Set a maximum of 128 connections to this pool.
            testPool.setMaxConnections(128);

            // Set a maximum lifetime for 30 minutes for connections.
            testPool.setMaxLifetime(1000*60*30); // 30 min Max lifetime since created.
        }
    }
}

```

```

// Preconnect 5 connections to the AS400.COMMAND service.
testPool.fill(system, userId, password, AS400.COMMAND, 1);
System.out.println();
System.out.println("Preconnected 1 connection to the AS400.COMMAND service");

// Call getActiveConnectionCount and getAvailableConnectionCount to see how many
// connections are in use and available for a particular system.
System.out.println("Number of active connections: "
    + testPool.getActiveConnectionCount(system, userId));
System.out.println("Number of available connections for use: "
    + testPool.getAvailableConnectionCount(system, userId));

// Create a connection to the AS400.COMMAND service. (Use the service number
// constants defined in the AS400 class (FILE, PRINT, COMMAND, DATAQUEUE, and so on.))
// Since connections have already been filled, the usual time spent connecting
// to the command service is avoided.
AS400 newConn1 = testPool.getConnection(system, userId, password, AS400.COMMAND);

System.out.println();
System.out.println("getConnection gives out an existing connection to user");
System.out.println("Number of active connections: "
    + testPool.getActiveConnectionCount(system, userId));
System.out.println("Number of available connections for use: "
    + testPool.getAvailableConnectionCount(system, userId));

// Create a new command call object and run a command.
CommandCall cmd1 = new CommandCall(newConn1);
cmd1.run("CRTLIB FRED");

// Return the connection to the pool.
testPool.returnConnectionToPool(newConn1);

System.out.println();
System.out.println("Returned a connection to pool");
System.out.println("Number of active connections: "
    + testPool.getActiveConnectionCount(system, userId));
System.out.println("Number of available connections for reuse: "
    + testPool.getAvailableConnectionCount(system, userId));

// Create a connection to the AS400.COMMAND service. This will return the same
// object as above for reuse.
AS400 newConn2 = testPool.getConnection(system, userId, password, AS400.COMMAND);

System.out.println();
System.out.println("getConnection gives out an existing connection to user");
System.out.println("Number of active connections: "
    + testPool.getActiveConnectionCount(system, userId));
System.out.println("Number of available connections for reuse: "
    + testPool.getAvailableConnectionCount(system, userId));

// Create a connection to the AS400.COMMAND service. This will create a new
// connection as there are not any connections in the pool to reuse.
AS400 newConn3 = testPool.getConnection(system, userId, password, AS400.COMMAND);

System.out.println();
System.out.println("getConnection creates a new connection because there are no
connections available");
System.out.println("Number of active connections: "
    + testPool.getActiveConnectionCount(system, userId));
System.out.println("Number of available connections for reuse: "
    + testPool.getAvailableConnectionCount(system, userId));

// Close the test pool.
testPool.close();
}
catch (Exception e)
{
    // If any of the above operations failed say the pool operations failed
    // and output the exception.

    System.out.println("Pool operations failed");
    System.out.println(e);
    e.printStackTrace();
}
}
}
}

```

## Examples: Using AS400JDBCManagedConnectionPoolDataSource class

These examples demonstrate the use of the AS400JDBCManagedConnectionPoolDataSource class. The AS400JDBCManagedConnectionPoolDataSource class simplifies connection pool maintenance by eliminating the need for user applications to implement their own management code.

**Note:** By using the code examples, you agree to the terms of the [“Code license and disclaimer information”](#) on page 534.

### Example 1

This brief example shows the basic use of the AS400JDBCManagedConnectionPoolDataSource class.

```
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.sql.DataSource;

import com.ibm.as400.access.AS400JDBCManagedConnectionPoolDataSource;
import com.ibm.as400.access.AS400JDBCManagedDataSource;

public class TestJDBCConnPoolSnippet
{
    void test()
    {
        AS400JDBCManagedConnectionPoolDataSource cpds0 = new AS400JDBCManagedConnectionPoolDataSource();

        // Set general datasource properties. Note that both connection pool datasource (CPDS) and
        managed // datasource (MDS) have these properties, and they might have different values.
        cpds0.setServerName(host);
        cpds0.setDatabaseName(host); //iasp can be here
        cpds0.setUser(userid);
        cpds0.setPassword(password);

        cpds0.setSavePasswordWhenSerialized(true);

        // Set connection pooling-specific properties.
        cpds0.setInitialPoolSize(initialPoolSize_);
        cpds0.setMinPoolSize(minPoolSize_);
        cpds0.setMaxPoolSize(maxPoolSize_);
        cpds0.setMaxLifetime((int)(maxLifetime_/1000)); // convert to seconds
        cpds0.setMaxIdleTime((int)(maxIdleTime_/1000)); // convert to seconds
        cpds0.setPropertyCycle((int)(propertyCycle_/1000)); // convert to seconds
        //cpds0.setReuseConnections(false); // do not re-use connections

        // Set the initial context factory to use.
        System.setProperty(Context.INITIAL_CONTEXT_FACTORY,
"com.sun.jndi.fscontext.RefFSContextFactory");

        // Get the JNDI Initial Context.
        Context ctx = new InitialContext();

        // Note: The following is an alternative way to set context properties locally:
        // Properties env = new Properties();
        // env.put(Context.INITIAL_CONTEXT_FACTORY, "com.sun.jndi.fscontext.RefFSContextFactory");
        // Context ctx = new InitialContext(env);

        ctx.rebind("mydatasource", cpds0); // We can now do lookups on cpds, by the name "mydatasource".

        // Create a standard DataSource object that references it.

        AS400JDBCManagedDataSource mds0 = new AS400JDBCManagedDataSource();
        mds0.setDescription("DataSource supporting connection pooling");
        mds0.setDataSourceName("mydatasource");
        ctx.rebind("ConnectionPoolingDataSource", mds0);

        DataSource dataSource_ = (DataSource)ctx.lookup("ConnectionPoolingDataSource");

        AS400JDBCManagedDataSource mds_ = (AS400JDBCManagedDataSource)dataSource_;

        boolean isHealthy = mds_.checkPoolHealth(false); //check pool health

        Connection c = dataSource_.getConnection();
    }
}
```

```
}
```

## Example 2

This example shows more details about how to use the AS400JDBCManagedConnectionPoolDataSource class.

```
import java.awt.TextArea;
import java.io.BufferedReader;
import java.io.File;
import java.io.FileReader;
import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.io.OutputStream;
import java.io.PrintStream;
import java.util.Vector;
import java.util.Properties;

import java.sql.Connection;
import javax.sql.DataSource;
import java.sql.ResultSet;
import java.sql.Statement;
import javax.naming.*;
import java.util.Date;
import java.util.ArrayList;
import java.util.Random;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400JDBCManagedConnectionPoolDataSource;
import com.ibm.as400.access.AS400JDBCManagedDataSource;
import com.ibm.as400.access.Trace;

public class TestJDBConnPool
{
    private static final boolean DEBUG = false;

    // If you turn this flag on, be sure to also turn on the following flag:
    // AS400JDBCConnection.TESTING_THREAD_SAFETY.
    private static final boolean TESTING_THREAD_SAFETY = false;

    private static String userid;
    private static String password;
    private static String host;

    // Note: For consistency, all time values are stored units of milliseconds.
    private int initialPoolSize_; // initial # of connections in pool
    private int minPoolSize_; // max # of connections in pool
    private int maxPoolSize_; // max # of connections in pool
    private long maxLifetime_; // max lifetime (msecs) of connections in pool
    private long maxIdleTime_; // max idle time (msecs) of available connections in pool
    private long propertyCycle_; // pool maintenance frequency (msecs)

    private int numDaemons_; // # of requester daemons to create
    private static long timeToRunDaemons_; // total duration (msecs) to let the daemons run
    private long daemonMaxSleepTime_; // max time (msecs) for requester daemons to sleep each cycle
    private long daemonMinSleepTime_; // min time (msecs) for requester daemons to sleep each cycle
    private long poolHealthCheckCycle_; // # of msecs between calls to checkPoolHealth()

    private boolean keepDaemonsAlive_ = true; // When this is false, the daemons shut down.

    private DataSource dataSource_;
    private AS400JDBCManagedDataSource mds_;

    private final Object daemonSleepLock_ = new Object();

    private Random random_ = new Random();

    static
    {
        try {
            Class.forName("com.ibm.as400.access.AS400JDBCdriver");
        }
        catch(Exception e){
            System.out.println("Unable to register JDBC driver.");
            System.exit(0);
        }
    }
}
```

```

public static void main(String[] args)
{
    host = args[0];
    userid = args[1];
    password = args[2];
    timeToRunDaemons_ = (new Integer(args[3])).intValue() * 1000; //milliseconds
    //args[3]=time to run in seconds
    TestJDBCConnPool cptest = new TestJDBCConnPool();

    cptest.setup();
    cptest.runTest();
}

public void setup()
{
    try
    {
        if (DEBUG)
            System.out.println("TESTING_THREAD_SAFETY flag is "
                + (TESTING_THREAD_SAFETY ? "true" : "false"));

        if (TESTING_THREAD_SAFETY)
        {
            // Adjust values for performing thread-intensive stress testing.
            // NOTE: This assumes that the AS400JDBCConnection class has also been modified to
            // not make actual connections to an actual server.
            // To do this, edit AS400JDBCConnection.java, changing its TESTING_THREAD_SAFETY
            // flag to 'false', and recompile.
            minPoolSize_ = 100;
            maxPoolSize_ = 190;
            initialPoolSize_ = 150; // this should get reset to maxPoolSize_
            numDaemons_ = 75;
            if (timeToRunDaemons_ == 0) {
                timeToRunDaemons_ = 180*1000; // 180 seconds == 3 minutes
            }
        }
        else
        {
            // Set more conservative values, as we'll be making actual connections to an
            // actual server, and we don't want to monopolize the server.
            minPoolSize_ = 5;
            maxPoolSize_ = 15;
            initialPoolSize_ = 9;
            numDaemons_ = 4;
            if (timeToRunDaemons_ == 0) {
                timeToRunDaemons_ = 15*1000; // 15 seconds
            }
        }
        maxLifetime_ = (int)timeToRunDaemons_ / 3;
        maxIdleTime_ = (int)timeToRunDaemons_ / 4;
        propertyCycle_ = timeToRunDaemons_ / 4;
        poolHealthCheckCycle_ = Math.min(timeToRunDaemons_ / 4, 20*60*1000);
        // at least once every 20 minutes (more frequently if shorter run-time)
        daemonMaxSleepTime_ = Math.min(timeToRunDaemons_ / 3, 10*1000);
        // at most 10 seconds (less if shorter run-time)
        daemonMinSleepTime_ = 20; // milliseconds

        if (DEBUG)
            System.out.println("setup: Constructing "
                + "AS400JDBCManagedConnectionPoolDataSource (cpds0)");
        AS400JDBCManagedConnectionPoolDataSource cpds0 =
            new AS400JDBCManagedConnectionPoolDataSource();

        // Set datasource properties. Note that both CPDS and MDS have these
        // properties, and they might have different values.
        cpds0.setServerName(host);
        cpds0.setDatabaseName(host);//iasp can be here
        cpds0.setUser(userid);
        cpds0.setPassword(password);

        cpds0.setSavePasswordWhenSerialized(true);

        // Set connection pooling-specific properties.
        cpds0.setInitialPoolSize(initialPoolSize_);
        cpds0.setMinPoolSize(minPoolSize_);
        cpds0.setMaxPoolSize(maxPoolSize_);
        cpds0.setMaxLifetime((int)(maxLifetime_/1000)); // convert to seconds
        cpds0.setMaxIdleTime((int)(maxIdleTime_/1000)); // convert to seconds
        cpds0.setPropertyCycle((int)(propertyCycle_/1000)); // convert to seconds
        //cpds0.setReuseConnections(false); // don't re-use connections

        // Set the initial context factory to use.
        System.setProperty(Context.INITIAL_CONTEXT_FACTORY,

```

```

        "com.sun.jndi.fscontext.RefFSContextFactory");

// Get the JNDI Initial Context.
Context ctx = new InitialContext();

// Note: The following is an alternative way to set context properties locally:
//   Properties env = new Properties();
//   env.put(Context.INITIAL_CONTEXT_FACTORY,
//           "com.sun.jndi.fscontext.RefFSContextFactory");
//   Context ctx = new InitialContext(env);

ctx.rebind("mydatasource", cpds0);
    // We can now do lookups on cpds, by the name "mydatasource".

if (DEBUG)
    System.out.println("setup: lookup(\"mydatasource\" + ")");
// AS400JDBCManagedConnectionPoolDataSource cpds1 =
//   (AS400JDBCManagedConnectionPoolDataSource)ctx.lookup("mydatasource");
// if (DEBUG) System.out.println("setup: cpds1.getUser() == |" + cpds1.getUser() + "|");

// Create a standard DataSource object that references it.

if (DEBUG)
    System.out.println("setup: Constructing AS400JDBCManagedDataSource (mds0)");
AS400JDBCManagedDataSource mds0 = new AS400JDBCManagedDataSource();
mds0.setDescription("DataSource supporting connection pooling");
mds0.setDataSourceName("mydatasource");
ctx.rebind("ConnectionPoolingDataSource", mds0);

if (DEBUG)
    System.out.println("setup: lookup(\"ConnectionPoolingDataSource\" + ")");
dataSource_ = (DataSource)ctx.lookup("ConnectionPoolingDataSource");
//dataSource_.setLogWriter(output_);
if (DEBUG)
    System.out.println("setup: dataSource_.getUser() == |" +
        ((AS400JDBCManagedDataSource)dataSource_).getUser() + "|");

    mds_ = (AS400JDBCManagedDataSource)dataSource_;
}
catch (Exception e)
{
    e.printStackTrace();
    System.out.println("Setup error during Trace file creation.");
}
}

void displayConnectionType(Connection conn, boolean specifiedDefaultId)
{
    if (conn instanceof com.ibm.as400.access.AS400JDBCConnectionHandle)
        System.out.print("(" + (specifiedDefaultId ? "+" : "-") + "P");
    else
        System.out.print("(" + (specifiedDefaultId ? "+" : "-") + "NP");
}

/**
 * Gets and returns connections from and to a connection pool for a while.
 */
public void runTest()
{
    boolean ok = true;
    try
    {
        System.out.println("Started test run at " + new Date());

        if (DEBUG)
            System.out.println("Checking health just after datasource creation "
                + "(we expect that the pool does not exist yet) ...");
        if (mds_.checkPoolHealth(true)) {
            ok = false;
            System.out.println("\nERROR: Pool exists prior to first getConnection().");
        }

        // Verify some setters/getters for JDBC properties.
        System.out.println("Verifying setters/getters ...");

        mds_.setAccess("read only");
        if (!mds_.getAccess().equals("read only")) {
            ok = false;
            System.out.println("\nERROR: getAccess() returned unexpected value: "
                + "|" + mds_.getAccess()+"|");
        }
    }
}

```

```

boolean oldBool = mds_.isBigDecimal();
boolean newBool = (oldBool ? false : true);
mds_.setBigDecimal(newBool);
if (mds_.isBigDecimal() != newBool) {
    ok = false;
    System.out.println("\nERROR: isBigDecimal() returned unexpected value: "
        + "|" + mds_.isBigDecimal() + "|");
}
mds_.setBigDecimal(oldBool);

int oldInt = mds_.getBlockCriteria();
int newInt = (oldInt == 2 ? 1 : 2);
mds_.setBlockCriteria(newInt);
if (mds_.getBlockCriteria() != newInt) {
    ok = false;
    System.out.println("\nERROR: getBlockCriteria() returned unexpected value: "
        + "|" + mds_.getBlockCriteria() + "|");
}
mds_.setBlockCriteria(oldInt);

// Verify some setters and getters for socket properties.

oldBool = mds_.isKeepAlive();
newBool = (oldBool ? false : true);
mds_.setKeepAlive(newBool);
if (mds_.isKeepAlive() != newBool) {
    ok = false;
    System.out.println("\nERROR: isKeepAlive() returned unexpected value: "
        + "|" + mds_.isKeepAlive() + "|");
}
mds_.setKeepAlive(oldBool);

oldInt = mds_.getReceiveBufferSize();
newInt = (oldInt == 256 ? 512 : 256);
mds_.setReceiveBufferSize(newInt);
if (mds_.getReceiveBufferSize() != newInt) {
    ok = false;
    System.out.println("\nERROR: getReceiveBufferSize() returned unexpected value: "
        + "|" + mds_.getReceiveBufferSize() + "|");
}
mds_.setReceiveBufferSize(oldInt);

System.out.println("CONNECTION 1");
Object o = dataSource_.getConnection();
System.out.println(o.getClass());
System.out.println("*****LOOK ABOVE*****");
Connection c1 = dataSource_.getConnection();

if (DEBUG)
    displayConnectionType(c1, true);

if (DEBUG)
    System.out.println("Checking health after first getConnection() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after first getConnection().");
}

if (!TESTING_THREAD_SAFETY)
{
    try
    {
        c1.setAutoCommit(false);
        if (DEBUG)
            System.out.println("SELECT * FROM QIWS.QCUSTCDT");
        Statement s = c1.createStatement();
        ResultSet rs = s.executeQuery("SELECT * FROM QIWS.QCUSTCDT");
        while(rs.next()){
            if (DEBUG)
                System.out.println(rs.getString(2));
        }
        rs.close();
        s.close();
    }
    catch (Exception e) {
        e.printStackTrace();
        if (DEBUG)
            System.out.println("Checking health after fatal connection error ...");
        if (!mds_.checkPoolHealth(true)) {
            ok = false;
        }
    }
}

```



```

        System.out.println("\nERROR: Pool is not healthy after fatal connection "
            + "error.");
    }
}

System.out.println("CONNECTION 2");
Connection c2 = dataSource_.getConnection(userid, password);
if (DEBUG)
    displayConnectionType(c2, false);
System.out.println("CONNECTION 3");
Connection c3 = dataSource_.getConnection();
if (DEBUG)
    displayConnectionType(c3, true);
c1.close();

if (DEBUG)
    System.out.println("Checking health after first close() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after first close().");
}

System.out.println("CONNECTION 4");
Connection c4 = dataSource_.getConnection();
if (DEBUG) displayConnectionType(c4, true);

c1.close(); // close this one again
c2.close();
c3.close();
c4.close();

if (DEBUG) System.out.println("Checking health after last close() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after last close().");
}

// Start the test daemons.
System.out.println("Starting test daemons");
startThreads();

// Run the test daemons for a while; check pool health periodically.

long startTime = System.currentTimeMillis();
long endTime = startTime + timeToRunDaemons_;
while (System.currentTimeMillis() < endTime)
{
    System.out.print("h");
    // Let the daemons run for a while, then check pool health.
    try {
        Thread.sleep(poolHealthCheckCycle_);
    }
    catch (InterruptedException ie) {}
    if (!mds_.checkPoolHealth(true)) {
        ok = false;
        System.out.println("\nERROR: Pool is not healthy after test daemons started.");
    }
}

// Stop the test daemons.
System.out.println("\nStopping test daemons");
stopThreads();

if (DEBUG)
    System.out.println("Checking health after connectionGetter daemons have run...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after test daemons stopped.");
}

if (!TESTING_THREAD_SAFETY)
{
    System.out.println("CONNECTION 5");
    Connection c = dataSource_.getConnection();
    if (DEBUG) displayConnectionType(c, true);
    c.setAutoCommit(false);
    if (DEBUG) System.out.println("SELECT * FROM QIWS.QCUSTCDT");
    Statement s = c.createStatement();
    ResultSet rs = s.executeQuery("SELECT * FROM QIWS.QCUSTCDT");
    while(rs.next()){
        if (DEBUG) System.out.println(rs.getString(2));
    }
}

```

```

        }
        rs.close();
        s.close();
        c.close();
    }

    System.out.println("\nClosing the pool...");
    mds_.closePool();

    if (DEBUG)
        System.out.println("Checking health after pool closed ...");
    Trace.setTraceJDBCOn(true); // make sure the final stats get printed out
    Trace.setTraceOn(true);
    if (!mds_.checkPoolHealth(true)) {
        ok = false;
        System.out.println("\nERROR: Pool is not healthy after pool closed.");
    }

    System.out.println();
    if(ok==true)
        System.out.println("test ran ok");
    else
        System.out.println("test failed");
}
catch (Exception e)
{
    System.out.println(e);
    e.printStackTrace();
}
finally {
    System.out.println("Ended test at " + new Date());
}
}

void startThreads()
{
    // Create a bunch of threads that call getConnection().
    Thread[] threads = new Thread[numDaemons_];
    for (int i=0; i<numDaemons_; i++)
    {
        ConnectionGetter getter;
        // Flip a coin to see if this daemon will specify the default uid, or unique uid.
        if (random_.nextBoolean())
        {
            getter = new ConnectionGetter(userid,password);
            if (TESTING_THREAD_SAFETY) { // we can use fictional userid
                getter = new ConnectionGetter("Thread"+i, "Pwd"+i);
            }
            else { // must use a real userid
                getter = new ConnectionGetter(userid,password);
            }
        }
        else
            getter = new ConnectionGetter(null, null);

        threads[i] = new Thread(getter, "["+i+"]");
        threads[i].setDaemon(true);
    }

    // Start the threads.
    for (int i=0; i<numDaemons_; i++)
    {
        threads[i].start();
    }
}

void stopThreads()
{
    // Tell the threads to stop.
    keepDaemonsAlive_ = false;
    synchronized (daemonSleepLock_) {
        daemonSleepLock_.notifyAll();
    }

    // Wait for the daemons to stop.
    try {
        Thread.sleep(3000);
    }
    catch (InterruptedException ie) {}
}
}

```

```

// ConnectionGetter -----
/**
 * Helper class. This daemon wakes up at random intervals and either
 * gets another connection from the connection pool or returns a
 * previously-gotten connection to the pool.
 */
private final class ConnectionGetter implements Runnable
{
    private String uid_;
    private String pwd_;
    private boolean useDefaultUid_;
    private long maxSleepTime_;
    private String threadName_;
    private boolean firstConnection_ = true;
    private ArrayList connections_ = new ArrayList();
    // list of connections that this getter currently 'owns'.

    ConnectionGetter(String uid, String pwd) {
        uid_ = uid;
        pwd_ = pwd;
        if (uid_ == null) useDefaultUid_ = true;
        else useDefaultUid_ = false;
        maxSleepTime_ = daemonMaxSleepTime_; // our own copy that we can adjust
    }

    public void run()
    {
        threadName_ = Thread.currentThread().getName();
        if (DEBUG) System.out.println("ConnectionGetter("+threadName_+") Starting up");

        try
        {
            while (keepDaemonsAlive_)
            {
                try
                {
                    // Pick a random sleep-time, between min and max values.
                    long sleepTime = Math.max((long)(maxSleepTime_ * random_.nextFloat()),
                        daemonMinSleepTime_);
                    // Note: Must never call wait(0), because that waits forever.
                    synchronized (daemonSleepLock_) {
                        try {
                            daemonSleepLock_.wait(sleepTime);
                            System.out.print(".");
                        }
                        catch (InterruptedException ie) {}
                    }
                }
                if (!keepDaemonsAlive_) break;

                // Decide by chance whether to request another connection or return a
                // previously-obtained connection.
                Connection conn;
                if (random_.nextBoolean()) // Leave the decision to chance.
                { // Request another connection.
                    if (useDefaultUid_)
                    {
                        if (DEBUG)
                            System.out.println("ConnectionGetter("+threadName_+") - get()");
                        conn = dataSource_.getConnection();
                    }
                    else
                    {
                        if (DEBUG)
                            System.out.println("ConnectionGetter("+threadName_+") - "
                                + "get("+uid_+",***)");
                        conn = dataSource_.getConnection(uid_, pwd_);
                    }

                    if (conn == null) {
                        System.out.println("ConnectionGetter("+threadName_+") ERROR: "
                            + "getConnection() returned null");
                    }
                    else
                    {
                        // Occasionally "forget" that we own a connection, and neglect to
                        // close it.
                        // Orphaned connections should eventually exceed their maximum
                        // lifetime and get "reaped" by the connection manager.
                        float val = random_.nextFloat();
                        if (firstConnection_ || val < 0.1) {
                            // 'orphan' a few gotten connections

```

```

        firstConnection_ = false;
    }
    else {
        connections_.add(conn);
    }
    if (DEBUG) displayConnectionType(conn, useDefaultUid_);
    if (conn instanceof com.ibm.as400.access.AS400JDBCConnectionHandle)
    { // We got a pooled connection. Try speeding up our cycle time.
        if (maxSleepTime_ > 100)
            maxSleepTime_--;
        else
            maxSleepTime_ = 100;
    }
    else
    { // We didn't get a pooled connection. That means that the pool
      // must be at capacity. Slow down our cycle time a bit.
        maxSleepTime_ = maxSleepTime_ + 50;
    }
}
}
else { // Close a connection that we currently own.
    if (connections_.size() != 0) {
        conn = (Connection)connections_.remove(0);
        conn.close();
    }
}
} // inner try
catch (Exception e)
{
    e.printStackTrace();
}
} // outer while
} // outer try
finally
{
    if (DEBUG)
        System.out.println("ConnectionGetter("+threadName_+") Stopping");
    // Return all the connections that I still have in my list.
    for (int i=0; i<connections_.size(); i++) {
        Connection conn = (Connection)connections_.remove(0);
        try { conn.close(); } catch (Exception e) { e.printStackTrace(); }
    }
}
}
} // internal class 'ConnectionGetter'
}

```

## Examples: Using the FieldDescription, RecordFormat, and Record classes

The following examples show how you can use the IBM Toolbox for Java FieldDescription, RecordFormat and Record classes with data queues.

**Note:** Read the [Code example disclaimer](#) for important legal information.

### Example: Using the FieldDescription classes

You can use the FieldDescription classes can to describe the different types of data that make up an entry on a data queue. These examples assume the following format for entries on the data queue:

Message number	Sender	Time sent	Message text	Reply required
bin(4)	char(50)	char(8)	char(1024)	char(1)

```

// Create field descriptions for the entry data
BinaryFieldDescription msgNumber = new BinaryFieldDescription(new AS400Bin4(),
    "msgnum");
CharacterFieldDescription sender = new CharacterFieldDescription(new AS400Text(50),
    "sender");
CharacterFieldDescription timeSent = new CharacterFieldDescription(new AS400Text(8),
    "timesent");
CharacterFieldDescription msgText = new CharacterFieldDescription(new AS400Text(1024),
    "msgtext");
CharacterFieldDescription replyRequired = new CharacterFieldDescription(new AS400Text(1),
    "replyreq");

```

## Using the RecordFormat class

You can use the RecordFormat class to describe the data that makes up the data queue entry.

### Example: Defining RecordFormat and using it dynamically

The following example uses the RecordFormat class to describe the format of the data queue entry and then dynamically uses it to retrieve a record:

```
RecordFormat entryFormat = new RecordFormat();
// Describe the fields in an entry on the data queue
entryFormat.addFieldDescription(msgNumber);
entryFormat.addFieldDescription(sender);
entryFormat.addFieldDescription(timeSent);
entryFormat.addFieldDescription(msgText);
entryFormat.addFieldDescription(replyRequired);

// Get a record based on the format of the entries on the data queue
Record rec = entryFormat.getNewRecord();
```

### Example: Defining RecordFormat statically

The following example defines the record format statically, which allows many programs to use the format without coding the record format multiple times.

```
public class MessageEntryFormat extends RecordFormat
{
    // The field descriptions are contained in the class
    static BinaryFieldDescription msgNumber = new BinaryFieldDescription(new AS400Bin4(),
        "msgnum");
    static CharacterFieldDescription sender = new CharacterFieldDescription(new AS400Text(50),
        "sender");
    static CharacterFieldDescription timeSent = new CharacterFieldDescription(new AS400Text(8),
        "timesent");
    static CharacterFieldDescription msgText = new CharacterFieldDescription(new
AS400Text(1024),
        "msgtext");
    static CharacterFieldDescription replyRequired = new CharacterFieldDescription(new
AS400Text(1),
        "replyreq");

    public MessageEntryFormat()
    {
        // We will name this format for posterity
        super("MessageEntryFormat");
        // Add the field descriptions
        addFieldDescription(msgNumber);
        addFieldDescription(sender);
        addFieldDescription(timeSent);
        addFieldDescription(msgText);
        addFieldDescription(replyRequired);
    }
}
```

### Example: Using RecordFormat statically

The following example shows how a Java program can use a statically defined RecordFormat:

```
MessageEntryFormat entryFormat = new MessageEntryFormat();
// Get a record based on the format of the entries on the data queue
Record rec = entryFormat.getNewRecord();
```

## Using the Record class

You can use the Record class to access individual fields of data queue entries.

### Example: Using a generic Record object

```
// Instantiate our data queue object
DataQueue dq = new DataQueue(new AS400(), "/qsys.lib/mylib.lib/myq.dtaq");

// Read an entry
DataQueueEntry dqEntry = null;
try
```

```

    {
        dqEntry = dq.read();
    }
    catch(Exception e)
    {
        // Handle any exceptions
    }

    // Get a record object from our record format, initializing it with the data from the entry we
    // just read.
    Record rec = entryFormat.getNewRecord(dqEntry.getData());

    // Output the complete entry as a String. The contents of the record are converted to Java
    Objects
    // based on the record format of the entry.
    System.out.println(rec.toString());
    // Get the contents of the individual fields of the entry. Each field's contents are
    converted to
    // a Java Object.
    Integer num = (Integer)rec.getField(0); // Retrieve contents by index
    String s = (String)rec.getField("sender");// Retrieve contents by field name
    String text = (String)rec.getField(3); // Retrieve the message text
    // Output the data
    System.out.println(num + " " + s + " " + text);

```

### Example: Using a specific Record object

You can also statically define and use a Record specific to the format of this data queue, which allows you to provide `get()` and `set()` methods for the fields that are more meaningfully named than `getField()` and `setField()`. Also, by using the statically defined specific Record, you can return basic Java types instead of objects, and you can identify the return type for your user.

Note that this example must explicitly cast the correct Java object.

```

public class MessageEntryRecord extends Record
{
    static private RecordFormat format = new MessageEntryFormat();

    public MessageEntryRecord()
    {
        super(format);
    }

    public int getMessageNumber()
    {
        // Return the message number as an int. Note: We know our record format and therefore
        // know the names of our fields. It is safest to get the field by name in case a field
        // has been inserted into the format unbeknownst to us.
        return ((Integer)getField("msgnum")).intValue();
    }

    public String getMessageText()
    {
        // Return the text of the message
        return (String)getField("msgtext");
    }

    public String getSender()
    {
        // Return the sender of the message
        return (String)getField("sender");
    }

    public String getTimeSent()
    {
        // Return the sender of the message
        return (String)getField("timesent");
    }

    // We could add setters here
}

```

### Example: Returning a new MessageEntryRecord

We need to override the `getNewRecord()` method in the `MessageEntryFormat` class (in the example above) in order to return a new `MessageEntryRecord`. To override the method, add the following to the `MessageEntryFormat` class:

```

public Record getNewRecord(byte[] data)
{
    Record r = new MessageEntryRecord();
    r.setContents(data);
    return r;
}

```

After adding the new `getNewRecord()` method, you can use the `MessageEntryRecord` to interpret the data queue entry:

```

// Get a record object from our record format, initializing it with the data from the entry we
// just read. Note the use of the new overridden method getNewRecord().
MessageEntryRecord rec = (MessageEntryRecord)entryFormat.getNewRecord(dqEntry.getData());

// Output the complete entry as a String. The contents of the record are converted to Java
Objects
// based on the record format of the entry.
System.out.println(rec.toString());
// Get the contents of the individual fields of the entry. Each field's contents are
converted to
// a Java Object.
int num = rec.getMessageNumber(); // Retrieve the message number as an int
String s = rec.getSender(); // Retrieve the sender
String text = rec.getMessageText(); // Retrieve the message text
// Output the data
System.out.println(num + " " + s + " " + text);

```

## Example: Using DataQueue classes to put data on a queue

This example uses the `Record` and `Record` format classes to put data on the queue. String data is converted from Unicode to ebcdic and numbers are converted from Java to the system format. Because data is converted the data queue, entries can be read by a server program, an IBM i program, or another Java program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Data Queue example. This program uses the DataQueue class to put
// records on a data queue.
//
// This example uses the Record and Record format classes to put data
// on the queue. String data is converted from Unicode to ebcdic
// and numbers are converted from Java to the server format. Because data
// is converted, entries can be read by a server program,
// an Access for Windows program, or another Java program.
//
// This is the producer side of the producer/consumer example. It puts work
// items on the queue for the consumer to process.
//
// Command syntax:
//   DQProducerExample system
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.net.*;
import com.ibm.as400.access.*;

public class DQProducerExample extends Object
{
    // Create a reader to get input from the user.
    static BufferedReader inputStream =
        new BufferedReader(new InputStreamReader(System.in),1);

    public static void main(String[] parameters)
    {
        System.out.println( " " );

        // if the system name was not specified, display help text and exit.
        if (parameters.length >= 1)
        {
            try

```

```

{
    // The first parameter is the system that contains the data queue.
    String system = parameters[0];

    // Create an AS400 object for the server that has the data queue.
    AS400 as400 = new AS400(system);

    // Build a record format for the format of the data queue entry.
    // This format matches the format in the DQConsumer class. A
    // record consists of:
    // - a four byte number -- the customer number
    // - a four byte number -- the part number
    // - a 20 character string -- the part description
    // - a four byte number -- the number of parts in this order
    // First create the base data types.
    BinaryFieldDescription customerNumber =
        new BinaryFieldDescription(new AS400Bin4(), "CUSTOMER_NUMBER");

    BinaryFieldDescription partNumber =
        new BinaryFieldDescription(new AS400Bin4(), "PART_NUMBER");

    CharacterFieldDescription partName =
        new CharacterFieldDescription(new AS400Text(20, as400), "PART_NAME");

    BinaryFieldDescription quantity =
        new BinaryFieldDescription(new AS400Bin4(), "QUANTITY");

    // Build a record format and fill it with the base data types.
    RecordFormat dataFormat = new RecordFormat();
    dataFormat.addFieldDescription(customerNumber);
    dataFormat.addFieldDescription(partNumber);
    dataFormat.addFieldDescription(partName);
    dataFormat.addFieldDescription(quantity);

    // Create the library that contains the data queue
    // using CommandCall.
    CommandCall crtlib = new CommandCall(as400);
    crtlib.run("CRTLIB JAVADEMO");

    // Create the data queue object.
    DataQueue dq = new DataQueue(as400, "/QSYS.LIB/JAVADEMO.LIB/PRODCONS.DTAQ");

    // Create the data queue just in case this is the first time this
    // program has run. The queue already exists exception is caught
    // and ignored.
    try
    {
        dq.create(96);
    }
    catch (Exception e) {};

    // Get the first field of data from the user.
    System.out.print("Enter customer number (or 0 to quit): ");
    int customer = getInt();

    // While there is data to put on the queue.
    while (customer > 0)
    {
        // Get the rest of the data for this order from the user.
        System.out.print("Enter part number: ");
        int part = getInt();

        System.out.print("Enter quantity: ");
        int quantityToOrder = getInt();

        String description = "part " + part;

        // Create a record based on the record format. The record
        // is empty now but will eventually contain the data.
        Record data = new Record(dataFormat);

        // Set the values we received from the user into the record.
        data.setField("CUSTOMER_NUMBER", new Integer(customer));
        data.setField("PART_NUMBER", new Integer(part));
        data.setField("QUANTITY", new Integer(quantityToOrder));
        data.setField("PART_NAME", description);

        // Convert the record into a byte array. The byte array is
        // what is actually put to the data queue.
        byte [] byteData = data.getContents();

        System.out.println("");
    }
}

```



```

        System.out.println("Writing record to the server ...");
        System.out.println("");

        // Write the record to the data queue.
        dq.write(byteData);

        // Get the next value from the user.
        System.out.print("Enter customer number (or 0 to quit): ");
        customer = getInt();
    }
}
catch (Exception e)
{
    // If any of the above operations failed say the data queue
    // operation failed and output the exception.

    System.out.println("Data Queue operation failed");
    System.out.println(e);
}
}

// Display help text when parameters are incorrect.
else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println(" DQProducer system");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println(" system = Server that has the data queue");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println(" DQProducerExample mySystem");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}

// This is the subroutine that gets a character string from the user
// and converts it into an int.
static int getInt()
{
    int i = 0;
    boolean Continue = true;

    while (Continue)
    {
        try
        {
            String s = inputStream.readLine();

            i = (new Integer(s)).intValue();
            Continue = false;
        }
        catch (Exception e)
        {
            System.out.println(e);
            System.out.print("Please enter a number ==>");
        }
    }

    return i;
}
}
}

```

## Example: Using DataQueue classes to read entries off a data queue

This program uses the Data Queue classes to read entries off a data queue on the server. The entries were put on the queue with the DQProducer example program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// Data Queue example. This program uses the Data Queue classes to read
// entries off a data queue on the server. The entries were put on the
// queue with the DQProducer example program.
//
// This is the consumer side of the producer/consumer example. It reads
// entries off the queue and process them.
//
// Command syntax:
//   DQConsumerExample system
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.net.*;
import com.ibm.as400.access.*;

public class DQConsumerExample extends Object
{
    public static void main(String[] parameters)
    {
        System.out.println( " " );

        // if a system name was not specified, display help text and exit.
        if (parameters.length >= 1)
        {
            try
            {
                // The first parameter is the system that contains the data queue.
                String system = parameters[0];

                // Create an AS400 object for the server that has the data queue.
                AS400 as400 = new AS400(system);

                // Build a record format for the format of the data queue entry.
                // This format matches the format in the DQProducer class. A
                // record consists of:
                //   - a four byte number -- the customer number
                //   - a four byte number -- the part number
                //   - a 20 character string -- the part description
                //   - a four byte number -- the number of parts in this order

                // First create the base data types.
                BinaryFieldDescription customerNumber =
                    new BinaryFieldDescription(new AS400Bin4(), "CUSTOMER_NUMBER");

                BinaryFieldDescription partNumber =
                    new BinaryFieldDescription(new AS400Bin4(), "PART_NUMBER");

                CharacterFieldDescription partName =
                    new CharacterFieldDescription(new AS400Text(20, as400), "PART_NAME"

                BinaryFieldDescription quantity =
                    new BinaryFieldDescription(new AS400Bin4(), "QUANTITY"

                // Build a record format and fill it with the base data types.
                RecordFormat dataFormat = new RecordFormat();

                dataFormat.addFieldDescription(customerNumber);
                dataFormat.addFieldDescription(partNumber);
                dataFormat.addFieldDescription(partName);
                dataFormat.addFieldDescription(quantity);

                // Create the data queue object that represents the data queue on
                // the server.
                DataQueue dq = new DataQueue(as400, "/QSYS.LIB/JAVADEMO.LIB/PRODCONS.DTAQ");

                boolean Continue = true;
            }
        }
    }
}
```

```

// Read the first entry off the queue. The timeout value is
// set to -1 so this program will wait forever for an entry.
System.out.println("*** Waiting for an entry for process ***");

DataQueueEntry DQData = dq.read(-1);

while (Continue)
{
    // We just read an entry off the queue. Put the data into
    // a record object so the program can access the fields of
    // the data by name. The Record object will also convert
    // the data from server format to Java format.
    Record data = dataFormat.getNewRecord(DQData.getData());

    // Get two values out of the record and display them.
    Integer amountOrdered = (Integer) data.getField("QUANTITY");
    String partOrdered = (String) data.getField("PART_NAME");

    System.out.println("Need " + amountOrdered + " of "
        + partOrdered);
    System.out.println(" ");
    System.out.println("*** Waiting for an entry for process ***");

    // Wait for the next entry.
    DQData = dq.read(-1);
}
}
catch (Exception e)
{
    // If any of the above operations failed say the data queue
    // operation failed and output the exception.
    System.out.println("Data Queue operation failed");
    System.out.println(e);
}
}

// Display help text when parameters are incorrect.
else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println(" DQConsumerExample system");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println(" system = Server that has the data queue");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println(" DQConsumerExample mySystem");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}
}
}

```

## Data types example usage

You can use the IBM Toolbox for Java AS400DataType classes with ProgramCall to supply data for program parameters and to interpret the data returned in program parameters.

**Note:** Read the [Code example disclaimer](#) for important legal information.

### Example: Using AS400DataType classes with ProgramCall

The following example shows how to use AS400DataType classes by using ProgramCall to call the system API, QUSRMBRD "Retrieve Member Description". The QUSRMBRD API retrieves the description

of a specific member in a database file. The tables following the example list the required QUSRMBRD parameters and the types of information that the example retrieves.

```

// Create a ProgramCall object. We will set the program name and
// parameter list later.
ProgramCall qusrmbrd = new ProgramCall(new AS400());

// Create an empty program parameter list
ProgramParameter[] parms = new ProgramParameter[6];

// Create AS400DataTypes to convert our input parameters from Java types
// to server data
AS400Bin4 bin4 = new AS400Bin4();

// We need a separate AS400Text object for each parameter with a
// different length because the AS400Text class requires the length to
// be specified.
AS400Text char8Converter = new AS400Text(8);
AS400Text char20Converter = new AS400Text(20);
AS400Text char10Converter = new AS400Text(10);
AS400Text char1Converter = new AS400Text(1);

// Populate our parameter list; we use the AS400DataType objects to
// convert our Java values to byte arrays containing server data.

// For the output parameter we need only specify how many bytes will
// be returned
parms[0] = new ProgramParameter(135);
parms[1] = new ProgramParameter(bin4.toBytes(new Integer(135)));
parms[2] = new ProgramParameter(char8Converter.toBytes("MBRD0100"));
parms[3] = new ProgramParameter(char20Converter.toBytes("MYFILE MYLIB "));
parms[4] = new ProgramParameter(char10Converter.toBytes("MYMEMBER "));
parms[5] = new ProgramParameter(char1Converter.toBytes("0"));

// Set the program name and parameter list
qusrmbrd.setProgram("/qsys.lib/qusrmbrd.pgm", parms);

// Call the program
try
{
    qusrmbrd.run();
}
catch(Exception e)
{
    // Handle any exceptions
}

// Get the information retrieved. Note that this is raw server data.
byte[] receiverVar = parms[0].getOutputData();

// We need this to convert the time and date data
AS400Text char13Converter = new AS400Text(13);

// We need this to convert the text description data
AS400Text char50Converter = new AS400Text(50);

// Create an AS400Structure to handle the returned information
AS400DataType[] dataTypeArray = new AS400DataType[11];
dataTypeArray[0] = bin4;
dataTypeArray[1] = bin4;
dataTypeArray[2] = char10Converter;
dataTypeArray[3] = char10Converter;
dataTypeArray[4] = char10Converter;
dataTypeArray[5] = char10Converter;
dataTypeArray[6] = char10Converter;
dataTypeArray[7] = char13Converter;
dataTypeArray[8] = char13Converter;
dataTypeArray[9] = char50Converter;
dataTypeArray[10] = char1Converter;
AS400Structure returnedDataConverter = new AS400Structure(dataTypeArray);

// Convert the data returned to an array of Java Objects using our
// returnedDataConverter
Object[] qusrmbrdInfo = dataConverter.toObject(receiverVar, 0);

// Get the number of bytes returned
Integer bytesReturned = (Integer)qusrmbrdInfo[0];

```

```

Integer bytesAvailable = (Integer)qusrmbInfo[1];
if (bytesReturned.intValue() != 135)
{
    System.out.println("Wrong amount of information returned.");
    System.exit(0);
}
String fileName = (String)qusrmbInfo[2];
String libName = (String)qusrmbInfo[3];
String mbrName = (String)qusrmbInfo[4];
String fileAttribute = (String)qusrmbInfo[5];
String sourceType = (String)qusrmbInfo[6];
String created = (String)qusrmbInfo[7];
String lastChanged = (String)qusrmbInfo[8];
String textDesc = (String)qusrmbInfo[9];
String isSourceFile = (String)qusrmbInfo[10];

// We will just output all the information to the screen
System.out.println(fileName + " " + libName + " " + mbrName + " " +
    fileAttribute + sourceType + " " + created + " " +
    lastChanged + " " + textDesc + " " + isSourceFile);

```

The following table lists the required parameters for the QUSRMBRD API as used in the preceding example.

QUSRMBRD parameter	Input or output	Type	Description
Receiver variable	Output	Char(*)	Character buffer which will contain the information retrieved.
Length of receiver variable	Input	Bin(4)	Length of the character buffer provided for the receiver variable.
Format name	Input	Char(8)	Format specifying the type of information to be retrieved. Must be one of: <ul style="list-style-type: none"> <li>• MBRD0100</li> <li>• MBRD0200</li> <li>• MBRD0300</li> </ul> The following example specifies MBRD0100.
Qualified database file name	Input	Char(20)	The qualified file name. This is the file name blank padded to 10 characters followed by the library name blank padded to 10 characters. Special values of *CURLIB and *LIBL are allowed for the library name.
Database member name	Input	Char(10)	The name of the member blank padded to 10 characters. Special values of *FIRST and *LAST are allowed.

QUSRMBRD parameter	Input or output	Type	Description
Override processing	Input	Char(1)	Whether overrides are to be processed. 0 indicates that overrides are not to be processed. This is the value we will specify.

The following table lists the type of information that the example retrieves (based on format MBRD0100, as specified in the preceding example):

Information retrieved	Type
Bytes returned	Bin(4)
Bytes available	Bin(4)
Database file name	Char(10)
Database file library name	Char(10)
Member name	Char(10)
File attribute (type of file: PF, LF, DDMF)	Char(10)
Source type (type of the source source member if this is a source file)	Char(10)
Creation date and time	Char(13)
Last source change date and time	Char(13)
Member text description	Char(50)
Source file (whether the file is a source file: 0=data file, 1=source file)	Char(1)

## Example: Using KeyedDataQueue

This program uses the KeyedDataQueue class to put records on a data queue.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Data Queue example. This program uses the KeyedDataQueue class to put
// records on a data queue.
//
// The key is a number and the data is a Unicode string. This program
// shows one way to convert an int into a byte array and how to convert
// a Java string into a byte array so it can be written to the queue.
//
// This is the producer side of the producer/consumer example. It puts work
// items on the queue for the consumer to process.
//
// Command syntax:
//   DQKeyedProducer system
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.net.*;
import com.ibm.as400.access.*;

public class DQKeyedProducer extends Object
{
    // Create a reader to get input from the user.

```

```

static BufferedReader inputStream =
    new BufferedReader(new InputStreamReader(System.in),1);

public static void main(String[] parameters)
{
    System.out.println( " " );

    // if the system name was not specified, display help text and exit.
    if (parameters.length >= 1)
    {
        // The first parameter is the system that contains the data queue.
        String system = parameters[0];

        System.out.println("Priority is a numeric value. The value ranges are:");
        System.out.println(" 0 - 49 = low priority");
        System.out.println(" 50 - 100 = medium priority");
        System.out.println("100 +   = high priority");
        System.out.println(" ");

        try
        {
            // Create an AS400 object for the server that has the data queue.
            AS400 as400 = new AS400(system);

            // Use CommandCall to create the library that contains the
            // data queue.
            CommandCall crtlib = new CommandCall(as400);
            crtlib.run("CRTLIB JAVADEMO");

            // Create the data queue object.
            QSYSObjectPathName name = new QSYSObjectPathName("JAVADEMO", "PRODCON2", "DTAQ");
            KeyedDataQueue dq = new KeyedDataQueue(as400, name.getPath());

            // Create the data queue just in case this is the first time this
            // program has run. The queue already exists exception is caught
            // and ignored. The length of the key is four bytes, the length
            // of an entry is 96 bytes.

            try
            {
                dq.create(4, 96);
            }
            catch (Exception e) {};

            // Get the data from the user.
            System.out.print("Enter message: ");
            String message = inputStream.readLine();

            System.out.print("Enter priority: ");
            int priority = getInt();

            // While there is data to put on the queue.
            while (priority > 0)
            {

```

```

        // We want to write a java string as the entry to the queue.
        // Input the data queue is a byte array, however, so convert
        // the string to a byte array.

        byte [] byteData = message.getBytes("UnicodeBigUnmarked");

        // The key is a number. Input to the data queue is a byte
        // array, however, so convert the int to a byte array;

        byte [] byteKey = new byte[4];
        byteKey[0] = (byte) (priority >>> 24);
        byteKey[1] = (byte) (priority >>> 16);
        byteKey[2] = (byte) (priority >>> 8);
        byteKey[3] = (byte) (priority);

        System.out.println("");
        System.out.println("Writing record to the server...");
        System.out.println("");

        // Write the record to the data queue.

        dq.write(byteKey, byteData);

        // Get the next value from the user.

        System.out.print("Enter message: ");
        message = inputStream.readLine();

        System.out.print("Enter priority: ");
        priority = getInt();
    }
}
catch (Exception e)
{

    // If any of the above operations failed say the data queue
    // operation and output the exception.

    System.out.println("Data Queue operation failed");
    System.out.println(e);
}
}

// Display help text when parameters are incorrect.
else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println("  DQKeyedProducer system");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println("  system = server that has the data queue");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("  DQKeyedProducer mySystem");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}

// This is the subroutine that gets a character string from the user
// and converts it into an int.

```



```

static int getInt()
{
    int i = 0;
    boolean Continue = true;

    while (Continue)
    {
        try
        {
            String s = inputStream.readLine();

            i = (new Integer(s)).intValue();
            Continue = false;
        }
        catch (Exception e)
        {
            System.out.println(e);
            System.out.print("Please enter a number ==>");
        }
    }

    return i;
}
}

```

### Example: Using KeyedDataQueue classes to read entries off a data queue

This program uses the KeyedDataQueue classes to read entries off a data queue on the server. The entries were put on the queue with the DQKeyedProducer example program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Keyed Data Queue example. This program uses the KeyedDataQueue classes to
// read entries off a data queue on the server. The entries were put on the
// queue with the DQKeyedProducer example program.
//
// The key is a number and the data is a unicode string. This program
// shows one way to convert the byte array to a Java int and to read
// a byte array and convert it into a Java string.
//
// This is the consumer side of the producer/consumer example. It reads
// entries off the queue and process them.
//
// Command syntax:
//   DQKeyedConsumer system
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.net.*;
import com.ibm.as400.access.*;

public class DQKeyedConsumer extends Object
{
    public static void main(String[] parameters)
    {
        System.out.println( " " );

        // if a system name was not specified, display help text and exit.
        if (parameters.length >= 1)
        {

            // The first parameter is the system that contains the data queue.
            String system = parameters[0];

            // Create byte arrays for the priority boundaries:
            // 100 +      = high priority
            // 50 - 100 = medium priority
            // 0 - 49 = low priority

            byte [] key0 = new byte[4];
            key0[0] = 0;
            key0[1] = 0;
            key0[2] = 0;
            key0[3] = 0;

```

```

byte [] key50 = new byte[4];
key50[0] = (byte) (50 >>> 24);
key50[1] = (byte) (50 >>> 16);
key50[2] = (byte) (50 >>> 8);
key50[3] = (byte) (50);

byte [] key100 = new byte[4];
key100[0] = (byte) (100 >>> 24);
key100[1] = (byte) (100 >>> 16);
key100[2] = (byte) (100 >>> 8);
key100[3] = (byte) (100);

try
{
    // Create an AS400 object for the server that has the data queue.
    AS400 as400 = new AS400(system);

    // Create the data queue object that represents the data queue
    // on the server.

    QSYSObjectPathName name = new QSYSObjectPathName("JAVADEMO",
                                                    "PRODCON2",
                                                    "DTAQ");
    KeyedDataQueue dq = new KeyedDataQueue(as400, name.getPath());
    KeyedDataQueueEntry DQData = null;

    try
    {
        boolean Continue = true;

        // Go until the user ends us.
        while (Continue)
        {
            // Look for a high priority item on the queue. If one is
            // found process that item. Note the peek method does not
            // remove the item if one is found. Also note the timeout
            // is 0. If an item is not found we get control back with
            // a null data queue entry.
            DQData = dq.read(key100, 0, "GE");

            if (DQData != null)
            {
                processEntry(DQData);
            }

            // else no high priority item was found. Look for a medium
            // priority item.
            else
            {
                DQData = dq.read(key50, 0, "GE");

                if (DQData != null)
                {
                    processEntry(DQData);
                }

                // else no medium priority item was found, look for a low
                // priority item.
                else
                {
                    DQData = dq.read(key0, 0, "GE");

                    if (DQData != null)
                    {
                        processEntry(DQData);
                    }

                    else
                    {
                        System.out.println("Nothing to process, will check again in 30
seconds");
                        Thread.sleep(30000);
                    }
                }
            }
        }
    }
}
catch (Exception e)
{
    // If any of the above operations failed say the data queue
    // operation failed and output the exception.
}

```

```

        System.out.println("Could not read from the data queue.");
        System.out.println(e);
    };
}
catch (Exception e)
{
    // If any of the above operations failed say the data queue
    // operation failed and output the exception.

    System.out.println("Data Queue operation failed");
    System.out.println(e);
}
}

// Display help text when parameters are incorrect.
else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println(" DQKeyedConsumer system");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println(" system = Server that has the data queue");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("");
    System.out.println(" DQKeyedConsumer mySystem");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}

static void processEntry(KeyedDataQueueEntry DQData)
{
    try
    {
        // The data is a string. Get the string out of the data queue entry.
        // In the data queue entry the data is a byte array so convert the
        // entry from a byte array into a string.
        String message = new String(DQData.getData(), "UnicodeBig");

        // The key is a byte array. Get the key out of the data queue entry
        // and convert it into a number.
        byte [] keyData = DQData.getKey();

        int keyValue = ((keyData[0] & 0xFF) << 24) +
            ((keyData[1] & 0xFF) << 16) +
            ((keyData[2] & 0xFF) << 8) +
            (keyData[3] & 0xFF);

        // Output the entry.
        System.out.println("Priority: " + keyValue + " message: " + message);
    }
    catch (Exception e)
    {
        // If any of the above operations failed say the data queue operation
        // failed and output the exception.

        System.out.println("Could not read from the data queue");
        System.out.println(e);
    }
}
}
}

```

## Examples: Using IFSFile

The following examples show how to use the IBM Toolbox for Java IFSFile class.

**Note:** Read the [Code example disclaimer](#) for important legal information.

- [Example: Creating a directory](#)
- [Example: Using IFSFile exceptions to track errors](#)
- [Example: Listing files with a .txt extension](#)
- [“Example: Using the IFSFile listFiles\(\) method to list the contents of a directory” on page 389](#)

### Example: Creating a directory

```
// Create an AS400 object. This new directory will
// be created on this system.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the directory.
IFSFile aDirectory = new IFSFile(sys, "/mydir1/mydir2/newdir");

// Create the directory.
if (aDirectory.mkdir())
    System.out.println("Create directory was successful");
else
{
    // The create directory failed.
    // If the object already exists, find out if it is a
    // directory or file, then display a message.
    if (aDirectory.exists())
    {
        if (aDirectory.isDirectory())
            System.out.println("Directory already exists");
        else
            System.out.println("File with this name already exists");
    }
    else
        System.out.println("Create directory failed");
}

// Disconnect since I am done accessing files.
sys.disconnectService(AS400.FILE);
```

### Example: Using IFSFile exceptions to track errors

When an error occurs, the IFSFile class throws the `ExtendedIOException` exception. This exception contains a return code that indicates the cause of the failure. The IFSFile class throws the exception even when the `java.io` class that IFSFile duplicates does not. For example, the `delete` method from `java.io.File` returns a boolean to indicate success or failure. The `delete` method in IFSFile returns a boolean, but if the `delete` fails, an `ExtendedIOException` is thrown. The `ExtendedIOException` provides the Java program with detailed information about why the `delete` failed.

```
// Create an AS400 object.
AS400 sys = new AS400("mySystem.myCompany.com");

// Create a file object that represents the file.
IFSFile aFile = new IFSFile(sys, "/mydir1/mydir2/myfile");

// Delete the file.
try
{
    aFile.delete();

    System.out.println("Delete successful ");
}
catch (ExtendedIOException e)
{
    // The delete failed. Get the return code out of
    // the exception and display why the delete failed.
    int rc = e.getReturnCode();

    switch (rc)
    {
        case ExtendedIOException.FILE_IN_USE:
            System.out.println("Delete failed, file is in use ");
            break;

        case ExtendedIOException.PATH_NOT_FOUND:
            System.out.println("Delete failed, path not found ");
    }
}
```

```

        break;

    // ... for every specific error you want to track.
    default:
        System.out.println("Delete failed, rc = ");
        System.out.println(rc);
    }
}

```

### Example: Listing files with a .txt extension

The Java program can optionally specify match criteria when listing files in the directory. Match criteria reduce the number of files that are returned by the server to the IFSFile object, which improves performance. The following example shows how to list files with extension .txt:

```

// Create the AS400 object.
AS400 system = new AS400("mySystem.myCompany.com");

// Create the file object.
IFSFile directory = new IFSFile(system, "/");

// Generate a list of all files with extension .txt
String[] names = directory.list("*.txt");

// Display the names.
if (names != null)
    for (int i = 0; i < names.length; i++)
        System.out.println(names[i]);
else
    System.out.println("No .txt files");

```

### Example: Using the IFSFile listFiles() method to list the contents of a directory

This example program uses the IBM Toolbox for Java IFS classes to list the contents of a directory on the server.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//
// IFSListFiles example. This program uses the integrated file system
// classes to list the contents of a directory on the server.
//
// Command syntax:
//   IFSListFiles system directory
//
// For example,
//   IFSListFiles MySystem /path1
//
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class IFSListFiles extends Object
{
    public static void main(String[] parameters)
    {
        System.out.println( " " );

        String directoryName = "";
        String system        = "";

        // if both parameters were not specified, display help text and exit.
        if (parameters.length >= 2)
        {
            // Assume the first parameter is the system name and
            // the second parameter is the directory name

```

```

system = parameters[0];
directoryName = parameters[1];

try
{
    // Create an AS400 object for the server that holds the files.
    AS400 as400 = new AS400(system);

    // Create the IFSFile object for the directory.
    IFSFile directory = new IFSFile(as400, directoryName);

    // Generate a list of IFSFiles. Pass the listFiles method
    // the directory filter object and the search match
    // criteria. This method caches attribute information. For
    // instance, when isDirectory() is called on an IFSFile
    // object in the file array returned in the following code,
    // no call to the server is required.
    //
    // However, with the user of the listFiles method, attribute
    // information will not be refreshed automatically from the
    // server. This means attribute information can become
    // inconsistent with information about the server.

    IFSFile[] directoryFiles = directory.listFiles(new MyDirectoryFilter(),"*");

    // Tell the user if the directory doesn't exist or is empty

    if (directoryFiles == null)
    {
        System.out.println("The directory does not exist");
        return;
    }

    else if (directoryFiles.length == 0)
    {
        System.out.println("The directory is empty");
        return;
    }

    for (int i=0; i< directoryFiles.length; i++)
    {
        // Print out information about list.
        // Print the name of the current file

        System.out.print(directoryFiles[i].getName());

        // Pad the output so the columns line up

        for (int j = directoryFiles[i].getName().length(); j <18; j++)
            System.out.print(" ");

        // Print the date the file was last changed.

        long changeDate = directoryFiles[i].lastModified();
        Date d = new Date(changeDate);
        System.out.print(d);
        System.out.print(" ");

        // Print if the entry is a file or directory

        System.out.print(" ");

        if (directoryFiles[i].isDirectory())
            System.out.println("");
        else
            System.out.println(directoryFiles[i].length());
    }
}

catch (Exception e)
{
    // If any of the above operations failed say the list failed

```

```

        // and output the exception.

        System.out.println("List failed");
        System.out.println(e);
    }
}

// Display help text when parameters are incorrect.
else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct.  Command syntax is:");
    System.out.println("");
    System.out.println("  IFSListFiles as400 directory");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println("  as400 = system that contains the files");
    System.out.println("  directory = directory to be listed");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("  IFSListFiles mySystem /dir1/dir2");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}
}

////////////////////////////////////
//
// The directory filter class prints information from the file object.
//
// Another way to use the filter is to simply return true or false
// based on information in the file object.  This lets the mainline
// function decide what to do with the list of files that meet the
// search criteria.
//
////////////////////////////////////

class MyDirectoryFilter implements IFSFileFilter
{
    public boolean accept(IFSFile file)
    {
        try
        {
            // Keep this entry.  Returning true tells the IFSList object
            // to return this file in the list of entries returned to the
            // .list() method.

            return true;
        }

        catch (Exception e)
        {
            return false;
        }
    }
}
}

```

## Example: Using IFS classes to copy a file from one directory to another

This program uses the installable file system classes to copy a file from one directory to another on the server.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// IFSCopyFile example.  This program uses the installable file system classes
// to copy a file from one directory to another on the server.

```

```

//
// Command syntax:
//   IFSCopyFile system sourceName TargetName
//
// For example,
//   IFSCopyFile MySystem /path1/path2/file.ext /path3/path4/path5/file.ext
//
////////////////////////////////////////////////////////////////

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class IFSCopyFile extends Object
{
    public static void main(String[] parameters)
    {
        System.out.println( " " );

        String sourceName = "";
        String targetName = "";
        String system      = "";
        byte[] buffer      = new byte[1024 * 64];

        IFSFileInputStream source = null;
        IFSFileOutputStream target = null;

        // if all three parameters were not specified, display help text and exit.

        if (parameters.length > 2)
        {

            // Assume the first parameter is the system name,
            // the second parameter is the source name and
            // the third parameter is the target name.

            system      = parameters[0];
            sourceName = parameters[1];
            targetName = parameters[2];

            try
            {
                // Create an AS400 object for the server that holds the files.

                AS400 as400 = new AS400(system);

                // Open the source file for exclusive access.

                source = new IFSFileInputStream(as400, sourceName, IFSFileInputStream.SHARE_NONE);
                System.out.println("Source file successfully opened");

                // Open the target file for exclusive access.

                target = new IFSFileOutputStream(as400, targetName, IFSFileOutputStream.SHARE_NONE,
false);

                System.out.println("Target file successfully opened");

                // Read the first 64K bytes from the source file.

                int bytesRead = source.read(buffer);

                // While there is data in the source file copy the data from
                // the source file to the target file.

                while (bytesRead > 0)
                {
                    target.write(buffer, 0, bytesRead);
                    bytesRead = source.read(buffer);
                }
            }
        }
    }
}

```



```

        System.out.println("Data successfully copied");

        // Clean up by closing the source and target files.
        source.close();
        target.close();

        // Get the last changed date/time from the source file and
        // set it on the target file.
        IFSFile src = new IFSFile(as400, sourceName);
        long dateTime = src.lastModified();

        IFSFile tgt = new IFSFile(as400, targetName);
        tgt.setLastModified(dateTime);

        System.out.println("Date/Time successfully set on target file");
        System.out.println("Copy Successful");
    }
    catch (Exception e)
    {
        // If any of the above operations failed say the copy failed
        // and output the exception.

        System.out.println("Copy failed");
        System.out.println(e);
    }
}

// Display help text when parameters are incorrect.
else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct.  Command syntax is:");
    System.out.println("");
    System.out.println("    IFSCopyFile as400 source target");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println("    as400 = system that contains the files");
    System.out.println("    source = source file in /path/path/name format");
    System.out.println("    target = target file in /path/path/name format");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("    IFSCopyFile myAS400 /dir1/dir2/a.txt /dir3/b.txt");
    System.out.println("");
    System.out.println("");
}

    System.exit(0);
}
}
}

```

## Example: Using the IFS classes to list the contents of a directory

This program uses the integrated file system classes to list the contents of a directory on the server.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// IFSListFile example.  This program uses the integrated file system classes
// to list the contents of a directory on the server.
//
// Command syntax:
//   IFSList system directory
//
// For example,
//   IFSList MySystem /path1
//

```

```

////////////////////////////////////
import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class IFSList extends Object
{
    public static void main(String[] parameters)
    {
        System.out.println( " " );

        String directoryName = "";
        String system         = "";

        // if both parameters were not specified, display help text and exit.

        if (parameters.length >= 2)
        {
            // Assume the first parameter is the system name and
            // the second parameter is the directory name

            system = parameters[0];
            directoryName = parameters[1];

            try
            {
                // Create an AS400 object for the server that holds the files.
                AS400 as400 = new AS400(system);

                // Create the IFSFile object for the directory.
                IFSFile directory = new IFSFile(as400, directoryName);

                // Generate the list of name. Pass the list method the
                // directory filter object and the search match criteria.
                //
                // Note - this example does the processing in the filter
                // object. An alternative is to process the list after
                // it is returned from the list method call.

                String[] directoryNames = directory.list(new MyDirectoryFilter(),"*");

                // Tell the user if the directory doesn't exist or is empty

                if (directoryNames == null)
                    System.out.println("The directory does not exist");

                else if (directoryNames.length == 0)
                    System.out.println("The directory is empty");
            }
            catch (Exception e)
            {
                // If any of the above operations failed say the list failed
                // and output the exception.

                System.out.println("List failed");
                System.out.println(e);
            }
        }

        // Display help text when parameters are incorrect.

        else
        {
            System.out.println("");
            System.out.println("");
            System.out.println("");
            System.out.println("Parameters are not correct. Command syntax is:");
            System.out.println("");
            System.out.println("  IFSList as400 directory");
            System.out.println("");
        }
    }
}

```

```

        System.out.println("Where");
        System.out.println("");
        System.out.println("    as400 = system that contains the files");
        System.out.println("    directory = directory to be listed");
        System.out.println("");
        System.out.println("For example:");
        System.out.println("");
        System.out.println("    IFSCopyFile mySystem /dir1/dir2");
        System.out.println("");
        System.out.println("");
    }

    System.exit(0);
}

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//
// The directory filter class prints information from the file object.
//
// Another way to use the filter is to simply return true or false
// based on information in the file object. This lets the mainline
// function decide what to do with the list of files that meet the
// search criteria.
//
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

class MyDirectoryFilter implements IFSFileFilter
{
    public boolean accept(IFSFile file)
    {
        try
        {
            // Print the name of the current file

            System.out.print(file.getName());

            // Pad the output so the columns line up

            for (int i = file.getName().length(); i < 18; i++)
                System.out.print(" ");

            // Print the date the file was last changed.

            long changeDate = file.lastModified();
            Date d = new Date(changeDate);
            System.out.print(d);
            System.out.print(" ");

            // Print if the entry is a file or directory

            System.out.print(" ");

            if (file.isDirectory())
                System.out.println("<DIR>");
            else
                System.out.println(file.length());

            // Keep this entry. Returning true tells the IFSList object
            // to return this file in the list of entries returned to the
            // .list() method.

            return true;
        }
        catch (Exception e)
        {
            return false;
        }
    }
}

```

```
}  
}
```

## Example: Using JDBCPopulate to create and populate a table

This program uses the IBM Toolbox for Java JDBC driver to create and populate a table.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////  
//  
// JDBCPopulate example. This program uses the IBM Toolbox for Java JDBC driver to  
// create and populate a table.  
//  
// Command syntax:  
//   JDBCPopulate system collectionName tableName  
//  
// For example,  
//   JDBCPopulate MySystem MyLibrary MyTable  
//  
////////////////////////////////////  
  
import java.sql.*;  
  
public class JDBCPopulate  
{  
  
    // Strings to be added in the WORD column of the table.  
    private static final String words[]  
        = { "One",      "Two",      "Three",    "Four",    "Five",  
          "Six",      "Seven",    "Eight",   "Nine",   "Ten",  
          "Eleven",   "Twelve", "Thirteen", "Fourteen", "Fifteen",  
          "Sixteen", "Seventeen", "Eighteen", "Nineteen", "Twenty" };  
  
    public static void main (String[] parameters)  
    {  
        // Check the input parameters.  
        if (parameters.length != 3) {  
            System.out.println("");  
            System.out.println("Usage:");  
            System.out.println("");  
            System.out.println(" JDBCPopulate system collectionName tableName");  
            System.out.println("");  
            System.out.println("");  
            System.out.println("For example:");  
            System.out.println("");  
            System.out.println("");  
            System.out.println(" JDBCPopulate MySystem MyLibrary MyTable");  
            System.out.println("");  
            return;  
        }  
  
        String system      = parameters[0];  
        String collectionName = parameters[1];  
        String tableName   = parameters[2];  
  
        Connection connection = null;  
  
        try {  
            // Load the IBM Toolbox for Java JDBC driver.  
            DriverManager.registerDriver(new com.ibm.as400.access.AS400JDBCdriver());  
  
            // Get a connection to the database. Since we do not  
            // provide a user id or password, a prompt will appear.  
            //  
            // Note that we provide a default SQL schema here so  
            // that we do not need to qualify the table name in  
            // SQL statements.  
            //  
            connection = DriverManager.getConnection ("jdbc:as400://" + system + "/" +  
collectionName);  
  
            // Drop the table if it already exists.  
            try {
```

```

        Statement dropTable = connection.createStatement ();
        dropTable.executeUpdate ("DROP TABLE " + tableName);
    }
    catch (SQLException e) {
        // Ignore.
    }

    // Create the table.
    Statement createTable = connection.createStatement ();
    createTable.executeUpdate ("CREATE TABLE " + tableName
        + " (I INTEGER, WORD VARCHAR(20), SQUARE INTEGER, "
        + " SQUAREROOT DOUBLE)");

    // Prepare a statement for inserting rows. Since we
    // execute this multiple times, it is best to use a
    // PreparedStatement and parameter markers.
    PreparedStatement insert = connection.prepareStatement ("INSERT INTO "
        + tableName + " (I, WORD, SQUARE, SQUAREROOT) " + " VALUES (?, ?, ?, ?)");

    // Populate the table.
    for (int i = 1; i <= words.length; ++i) {
        insert.setInt (1, i);
        insert.setString (2, words[i-1]);
        insert.setInt (3, i*i);
        insert.setDouble (4, Math.sqrt(i));
        insert.executeUpdate ();
    }

    // Output a completion message.
    System.out.println ("Table " + collectionName + "." + tableName + " has been
populated.");
}

catch (Exception e) {
    System.out.println ();
    System.out.println ("ERROR: " + e.getMessage());
}

finally {
    // Clean up.
    try {
        if (connection != null)
            connection.close ();
    }
    catch (SQLException e) {
        // Ignore.
    }
}

System.exit (0);
}
}
}

```

## Examples: Using AS400JDBCManagedConnectionPoolDataSource class

These examples demonstrate the use of the AS400JDBCManagedConnectionPoolDataSource class. The AS400JDBCManagedConnectionPoolDataSource class simplifies connection pool maintenance by eliminating the need for user applications to implement their own management code.

**Note:** By using the code examples, you agree to the terms of the [“Code license and disclaimer information”](#) on page 534.

### Example 1

This brief example shows the basic use of the AS400JDBCManagedConnectionPoolDataSource class.

```

import javax.naming.Context;
import javax.naming.InitialContext;
import javax.sql.DataSource;

import com.ibm.as400.access.AS400JDBCManagedConnectionPoolDataSource;
import com.ibm.as400.access.AS400JDBCManagedDataSource;

```

```

public class TestJDBCConnPoolSnippet
{
    void test()
    {
        AS400JDBCManagedConnectionPoolDataSource cpds0 = new AS400JDBCManagedConnectionPoolDataSource();
        // Set general datasource properties. Note that both connection pool datasource (CPDS) and
managed // datasource (MDS) have these properties, and they might have different values.
        cpds0.setServerName(host);
        cpds0.setDatabaseName(host); //iasp can be here
        cpds0.setUser(userid);
        cpds0.setPassword(password);

        cpds0.setSavePasswordWhenSerialized(true);

        // Set connection pooling-specific properties.
        cpds0.setInitialPoolSize(initialPoolSize_);
        cpds0.setMinPoolSize(minPoolSize_);
        cpds0.setMaxPoolSize(maxPoolSize_);
        cpds0.setMaxLifetime((int)(maxLifetime_/1000)); // convert to seconds
        cpds0.setMaxIdleTime((int)(maxIdleTime_/1000)); // convert to seconds
        cpds0.setPropertyCycle((int)(propertyCycle_/1000)); // convert to seconds
        //cpds0.setReuseConnections(false); // do not re-use connections

        // Set the initial context factory to use.
        System.setProperty(Context.INITIAL_CONTEXT_FACTORY,
"com.sun.jndi.fscontext.ReffSContextFactory");

        // Get the JNDI Initial Context.
        Context ctx = new InitialContext();

        // Note: The following is an alternative way to set context properties locally:
        // Properties env = new Properties();
        // env.put(Context.INITIAL_CONTEXT_FACTORY, "com.sun.jndi.fscontext.ReffSContextFactory");
        // Context ctx = new InitialContext(env);

        ctx.rebind("mydatasource", cpds0); // We can now do lookups on cpds, by the name "mydatasource".

        // Create a standard DataSource object that references it.

        AS400JDBCManagedDataSource mds0 = new AS400JDBCManagedDataSource();
        mds0.setDescription("DataSource supporting connection pooling");
        mds0.setDataSourceName("mydatasource");
        ctx.rebind("ConnectionPoolingDataSource", mds0);

        DataSource dataSource_ = (DataSource)ctx.lookup("ConnectionPoolingDataSource");

        AS400JDBCManagedDataSource mds_ = (AS400JDBCManagedDataSource)dataSource_;

        boolean isHealthy = mds_.checkPoolHealth(false); //check pool health

        Connection c = dataSource_.getConnection();
    }
}
}

```

## Example 2

This example shows more details about how to use the AS400JDBCManagedConnectionPoolDataSource class.

```

import java.awt.TextArea;
import java.io.BufferedReader;
import java.io.File;
import java.io.FileReader;
import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.io.OutputStream;
import java.io.PrintStream;
import java.util.Vector;
import java.util.Properties;

import java.sql.Connection;
import javax.sql.DataSource;
import java.sql.ResultSet;

```

```

import java.sql.Statement;
import javax.naming.*;
import java.util.Date;
import java.util.ArrayList;
import java.util.Random;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400JDBCManagedConnectionPoolDataSource;
import com.ibm.as400.access.AS400JDBCManagedDataSource;
import com.ibm.as400.access.Trace;

public class TestJDBConnPool
{
    private static final boolean DEBUG = false;

    // If you turn this flag on, be sure to also turn on the following flag:
    // AS400JDBCConnection.TESTING_THREAD_SAFETY.
    private static final boolean TESTING_THREAD_SAFETY = false;

    private static String userid;
    private static String password;
    private static String host;

    // Note: For consistency, all time values are stored units of milliseconds.
    private int initialPoolSize_; // initial # of connections in pool
    private int minPoolSize_; // max # of connections in pool
    private int maxPoolSize_; // max # of connections in pool
    private long maxLifetime_; // max lifetime (msecs) of connections in pool
    private long maxIdleTime_; // max idle time (msecs) of available connections in pool
    private long propertyCycle_; // pool maintenance frequency (msecs)

    private int numDaemons_; // # of requester daemons to create
    private static long timeToRunDaemons_; // total duration (msecs) to let the daemons run
    private long daemonMaxSleepTime_; // max time (msecs) for requester daemons to sleep each cycle
    private long daemonMinSleepTime_; // min time (msecs) for requester daemons to sleep each cycle
    private long poolHealthCheckCycle_; // # of msecs between calls to checkPoolHealth()

    private boolean keepDaemonsAlive_ = true; // When this is false, the daemons shut down.

    private DataSource dataSource_;
    private AS400JDBCManagedDataSource mds_;

    private final Object daemonSleepLock_ = new Object();

    private Random random_ = new Random();

    static
    {
        try {
            Class.forName("com.ibm.as400.access.AS400JDBCdriver");
        }
        catch(Exception e){
            System.out.println("Unable to register JDBC driver.");
            System.exit(0);
        }
    }

    public static void main(String[] args)
    {
        host = args[0];
        userid = args[1];
        password = args[2];
        timeToRunDaemons_ = (new Integer(args[3])).intValue() * 1000; //milliseconds
        //args[3]=time to run in seconds
        TestJDBConnPool cptest = new TestJDBConnPool();

        cptest.setup();
        cptest.runTest();
    }

    public void setup()
    {
        try
        {
            if (DEBUG)
                System.out.println("TESTING_THREAD_SAFETY flag is "
                    + (TESTING_THREAD_SAFETY ? "true" : "false"));

            if (TESTING_THREAD_SAFETY)
            {
                // Adjust values for performing thread-intensive stress testing.
            }
        }
    }
}

```

```

// NOTE: This assumes that the AS400JDBCConnection class has also been modified to
// not make actual connections to an actual server.
// To do this, edit AS400JDBCConnection.java, changing its TESTING_THREAD_SAFETY
// flag to 'false', and recompile.
minPoolSize_ = 100;
maxPoolSize_ = 190;
initialPoolSize_ = 150; // this should get reset to maxPoolSize_
numDaemons_ = 75;
if (timeToRunDaemons_ == 0) {
    timeToRunDaemons_ = 180*1000; // 180 seconds == 3 minutes
}
}
else
{ // Set more conservative values, as we'll be making actual connections to an
// actual server, and we don't want to monopolize the server.
minPoolSize_ = 5;
maxPoolSize_ = 15;
initialPoolSize_ = 9;
numDaemons_ = 4;
if (timeToRunDaemons_ == 0) {
    timeToRunDaemons_ = 15*1000; // 15 seconds
}
}
maxLifetime_ = (int)timeToRunDaemons_ / 3;
maxIdleTime_ = (int)timeToRunDaemons_ / 4;
propertyCycle_ = timeToRunDaemons_ / 4;
poolHealthCheckCycle_ = Math.min(timeToRunDaemons_ / 4, 20*60*1000);
// at least once every 20 minutes (more frequently if shorter run-time)
daemonMaxSleepTime_ = Math.min(timeToRunDaemons_ / 3, 10*1000);
// at most 10 seconds (less if shorter run-time)
daemonMinSleepTime_ = 20; // milliseconds

if (DEBUG)
    System.out.println("setup: Constructing "
        + "AS400JDBCManagedConnectionPoolDataSource (cpds0)");
AS400JDBCManagedConnectionPoolDataSource cpds0 =
    new AS400JDBCManagedConnectionPoolDataSource();

// Set datasource properties. Note that both CPDS and MDS have these
// properties, and they might have different values.
cpds0.setServerName(host);
cpds0.setDatabaseName(host); //iasp can be here
cpds0.setUser(userid);
cpds0.setPassword(password);

cpds0.setSavePasswordWhenSerialized(true);

// Set connection pooling-specific properties.
cpds0.setInitialPoolSize(initialPoolSize_);
cpds0.setMinPoolSize(minPoolSize_);
cpds0.setMaxPoolSize(maxPoolSize_);
cpds0.setMaxLifetime((int)(maxLifetime_/1000)); // convert to seconds
cpds0.setMaxIdleTime((int)(maxIdleTime_/1000)); // convert to seconds
cpds0.setPropertyCycle((int)(propertyCycle_/1000)); // convert to seconds
//cpds0.setReuseConnections(false); // don't re-use connections

// Set the initial context factory to use.
System.setProperty(Context.INITIAL_CONTEXT_FACTORY,
    "com.sun.jndi.fscontext.RefFSContextFactory");

// Get the JNDI Initial Context.
Context ctx = new InitialContext();

// Note: The following is an alternative way to set context properties locally:
// Properties env = new Properties();
// env.put(Context.INITIAL_CONTEXT_FACTORY,
//     "com.sun.jndi.fscontext.RefFSContextFactory");
// Context ctx = new InitialContext(env);

ctx.rebind("mydatasource", cpds0);
// We can now do lookups on cpds, by the name "mydatasource".

if (DEBUG)
    System.out.println("setup: lookup(\"mydatasource\" + \"\");");
// AS400JDBCManagedConnectionPoolDataSource cpds1 =
//     (AS400JDBCManagedConnectionPoolDataSource)ctx.lookup("mydatasource");
// if (DEBUG) System.out.println("setup: cpds1.getUser() == |" + cpds1.getUser() + "|");

// Create a standard DataSource object that references it.

if (DEBUG)
    System.out.println("setup: Constructing AS400JDBCManagedDataSource (mds0)");

```



```

AS400JDBCManagedDataSource mds0 = new AS400JDBCManagedDataSource();
mds0.setDescription("DataSource supporting connection pooling");
mds0.setDataSourceName("mydatasource");
ctx.rebind("ConnectionPoolingDataSource", mds0);

if (DEBUG)
    System.out.println("setup: lookup(\"ConnectionPoolingDataSource\" + ")");
dataSource_ = (DataSource)ctx.lookup("ConnectionPoolingDataSource");
//dataSource_.setLogWriter(output_);
if (DEBUG)
    System.out.println("setup: dataSource_.getUser() == |" +
        ((AS400JDBCManagedDataSource)dataSource_).getUser() + "|");

    mds_ = (AS400JDBCManagedDataSource)dataSource_;
}
catch (Exception e)
{
    e.printStackTrace();
    System.out.println("Setup error during Trace file creation.");
}
}

void displayConnectionType(Connection conn, boolean specifiedDefaultId)
{
    if (conn instanceof com.ibm.as400.access.AS400JDBCConnectionHandle)
        System.out.print("(" + (specifiedDefaultId ? "+" : "-") + "P");
    else
        System.out.print("(" + (specifiedDefaultId ? "+" : "-") + "NP");
}

/**
 * Gets and returns connections from and to a connection pool for a while.
 */
public void runTest()
{
    boolean ok = true;
    try
    {
        System.out.println("Started test run at " + new Date());

        if (DEBUG)
            System.out.println("Checking health just after datasource creation "
                + "(we expect that the pool does not exist yet) ...");
        if (mds_.checkPoolHealth(true)) {
            ok = false;
            System.out.println("\nERROR: Pool exists prior to first getConnection().");
        }

        // Verify some setters/getters for JDBC properties.
        System.out.println("Verifying setters/getters ...");

        mds_.setAccess("read only");
        if (!mds_.getAccess().equals("read only")) {
            ok = false;
            System.out.println("\nERROR: getAccess() returned unexpected value: "
                + "|" + mds_.getAccess()+"|");
        }

        boolean oldBool = mds_.isBigDecimal();
        boolean newBool = (oldBool ? false : true);
        mds_.setBigDecimal(newBool);
        if (mds_.isBigDecimal() != newBool) {
            ok = false;
            System.out.println("\nERROR: isBigDecimal() returned unexpected value: "
                + "|" + mds_.isBigDecimal()+"|");
        }
        mds_.setBigDecimal(oldBool);

        int oldInt = mds_.getBlockCriteria();
        int newInt = (oldInt == 2 ? 1 : 2);
        mds_.setBlockCriteria(newInt);
        if (mds_.getBlockCriteria() != newInt) {
            ok = false;
            System.out.println("\nERROR: getBlockCriteria() returned unexpected value: "
                + "|" + mds_.getBlockCriteria()+"|");
        }
        mds_.setBlockCriteria(oldInt);

        // Verify some setters and getters for socket properties.
        oldBool = mds_.isKeepAlive();
    }
}

```

```

newBool = (oldBool ? false : true);
mds_.setKeepAlive(newBool);
if (mds_.isKeepAlive() != newBool) {
    ok = false;
    System.out.println("\nERROR: isKeepAlive() returned unexpected value: "
        + "|" + mds_.isKeepAlive() + "|");
}
mds_.setKeepAlive(oldBool);

oldInt = mds_.getReceiveBufferSize();
newInt = (oldInt == 256 ? 512 : 256);
mds_.setReceiveBufferSize(newInt);
if (mds_.getReceiveBufferSize() != newInt) {
    ok = false;
    System.out.println("\nERROR: getReceiveBufferSize() returned unexpected value: "
        + "|" + mds_.getReceiveBufferSize() + "|");
}
mds_.setReceiveBufferSize(oldInt);

System.out.println("CONNECTION 1");
Object o = dataSource_.getConnection();
System.out.println(o.getClass());
System.out.println("*****LOOK ABOVE*****");
Connection c1 = dataSource_.getConnection();

if (DEBUG)
    displayConnectionType(c1, true);

if (DEBUG)
    System.out.println("Checking health after first getConnection() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after first getConnection().");
}

if (!TESTING_THREAD_SAFETY)
{
    try
    {
        c1.setAutoCommit(false);
        if (DEBUG)
            System.out.println("SELECT * FROM QIWS.QCUSTCDT");
        Statement s = c1.createStatement();
        ResultSet rs = s.executeQuery("SELECT * FROM QIWS.QCUSTCDT");
        while(rs.next()){
            if (DEBUG)
                System.out.println(rs.getString(2));
        }
        rs.close();
        s.close();
    }
    catch (Exception e) {
        e.printStackTrace();
        if (DEBUG)
            System.out.println("Checking health after fatal connection error ...");
        if (!mds_.checkPoolHealth(true)) {
            ok = false;
            System.out.println("\nERROR: Pool is not healthy after fatal connection "
                + "error.");
        }
    }
}

System.out.println("CONNECTION 2");
Connection c2 = dataSource_.getConnection(userid, password);
if (DEBUG)
    displayConnectionType(c2, false);
System.out.println("CONNECTION 3");
Connection c3 = dataSource_.getConnection();
if (DEBUG)
    displayConnectionType(c3, true);
c1.close();

if (DEBUG)
    System.out.println("Checking health after first close() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after first close().");
}

System.out.println("CONNECTION 4");

```

```

Connection c4 = dataSource_.getConnection();
if (DEBUG) displayConnectionType(c4, true);

c1.close(); // close this one again
c2.close();
c3.close();
c4.close();

if (DEBUG) System.out.println("Checking health after last close() ...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after last close().");
}

// Start the test daemons.
System.out.println("Starting test daemons");
startThreads();

// Run the test daemons for a while; check pool health periodically.

long startTime = System.currentTimeMillis();
long endTime = startTime + timeToRunDaemons_;
while (System.currentTimeMillis() < endTime)
{
    System.out.print("h");
    // Let the daemons run for a while, then check pool health.
    try {
        Thread.sleep(poolHealthCheckCycle_);
    }
    catch (InterruptedException ie) {}
    if (!mds_.checkPoolHealth(true)) {
        ok = false;
        System.out.println("\nERROR: Pool is not healthy after test daemons started.");
    }
}

// Stop the test daemons.
System.out.println("\nStopping test daemons");
stopThreads();

if (DEBUG)
    System.out.println("Checking health after connectionGetter daemons have run...");
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after test daemons stopped.");
}

if (!TESTING_THREAD_SAFETY)
{
    System.out.println("CONNECTION 5");
    Connection c = dataSource_.getConnection();
    if (DEBUG) displayConnectionType(c, true);
    c.setAutoCommit(false);
    if (DEBUG) System.out.println("SELECT * FROM QIWS.QCUSTCDT");
    Statement s = c.createStatement();
    ResultSet rs = s.executeQuery("SELECT * FROM QIWS.QCUSTCDT");
    while(rs.next()){
        if (DEBUG) System.out.println(rs.getString(2));
    }
    rs.close();
    s.close();
    c.close();
}

System.out.println("\nClosing the pool...");
mds_.closePool();

if (DEBUG)
    System.out.println("Checking health after pool closed ...");
Trace.setTraceJDBCOn(true); // make sure the final stats get printed out
Trace.setTraceOn(true);
if (!mds_.checkPoolHealth(true)) {
    ok = false;
    System.out.println("\nERROR: Pool is not healthy after pool closed.");
}

System.out.println();
if(ok==true)
    System.out.println("test ran ok");
else
    System.out.println("test failed");
}

```

```

    catch (Exception e)
    {
        System.out.println(e);
        e.printStackTrace();
    }
    finally {
        System.out.println("Ended test at " + new Date());
    }
}

void startThreads()
{
    // Create a bunch of threads that call getConnection().
    Thread[] threads = new Thread[numDaemons_];
    for (int i=0; i<numDaemons_; i++)
    {
        ConnectionGetter getter;
        // Flip a coin to see if this daemon will specify the default uid, or unique uid.
        if (random_.nextBoolean())
        {
            getter = new ConnectionGetter(userid,password);
            if (TESTING_THREAD_SAFETY) { // we can use fictional userid
                getter = new ConnectionGetter("Thread"+i, "Pwd"+i);
            }
            else { // must use a real userid
                getter = new ConnectionGetter(userid,password);
            }
        }
        else
            getter = new ConnectionGetter(null, null);

        threads[i] = new Thread(getter, "["+i+"]");
        threads[i].setDaemon(true);
    }

    // Start the threads.
    for (int i=0; i<numDaemons_; i++)
    {
        threads[i].start();
    }
}

void stopThreads()
{
    // Tell the threads to stop.
    keepDaemonsAlive_ = false;
    synchronized (daemonSleepLock_) {
        daemonSleepLock_.notifyAll();
    }

    // Wait for the daemons to stop.
    try {
        Thread.sleep(3000);
    }
    catch (InterruptedException ie) {}
}

// ConnectionGetter -----
/**
 * Helper class. This daemon wakes up at random intervals and either
 * gets another connection from the connection pool or returns a
 * previously-gotten connection to the pool.
 */
private final class ConnectionGetter implements Runnable
{
    private String uid_;
    private String pwd_;
    private boolean useDefaultUid_;
    private long maxSleepTime_;
    private String threadName_;
    private boolean firstConnection_ = true;
    ArrayList connections_ = new ArrayList();
    // list of connections that this getter currently 'owns'.

    ConnectionGetter(String uid, String pwd) {
        uid_ = uid;
        pwd_ = pwd;
        if (uid_ == null) useDefaultUid_ = true;
        else useDefaultUid_ = false;
        maxSleepTime_ = daemonMaxSleepTime_; // our own copy that we can adjust
    }
}

```

```

}
public void run()
{
    threadName_ = Thread.currentThread().getName();
    if (DEBUG) System.out.println("ConnectionGetter("+threadName_+") Starting up");

    try
    {
        while (keepDaemonsAlive_)
        {
            try
            {
                // Pick a random sleep-time, between min and max values.
                long sleepTime = Math.max((long)(maxSleepTime_ * random_.nextFloat()),
                    daemonMinSleepTime_);
                // Note: Must never call wait(0), because that waits forever.
                synchronized (daemonSleepLock_) {
                    try {
                        daemonSleepLock_.wait(sleepTime);
                        System.out.print(".");
                    }
                    catch (InterruptedException ie) {}
                }
                if (!keepDaemonsAlive_) break;

                // Decide by chance whether to request another connection or return a
                // previously-obtained connection.
                Connection conn;
                if (random_.nextBoolean()) // Leave the decision to chance.
                { // Request another connection.
                    if (useDefaultUid_)
                    {
                        if (DEBUG)
                            System.out.println("ConnectionGetter("+threadName_+") - get()");
                        conn = dataSource_.getConnection();
                    }
                    else
                    {
                        if (DEBUG)
                            System.out.println("ConnectionGetter("+threadName_+") - "
                                + "get("+uid_+",***)");
                        conn = dataSource_.getConnection(uid_, pwd_);
                    }

                    if (conn == null) {
                        System.out.println("ConnectionGetter("+threadName_+") ERROR: "
                            + "getConnection() returned null");
                    }
                    else
                    {
                        // Occasionally "forget" that we own a connection, and neglect to
                        // close it.
                        // Orphaned connections should eventually exceed their maximum
                        // lifetime and get "reaped" by the connection manager.
                        float val = random_.nextFloat();
                        if (firstConnection_ || val < 0.1) {
                            // 'orphan' a few gotten connections
                            firstConnection_ = false;
                        }
                        else {
                            connections_.add(conn);
                        }
                        if (DEBUG) displayConnectionType(conn, useDefaultUid_);
                        if (conn instanceof com.ibm.as400.access.AS400JDBCConnectionHandle)
                        { // We got a pooled connection. Try speeding up our cycle time.
                            if (maxSleepTime_ > 100)
                                maxSleepTime_--;
                            else
                                maxSleepTime_ = 100;
                        }
                        else
                        { // We didn't get a pooled connection. That means that the pool
                            // must be at capacity. Slow down our cycle time a bit.
                                maxSleepTime_ = maxSleepTime_ + 50;
                        }
                    }
                }
            }
            else { // Close a connection that we currently own.
                if (connections_.size() != 0) {
                    conn = (Connection)connections_.remove(0);
                    conn.close();
                }
            }
        }
    }
}

```

```

        }
    } // inner try
    catch (Exception e)
    {
        e.printStackTrace();
    }
} // outer while
} // outer try
finally
{
    if (DEBUG)
        System.out.println("ConnectionGetter("+threadName+") Stopping");
    // Return all the connections that I still have in my list.
    for (int i=0; i<connections_.size(); i++) {
        Connection conn = (Connection)connections_.remove(0);
        try { conn.close(); } catch (Exception e) { e.printStackTrace(); }
    }
}
}
} // internal class 'ConnectionGetter'
}

```

## Example: Using JDBCQuery to query a table

This program uses the IBM Toolbox for Java JDBC driver to query a table and output its contents.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//
// JDBCQuery example. This program uses the IBM Toolbox for Java JDBC driver to
// query a table and output its contents.
//
// Command syntax:
//   JDBCQuery system collectionName tableName
//
// For example,
//   JDBCQuery MySystem qiws qcustcdt
//
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

import java.sql.*;

public class JDBCQuery
{

    // Format a string so that it has the specified width.
    private static String format (String s, int width)
    {
        String formattedString;

        // The string is shorter than specified width,
        // so we need to pad with blanks.
        if (s.length() < width) {
            StringBuffer buffer = new StringBuffer (s);
            for (int i = s.length(); i < width; ++i)
                buffer.append (" ");
            formattedString = buffer.toString();
        }

        // Otherwise, we need to truncate the string.
        else
            formattedString = s.substring (0, width);

        return formattedString;
    }

    public static void main (String[] parameters)
    {
        // Check the input parameters.
        if (parameters.length != 3) {
            System.out.println("");

```

```

System.out.println("Usage:");
System.out.println("");
System.out.println("  JDBCQuery system collectionName tableName");
System.out.println("");
System.out.println("");
System.out.println("For example:");
System.out.println("");
System.out.println("");
System.out.println("  JDBCQuery mySystem qiws qcustcdt");
System.out.println("");
return;
}

String system      = parameters[0];
String collectionName = parameters[1];
String tableName   = parameters[2];

Connection connection = null;

try {
    // Load the IBM Toolbox for Java JDBC driver.
    DriverManager.registerDriver(new com.ibm.as400.access.AS400JDBCDriver());

    // Get a connection to the database. Since we do not
    // provide a user id or password, a prompt will appear.
    connection = DriverManager.getConnection ("jdbc:as400://" + system);
    DatabaseMetaData dmd = connection.getMetaData ();

    // Execute the query.
    Statement select = connection.createStatement ();
    ResultSet rs = select.executeQuery (
        "SELECT * FROM " + collectionName + dmd.getCatalogSeparator() + tableName);

    // Get information about the result set. Set the column
    // width to whichever is longer: the length of the label
    // or the length of the data.
    ResultSetMetaData rsmd = rs.getMetaData ();
    int columnCount = rsmd.getColumnCount ();
    String[] columnLabels = new String[columnCount];
    int[] columnWidths = new int[columnCount];
    for (int i = 1; i <= columnCount; ++i) {
        columnLabels[i-1] = rsmd.getColumnLabel (i);
        columnWidths[i-1] = Math.max (columnLabels[i-1].length(),
rsmd.getColumnDisplaySize (i));
    }

    // Output the column headings.
    for (int i = 1; i <= columnCount; ++i) {
        System.out.print (format (rsmd.getColumnLabel(i), columnWidths[i-1]));
        System.out.print (" ");
    }
    System.out.println ();

    // Output a dashed line.
    StringBuffer dashedLine;
    for (int i = 1; i <= columnCount; ++i) {
        for (int j = 1; j <= columnWidths[i-1]; ++j)
            System.out.print ("-");
        System.out.print (" ");
    }
    System.out.println ();

    // Iterate through the rows in the result set and output
    // the columns for each row.
    while (rs.next ()) {
        for (int i = 1; i <= columnCount; ++i) {
            String value = rs.getString (i);
            if (rs.isNull ())
                value = "<null>";
            System.out.print (format (value, columnWidths[i-1]));
            System.out.print (" ");
        }
        System.out.println ();
    }
}

catch (Exception e) {
    System.out.println ();
    System.out.println ("ERROR: " + e.getMessage());
}
}

```

```

        finally {
            // Clean up.
            try {
                if (connection != null)
                    connection.close ();
            }
            catch (SQLException e) {
                // Ignore.
            }
        }
        System.exit (0);
    }
}
}

```

## Example: Using JobList to list job identification information

This program is an example of the Job support in the IBM Toolbox for Java. It lists job identification information for a specific user on the system.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// This program is an example of the Job support in the IBM Toolbox
// for Java. It lists job identification information for a specific
// user on the system.
//
// Command syntax:
//   listJobs2 system userID password
//
////////////////////////////////////

import java.io.*;
import java.lang.*;
import java.util.*;
import com.ibm.as400.access.*;

public class listJobs2 extends Object
{
    // Create an object in case we want to call
    // any non-static methods.
    public static void main(String[] parameters)
    {
        listJobs2 me = new listJobs2();
        me.Main(parameters);

        System.exit(0);
    }

    void Main(String[] parameters)
    {
        // If a system was not specified, display help text and exit.
        if (parameters.length == 0)
        {
            showHelp();
            return;
        }

        // Assign the parameters to variables. The
        // first parameter is assumed to be the system
        // name the second is a userID and the third
        // is a password.
        String systemName = parameters[0];
        String userID     = null;
        String password   = null;

        if (parameters.length > 1)
            userID = parameters[1].toUpperCase();
    }
}

```



```

if (parameters.length >= 2)
    password = parameters[2].toUpperCase();

System.out.println(" ");

try
{
    // Create an AS400 object using the system name
    // specified by the user. Set the userid and
    // password if specified by the user.
    AS400 as400 = new AS400(parameters[0]);

    if (userID != null)
        as400.setUserId(userID);

    if (password != null)
        as400.setPassword(password);

    System.out.println("retrieving list ... ");

    // Create a jobList object. This object is used
    // to retrieve the list of active jobs on the server.
    JobList joblist = new JobList(as400);

    // Get the list of active jobs.
    Enumeration list = joblist.getJobs();

    // For each job in the list ...
    while (list.hasMoreElements())
    {
        // Get a job off the list. If a userID was
        // specified then print identification information
        // only if the job's user matches the userID. If
        // no userID was specified then print information
        // for every job on the system.
        Job j = (Job) list.nextElement();

        if (userID != null)
        {
            if (j.getUser().trim().equalsIgnoreCase(userID))
            {
                System.out.println(j.getName().trim() + "." +
                    j.getUser().trim() + "." +
                    j.getNumber());
            }
        }
        else
            System.out.println(j.getName().trim() + "." +
                j.getUser().trim() + "." +
                j.getNumber());
    }

}
catch (Exception e)
{
    System.out.println("Unexpected error");
    e.printStackTrace();
}
}

// Display help text when parameters are incorrect.
void showHelp()
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println("    listJobs2 System UserID Password");
    System.out.println("");
    System.out.println("Where");
}

```

```

        System.out.println("");
        System.out.println("    System = server to connect to");
        System.out.println("    UserID = valid userID on that system ");
        System.out.println("    Password = password for the UserID (optional)");
        System.out.println("");
        System.out.println("For example:");
        System.out.println("");
        System.out.println("    listJobs2 MYAS400 JavaUser pwd1");
        System.out.println("");
        System.out.println("");
    }
}

```

## Example: Using JobList to get a list of jobs

This example gets a list of jobs on the server and outputs the job status followed by job identifier using the IBM Toolbox for Java Job classes.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// This program is an example of the "job" classes in the
// IBM Toolbox for Java. It gets a list of jobs on the server
// and outputs the job's status followed by job identifier.
//
//
// Command syntax:
//   listJobs system userID password
//
// (UserID and password are optional)
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class listJobs extends Object
{
    public static void main(String[] parameters)
    {
        listJobs me = new listJobs();
        me.Main(parameters);

        System.exit(0);
    }

    void Main(String[] parameters)
    {
        // If a system was not specified, display help text and exit.
        if (parameters.length == 0)
        {
            showHelp();
            return;
        }

        // Set up AS400 object parms. The first is the system name and must
        // be specified by the user. The second and third are optional. They
        // are the userid and password. Convert the userid and password
        // to uppercase before setting them on the AS400 object.
        String userID = null;
        String password = null;

        if (parameters.length > 1)
            userID = parameters[1].toUpperCase();

        if (parameters.length >= 2)
            password = parameters[2].toUpperCase();

        System.out.println(" ");

        try
        {
            // Create an AS400 object using the system name specified by the user.

```

```

AS400 as400 = new AS400(parameters[0]);

// If a userid and/or password was specified, set them on the
// AS400 object.
if (userID != null)
    as400.setUserId(userID);

if (password != null)
    as400.setPassword(password);

// Create a job list object. Input parm is the AS400 we want job
// information from.
JobList jobList = new JobList(as400);

// Get a list of jobs running on the server.
Enumeration listOfJobs = jobList.getJobs();

// For each job in the list print information about the job.
while (listOfJobs.hasMoreElements())
{
    printJobInfo((Job) listOfJobs.nextElement(), as400);
}

}
catch (Exception e)
{
    System.out.println("Unexpected error");
    System.out.println(e);
}
}

void printJobInfo(Job job, AS400 as400)
{
    // Create the various converters we need
    AS400Bin4 bin4Converter = new AS400Bin4( );
    AS400Text text26Converter = new AS400Text(26, as400);
    AS400Text text16Converter = new AS400Text(16, as400);
    AS400Text text10Converter = new AS400Text(10, as400);
    AS400Text text8Converter = new AS400Text(8, as400);
    AS400Text text6Converter = new AS400Text(6, as400);
    AS400Text text4Converter = new AS400Text(4, as400);

    // We have the job name/number/etc. from the list request. Now
    // make a server API call to get the status of the job.
    try
    {
        // Create a program call object
        ProgramCall pgm = new ProgramCall(as400);

        // The server program we call has five parameters
        ProgramParameter[] parmlist = new ProgramParameter[5];

        // The first parm is a byte array that holds the output
        // data. We will allocate a 1k buffer for output data.
        parmlist[0] = new ProgramParameter( 1024 );

        // The second parm is the size of our output data buffer (1K).
        Integer iStatusLength = new Integer( 1024 );
        byte[] statusLength = bin4Converter.toBytes( iStatusLength );
        parmlist[1] = new ProgramParameter( statusLength );

        // The third parm is the name of the format of the data.
        // We will use format JOBI0200 because it has job status.
        byte[] statusFormat = text8Converter.toBytes("JOBI0200");
        parmlist[2] = new ProgramParameter( statusFormat );

        // The fourth parm is the job name is format "name user number".
        // Name must be 10 characters, user must be 10 characters and
        // number must be 6 characters. We will use a text converter
        // to do the conversion and padding.
        byte[] jobName = text26Converter.toBytes(job.getName());

        int i = text10Converter.toBytes(job.getUser(),
                                        jobName,
                                        10);

        i = text6Converter.toBytes(job.getNumber(),
                                    jobName,

```

```

                20);

    parmlist[3] = new ProgramParameter( jobName );

    // The last paramter is job identifier. We will leave this blank.
    byte[] jobID = text16Converter.toBytes("                ");
    parmlist[4] = new ProgramParameter( jobID );

    // Run the program.
    if (pgm.run( "/QSYS.LIB/QUSRJOBI.PGM", parmlist )==false)
    {
        // if the program failed display the error message.
        AS400Message[] msgList = pgm.getMessageList();
        System.out.println(msgList[0].getText());
    }
    else
    {
        // else the program worked. Output the status followed by
        // the jobName.user.jobID
        byte[] as400Data = parmlist[0].getOutputData();
        System.out.print(" " + text4Converter.toObject(as400Data, 107) + " ");

        System.out.println(job.getName().trim() + "." +
                            job.getUser().trim() + "." +
                            job.getNumber() + " ");
    }
}
}
catch (Exception e)
{
    System.out.println(e);
}
}

// Display help text when parameters are incorrect.
void showHelp()
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println("    listJobs System UserID Password");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println("    System = server to connect to");
    System.out.println("    UserID = valid userID on that system (optional)");
    System.out.println("    Password = password for the UserID (optional)");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("    listJobs MYAS400 JavaUser pwd1");
    System.out.println("");
    System.out.println("");
}
}
}

```

## Example: Using JobLog to display messages in the job log

This program is an example of the job log function of the IBM Toolbox for Java. It will display the messages in the job log for a job that belongs to the current user.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// This program is an example of the job log fuction of the
// IBM Toolbox for Java. It will display the messages in the job
// log for a job that belongs to the current user.
//
// Command syntax:
//    jobLogExample system userID password
//
// (Password is optional)

```

```

//
//////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
import java.lang.*;
import java.util.*;
import com.ibm.as400.access.*;

public class jobLogExample
{

    public static void main (String[] args)
    {
        // If a system and user were not specified, display help text and exit.
        if (args.length < 2)
        {
            System.out.println("Usage:  jobLogExample system userid <password>");
            return;
        }

        String userID = null;

        try
        {
            // Create an AS400 object.  The system name was passed
            // as the first command line argument.  If a userid
            // and password were passed on the command line,
            // set those as well.
            AS400 system = new AS400 (args[0]);

            if (args.length > 1)
            {
                userID = args[1];
                system.setUserId(userID);
            }

            if (args.length > 2)
                system.setPassword(args[2]);

            // Create a job list object.  This object will be used to get
            // the list of active jobs on the system.  Once the list of
            // jobs is retrieved, the program will find a job for the
            // current user.
            JobList jobList = new JobList(system);

            // Get the list of active jobs on the AS/400
            Enumeration list = jobList.getJobs();

            boolean Continue = true;

            // Look through the list to find a job for the current user.
            while (list.hasMoreElements() && Continue)
            {
                Job j = (Job) list.nextElement();

                if (j.getUser().trim().equalsIgnoreCase(userID))
                {
                    // A job matching the current user was found.  Create
                    // a job log object for this job.
                    JobLog jlog = new JobLog(system, j.getName(), j.getUser(), j.getNumber());

                    // Enumerate the messages in the job log then print them.
                    Enumeration messageList = jlog.getMessages();

                    while (messageList.hasMoreElements())
                    {
                        AS400Message message = (AS400Message) messageList.nextElement();
                        System.out.println(message.getText());
                    }

                    // We found one job matching the current user so exit.
                    Continue = false;
                }
            }
        }
        catch (Exception e)
        {
            System.out.println ("Error: " + e.getMessage ());
        }

        System.exit(0);
    }
}

```

```
}  
  
}
```

## Example: Creating spooled files

This example shows how to create a spooled file on a server from an input stream.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////  
//  
// Example that shows creating a spooled file on a server from an input stream.  
//  
////////////////////////////////////  
  
import java.io.*;  
import java.util.*;  
  
import com.ibm.as400.access.*;  
  
class NPExampleCreateSplf  
{  
  
    // method to create the spooled file on the specified server, in the specified  
    // output queue from the given input stream.  
    public SpooledFile createSpooledFile(AS400 system, OutputQueue outputQueue, InputStream in)  
    {  
        SpooledFile spooledFile = null;  
        try  
        {  
            byte[] buf = new byte[2048];  
            int bytesRead;  
            SpooledFileOutputStream out;  
            PrintParameterList parms = new PrintParameterList();  
  
            // create a PrintParameterList with the values that we want  
            // to override from the default printer file...we will override  
            // the output queue and the copies value.  
            parms.setParameter(PrintObject.ATTR_COPIES, 4);  
            if (outputQueue != null)  
            {  
                parms.setParameter(PrintObject.ATTR_OUTPUT_QUEUE, outputQueue.getPath());  
            }  
            out = new SpooledFileOutputStream(system,  
                                              parms,  
                                              null,  
                                              null);  
  
            // read from the inputstream in until end of stream, passing all data  
            // to the spooled file output stream.  
            do  
            {  
                bytesRead = in.read(buf);  
                if (bytesRead != -1)  
                {  
                    out.write(buf, 0, bytesRead);  
                }  
            } while (bytesRead != -1);  
  
            out.close(); // close the spooled file  
  
            spooledFile = out.getSpooledFile(); // get a reference to the new spooled file  
  
        }  
        catch (Exception e)  
        {  
            //...handle exception...  
        }  
        return spooledFile;  
    }  
}
```

## Example: Creating SCS spooled files

This example uses the SCS3812Writer class to generate an SCS data stream and write it to a spooled file on the server.

This application can take the following arguments, or it can use the defined defaults:

- Name of the server to receive the spooled file.
- Name of the outqueue on the server to receive the spooled file.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// This source is an example of IBM Toolbox for Java "SCS3812Writer".
//
////////////////////////////////////

import com.ibm.as400.access.*;

class NPExampleCreateSCSSplf
{
    private static final String DEFAULT_SYSTEM = new String("RCHAS1");
    private static final String DEFAULT_OUTQ = new String("/QSYS.LIB/QUSRSYS.LIB/PRT01.OUTQ");

    public static void main(String [] args)
    {
        try
        {
            AS400 system;
            SpooledFileOutputStream out;
            PrintParameterList parms = new PrintParameterList();
            SCS3812Writer scsWtr;

            // Process the arguments.
            if (args.length >= 1)
            {
                system = new AS400(args[0]); // Create an AS400 object
            } else {
                system = new AS400(DEFAULT_SYSTEM);
            }

            if (args.length >= 2) // Set the outq
            {
                parms.setParameter(PrintObject.ATTR_OUTPUT_QUEUE, args[1]);
            } else {
                parms.setParameter(PrintObject.ATTR_OUTPUT_QUEUE, DEFAULT_OUTQ);
            }

            out = new SpooledFileOutputStream(system, parms, null, null);

            scsWtr = new SCS3812Writer(out, 37);

            // Write the contents of the spool file.
            scsWtr.setLeftMargin(1.0);
            scsWtr.absoluteVerticalPosition(6);
            scsWtr.setFont(scsWtr.FONT_COURIER_BOLD_5);
            scsWtr.write(" Java Printing");
            scsWtr.newLine();
            scsWtr.newLine();
            scsWtr.setCPI(10);
            scsWtr.write("This document was created using the IBM Toolbox for Java.");
            scsWtr.newLine();
            scsWtr.write("The rest of this document shows some of the things that");
            scsWtr.newLine();
            scsWtr.write("can be done with the SCS3812Writer class.");
            scsWtr.newLine();
            scsWtr.newLine();
            scsWtr.setUnderline(true); scsWtr.write("Setting fonts:");
            scsWtr.setUnderline(false);
            scsWtr.newLine();
            scsWtr.setFont(scsWtr.FONT_COURIER_10); scsWtr.write("Courier font ");
            scsWtr.setFont(scsWtr.FONT_COURIER_BOLD_10); scsWtr.write(" Courier bold font ");
            scsWtr.setFont(scsWtr.FONT_COURIER_ITALIC_10); scsWtr.write(" Courier italic font ");

            scsWtr.newLine();
            scsWtr.setBold(true); scsWtr.write("Courier bold italic font ");
            scsWtr.setBold(false);
            scsWtr.setCPI(10);
        }
    }
}
```

```

        scsWtr.newLine();
        scsWtr.newLine();
        scsWtr.setUnderline(true); scsWtr.write("Lines per inch:");
scsWtr.setUnderline(false);
        scsWtr.newLine();
        scsWtr.write("The following lines should print at 8 lines per inch.");
        scsWtr.newLine();
        scsWtr.newLine();
        scsWtr.setLPI(8);
        scsWtr.write("Line one"); scsWtr.newLine();
        scsWtr.write("Line two"); scsWtr.newLine();
        scsWtr.write("Line three"); scsWtr.newLine();
        scsWtr.write("Line four"); scsWtr.newLine();
        scsWtr.write("Line five"); scsWtr.newLine();
        scsWtr.write("Line six"); scsWtr.newLine();
        scsWtr.write("Line seven"); scsWtr.newLine();
        scsWtr.write("Line eight"); scsWtr.newLine();
        scsWtr.endPage();
        scsWtr.setLPI(6);
        scsWtr.setSourceDrawer(1);
        scsWtr.setTextOrientation(0);
        scsWtr.absoluteVerticalPosition(6);
        scsWtr.write("This page should print in portrait orientation from drawer 1.");
        scsWtr.endPage();
        scsWtr.setSourceDrawer(2);
        scsWtr.setTextOrientation(90);
        scsWtr.absoluteVerticalPosition(6);
        scsWtr.write("This page should print in landscape orientation from drawer 2.");
        scsWtr.endPage();
        scsWtr.close();
        System.out.println("Sample spool file created.");
        System.exit(0);
    }
    catch (Exception e)
    {
        // Handle error.
        System.out.println("Exception occurred while creating spooled file. " + e);
        System.exit(0);
    }
}
}
}

```

## Example: Reading spooled files

This example shows the use of the `PrintObjectInputStream` class to read an existing spooled file.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example that reads an existing server spooled file.
//
// This source is an example of IBM Toolbox for Java "PrintObjectInputStream".
//
////////////////////////////////////
try{
    byte[] buf = new byte[2048];
    int bytesRead;
    AS400 sys = new AS400();
    SpooledFile splf = new SpooledFile( sys,          // AS400
                                       "MICR",       // splf name
                                       17,          // splf number
                                       "QPRTJOB",    // job name
                                       "QUSER",     // job user
                                       "020791" );  // job number

    // open the spooled file for reading and get the input stream to
    // read from it.
    InputStream in = splf.getInputStream(null);

    do
    {
        // read up to buf.length bytes of raw spool data into
        // our buffer.  The actual bytes read will be returned.
        // The data will be a binary printer data stream that is the
        // contents of the spooled file.
        bytesRead = in.read( buf );
        if( bytesRead != -1 )
        {

```



```

        // process the spooled file data.
        System.out.println( "Read " + bytesRead + " bytes" );
    }
} while( bytesRead != -1 );

in.close();
}
catch( Exception e )
{
    // exception
}

```

## Example: Reading and transforming spooled files

The following examples demonstrate how to set up a `PrintParameterList` to obtain different transformations when reading spooled file data. In the code segments that follow, assume a spooled file already exists on a server, and the `createSpooledFile()` method creates an instance of the `SpooledFile` class representing the spooled file.

### Example of `PrintObjectPageInputStream`

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to create a `PrintObjectPageInputStream` object for reading pages of data formatted as GIF images. In this case, each page from the spooled file will be transformed into a GIF image. A GIF workstation customization object is used to specify the data transform.

```

// Create a spooled file
SpooledFile splF = createSpooledFile();

// Set up print parameter list
PrintParameterList printParms = new PrintParameterList();
printParms.setParameter(PrintObject.ATTR_WORKSTATION_CUST_OBJECT, "/QSYS.LIB/QWPGIF.WSCST");
printParms.setParameter(PrintObject.ATTR_MFGTYPE, "*WSCST");

// Create a page input stream from the spooled file
PrintObjectPageInputStream is = splF.getPageInputStream(printParms);

```

### Example of `PrintObjectTransformedInputStream`

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to create a `PrintObjectTransformedInputStream` object for reading data formatted as TIFF. A TIFF (G4 compression) workstation customization object is used to specify the data transform.

```

// Create a spooled file
SpooledFile splF = createSpooledFile();

// Set up print parameter list
PrintParameterList printParms = new PrintParameterList();
printParms.setParameter(PrintObject.ATTR_WORKSTATION_CUST_OBJECT, "/QSYS.LIB/QWPTIFFG4.WSCST");
printParms.setParameter(PrintObject.ATTR_MFGTYPE, "*WSCST");

// Create a transformed input stream from the spooled file
PrintObjectTransformedInputStream is = splF.getTransformedInputStream(printParms);

```

### Example of `PrintObjectTransformedInputStream` using manufacturer type and model

**Note:** Read the [Code example disclaimer](#) for important legal information.

The following example shows how to create a `PrintObjectTransformedInputStream` object for reading data formatted for output to an ASCII printer. A manufacturer type and model of \*HP4 is used to specify the data transform.

```

// Create a spooled file
SpooledFile splF = createSpooledFile();

// Set up print parameter list
PrintParameterList printParms = new PrintParameterList();
printParms.setParameter(PrintObject.ATTR_MFGTYPE, "*HP4");

```

```
// Create a transformed input stream from the spooled file
PrintObjectTransformedInputStream is = splF.getTransformedInputStream(printParms);
```

## Example: Listing spooled files asynchronously (using listeners)

This example demonstrates listing all spooled files on a server asynchronously using the `PrintObjectListListener` interface to get feedback as the list is being built. Listing asynchronously allows the caller to start processing the list objects before the entire list is built for a faster perceived response time for the user.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// Example that shows listing all spooled files on a server asynchronously using
// the PrintObjectListListener interface to get feedback as the list is being built.
// Listing asynchronously allows the caller to start processing the list objects
// before the entire list is built for a faster perceived response time
// for the user.
//
////////////////////////////////////

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.SpooledFileList;
import com.ibm.as400.access.SpooledFile;
import com.ibm.as400.access.ExtendedIllegalStateException;
import com.ibm.as400.access.PrintObjectListListener;
import com.ibm.as400.access.PrintObjectListEvent;

public class NPExampleListSplfAsynch extends Object implements PrintObjectListListener
{
    private AS400 system_;
    private boolean fListError;
    private boolean fListClosed;
    private boolean fListCompleted;
    private Exception listException;
    private int listObjectCount;

    public NPExampleListSplfAsynch(AS400 system)
    {
        system_ = system;
    }

    // list all spooled files on the server asynchronously using a listener
    public void listSpooledFiles()
    {
        fListError = false;
        fListClosed = false;
        fListCompleted = false;
        listException = null;
        listObjectCount = 0;

        try
        {
            String strSpooledFileName;
            boolean fCompleted = false;
            int listed = 0, size;

            if( system_ == null )
            {
                system_ = new AS400();
            }

            System.out.println(" Now receiving all spooled files Asynchronously using a
listener");

            SpooledFileList splfList = new SpooledFileList(system_);

            // set filters, all users, on all queues
            splfList.setUserFilter("*ALL");
            splfList.setQueueFilter("/QSYS.LIB/%ALL%.LIB/%ALL%.OUTQ");

            // add the listener.
            splfList.addPrintObjectListListener(this);

            // open the list, openAsynchronously returns immediately
            splfList.openAsynchronously();
        }
    }
}
```

```

do
{
    // wait for the list to have at least 25 objects or to be done
    waitForWakeUp();

    fCompleted = splfList.isCompleted();
    size = splfList.size();

    // output the names of all objects added to the list
    // since we last woke up
    while (listed < size)
    {
        if (fListError)
        {
            System.out.println(" Exception on list - " + listException);
            break;
        }

        if (fListClosed)
        {
            System.out.println(" The list was closed before it completed!");
            break;
        }

        SpooledFile splf = (SpooledFile)splfList.getObject(listed++);
        if (splf != null)
        {
            // output this spooled file name
            strSpooledFileName =
splf.getStringAttribute(SpooledFile.ATTR_SPOOLFILE);
            System.out.println(" spooled file = " + strSpooledFileName);
        }
    }

    } while (!fCompleted);

    // clean up after we are done with the list
    splfList.close();
    splfList.removePrintObjectListListener(this);
}

catch( ExtendedIllegalStateException e )
{
    System.out.println(" The list was closed before it completed!");
}

catch( Exception e )
{
    // ...handle any other exceptions...
    e.printStackTrace();
}

}

// This is where the foreground thread waits to be awoken by the
// the background thread when the list is updated or it ends.
private synchronized void waitForWakeUp() throws InterruptedException
{
    // don't go back to sleep if the listener says the list is done
    if (!fListCompleted)
    {
        wait();
    }
}

// The following methods implement the PrintObjectListListener interface

// This method is invoked when the list is closed.
public void listClosed(PrintObjectListEvent event)
{
    System.out.println("*****The list was closed*****");
    fListClosed = true;
    synchronized(this)
    {
        // Set flag to indicate that the list has
        // completed and wake up foreground thread.
        fListCompleted = true;
        notifyAll();
    }
}

// This method is invoked when the list is completed.

```

```

public void listCompleted(PrintObjectListEvent event)
{
    System.out.println("*****The list has completed*****");
    synchronized (this)
    {
        // Set flag to indicate that the list has
        // completed and wake up foreground thread.
        fListCompleted = true;
        notifyAll();
    }
}

// This method is invoked if an error occurs while retrieving
// the list.
public void listErrorOccurred(PrintObjectListEvent event)
{
    System.out.println("*****The list had an error*****");
    fListError = true;
    listException = event.getException();
    synchronized(this)
    {
        // Set flag to indicate that the list has
        // completed and wake up foreground thread.
        fListCompleted = true;
        notifyAll();
    }
}

// This method is invoked when the list is opened.
public void listOpened(PrintObjectListEvent event)
{
    System.out.println("*****The list was opened*****");
    listObjectCount = 0;
}

// This method is invoked when an object is added to the list.
public void listObjectAdded(PrintObjectListEvent event)
{
    // every 25 objects we'll wake up the foreground
    // thread to get the latest objects...
    if( (++listObjectCount % 25) == 0 )
    {
        System.out.println("*****25 more objects added to the list*****");
        synchronized (this)
        {
            // wake up foreground thread
            notifyAll();
        }
    }
}

public static void main( String args[] )
{
    NPExampleListSplfAsynch list = new NPExampleListSplfAsynch(new AS400());
    try{
        list.listSpooledFiles();
    }
    catch( Exception e )
    {
        e.printStackTrace();
    }
    System.exit(0);
}
}

```

## Example: Listing spooled files asynchronously (without using listeners)

This example demonstrates how to list all the spooled files on the system asynchronously without using the `PrintObjectListListener` interface.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// This example lists all spooled files on a system asynchronously without
// using the PrintObjectListListener interface. After opening the list the caller
// can do some additional work before waiting for the list to complete.
//

```

```

////////////////////////////////////
//
// This source is an example of IBM Toolbox for Java "PrintObjectList".
//
////////////////////////////////////

import java.util.Enumeration;

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.SpooledFileList;
import com.ibm.as400.access.SpooledFile;

public class NPExampleListSplfAsynch2 extends Object
{
    private AS400 system_;

    public NPExampleListSplfAsynch2(AS400 system)
    {
        system_ = system;
    }

    // list all spooled files on the system asynchronously
    public void listSpooledFiles()
    {
        try
        {
            String strSpooledFileName;
            int listed, size;

            if( system_ == null )
            {
                system_ = new AS400();
            }

            System.out.println(
                "Now receiving all spooled files Asynchronously without using a listener");

            SpooledFileList splfList = new SpooledFileList(system_);

            // set filters, all users, on all queues
            splfList.setUserFilter("*ALL");
            splfList.setQueueFilter("/QSYS.LIB/%ALL%.LIB/%ALL%.OUTQ");

            // open list, openAsynchronously() returns immediately
            // we have not added any listeners...
            splfList.openAsynchronously();

            System.out.println(" Do some processing before waiting...");

            // ... do some processing here while the list is being built....

            System.out.println(" Now wait for list to complete.");

            // wait for the list to complete
            splfList.waitForListToComplete();

            Enumeration enum = splfList.getObjects();

            // output the name of all objects on the list
            while( enum.hasMoreElements() )
            {
                SpooledFile splf = (SpooledFile)enum.nextElement();
                if (splf != null)
                {
                    // output this spooled file's name
                    strSpooledFileName = splf.getStringAttribute(SpooledFile.ATTR_SPOOLFILE);
                    System.out.println(" spooled file = " + strSpooledFileName);
                }
            }
            // clean up after we are done with the list
            splfList.close();
        }

        catch( Exception e )
        {
            // ..handle any exceptions...
            e.printStackTrace();
        }
    }

    public static void main( String args[] )
    {

```

```

        NPExampleListSplfAsynch2 list = new NPExampleListSplfAsynch2(new AS400());
        try{
            list.listSpooledFiles();
        }
        catch( Exception e )
        {
            e.printStackTrace();
        }
        System.exit(0);
    }
}

```

## Example: Listing spooled files synchronously

This example demonstrates listing all spooled files on a server synchronously. Listing synchronously does not return to the caller until the complete list is built. The user perceives a slower response time as compared to listing asynchronously.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example that shows listing all spooled files on a server synchronously.
// Listing synchronously does not return to the caller until the complete list
// is built. The user perceives a slower response time then listing asynchronously.
//
////////////////////////////////////
//
// This source is an example of IBM Toolbox for Java "PrintObjectList".
//
////////////////////////////////////

import java.util.Enumeration;

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.SpooledFileList;
import com.ibm.as400.access.SpooledFile;

public class NPExampleListSplfSynch
{
    private AS400 system_ = new AS400();

    public NPExampleListSplfSynch(AS400 system)
    {
        system_ = system;
    }

    public void listSpooledFiles()
    {
        try{
            String strSpooledFileName;

            if( system_ == null )
            {
                system_ = new AS400();
            }

            System.out.println(" Now receiving all spooled files Synchronously");

            SpooledFileList splfList = new SpooledFileList( system_ );

            // set filters, all users, on all queues
            splfList.setUserFilter("*ALL");
            splfList.setQueueFilter("/QSYS.LIB/%ALL%.LIB/%ALL%.OUTQ");

            // open list, openSynchronously() returns when the list is completed.
            splfList.openSynchronously();
            Enumeration enum = splfList.getObjects();

            while( enum.hasMoreElements() )
            {
                SpooledFile splf = (SpooledFile)enum.nextElement();
                if ( splf != null )
                {
                    // output this spooled file's name
                    strSpooledFileName = splf.getStringAttribute(SpooledFile.ATTR_SPOOLFILE);
                    System.out.println(" spooled file = " + strSpooledFileName);
                }
            }
        }
    }
}

```

```

        }
        // clean up after we are done with the list
        splfList.close();
    }
    catch( Exception e )
    {
        // ...handle any exceptions...
        e.printStackTrace();
    }
}

public static void main( String args[] )
{
    NPExampleListSplfSynch list = new NPExampleListSplfSynch(new AS400());
    try{
        list.listSpooledFiles();
    }
    catch( Exception e )
    {
        e.printStackTrace();
    }
    System.exit(0);
}
}
}

```

## Example: Using ProgramCall

This program calls the QWCRSSTS server program to retrieve the status of the system.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Program call example. This program calls the QWCRSSTS server program
// to retrieve the status of the system.
//
// Command syntax:
//   PCSystemStatusExample system
//
// This source is an example of IBM Toolbox for Java "ProgramCall".
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.math.*;
import java.lang.Thread.*;
import com.ibm.as400.access.*;

public class PCSystemStatusExample extends Object
{
    public static void main(String[] parameters)
    {
        System.out.println( " " );

        // if a system was not specified, display help text and exit.

        if (parameters.length >= 1)
        {
            try
            {
                // Create an AS400 object for the server that contains the
                // program. Assume the first parameter is the system name.

                AS400 as400 = new AS400(parameters[0]);

                // Create the path to the program.

                QSYSObjectPathName programName = new QSYSObjectPathName("QSYS", "QWCRSSTS", "PGM");
            }
            catch (Exception e)
            {
                e.printStackTrace();
            }
        }
    }
}

```

```

// Create the program call object. Associate the object with the
// AS400 object that represents the server we get status from.

ProgramCall getSystemStatus = new ProgramCall(as400);

// Create the program parameter list. This program has five
// parameters that will be added to this list.

ProgramParameter[] parmlist = new ProgramParameter[5];

// The server program returns data in parameter 1. It is an output
// parameter. Allocate 64 bytes for this parameter.

parmlist[0] = new ProgramParameter( 64 );

// Parameter 2 is the buffer size of parm 1. It is a numeric input
// parameter. Sets its value to 64, convert it to the server format,
// then add the parm to the parm list.

AS400Bin4 bin4 = new AS400Bin4( );
Integer iStatusLength = new Integer( 64 );
byte[] statusLength = bin4.toBytes( iStatusLength );
parmlist[1] = new ProgramParameter( statusLength );

// Parameter 3 is the status-format parameter. It is a string input
// parameter. Set the string value, convert it to the server format,
// then add the parameter to the parm list.

AS400Text text1 = new AS400Text(8, as400);
byte[] statusFormat = text1.toBytes("SSTS0200");
parmlist[2] = new ProgramParameter( statusFormat );

// Parameter 4 is the reset-statistics parameter. It is a string input
// parameter. Set the string value, convert it to the server format,
// then add the parameter to the parm list.

AS400Text text3 = new AS400Text(10, as400);
byte[] resetStats = text3.toBytes("*N0      ");
parmlist[3] = new ProgramParameter( resetStats );

// Parameter 5 is the error info parameter. It is an input/output
// parameter. Add it to the parm list.

byte[] errorInfo = new byte[32];
parmlist[4] = new ProgramParameter( errorInfo, 0 );

// Set the program to call and the parameter list to the program
// call object.

getSystemStatus.setProgram(programName.getPath(), parmlist );

// Run the program then sleep. We run the program twice because
// the first set of results are inflated. If we discard the first
// set of results and run the command again five seconds later the
// number will be more accurate.

getSystemStatus.run();
Thread.sleep(5000);

// Run the program

if (getSystemStatus.run()!=true)
{

```



```

// If the program did not run get the list of error messages
// from the program object and display the messages. The error
// would be something like program-not-found or not-authorized
// to the program.

AS400Message[] msgList = getSystemStatus.getMessageList();

System.out.println("The program did not run. Server messages:");

for (int i=0; i<msgList.length; i++)
{
    System.out.println(msgList[i].getText());
}

}

// Else the program did run.

else
{
    // Create a server to Java numeric converter. This converter
    // will be used in the following section to convert the numeric
    // output from the server format to Java format.

    AS400Bin4 as400Int = new AS400Bin4( );

    // Get the results of the program. Output data is in
    // a byte array in the first parameter.

    byte[] as400Data = parmlist[0].getOutputData();

    // CPU utilization is a numeric field starting at byte
    // 32 of the output buffer. Convert this number from the
    // server format to Java format and output the number.

    Integer cpuUtil = (Integer)as400Int.toObject( as400Data, 32 );
    cpuUtil = new Integer(cpuUtil.intValue()/10);
    System.out.print("CPU Utilization: ");
    System.out.print(cpuUtil);
    System.out.println("%");

    // DASD utilization is a numeric field starting at byte
    // 52 of the output buffer. Convert this number from the
    // server format to Java format and output the number.

    Integer dasdUtil = (Integer)as400Int.toObject( as400Data, 52 );
    dasdUtil = new Integer(dasdUtil.intValue()/10000);
    System.out.print("Dasd Utilization: ");
    System.out.print(dasdUtil);
    System.out.println("%");

    // Number of jobs is a numeric field starting at byte
    // 36 of the output buffer. Convert this number from the
    // server format to Java format and output the number.

    Integer nj = (Integer)as400Int.toObject( as400Data, 36 );
    System.out.print("Active jobs:      ");
    System.out.print(nj);
    System.out.println("%");

}

// This program is done running program so disconnect from
// the command server on the server. Program call and command
// call use the same server on the server.

as400.disconnectService(AS400.COMMAND);
}
catch (Exception e)
{
    // If any of the above operations failed say the program failed
    // and output the exception.

```

```

        System.out.println("Program call failed");
        System.out.println(e);
    }
}

// Display help text when parameters are incorrect.

else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct.  Command syntax is:");
    System.out.println("");
    System.out.println("    PCSystemStatusExample myServer");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println("    myServer = get status of this server ");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("    PCSystemStatusExample mySystem");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}
}
}

```

## Example: Using record-level access classes

This IBM Toolbox for Java example program will prompt the user for the name of the server and the file to display. The file must exist and contain records. Each record in the file will be displayed to System.out.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//
// Record level access example.  This program will prompt the user
// for the name of the server and the file to display.  The file must exist
// and contain records.  Each record in the file will be displayed
// to System.out.
//
// Calling syntax: java RLSequentialAccessExample
//
// This source is an example of IBM Toolbox for Java "RecordLevelAccess"
//
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class RLSequentialAccessExample
{
    public static void main(String[] parameters)
    {
        // Created a reader to get input from the user
        BufferedReader inputStream = new BufferedReader(new InputStreamReader(System.in),1);

        // Declare variables to hold the system name, library, file and member names
        String systemName = "";
        String library = "";
        String file = "";
        String member = "";

        // Get the system name and and file to display from the user
        System.out.println();
        try
        {
            System.out.print("System name: ");
            systemName = inputStream.readLine();

            System.out.print("Library in which the file exists: ");
            library = inputStream.readLine();

```

```

System.out.print("File name: ");
file = inputStream.readLine();

System.out.print("Member name (press enter for first member): ");
member = inputStream.readLine();
if (member.equals(""))
{
    member = "*FIRST";
}

System.out.println();
}
catch (Exception e)
{
    System.out.println("Error obtaining user input.");
    e.printStackTrace();
    System.exit(0);
}

// Create AS400 object and connect for the record level access service.
AS400 system = new AS400(systemName);
try
{
    system.connectService(AS400.RECORDACCESS);
}
catch(Exception e)
{
    System.out.println("Unable to connect for record level access.");
    System.out.println("Check the readme file for special instructions regarding record
        level access");
    e.printStackTrace();
    System.exit(0);
}

// Create a QSYSObjectPathName object to obtain the integrated file system path name form
// of the file to be displayed.
QSYSObjectPathName filePathName = new QSYSObjectPathName(library, file, member, "MBR");

// Create a SequentialFile object representing the file to be displayed
SequentialFile theFile = new SequentialFile(system, filePathName.getPath());

// Retrieve the record format for the file
AS400FileRecordDescription recordDescription =
    new AS400FileRecordDescription(system, filePathName.getPath());
try
{
    RecordFormat[] format = recordDescription.retrieveRecordFormat();

    // Set the record format for the file
    theFile.setRecordFormat(format[0]);

    // Open the file for reading. Read 100 records at a time if possible.
    theFile.open(AS400File.READ_ONLY, 100, AS400File.COMMIT_LOCK_LEVEL_NONE);

    // Display each record in the file
    System.out.println("Displaying file " + library.toUpperCase() + "/"
        + file.toUpperCase() + "(" + theFile.getMemberName().trim() + "):");

    Record record = theFile.readNext();
    while (record != null)
    {
        System.out.println(record);
        record = theFile.readNext();
    }
    System.out.println();

    // Close the file
    theFile.close();

    // Disconnect from the record level access service
    system.disconnectService(AS400.RECORDACCESS);
}
catch (Exception e)
{
    System.out.println("Error occurred attempting to display the file.");
    e.printStackTrace();

    try
    {
        // Close the file
        theFile.close();
    }
}

```

```

    }
    catch(Exception x)
    {
    }
}

// Disconnect from the record level access service
system.disconnectService(AS400.RECORDACCESS);
System.exit(0);
}

// Make sure that the application ends; see readme for details
System.exit(0);
}
}
}

```

## Example: Using record-level access classes to read records from a file

This program uses the record-level access classes to read records from a file on the server.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Record-Level Access example. This program uses the record-level
// access classes to read records from a file on the server.
//
// Command syntax:
//   java RLReadFile system
//
// This program reads the records from CA/400's sample database file
// (QCUSTCDT in library QIWS). If you change this example to update
// records, make a copy of QCUSTCDT and update the copy.
//
// This source is an example of IBM Toolbox for Java "Record-level access".
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.math.*;
import com.ibm.as400.access.*;

public class RLReadFile extends Object
{
    public static void main(String[] parameters)
    {
        String system = "";

        // Continue only if a system name was specified.

        if (parameters.length >= 1)
        {
            try
            {
                // Assume the first parameter is the system name.

                system = parameters[0];

                // Create an AS400 object for the server that has the file.

                AS400 as400 = new AS400(system);

                // Create a record description for the file. The file is QCUSTCDT
                // in library QIWS.

                ZonedDecimalFieldDescription customerNumber =
                    new ZonedDecimalFieldDescription(new AS400ZonedDecimal(6,0),
                                                       "CUSNUM");

                CharacterFieldDescription lastName =
                    new CharacterFieldDescription(new AS400Text(8, as400), "LSTNAM");

                CharacterFieldDescription initials =
                    new CharacterFieldDescription(new AS400Text(3, as400), "INIT");
            }
            catch (Exception e)
            {
                System.out.println("Error: " + e.getMessage());
            }
        }
    }
}

```

```

CharacterFieldDescription street =
    new CharacterFieldDescription(new AS400Text(13, as400), "STREET");

CharacterFieldDescription city =
    new CharacterFieldDescription(new AS400Text(6, as400), "CITY");

CharacterFieldDescription state =
    new CharacterFieldDescription(new AS400Text(2, as400), "STATE");

ZonedDecimalFieldDescription zipCode =
    new ZonedDecimalFieldDescription(new AS400ZonedDecimal(5,0),
        "ZIPCOD");

ZonedDecimalFieldDescription creditLimit =
    new ZonedDecimalFieldDescription(new AS400ZonedDecimal(4,0),
        "CDTLMT");

ZonedDecimalFieldDescription chargeCode =
    new ZonedDecimalFieldDescription(new AS400ZonedDecimal(1,0),
        "CHGCOD");

ZonedDecimalFieldDescription balanceDue =
    new ZonedDecimalFieldDescription(new AS400ZonedDecimal(6,2),
        "BALDUE");

ZonedDecimalFieldDescription creditDue =
    new ZonedDecimalFieldDescription(new AS400ZonedDecimal(6,2),
        "CTDUE");

// The record format name must be specified for a DDM file.
// In the case of the QCUSTCDT file, its record format is called CUSREC.

RecordFormat qcustcdt = new RecordFormat("CUSREC");

qcustcdt.addFieldDescription(customerNumber);
qcustcdt.addFieldDescription(lastName);
qcustcdt.addFieldDescription(initials);
qcustcdt.addFieldDescription(street);
qcustcdt.addFieldDescription(city);
qcustcdt.addFieldDescription(state);
qcustcdt.addFieldDescription(zipCode);
qcustcdt.addFieldDescription(creditLimit);
qcustcdt.addFieldDescription(chargeCode);
qcustcdt.addFieldDescription(balanceDue);
qcustcdt.addFieldDescription(creditDue);

// Create the sequential file object that represents the
// file on the server. We use a QSYSObjectPathName object
// to get the name of the file into the correct format.

QSYSObjectPathName fileName = new QSYSObjectPathName("QIWS",
    "QCUSTCDT",
    "FILE");

SequentialFile file = new SequentialFile(as400, fileName.getPath());

// Let the file object know the format of the records.
file.setRecordFormat(qcustcdt);

// Open the file for read-only access. Specify a blocking
// factor of 10 (the file object will get 10 records when
// it accesses the server for data). Do not use commitment
// control.
file.open(SequentialFile.READ_ONLY,
    10,
    SequentialFile.COMMIT_LOCK_LEVEL_NONE);

// Read the first record of the file.
Record data = file.readNext();

// Loop while there are records in the file (while we have not
// reached end-of-file).
while (data != null)
{
    // Display the record only if balance due is greater than

```

```

        // zero. In that case display the customer name and
        // the balance due. The following code pulls fields out
        // of the record by field name. As the field is retrieved
        // from the record it is converted from server format to
        // Java format.

        if (((BigDecimal)data.getField("BALDUE")).floatValue() > 0.0)
        {
            System.out.print((String) data.getField("INIT") + " ");
            System.out.print((String) data.getField("LSTNAM") + " ");
            System.out.println((BigDecimal) data.getField("BALDUE"));
        }

        // Read the next record in the file.

        data = file.readNext();
    }

    // When there are no more records to read, disconnect from the server.
    as400.disconnectAllServices();
}

catch (Exception e)
{

    // If any of the above operations failed, print an error message
    // and output the exception.

    System.out.println("Could not read the file");
    System.out.println(e);
}

}

// Display help text when parameters are incorrect.

else
{
    System.out.println("");
    System.out.println("");
    System.out.println("");
    System.out.println("Parameters are not correct. Command syntax is:");
    System.out.println("");
    System.out.println("    RLReadFile as400");
    System.out.println("");
    System.out.println("Where");
    System.out.println("");
    System.out.println("    as400 = system that contains the file");
    System.out.println("");
    System.out.println("For example:");
    System.out.println("");
    System.out.println("    RLReadFile mySystem");
    System.out.println("");
    System.out.println("");
    System.out.println("Note, this program reads data base file QIWS/QCUSTCDT. ");
    System.out.println("");
    System.out.println("");
}

System.exit(0);
}
}
}

```

## Example: Using record-level access classes to read records by key

This program uses the record-level access classes to read records by key from a file on the server. The user will be prompted for the server name to which to run and the library in which to create file QCUSTCDTKY.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Record-Level Access example. This program uses the record-level
// access classes to read records by key from a file on the server.

```

```

// The user will be prompted for the server name to which to run and
// the library in which to create file QCUSTCDTKY.
//
// Command syntax:
//   java RLKeyedFileExample
//
// This program will copy the records from the IBM i Access for Windows sample
// database file (QCUSTCDT in library QIWS) to file QCUSTCDTKY which has
// the same format as QIWS/QCUSTCDT but has set the CUSNUM field as the key
// for the file.
//
// This source is an example of IBM Toolbox for Java "Record-level access".
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import java.math.*;
import com.ibm.as400.access.*;

public class RLKeyedFileExample
{
    public static void main(String[] parameters)
    {
        // Created a reader to get input from the user
        BufferedReader inputStream = new BufferedReader(new InputStreamReader(System.in),1);

        // Declare variables to hold the system name, library, file and member names
        String systemName = "";
        String library = "";

        // Get the system name from the user
        System.out.println();
        try
        {
            System.out.print("System name: ");
            systemName = inputStream.readLine();

            System.out.print("Library in which to create file QCUSTCDTKY: ");
            library = inputStream.readLine();
        }
        catch(Exception e)
        {
            System.out.println("Error obtaining user input.");
            e.printStackTrace();
            System.exit(0);
        }

        // Create AS400 object and connect for the record level access service.
        AS400 system = new AS400(systemName);
        try
        {
            system.connectService(AS400.RECORDACCESS);
        }
        catch(Exception e)
        {
            System.out.println("Unable to connect for record level access.");
            System.out.println("Check the readme file for special instructions regarding record
                level access");
            e.printStackTrace();
            System.exit(0);
        }

        RecordFormat qcustcdtFormat = null;
        try
        {
            // Create the RecordFormat object for creating the file. The record format for the new
            // file will be the same as the record format for file QIWS/QCUSTCDT. However we will
            // make the CUSNUM field a key field.
            AS400FileRecordDescription recordDescription =
                new AS400FileRecordDescription(system, "/QSYS.LIB/QIWS.LIB/QCUSTCDT.FILE");

            // There is only one record format for the file, so take the first (and only) element
            // of the RecordFormat array returned as the RecordFormat for the file.
            System.out.println("Retrieving record format of QIWS/QCUSTCDT...");
            qcustcdtFormat = recordDescription.retrieveRecordFormat()[0];
            // Indicate that CUSNUM is a key field
            qcustcdtFormat.addKeyFieldDescription("CUSNUM");
        }
        catch(Exception e)
    }
}

```

```

    {
        System.out.println("Unable to retrieve record format from QIWS/QCUSTCDT");
        e.printStackTrace();
        System.exit(0);
    }

    // Create the keyed file object that represents the
    // file we will create on the server. We use a QSYSObjectPathName object
    // to get the name of the file into the correct format.
    QSYSObjectPathName fileName = new QSYSObjectPathName(library,
                                                         "QCUSTCDTKY",
                                                         "*FILE",
                                                         "MBR");

    KeyedFile file = new KeyedFile(system, fileName.getPath());

    try
    {
        System.out.println("Creating file " + library + "/QCUSTCDTKY...");
        // Create the file using the qcustcdtFormat object
        file.create(qcustcdtFormat, "Keyed QCUSTCDT file");

        // Populate the file with the records contained in QIWS/QCUSTCDT
        copyRecords(system, library);

        // Open the file for read-only access. Because we will be randomly
        // accessing the file, specify a blocking factor of 1. The
        // commit lock level parameter will be ignored since commitment
        // control has not been started.
        file.open(AS400File.READ_ONLY,
                 1,
                 AS400File.COMMIT_LOCK_LEVEL_NONE);

        // Assume that we want to display the information for customers
        // 192837, 392859 and 938472
        // The CUSNUM field is a zoned decimal field of length 6 with
        // no decimal positions. Therefore, the key field value is
        // represented with a BigDecimal.
        BigDecimal[] keyValues = {new BigDecimal(192837),
                                   new BigDecimal(392859),
                                   new BigDecimal(938472)};

        // Create the key for reading the records. The key for a KeyedFile
        // is specified with an Object[]
        Object[] key = new Object[1];

        Record data = null;
        for (int i = 0; i < keyValues.length; i++)
        {
            // Setup the key for reading
            key[0] = keyValues[i];

            // Read the record for customer number keyValues[i]
            data = file.read(key);
            if (data != null)
            {
                // Display the record only if balance due is greater than
                // zero. In that case display the customer name and
                // the balance due. The following code pulls fields out
                // of the record by field name. As the field is retrieved
                // from the record it is converted from the server format to
                // Java format.
                if (((BigDecimal)data.getField("BALDUE")).floatValue() > 0.0)
                {
                    System.out.print((String) data.getField("INIT") + " ");
                    System.out.print((String) data.getField("LSTNAM") + " ");
                    System.out.println((BigDecimal) data.getField("BALDUE"));
                }
            }
        }

        // All done with the file
        file.close();

        // Get rid of the file from the user's system
        file.delete();
    }
    catch (Exception e)
    {
        System.out.println("Unable to create/read from QTEMP/QCUSTCDT");
        e.printStackTrace();
        try
        {

```





```

    return;
}

try
{
    // Create an AS400 object. The system name was passed
    // as the first command line argument.
    AS400 system = new AS400 (args[0]);

    // The group name was passed as the second command line
    // argument.
    String groupName = args[1];

    // Create the user list object.
    UserList userList = new UserList (system);

    // Get a list of the users in the given group.
    userList.setUserInfo (UserList.MEMBER);
    userList.setGroupInfo (groupName);
    Enumeration enum = userList.getUsers ();

    // Iterate through the list and print out the
    // users' names and descriptions.
    while (enum.hasMoreElements ())
    {
        User u = (User) enum.nextElement ();
        System.out.println ("User name: " + u.getName ());
        System.out.println ("Description: " + u.getDescription ());
        System.out.println ("");
    }

}
catch (Exception e)
{
    System.out.println ("Error: " + e.getMessage ());
}

System.exit (0);
}
}

```

## Examples: JavaBeans

This section lists the code examples that are provided throughout the IBM Toolbox for Java bean information.

The following disclaimer applies to all of the IBM Toolbox for Java examples:

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### Example: IBM Toolbox for Java bean code

The following example creates an AS400 object and a CommandCall object, and then registers listeners on the objects. The listeners on the objects print a comment when the server connects or disconnects and when the CommandCall object completes the running of a command.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Beans example. This program uses the JavaBeans support in the

```

```

// IBM Toolbox for Java classes.
//
// Command syntax:
//   BeanExample
//
//
/////////////////////////////////////////////////////////////////

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.CommandCall;
import com.ibm.as400.access.ConnectionListener;
import com.ibm.as400.access.ConnectionEvent;
import com.ibm.as400.access.ActionCompletedListener;
import com.ibm.as400.access.ActionCompletedEvent;

class BeanExample
{
    AS400      as400_   = new AS400();
    CommandCall cmd_   = new CommandCall( as400_ );

    BeanExample()
    {
        // Whenever the system is connected or disconnected print a
        // comment. Do this by adding a listener to the AS400 object.
        // When a system is connected or disconnected, the AS400 object
        // will call this code.

        as400_.addConnectionListener(
            new ConnectionListener()
            {
                public void connected(ConnectionEvent event)
                {
                    System.out.println( "System connected." );
                }
                public void disconnected(ConnectionEvent event)
                {
                    System.out.println( "System disconnected." );
                }
            }
        );

        // Whenever a command runs to completion print a comment. Do this
        // by adding a listener to the commandCall object. The commandCall
        // object will call this code when it runs a command.

        cmd_.addActionCompletedListener(
            new ActionCompletedListener()
            {
                public void actionCompleted(ActionCompletedEvent event)
                {
                    System.out.println( "Command completed." );
                }
            }
        );
    }

    void runCommand()
    {
        try
        {
            // Run a command. The listeners will print comments when the
            // system is connected and when the command has run to
            // completion.
            cmd_.run( "TESTCMD PARS" );
        }
        catch (Exception ex)
        {
            System.out.println( ex );
        }
    }

    public static void main(String[] parameters)
    {
        BeanExample be = new BeanExample();

        be.runCommand();

        System.exit(0);
    }
}

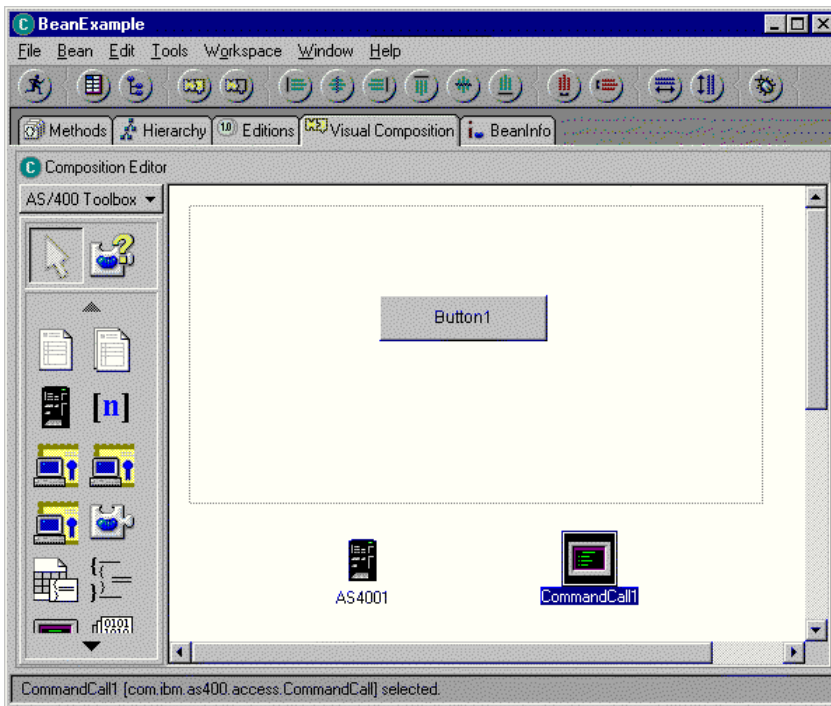
```

## Example: Creating beans with a visual bean builder

This example uses the IBM VisualAge for Java Enterprise Edition V2.0 Composition Editor, but other visual bean builders are similar. This example creates an applet for a button that, when pressed, runs a command on the server.

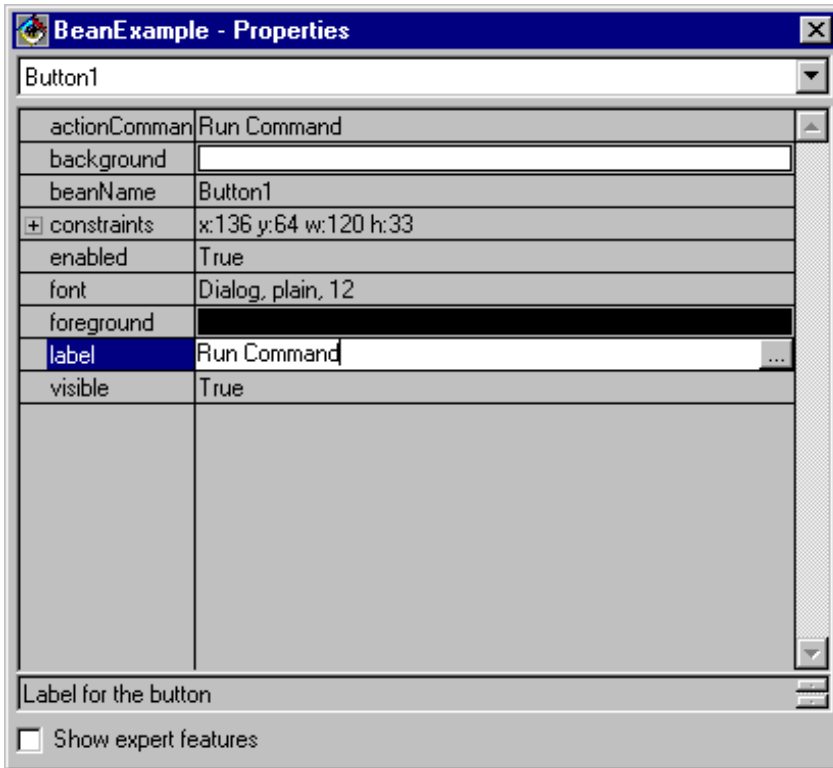
- Drag-and-drop a Button on the applet. (The Button can be found in the bean builder on the left side of the Visual Composition tab in Figure 1.)
- Drop a CommandCall bean and an AS400 bean outside the applet. (The beans can be found in the bean builder on the left side of the Visual Composition tab in Figure 1.)

**Figure 1: VisualAge Visual Composition Editor window - gui.BeanExample**



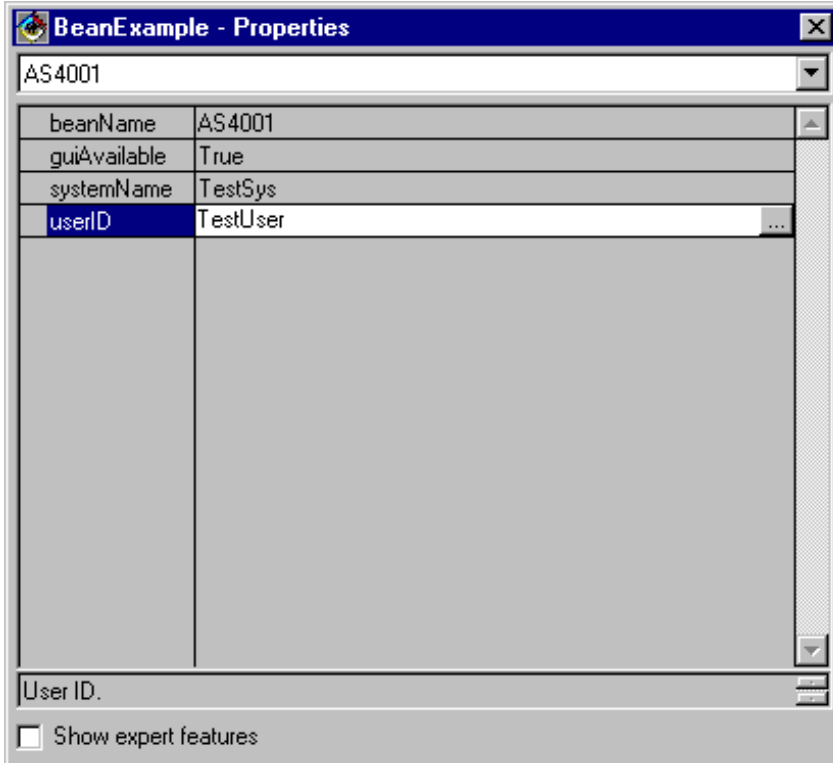
- Edit the bean properties. (To edit, select the bean and then right-click to display a window, which has Properties as an option.)
  - Change the label of the Button to **Run command**, as shown in Figure 2.

**Figure 2: Changing the label of the button to Run command**



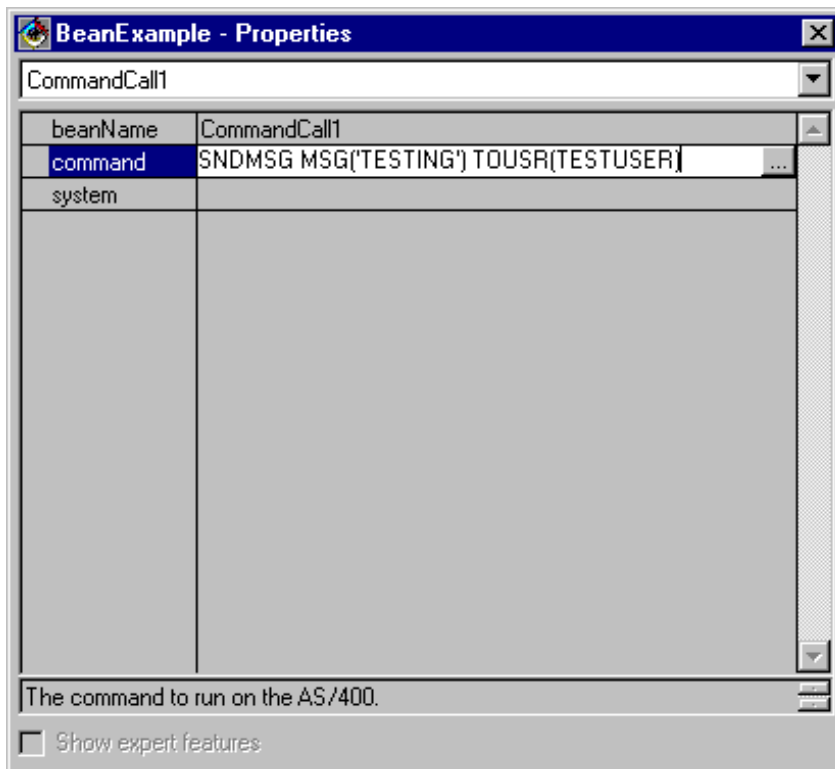
- Change the system name of the AS400 bean to **TestSys**
- Change the user ID of the AS400 bean to **TestUser**, as shown in Figure 3.

**Figure 3: Changing the name of the user ID to TestUser**



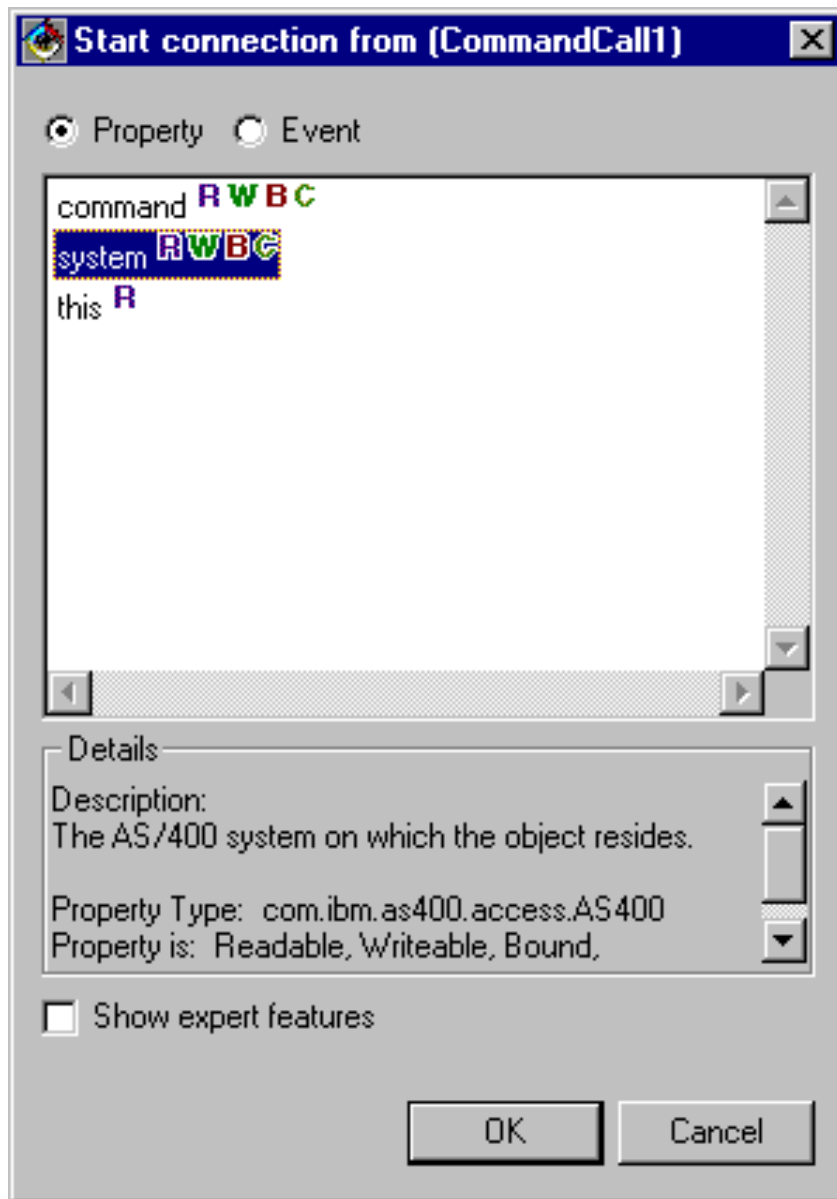
- Change the command of the CommandCall bean to **SNDMSG MSG('Testing') TOUSR('TESTUSER')**, as shown in Figure 4.

**Figure 4: Changing the command of the CommandCall bean**



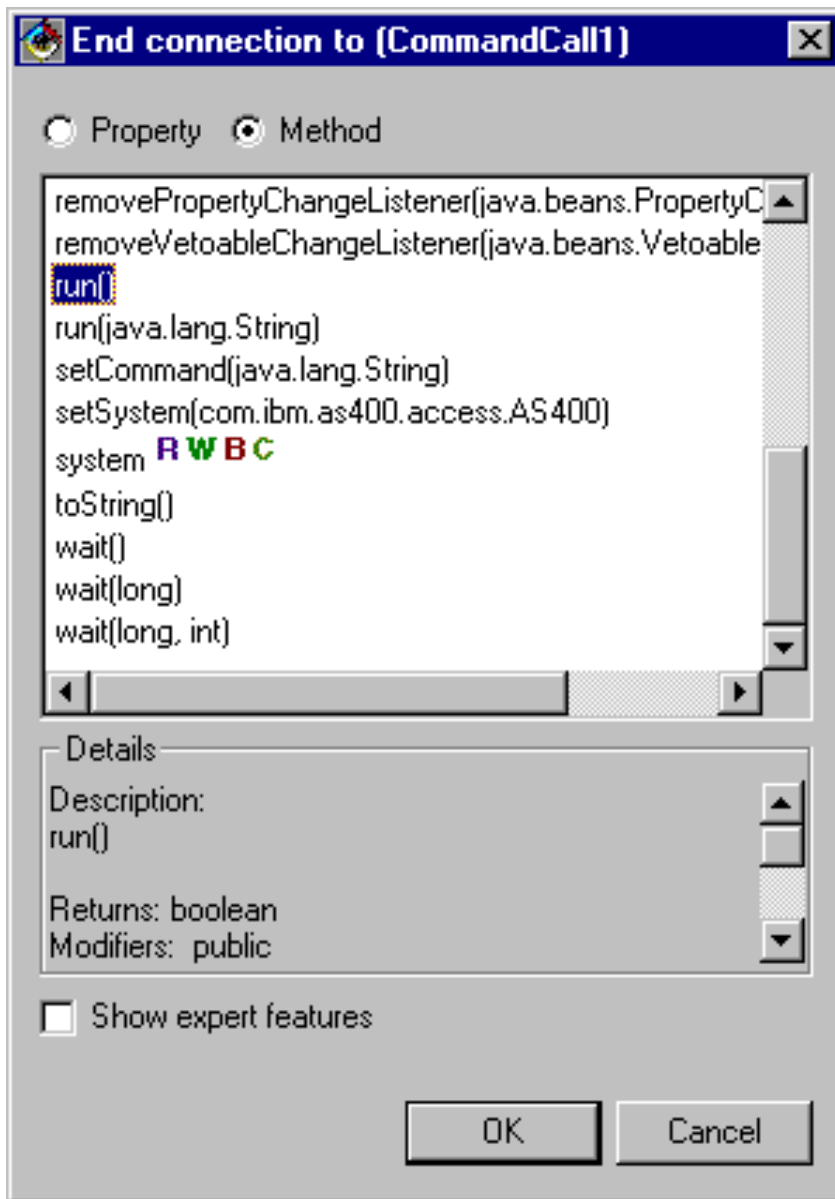
- Connect the AS400 bean to the CommandCall bean. The method you use to do this varies between bean builders. For this example, do the following:
  - Select the CommandCall bean and then click the right mouse button
  - Select **Connect**
  - Select **Connectable Features**
  - Select **system** from the list of features as shown in Figure 5.
  - Select the AS400 bean
  - Select **this** from the pop-up menu that appears over the AS400 bean

**Figure 5: Connecting AS400 bean to CommandCall bean**



- Connect the button to the CommandCall bean.
  - Select the Button bean and then click the right mouse button
  - Select **Connect**
  - Select **actionPerformed**
  - Select the CommandCall bean
  - Select **Connectable Features** from the pop-up menu that appears
  - Select **run()** from the list of methods as shown in Figure 6.

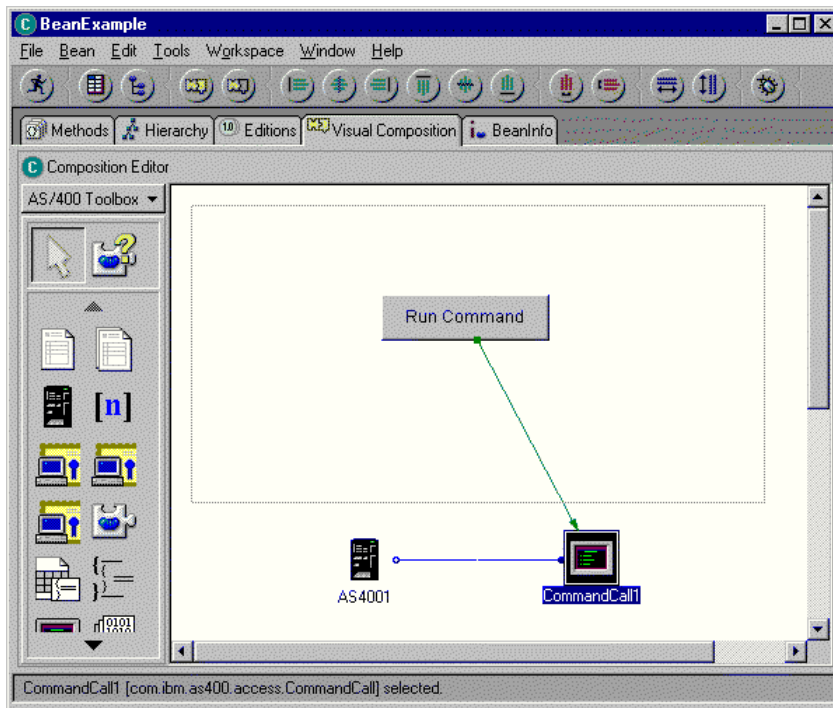
**Figure 6: Connecting a method to a button**



When you are finished, the VisualAge Visual Composition Editor window might look like Figure 7.

**Figure 7: VisualAge Visual Composition Editor window - Finished bean example**





## Examples: Commtrace classes

This topic links to the code example provided in the documentation of IBM Toolbox for Java commtrace classes.

- [“Example: Using the commtrace classes” on page 184](#)

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## Examples from the HTML classes

The following examples show you some of the ways that you can use the IBM Toolbox for Java HTML classes.

- [Example: Using the BidiOrdering class](#)
- [Example Creating HTMLAlign objects](#)
- HTMLDocument class examples:
  - [Example: Using HTMLDocument to create HTML data](#)
  - [Example: Using HTMLDocument to create XSL FO data](#)
- [Example: Using the HTML form classes](#)
- Form input class examples:
  - [Example: Creating a ButtonFormInput object](#)

- [Example: Creating a FileFormInput object](#)
- [Example: Creating a HiddenFormInput object](#)
- [Example: Creating an ImageFormInput object](#)
- [Example: Creating a ResetFormInput object](#)
- [Example: Creating a SubmitFormInput object](#)
- [Example: Creating a TextFormInput object](#)
- [Example: Creating a PasswordFormInput object](#)
- [Example: Creating a RadioFormInput object](#)
- [Example: Creating a CheckboxFormInput object](#)
- [Example Creating HTMLHeading objects](#)
- [Example: Using the HTMLHyperlink class](#)
- [Example: Using the HTMLImage class](#)
- HTMLList examples
  - [Example: Creating ordered lists](#)
  - [Example: Creating unordered lists](#)
  - [Example: Creating nested lists](#)
- [Example: Creating HTMLMeta tags](#)
- [Example: Creating HTMLParameter tags](#)
- [Example: Creating HTMLServlet tags](#)
- [Example: Using the HTMLText class](#)
- HTMLTree examples
  - [Example: Using the HTMLTree class](#)
  - [Example: Creating a traversable integrated file system tree](#)
- Layout form classes:
  - [Example: Using the GridLayoutFormPanel class](#)
  - [Example: Using the LineLayoutFormPanel class](#)
- [Example: Using the TextAreaFormElement class](#)
- [Example: Using the LabelFormOutput class](#)
- [Example: Using the SelectFormElement class](#)
- [Example: Using the SelectOption class](#)
- [Example: Using the RadioFormInputGroup class](#)
- [Example: Using the RadioFormInput class](#)
- [Example: Using the HTMLTable classes](#)
  - [Example: Using the HTMLTableCell class](#)
  - [Example: Using the HTMLTableRow class](#)
  - [Example: Using the HTMLTableHeader class](#)
  - [Example: Using the HTMLTableCaption class](#)

You can also use the HTML and [servlet](#) classes together, like in this [example](#).

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## Example: Using the HTML form classes

The following IBM Toolbox for Java example shows you how to use the HTML form classes.

You can also view a [sample output](#) from running this code. The HTML classes used in the "showHTML" method are **bold**.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// This source is an example of using the HTML
// package classes, which allow you to easily build HTML Forms.
//
////////////////////////////////////

package customer;

import java.io.*;
import java.awt.Color;

import javax.servlet.*;
import javax.servlet.http.*;

import com.ibm.as400.access.*;
import com.ibm.as400.util.html.*;

public class HTMLExample extends HttpServlet
{
    // Determines if user already exists in the list of registrants.
    private static boolean found = false;

    // Registration information will be stored here
    String regPath = "c:\\registration.txt";

    public void init(ServletConfig config)
    {
        try
        {
            super.init(config);
        }
        catch(Exception e)
        {
            e.printStackTrace();
        }
    }

    /**
     * Process the GET request.
     * @param req The request.
     * @param res The response.
     */
    public void doGet (HttpServletRequest req, HttpServletResponse res)
        throws ServletException, IOException
    {
        res.setContentType("text/html");
        ServletOutputStream out = res.getOutputStream();

        // Display the Web using the new HTML classes
        out.println(showHTML());
        out.close();
    }
}
```

```

public void doPost (HttpServletRequest req, HttpServletResponse res)
    throws ServletException, IOException
{
    String nameStr    = req.getParameter("name");
    String emailStr   = req.getParameter("email");
    String errorText = "";

    // Output stream to write to the servlet
    ServletOutputStream out = res.getOutputStream();

    res.setContentType("text/html");

    // Check name & e-mail parameters for valid values
    if (nameStr.length() == 0)
        errorText += "Customer Name not entered. ";
    if (emailStr.length() == 0)
        errorText += "E-mail not entered. ";

    // If name & e-mail have both been provided, continue.
    if (errorText.length() == 0)
    {
        try
        {
            //Create the registration.txt file
            FileWriter f = new FileWriter(regPath, true);
            BufferedWriter output = new BufferedWriter(f);

            //buffered reader for searching the file
            BufferedReader in = new BufferedReader(new FileReader(regPath));

            String line = in.readLine();

            // reset the found flag
            found = false;

            // Check to see if this customer has already registered
            // or has already used the same e-mail address
            while (!found)
            {
                // if file is empty or end of file reached.
                if (line == null)
                    break;

                // if customer already registered
                if ((line.equals("Customer Name: " + nameStr)) ||
                    (line.equals("Email address: " + emailStr)))
                {
                    // Output a message to the customer saying they have
                    // already registered
                    out.println ("<HTML> " +
                                "<TITLE> Toolbox Registration</TITLE> " +
                                "<META HTTP-EQUIV=\"pragma\" content=\"no-cache\" " +
                                "<BODY BGCOLOR=\"blanchedalmond\" TEXT=\"black\" " );
                    out.println ("<P><HR>" +
                                "<P>" + nameStr +
                                "</B>, you have already registered using that " +
                                "<B>Name</B> or <B>E-mail address</B>." +
                                "<P> Thank You!...<P><HR>");

                    // Create a HTMLHyperlink object and display it
                    out.println ("<UL><LI>" +
                                new HTMLHyperlink("./customer.HTMLExample",
                                                    "Back to Registration Form") +
                                "</UL></BODY></HTML>");

                    found = true;
                    break;
                }
                else // read the next line
                    line = in.readLine();
            }

            // String object to hold data submitted from the HTML Form
            String data;

            // If the users name or e-mail aren't found in our
            // text file, continue.
            if (!found)
            {
                //-----

```

```

// Insert the new customer info into a file
output.newLine();
output.write("Customer Name: " + nameStr);
output.newLine();
output.write("Email address: " + emailStr);
output.newLine();
//-----

//-----
//Getting "USE" checkbox from form
data = req.getParameter("use");
if(data != null)
{
    output.write("Currently Using Toolbox: " + data);
    output.newLine();
}
//-----

//-----
//Getting "More Information" checkbox from form
data = req.getParameter("contact");
if (data != null)
{
    output.write("Requested More Information: " + data);
    output.newLine();
}
//-----

//-----
//Getting "AS400 Version" from form
data = req.getParameter("version");
if (data != null)
{
    if (data.equals("multiple versions"))
    {
        data = req.getParameter("MultiList");
        output.write("Multiple Versions: " + data);
    }
    else
        output.write("AS400 Version: " + data);
    output.newLine();
}
//-----

//-----
//Getting "Current Projects" from form
data = req.getParameter("interest");
if (data != null)
{
    output.write("Using Java or Interested In: " + data);
    output.newLine();
}
//-----

//-----
//Getting "Platforms" from form
data = req.getParameter("platform");
if (data != null)
{
    output.write("Platforms: " + data);
    output.newLine();
    if (data.indexOf("Other") >= 0)
    {
        output.write("Other Platforms: " + req.getParameter("OtherPlatforms"));
        output.newLine();
    }
}
//-----

//-----
//Getting "Number of IBM i servers" from form
data = req.getParameter("list1");
if (data != null)
{
    output.write("Number of IBM i servers: " + data);
}

```

```

        output.newLine();
    }
    //-----

    //-----
    //Getting "Comments" from form
    data = req.getParameter("comments");
    if (data != null && data.length() > 0)
    {
        output.write("Comments: " + data);
        output.newLine();
    }
    //-----

    //-----
    //Getting "Attachment"
    data = req.getParameter("myAttachment");
    if (data != null && data.length() > 0)
    {
        output.write("Attachment File: " + data);
        output.newLine();
    }
    //-----

    //-----
    //Getting Hidden "Copyright" infomation
    data = req.getParameter("copyright");
    if (data != null)
    {
        output.write(data);
        output.newLine();
    }
    //-----

    output.flush();
    output.close();

    // Print a thanks to the customer
    out.println("<HTML>");
    out.println("<TITLE>Thank You!</TITLE>");
    out.println("<META HTTP-EQUIV=\"pragma\" content=\"no-cache\"> ");
    out.println("<BODY BGCOLOR=\"blanchedalmond\">");
    out.println("<HR><P>Thank You for Registering, <B>" + nameStr + "</B>!");
    <P><HR>");

    // Create a HTMLHyperlink object and display it
    out.println("<UL><LI>" +
        new HTMLHyperlink("./customer.HTMLExample", "Back to Registration
Form"));

    out.println("</UL></BODY></HTML>");

    }
}
catch (Exception e)
{
    // Show error in browser
    out.println("<HTML>");
    out.println("<TITLE>ERROR!</TITLE>");
    out.println("<META HTTP-EQUIV=\"pragma\" content=\"no-cache\"> ");
    out.println("<BODY BGCOLOR=\"blanchedalmond\">");
    out.println("<BR><B>Error Message:</B><P>");
    out.println(e + "<P>");

    // Create a HTMLHyperlink object and display it
    out.println("<UL><LI>" +
        new HTMLHyperlink("./customer.HTMLExample", "Back to Registration
Form"));

    out.println("</UL></BODY></HTML>");

    e.printStackTrace();
}
}
else
{
    // Output a message to the customer saying customer name &
    // e-mail not entered. Please try again
    out.println("<HTML> " +

```

```

        "<TITLE>Invalid Registration Form</TITLE> " +
        "<META HTTP-EQUIV=\"pragma\" content=\"no-cache\"> " +
        "<BODY BGCOLOR=\"blanchedalmond\" TEXT=\"black\"> " );

    out.println ( "<HR><B>ERROR</B> in customer data - <P><B> " +
        errorText +
        "</B><P>Please Try Again... <HR>");

    // Create a HTMLHyperlink object and display it
    out.println("<UL><LI> " +
        new HTMLHyperlink("./customer.HTMLExample", "Back to Registration Form")
        "</UL></BODY></HTML>");
}
// Close the writer
out.close();

}

public void destroy(ServletConfig config)
{
    // do nothing
}

public String getServletInfo()
{
    return "My Product Registration";
}

private String showHTML()
{
    // String Buffer to hold HTML Page
    StringBuffer page = new StringBuffer();

    // Create the HTML Form object
    HTMLForm form = new HTMLForm("/servlet/customer.HTMLExample");
    HTMLText txt;

    // Build the beginning of the HTML Page and add it to the String Buffer
    page.append("<HTML>\n");
    page.append("<TITLE> Welcome!!</TITLE>\n");
    page.append("<HEAD><SCRIPT LANGUAGE=\"JavaScript\"
        function test(){alert(\"This is a sample script executed with a
        ButtonFormInput.\")}</SCRIPT></HEAD>");
    page.append("<META HTTP-EQUIV=\"pragma\" content=\"no-cache\">\n");
    page.append("<BODY BGCOLOR=\"blanchedalmond\" TEXT=\"black\"><BR>\n");

    try
    {
        //-----
        // Create page title using HTML Text
        txt = new HTMLText("Product Registration");
        txt.setSize(5);
        txt.setBold(true);
        txt.setColor(new Color(199, 21, 133));
        txt.setAlignment(HTMLConstants.CENTER);

        // Add HTML Text to the String Buffer
        page.append(txt.getTag(true) + "<HR><BR>\n");
        //-----

        //-----
        // Create a Line Layout
        LineLayoutFormPanel line = new LineLayoutFormPanel();
        txt = new HTMLText("Enter your name and e-mail address:");
        txt.setSize(4);
        line.addElement(txt);

        // Add the Line Layout to String Buffer
        page.append(line.toString());
        page.append("<BR>");
        //-----

        //-----
        // Set the HTML Form METHOD
        form.setMethod(HTMLForm.METHOD_POST);
        //-----
    }
}

```

```

//-----
// Create a Text input for the name.
TextFormField user = new TextFormField("name");
user.setSize(25);
user.setMaxLength(40);

// Create a Text input for the email address.
TextFormField email = new TextFormField("email");
email.setSize(30);
email.setMaxLength(40);

// Create a ImageFormInput
ImageFormInput img =
    new ImageFormInput("Submit Form", "..\\images\\myPiimages/c.gif");
img.setAlignment(HTMLConstants.RIGHT);
//-----

//-----
// Create a LineLayoutFormPanel object for the name & e-mail address
LineLayoutFormPanel line2 = new LineLayoutFormPanel();

// Add elements to the line form
line2.addElement(new LabelFormElement("Name:"));
line2.addElement(user);
// Create and add a Label Element to the Line Layout
line2.addElement(new LabelFormElement("E-mail:"));
line2.addElement(email);
line2.addElement(img);
//-----

//-----
// Create Questions line layout
LineLayoutFormPanel line3 = new LineLayoutFormPanel();

// Add elements to the line layout
line3.addElement(new LineLayoutFormPanel());
line3.addElement(new
    CheckboxFormInput("use",
        "yes",
        "Do you currently use the Toolbox?",
        false));
line3.addElement(new LineLayoutFormPanel());
line3.addElement(new CheckboxFormInput(
    "contact",
    "yes",
    "Would you like information about future Toolbox releases?",
    true));
line3.addElement(new LineLayoutFormPanel());
//-----

//-----
// Create Version Radio Group
RadioFormInputGroup group = new RadioFormInputGroup("version");

// Add Radio Form Inputs to the Group
group.add(new RadioFormInput("version", "v3r2", "V3R2", false));
group.add(new RadioFormInput("version", "v4r1", "V4R1", false));
group.add(new RadioFormInput("version", "v4r2", "V4R2", false));
group.add(new RadioFormInput("version", "v4r3", "V4R3", false));
group.add(new RadioFormInput("version", "v4r4", "V4R4", false));
group.add(new
    RadioFormInput("version",
        "multiple versions",
        "Multiple Versions? Which ones:",
        false));

//Create a Select Form Element
SelectFormElement mlist = new SelectFormElement("MultiList");
mlist.setMultiple(true);
mlist.setSize(3);

//Create the Options for the Select Form Element
SelectOption option1 = mlist.addOption("V3R2", "v3r2");
SelectOption option2 = mlist.addOption("V4R1", "v4r1");
SelectOption option3 = mlist.addOption("V4R2", "v4r2");
SelectOption option4 = mlist.addOption("V4R3", "v4r3");
SelectOption option5 = mlist.addOption("V4R4", "v4r4");

// Create HTML text
txt = new HTMLText("Current Server Level:");
txt.setSize(4);

```



```

// Create Grid Layout
GridLayoutFormPanel grid1 = new GridLayoutFormPanel(3);

// Add radio group & select form element to the grid
grid1.addElement(txt);
grid1.addElement(group);
grid1.addElement(mlist);
//-----

//-----
// Create Grid Layout for interests
GridLayoutFormPanel grid2 = new GridLayoutFormPanel(1);
txt = new HTMLText("Current Projects or Area of Interest: " +
    "(check all that apply)");
txt.setSize(4);

// Add elements to Grid Layout
grid2.addElement(new LineLayoutFormPanel());
grid2.addElement(txt);
// Create and add a Checkbox to the Grid Layout
grid2.addElement(new
    CheckboxFormInput("interest", "applications", "Applications", true));
grid2.addElement(new
    CheckboxFormInput("interest", "applets", "Applets", false));
grid2.addElement(new
    CheckboxFormInput("interest", "servlets", "Servlets", false));
//-----

//-----
// Create Line Layout for platforms
LineLayoutFormPanel line4 = new LineLayoutFormPanel();
txt = new HTMLText("Client Platforms Used: " +
    "(check all that apply)");
txt.setSize(4);

// Add elements to Line Layout
line4.addElement(new LineLayoutFormPanel());
line4.addElement(txt);
line4.addElement(new LineLayoutFormPanel());
line4.addElement(new CheckboxFormInput("platform",
    "95",
    "Windows95",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "98",
    "Windows98",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "NT",
    "WindowsNT",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "OS2",
    "OS/2",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "AIX",
    "AIX",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "Linux",
    "Linux",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "AS400",
    "System i",
    false));
line4.addElement(new CheckboxFormInput("platform",
    "Other",
    "Other:",
    false));

TextFormInput other = new TextFormInput("OtherPlatforms");
other.setSize(20);
other.setMaxLength(50);

line4.addElement(other);
//-----

//-----
// Create a Line Layout for number of servers
LineLayoutFormPanel grid3 = new LineLayoutFormPanel();

```

```

txt = new HTMLText(
    "How many System i servers do you have?");
txt.setSize(4);

// Create a Select Form Element for number of servers owned
SelectFormElement list = new SelectFormElement("list1");
// Create and add the Select Options to the Select Form Element List
SelectOption opt0 = list.addOption("0", "zero");
SelectOption opt1 = list.addOption("1", "one", true);
SelectOption opt2 = list.addOption("2", "two");
SelectOption opt3 = list.addOption("3", "three");
SelectOption opt4 = list.addOption("4", "four");
SelectOption opt5 = new SelectOption("5+", "FiveOrMore", false);
list.addOption(opt5);

// Add Elements to the Grid Layout
grid3.addElement(new LineLayoutFormPanel());
grid3.addElement(txt);
grid3.addElement(list);
//-----

//-----
// Create a Grid Layout for Product Comments
GridLayoutFormPanel grid4 = new GridLayoutFormPanel(1);
txt = new HTMLText("Product Comments:");
txt.setSize(4);

// Add elements to the Grid Layout
grid4.addElement(new LineLayoutFormPanel());
grid4.addElement(txt);
// Create a Text Area Form
grid4.addElement(new TextAreaFormElement("comments", 5, 75));
grid4.addElement(new LineLayoutFormPanel());
//-----

//-----
// Create a Grid Layout
GridLayoutFormPanel grid5 = new GridLayoutFormPanel(2);
txt = new HTMLText("Would you like to sign on to a server?");
txt.setSize(4);

// Create a Text input and Label for the system name.
TextFormInput sys = new TextFormInput("system");
LabelFormElement sysLabel = new LabelFormElement("System:");

// Create a Text input and Label for the userid.
TextFormInput uid = new TextFormInput("uid");
LabelFormElement uidLabel = new LabelFormElement("UserID");

// Create a Password input and Label for the password.
PasswordFormInput pwd = new PasswordFormInput("pwd");
LabelFormElement pwdLabel = new LabelFormElement("Password");

// Add the Text inputs, password inputs, and Labels to the grid
grid5.addElement(sysLabel);
grid5.addElement(sys);
grid5.addElement(uidLabel);
grid5.addElement(uid);
grid5.addElement(pwdLabel);
grid5.addElement(pwd);
//-----

//-----
// Add the various panels created to the HTML Form
// in the order you wish them to appear
form.addElement(line2);
form.addElement(line3);
form.addElement(grid1);
form.addElement(grid2);
form.addElement(line4);
form.addElement(grid3);
form.addElement(grid4);
form.addElement(txt);
form.addElement(new LineLayoutFormPanel());
form.addElement(grid5);
form.addElement(new LineLayoutFormPanel());
form.addElement(
    new HTMLText("Submit an attachment Here: <br />"));
// Add a File Input to the form
form.addElement(new FileFormInput("myAttachment"));
form.addElement(new ButtonFormInput("button",

```

```

        "TRY ME!",
        "test()");
    // Adds a empty Line Layout, which in turn
    // adds a line break <br /> to the form
    form.addElement(new LineLayoutFormPanel());
    form.addElement(new LineLayoutFormPanel());
    form.addElement(new SubmitFormInput("submit", "Register"));
    form.addElement(new LineLayoutFormPanel());
    form.addElement(new LineLayoutFormPanel());
    form.addElement(new ResetFormInput("reset", "Reset"));
    // Add a Hidden Input to the form
    form.addElement(new
        HiddenFormInput("copyright",
            "(C) Copyright IBM Corp. 1999, 1999"));
    //-----

    // Add the entire HTML Form to the String Buffer
    page.append(form.toString());

}
catch(Exception e)
{
    e.printStackTrace();
}

// Add the Ending HTML tags to the Buffer
page.append("</BODY>\n");
page.append("</HTML>\n");

// Return the entire HTML page string
return page.toString();
}
}
}

```

## HTML class example output

These are some possible sample outputs you may get from running the HTML class example.

- Customer Name: Fred Flinstone  
 Email address: flinstone@bedrock.com  
 Currently Using Toolbox: yes  
 Requested More Information: yes  
 Multiple Versions: v4r2,v4r4  
 Using Java or Interested In: applications,servlets  
 Platforms: NT,Linux  
 Number of IBM i servers: three  
 Comments: The Toolbox is being used by our entire Programming department  
 to build customer applications!  
 Attachment File: U:\wiedrich\servlet\temp.html  
 (C) Copyright IBM Corp. 1999, 1999
- Customer Name: Barney Rubble  
 Email address: rubble@bedrock.com  
 Currently Using Toolbox: yes  
 AS400 Version: v4r4  
 Using Java or Interested In: servlets  
 Platforms: OS2  
 Number of IBM i servers: FiveOrMore  
 (C) Copyright IBM Corp. 1999, 1999
- Customer Name: George Jetson  
 Email address: jetson@sprocket.com  
 Requested More Information: yes  
 AS400 Version: v4r2  
 Using Java or Interested In: applications  
 Platforms: NT,Other  
 Other Platforms: Solaris  
 Number of IBM i servers: one

Comments: This is my first time using this! Very Cool!

(C) Copyright IBM Corp. 1999, 1999

- Customer Name: Clark Kent  
Email address: superman@krypton.com  
AS400 Version: v4r2  
Number of IBM i servers: one  
(C) Copyright IBM Corp. 1999, 1999

### Related reference

[“Example: Using the HTML form classes” on page 443](#)

The following IBM Toolbox for Java example shows you how to use the HTML form classes.

## Example: Using HTMLTree classes

This example shows how to build HTML and file trees using the IBM Toolbox for Java HTML package classes.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////  
//  
// This source is an example of using the IBM Toolbox for Java HTML  
// package classes, which allow you to easily build HTML and File Trees.  
//  
////////////////////////////////////  
  
import java.io.File;  
import java.io.PrintWriter;  
import java.io.IOException;  
  
import java.util.Vector;  
import java.util.Properties;  
  
import javax.servlet.*;  
import javax.servlet.http.*;  
  
import com.ibm.as400.access.AS400;  
import com.ibm.as400.access.Trace;  
import com.ibm.as400.access.IFSJavaFile;  
import com.ibm.as400.util.html.HTMLMeta;  
import com.ibm.as400.util.html.HTMLTree;  
import com.ibm.as400.util.html.HTMLTreeElement;  
import com.ibm.as400.util.html.URLParser;  
import com.ibm.as400.util.html.DirFilter;  
import com.ibm.as400.util.html.FileTreeElement;  
import com.ibm.as400.util.servlet.ServletHyperlink;  
  
/**  
 * An example of using the HTMLTree and FileTreeElement classes in a servlet.  
 **/  
public class TreeNav extends HttpServlet  
{  
    public void init(ServletConfig config)  
        throws ServletException  
    {  
        super.init(config);  
  
        // The Toolbox uses a set of default icons to represents expanded,  
        // collapsed, and documents within the HTMLTree. To enhance those icons,  
        // the Toolbox ships three gifs (expanded.gif, collapsed.gif, bullet.gif)  
        // in the jt400Servlet.jar file. Browsers do not have the ability to  
        // find gifs in a JAR or zip file, so those images need to be extracted  
        // from the JAR file and placed in the appropriate webserver directory  
        // (by default it is the /html directory). Then uncomment the following  
        // lines of code and specify the correct location in the these set  
        // methods. The location can be absolute or relative.  
  
        HTMLTreeElement.setExpandedGif("/images/expanded.gif");  
        HTMLTreeElement.setCollapsedGif("/images/collapsed.gif");  
        HTMLTreeElement.setDocGif("/images/bullet.gif");  
    }  
  
    /**  
     * Process the GET request.  
     * @param req The request.
```

```

* @param res The response.
**/
public void doGet (HttpServletRequest req, HttpServletResponse resp)
    throws ServletException, IOException
{
    HttpSession session = req.getSession(true);
    HTMLTree fileTree = (HTMLTree)session.getValue("filetree");

    // If this session does not already have a file tree, then
    // create the initial tree.
    if (fileTree == null)
        fileTree = createTree(req, resp, req.getRequestURI());

    // Set the Http servlet request on the HTMLTree.
    fileTree.setHttpServletRequest(req);

    resp.setContentType("text/html");

    PrintWriter out = resp.getWriter();
    out.println("<html>\n");
    out.println(new HTMLMeta("Expires", "Mon, 03 Jan 1990 13:00:00 GMT"));
    out.println("<body>\n");

    // Get the tag for the HTMLTree.
    out.println(fileTree.getTag());

    out.println("</body>\n");
    out.println("</html>\n");
    out.close();

    // Set the session tree value, so when entering this servlet for
    // the second time, the FileTree object will be reused.
    session.putValue("filetree", fileTree);
}

/**
 * Process the POST request.
 * @param req The request.
 * @param res The response.
 **/
public void doPost (HttpServletRequest req, HttpServletResponse res)
    throws ServletException, IOException
{
    res.setContentType("text/html");
    ServletOutputStream out = res.getOutputStream();
}

/**
 * This method will create the initial HTMLTree.
 **/
private HTMLTree createTree(HttpServletRequest req, HttpServletResponse resp, String uri)
{
    // Create an HTMLTree object.
    HTMLTree tree = new HTMLTree(req);

    try
    {
        // Create a URLParser object.
        URLParser urlParser = new URLParser(uri);

        AS400 sys = new AS400(CPUStatus.systemName_, "javact1", "jteam1");

        // Create a File object and set the root IFS directory.
        IFSJavaFile root = new IFSJavaFile(sys, "/QIBM");

        // Create a Filter and list all of the directories.
        DirFilter filter = new DirFilter();
        //File[] dirList = root.listFiles(filter);

        // Get the list of files that satisfy the directory filter.
        String[] list = root.list(filter);

        File[] dirList = new File[list.length];

        // We don't want to require webserver to use JDK1.2 because
        // most webserver JVM's are slower to upgrade to the latest JDK level.
        // The most efficient way to create these file objects is to use
        // the listFiles(filter) method in JDK1.2 which would be done
        // like the following, instead of using the list(filter) method
        // and then converting the returned string array into the appropriate
        // File array.
        // File[] dirList = root.listFiles(filter);
    }
}

```

```

for (int j=0; j<dirList.length; ++j)
{
    if (root instanceof IFSJavaFile)
        dirList[j] = new IFSJavaFile((IFSJavaFile)root, list[j]);
    else
        dirList[j] = new File(list[j]);
}

for (int i=0; i<dirList.length; i++)
{
    // Create a FileTreeElement for each directory in the list.
    FileTreeElement node = new FileTreeElement(dirList[i]);

    // Create a ServletHyperlink for the expand/collapse icons.
    ServletHyperlink sl = new ServletHyperlink(urlParser.getURI());
    //sl.setHttpServletResponse(resp);
    node.setIconUrl(sl);

    // Create a ServletHyperlink to the TreeList servlet, which will
    // display the contents of this FileTreeElement (directory).
    ServletHyperlink tl = new ServletHyperlink("/servlet/TreeList");
    tl.setTarget("list");

    // If the ServletHyperlink doesn't have a name, then set it to the
    // name of the directory.
    if (tl.getText() == null)
        tl.setText(dirList[i].getName());

    // Set the TextUrl for the FileTreeElement.
    node.setTextUrl(tl);

    // Add the FileTreeElement to the HTMLTree.
    tree.addElement(node);
}
}
catch (Exception e)
{
    e.printStackTrace();
}
}

return tree;
}

public void destroy(ServletConfig config)
{
    // do nothing
}

public String getServletInfo()
{
    return "FileTree Navigation";
}
}
}

```

## Example: Creating a traversable integrated file system tree (File one of three)

This IBM Toolbox for Java example code, in conjunction with the code in the other two example files, displays an HTMLTree and FileListElement in a servlet.

The three files in the example are:

- `FileTreeExample.java` - this file, which generates the HTML frames and starts the servlet
- `TreeNav.java` - builds and manages the tree
- `TreeList.java` - displays the contents of selections made in the `TreeNav.java` class

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// This source is an example of using the HTML package
// classes, which allow you to easily build HTML and File Trees.
//
////////////////////////////////////

import java.io.PrintWriter;
import java.io.IOException;

```

```

import javax.servlet.*;
import javax.servlet.http.*;

import com.ibm.as400.util.html.HTMLMeta;

//
// An example of using frames to display an HTMLTree and FileListElement
// in a servlet.
//

public class FileTreeExample extends HttpServlet
{
    public void init(ServletConfig config)
        throws ServletException
    {
        super.init(config);
    }

    /**
     * Process the GET request.
     * @param req The request.
     * @param res The response.
     */

    public void doGet (HttpServletRequest req, HttpServletResponse resp)
        throws ServletException, IOException
    {
        resp.setContentType("text/html");

        // Set up two frames. The first, a navigation frame, will display
        // the HTMLTree, which will contain FileTreeElements and allow
        // navigation of the File system. The second frame will display/list
        // the contents of a selected directory from the navigation frame.
        PrintWriter out = resp.getWriter();
        out.println("<html>\n");
        out.println(new HTMLMeta("Expires", "Mon, 04 Jan 1990 13:00:00 GMT"));
        out.println("<frameset cols=\"25%,*\">");
        out.println("<frame frameborder=\"5\" src=\"/servlet/TreeNav\" name=\"nav\">");
        out.println("<frame frameborder=\"3\" src=\"/servlet/TreeList\" name=\"list\">");
        out.println("</frameset>");
        out.println("</html>\n");
        out.close();
    }

    /**
     * Process the POST request.
     * @param req The request.
     * @param res The response.
     */

    public void doPost (HttpServletRequest req, HttpServletResponse res)
        throws ServletException, IOException
    {
        res.setContentType("text/html");
        ServletOutputStream out = res.getOutputStream();
    }

    public void destroy(ServletConfig config)
    {
        // do nothing
    }

    public String getServletInfo()
    {
        return "FileTree Servlet";
    }
}

```

## Example: Creating a traversable integrated file system tree (File two of three)

This example code, in conjunction with the code in the other two example files, displays an HTMLTree and FileListElement in a servlet.

The three files in the example are:

- [FileTreeExample.java](#) - generates the HTML frames and starts the servlet

- [TreeNav.java](#) - this file, which builds and manages the tree
- [TreeList.java](#) - displays the contents of selections made in the [TreeNav.java](#) class

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//
// This source is an example of using the IBM Toolbox for Java HTML
// package classes, which allow you to easily build HTML and File Trees.
//
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

import java.io.File;
import java.io.PrintWriter;
import java.io.IOException;

import javax.servlet.*;
import javax.servlet.http.*;

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.IFSJavaFile;
import com.ibm.as400.util.html.HTMLMeta;
import com.ibm.as400.util.html.HTMLTree;
import com.ibm.as400.util.html.HTMLTreeElement;
import com.ibm.as400.util.html.URLParser;
import com.ibm.as400.util.html.DirFilter;
import com.ibm.as400.util.html.FileTreeElement;
import com.ibm.as400.util.servlet.ServletHyperlink;

//
// An example of using the HTMLTree and FileTreeElement classes
// in a servlet.
//

public class TreeNav extends HttpServlet
{
    private AS400 sys_;

    public void init(ServletConfig config)
        throws ServletException
    {
        super.init(config);

        // Create an AS400 object.
        sys_ = new AS400("mySystem", "myUserID", "myPassword");

        // IBM Toolbox for Java uses a set of default icons to represent expanded,
        // collapsed, and documents within the HTMLTree. To enhance those icons,
        // IBM Toolbox for Java ships three gifs (expanded.gif, collapsed.gif, bullet.gif)
        // in the jt400Servlet.jar file. Browsers do not have the ability to find
        // gifs in a JAR or zip file, so you need to extract those images from the
        // JAR file and place them in the appropriate webserver directory (by default
        // it is the /html directory). Then change the following lines of code to
        // specify the correct location in the set methods. The location can be
        // absolute or relative.

        HTMLTreeElement.setExpandedGif("http://myServer/expanded.gif");
        HTMLTreeElement.setCollapsedGif("http://myServer/collapsed.gif");
        HTMLTreeElement.setDocGif("http://myServer/bullet.gif");
    }

    /**
     * Process the GET request.
     * @param req The request.
     * @param res The response.
     */

    public void doGet (HttpServletRequest req, HttpServletResponse resp)
        throws ServletException, IOException
    {
        // Use session data to remember the state of the tree.
        HttpSession session = req.getSession(true);
        HTMLTree fileTree = (HTMLTree)session.getValue("filetree");

        // If this session does not already have a file tree, then
        // create the initial tree.
        if (fileTree == null)
            fileTree = createTree(req, resp, req.getRequestURI());

        // Set the Http servlet request on the HTMLTree.
    }
}

```



```

fileTree.setHttpServletRequest(req);

resp.setContentType("text/html");

PrintWriter out = resp.getWriter();
out.println("<html>\n");
out.println(new HTMLMeta("Expires","Mon, 03 Jan 1990 13:00:00 GMT"));
out.println("<body>\n");

// Get the tag for the HTMLTree.
out.println(fileTree.getTag());

out.println("</body>\n");
out.println("</html>\n");
out.close();

// Set the session tree value, so when entering this servlet for
// the second time, the FileTree object will be reused.
session.putValue("filetree", fileTree);
}

/**
 * Process the POST request.
 * @param req The request.
 * @param res The response.
 */

public void doPost (HttpServletRequest req, HttpServletResponse res)
    throws ServletException, IOException
{
    res.setContentType("text/html");
    ServletOutputStream out = res.getOutputStream();
}

/**
 * This method will create the initial HTMLTree.
 */

private HTMLTree createTree(HttpServletRequest req,
    HttpServletResponse resp, String uri)
{
    // Create an HTMLTree object.
    HTMLTree tree = new HTMLTree(req);

    try
    {
        // Create a URLParser object.
        URLParser urlParser = new URLParser(uri);

        // Create a File object and set the root IFS directory.
        IFSJavaFile root = new IFSJavaFile(sys_, "/QIBM");

        // Create a Filter.
        DirFilter filter = new DirFilter();

        // Get the list of files that satisfy the directory filter.
        String[] list = root.list(filter);

        File[] dirList = new File[list.length];

        // We don't want to require web servers to use JDK1.2 because
        // most web server JVM's are slower to upgrade to the latest
        // JDK level. The most efficient way to create these file objects
        // is to use the listFiles(filter) method in JDK1.2 which would
        // be done like the following, instead of using the list(filter)
        // method and then converting the returned string array into the
        // appropriate File array.
        // File[] dirList = root.listFiles(filter);

        for (int j=0; j<dirList.length; ++j)
        {
            if (root instanceof IFSJavaFile)
                dirList[j] = new IFSJavaFile((IFSJavaFile)root, list[j]);
            else
                dirList[j] = new File(list[j]);
        }

        for (int i=0; i<dirList.length; i++)
        {
            // Create a FileTreeElement for each directory in the list.
            FileTreeElement node = new FileTreeElement(dirList[i]);

```

```

        // Create a ServletHyperlink for the expand/collapse icons.
        ServletHyperlink sl = new ServletHyperlink(urlParser.getURI());
        sl.setHttpServletResponse(resp);
        node.setIconUrl(sl);

        // Create a ServletHyperlink to the TreeList servlet, which will
        // display the contents of this FileTreeElement (directory).
        ServletHyperlink tl = new ServletHyperlink("/servlet/TreeList");
        tl.setTarget("list");

        // If the ServletHyperlink doesn't have a name, then set it to the
        // name of the directory.
        if (tl.getText() == null)
            tl.setText(dirList[i].getName());

        // Set the TextUrl for the FileTreeElement.
        node.setTextUrl(tl);

        // Add the FileTreeElement to the HTMLTree.
        tree.addElement(node);
    }

    sys_.disconnectAllServices();
}

catch (Exception e)
{
    e.printStackTrace();
}

return tree;
}

public void destroy(ServletConfig config)
{
    // do nothing
}

public String getServletInfo()
{
    return "FileTree Navigation";
}
}
}

```

## Example: Creating a traversable integrated file system tree(File three of three)

This example code, in conjunction with the code in the other two example files, displays an HTMLTree and FileListElement in a servlet.

The three files in the example are:

- [FileTreeExample.java](#) - generates the HTML frames and starts the servlet
- [TreeNav.java](#) - builds and manages the tree
- [TreeList.java](#) - this file, which displays the contents of selections made in the TreeNav.java class

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// This source is an example of using the IBM Toolbox for Java HTML
// package classes, which allow you to easily build HTML and File Lists.
//
////////////////////////////////////

import java.io.PrintWriter;
import java.io.IOException;
import java.io.File;

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.Trace;
import com.ibm.as400.access.IFSJavaFile;
import com.ibm.as400.util.html.HTMLMeta;
import com.ibm.as400.util.html.HTMLHeading;
import com.ibm.as400.util.html.HTMLConstants;
import com.ibm.as400.util.html.FileListElement;

```

```

import com.ibm.as400.util.html.*;

import javax.servlet.*;
import javax.servlet.http.*;

/**
 * An example of using the FileListElement class in a servlet.
 */
public class TreeList extends HttpServlet
{
    private AS400 sys_;

    /**
     * Process the GET request.
     * @param req The request.
     * @param res The response.
     */
    public void doGet(HttpServletRequest req, HttpServletResponse resp)
    throws ServletException, IOException
    {
        resp.setContentType("text/html");

        try
        {
            PrintWriter out = resp.getWriter();
            out.println("<html>\n");
            out.println(new HTMLMeta("Expires",
                "Mon, 02 Jan 1990 13:00:00 GMT"));
            out.println("<body>\n");

            // If the path parameter is not null, then the user has selected an
            // element from the FileTreeElement list in the navigation frame.
            if (req.getPathInfo() != null)
            {
                // Create a FileListElement passing in an AS400 system object and
                // the Http servlet request. The request will contain the necessary
                // path information to list out the contents of the FileTreeElement
                // (directory) selected.
                FileListElement fileList = new FileListElement(sys_, req);

                // Alternately, create a FileListElement from a NetServer share name
                // and share path.
                // FileListElement fileList =
                //     new FileListElement(sys_, req, "TreeShare",
                //         "/QIBM/ProdData/HTTP/Public/jt400");

                // Display the FileListElement contents.
                out.println(fileList.list());
            }
            // Display this HTMLHeading if no FileTreeElement has been selected.
            else
            {
                HTMLHeading heading = new
                    HTMLHeading(1, "An HTML File List Example");
                heading.setAlign(HTMLConstants.CENTER);

                out.println(heading.getTag());
            }

            out.println("</body>\n");
            out.println("</html>\n");
            out.close();
        }
        catch (Exception e)
        {
            e.printStackTrace();
        }
    }

    /**
     * Process the POST request.
     * @param req The request.
     * @param res The response.
     */
    public void doPost (HttpServletRequest req, HttpServletResponse res)
    throws ServletException, IOException
    {
        res.setContentType("text/html");

```

```

        ServletOutputStream out = res.getOutputStream();
    }

    public void init(ServletConfig config)
    throws ServletException
    {
        super.init(config);

        // Create an AS400 object.
        sys_ = new AS400("mySystem", "myUID", "myPWD");
    }
}

```

## Example: Using HTMLTable classes

The following example shows you how the HTMLTable classes work.

```

// Create a default HTMLTable object.
HTMLTable table = new HTMLTable();

// Set the table attributes.
table.setAlignment(HTMLTable.CENTER);
table.setBorderWidth(1);

// Create a default HTMLTableCaption object and set the caption text.
HTMLTableCaption caption = new HTMLTableCaption();
caption.setElement("Customer Account Balances - January 1, 2000");

// Set the caption.
table.setCaption(caption);

// Create the table headers and add to the table.
HTMLTableHeader account_header = new HTMLTableHeader(new HTMLText("ACCOUNT"));
HTMLTableHeader name_header = new HTMLTableHeader(new HTMLText("NAME"));
HTMLTableHeader balance_header = new HTMLTableHeader(new HTMLText("BALANCE"));

table.addColumnHeader(account_header);
table.addColumnHeader(name_header);
table.addColumnHeader(balance_header);

// Add rows to the table. Each customer record represents a row in the table.
int numCols = 3;
for (int rowIndex=0; rowIndex< numCustomers; rowIndex++)
{
    HTMLTableRow row = new HTMLTableRow();
    row.setHorizontalAlignment(HTMLTableRow.CENTER);

    HTMLText account = new HTMLText(customers[rowIndex].getAccount());
    HTMLText name = new HTMLText(customers[rowIndex].getName());
    HTMLText balance = new HTMLText(customers[rowIndex].getBalance());

    row.addColumn(new HTMLTableCell(account));
    row.addColumn(new HTMLTableCell(name));
    row.addColumn(new HTMLTableCell(balance));

    // Add the row to the table.
    table.addRow(row);
}
System.out.println(table.getTag());

```

The Java code example above generates the following HTML code:

```

<table align="center" border="1">
<caption>Customer Account Balances - January 1, 2000</caption>
<tr>
<th>ACCOUNT</th>
<th>NAME</th>
<th>BALANCE</th>
</tr>
<tr align="center">
<td>0000001</td>
<td>Customer1</td>
<td>100.00</td>
</tr>
<tr align="center">
<td>0000002</td>
<td>Customer2</td>

```

```

<td>200.00</td>
</tr>
<tr align="center">
<td>0000003</td>
<td>Customer3</td>
<td>550.00</td>
</tr>
</table>

```

The following table shows how the HTML code above displays in a Web browser.

ACCOUNT	NAME	BALANCE
0000001	Customer1	100.00
0000002	Customer2	200.00
0000003	Customer3	550.00

## Examples: Program Call Markup Language (PCML)

The following examples use Program Call Markup Language to call IBM i APIs, and each one links to a page that shows the PCML source followed by a Java program.

**Note:** The proper authority for each example varies but may include specific object authorities and special authorities. In order to run these examples, you must sign on with a user profile that has authority to perform the following actions:

- Call the IBM i API in the example
- Access the information being requested

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## Example: Simple example of retrieving data

This example the PCML source and Java program needed to retrieve information about a user profile on the server. The API being called is the Retrieve User Information (QSYRUSRI) API.

**Note:** Read the [Code example disclaimer](#) for important legal information.

This simple example has two parts:

- [PCML source for calling QSYRUSRI](#)
- [Java program source for calling QSYRUSRI](#)

### PCML source for calling QSYRUSRI

```

<pcml version="1.0">
<!-- PCML source for calling "Retrieve user Information" (QSYRUSRI) API -->
  <!-- Format USRI0150 - Other formats are available -->
  <struct name="usri0100">

```

```

<data name="bytesReturned" type="int" length="4" usage="output"/>
<data name="bytesAvailable" type="int" length="4" usage="output"/>
<data name="userProfile" type="char" length="10" usage="output"/>
<data name="previousSignonDate" type="char" length="7" usage="output"/>
<data name="previousSignonTime" type="char" length="6" usage="output"/>
<data type="byte" length="1" usage="output"/>
<data name="badSignonAttempts" type="int" length="4" usage="output"/>
<data name="status" type="char" length="10" usage="output"/>
<data name="passwordChangeDate" type="byte" length="8" usage="output"/>
<data name="noPassword" type="char" length="1" usage="output"/>
<data type="byte" length="1" usage="output"/>
<data name="passwordExpirationInterval" type="int" length="4" usage="output"/>
<data name="datePasswordExpires" type="byte" length="8" usage="output"/>
<data name="daysUntilPasswordExpires" type="int" length="4" usage="output"/>
<data name="setPasswordToExpire" type="char" length="1" usage="output"/>
<data name="displaySignonInfo" type="char" length="10" usage="output"/>
</struct>

<!-- Program QSYRUSRI and its parameter list for retrieving USRI0100 format -->
<program name="qsyrusri" path="/QSYS.lib/QSYRUSRI.pgm">
  <data name="receiver" type="struct" struct="usri0100" usage="output"/>
  <data name="receiverLength" type="int" length="4" usage="input" />
  <data name="format" type="char" length="8" usage="input"
init="USRI0100"/>
  <data name="profileName" type="char" length="10" usage="input"
init="*CURRENT"/>
  <data name="errorCode" type="int" length="4" usage="input"
init="0"/>
</program>
</pcml>

```

## Java program source for calling QSYRUSRI

```

import com.ibm.as400.data.ProgramCallDocument;
import com.ibm.as400.data.PcmlException;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400Message;

// Example program to call "Retrieve User Information" (QSYRUSRI) API
public class qsyrusri {

    public qsyrusri() {
    }

    public static void main(String[] argv)
    {
        AS400 as400System; // com.ibm.as400.access.AS400
        ProgramCallDocument pcml; // com.ibm.as400.data.ProgramCallDocument
        boolean rc = false; // Return code from ProgramCallDocument.callProgram()
        String msgId, msgText; // Messages returned from the server
        Object value; // Return value from ProgramCallDocument.getValue()

        System.setErr(System.out);

        // Construct AS400 without parameters, user will be prompted
        as400System = new AS400();

        try
        {
            // Uncomment the following to get debugging information
            //com.ibm.as400.data.PcmlMessageLog.setTraceEnabled(true);

            System.out.println("Beginning PCML Example..");
            System.out.println("    Constructing ProgramCallDocument for QSYRUSRI API...");

            // Construct ProgramCallDocument
            // First parameter is system to connect to
            // Second parameter is pcml resource name. In this example,
            // serialized PCML file "qsyrusri.pcml.ser" or
            // PCML source file "qsyrusri.pcml" must be found in the classpath.
            pcml = new ProgramCallDocument(as400System, "qsyrusri");

            // Set input parameters. Several parameters have default values
            // specified in the PCML source. Do not need to set them using Java code.
            System.out.println("    Setting input parameters...");
            pcml.setValue("qsyrusri.receiverLength",
                new Integer((pcml.getOutputsize("qsyrusri.receiver"))));

```

```

// Request to call the API
// User will be prompted to sign on to the system
System.out.println("    Calling QSYRUSRI API requesting information for the sign-on
user.");
rc = pcml.callProgram("qsyrusri");

// If return code is false, we received messages from the server
if(rc == false)
{
    // Retrieve list of server messages
    AS400Message[] msgs = pcml.getMessageList("qsyrusri");

    // Iterate through messages and write them to standard output
    for (int m = 0; m < msgs.length; m++)
    {
        msgId = msgs[m].getID();
        msgText = msgs[m].getText();
        System.out.println("    " + msgId + " - " + msgText);
    }
    System.out.println("** Call to QSYRUSRI failed. See messages above **");
    System.exit(0);
}
// Return code was true, call to QSYRUSRI succeeded
// Write some of the results to standard output
else
{
    value = pcml.getValue("qsyrusri.receiver.bytesReturned");
    System.out.println("    Bytes returned:    " + value);
    value = pcml.getValue("qsyrusri.receiver.bytesAvailable");
    System.out.println("    Bytes available:    " + value);
    value = pcml.getValue("qsyrusri.receiver.userProfile");
    System.out.println("    Profile name:    " + value);
    value = pcml.getValue("qsyrusri.receiver.previousSignonDate");
    System.out.println("    Previous signon date:" + value);
    value = pcml.getValue("qsyrusri.receiver.previousSignonTime");
    System.out.println("    Previous signon time:" + value);
}
}
catch (PcmlException e)
{
    System.out.println(e.getLocalizedMessage());
    e.printStackTrace();
    System.out.println("*** Call to QSYRUSRI failed. ***");
    System.exit(0);
}

    System.exit(0);
} // End main()
}

```

## Example: Retrieving a list of information

This example shows the PCML source and Java program needed to retrieve a list of authorized users on a server. The API being called is the Open List of Authorized Users (QGYOLAUS) API. This example illustrates how to access an array of structures returned by a server program.

This example has two parts:

- [PCML source for calling QGYOLAUS](#)
- [Java program source for calling QGYOLAUS](#)

### PCML source for calling QGYOLAUS

```

<pcml version="1.0">
<!-- PCML source for calling "Open List of Authorized Users" (QGYOLAUS) API -->

<!-- Format AUTU0150 - Other formats are available -->
<struct name="autu0150">
  <data name="name" type="char" length="10" />
  <data name="userOrGroup" type="char" length="1" />
  <data name="groupMembers" type="char" length="1" />
  <data name="description" type="char" length="50" />
</struct>

```

```

<!-- List information structure (common for "Open List" type APIs) -->
<struct name="listInfo">
  <data name="totalRcds" type="int" length="4" />
  <data name="rcdsReturned" type="int" length="4" />
  <data name="rqshandle" type="byte" length="4" />
  <data name="rcdLength" type="int" length="4" />
  <data name="infoComplete" type="char" length="1" />
  <data name="dateCreated" type="char" length="7" />
  <data name="timeCreated" type="char" length="6" />
  <data name="listStatus" type="char" length="1" />
  <data name="lengthOfInfo" type="int" length="4" />
  <data name="firstRecord" type="int" length="4" />
  <data name="rcdLength" type="byte" length="40" />
</struct>

<!-- Program QGYOLAUS and its parameter list for retrieving AUTU0150 format -->
<program name="qgyolaus" path="/QSYS.lib/QGY.lib/QGYOLAUS.pgm" parseorder="listInfo receiver">
  <data name="receiver" type="struct" struct="autu0150" usage="output"
    count="listInfo.rcdsReturned" outputsize="receiverLength" />
  <data name="receiverLength" type="int" length="4" usage="input" init="16384" />
  <data name="listInfo" type="struct" struct="listInfo" usage="output" />
  <data name="rcdsToReturn" type="int" length="4" usage="input" init="264" />
  <data name="format" type="char" length="10" usage="input"
init="AUTU0150" />
  <data name="selection" type="char" length="10" usage="input" init="*USER" />
  <data name="member" type="char" length="10" usage="input" init="*NONE" />
  <data name="errorCode" type="int" length="4" usage="input" init="0" />
</program>

<!-- Program QGYGTLE returned additional "records" from the list
created by QGYOLAUS. -->
<program name="qgygtle" path="/QSYS.lib/QGY.lib/QGYGTLE.pgm" parseorder="listInfo receiver">
  <data name="receiver" type="struct" struct="autu0150" usage="output"
    count="listInfo.rcdsReturned" outputsize="receiverLength" />
  <data name="receiverLength" type="int" length="4" usage="input" init="16384" />
  <data name="requestHandle" type="byte" length="4" usage="input" />
  <data name="listInfo" type="struct" struct="listInfo" usage="output" />
  <data name="rcdsToReturn" type="int" length="4" usage="input" init="264" />
  <data name="startingRcd" type="int" length="4" usage="input" />
  <data name="errorCode" type="int" length="4" usage="input" init="0" />
</program>

<!-- Program QGYCLST closes the list, freeing resources on the server -->
<program name="qgyclst" path="/QSYS.lib/QGY.lib/QGYCLST.pgm" >
  <data name="requestHandle" type="byte" length="4" usage="input" />
  <data name="errorCode" type="int" length="4" usage="input" init="0" />
</program>
</pcml>

```

## Java program source for calling QGYOLAUS

```

import com.ibm.as400.data.ProgramCallDocument;
import com.ibm.as400.data.PcmlException;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400Message;

// Example program to call "Retrieve List of Authorized Users" (QGYOLAUS) API
public class qgyolaus
{
    public static void main(String[] argv)
    {
        AS400 as400System; // com.ibm.as400.access.AS400
        ProgramCallDocument pcml; // com.ibm.as400.data.ProgramCallDocument
        boolean rc = false; // Return code from ProgramCallDocument.callProgram()
        String msgId, msgText; // Messages returned from the server
        Object value; // Return value from ProgramCallDocument.getValue()

        int[] indices = new int[1]; // Indices for access array value
        int nbrRcds, // Number of records returned from QGYOLAUS and QGYGTLE
            nbrUsers; // Total number of users retrieved
        String listStatus; // Status of list on the server
        byte[] requestHandle = new byte[4];

        System.setErr(System.out);

        // Construct AS400 without parameters, user will be prompted

```



```

as400System = new AS400();

try
{
    // Uncomment the following to get debugging information
    //com.ibm.as400.data.PcmlMessageLog.setTraceEnabled(true);

    System.out.println("Beginning PCML Example..");
    System.out.println("    Constructing ProgramCallDocument for QGYOLAUS API...");

    // Construct ProgramCallDocument
    // First parameter is system to connect to
    // Second parameter is pcml resource name. In this example,
    // serialized PCML file "qgyolaus.pcml.ser" or
    // PCML source file "qgyolaus.pcml" must be found in the classpath.
    pcml = new ProgramCallDocument(as400System, "qgyolaus");

    // All input parameters have default values specified in the PCML source.
    // Do not need to set them using Java code.

    // Request to call the API
    // User will be prompted to sign on to the system
    System.out.println("    Calling QGYOLAUS API requesting information for the sign-on
user.");
    rc = pcml.callProgram("qgyolaus");

    // If return code is false, we received messages from the server
    if(rc == false)
    {
        // Retrieve list of server messages
        AS400Message[] msgs = pcml.getMessageList("qgyolaus");

        // Iterate through messages and write them to standard output
        for (int m = 0; m < msgs.length; m++)
        {
            msgId = msgs[m].getID();
            msgText = msgs[m].getText();
            System.out.println("    " + msgId + " - " + msgText);
        }
        System.out.println("** Call to QGYOLAUS failed. See messages above **");
        System.exit(0);
    }
    // Return code was true, call to QGYOLAUS succeeded
    // Write some of the results to standard output
    else
    {
        boolean doneProcessingList = false;
        String programName = "qgyolaus";
        nbrUsers = 0;
        while (!doneProcessingList)
        {
            nbrRcds = pcml.getIntValue(programName + ".listInfo.rcdsReturned");
            requestHandle = (byte[]) pcml.getValue(programName + ".listInfo.rqsHandle");

            // Iterate through list of users
            for (indices[0] = 0; indices[0] < nbrRcds; indices[0]++)
            {
                value = pcml.getValue(programName + ".receiver.name", indices);
                System.out.println("User: " + value);

                value = pcml.getValue(programName + ".receiver.description", indices);
                System.out.println("\t\t" + value);
            }

            nbrUsers += nbrRcds;

            // See if we retrieved all the users.
            // If not, subsequent calls to "Get List Entries" (QGYGTLE)
            // would need to be made to retrieve the remaining users in the list.
            listStatus = (String) pcml.getValue(programName + ".listInfo.listStatus");
            if ( listStatus.equals("2") // List is marked as "Complete"
                || listStatus.equals("3") ) // Or list is marked "Error building"
            {
                doneProcessingList = true;
            }
        }
        else
        {
            programName = "qgygtle";

            // Set input parameters for QGYGTLE
            pcml.setValue("qgygtle.requestHandle", requestHandle);
            pcml.setIntValue("qgygtle.startingRcd", nbrUsers + 1);
        }
    }
}

```

```

// Call "Get List Entries" (QGYGTLE) to get more users from list
rc = pcml.callProgram("qgygtle");

// If return code is false, we received messages from the server
if(rc == false)
{
    // Retrieve list of server messages
    AS400Message[] msgs = pcml.getMessageList("qgygtle");

    // Iterate through messages and write them to standard output
    for (int m = 0; m < msgs.length; m++)
    {
        msgId = msgs[m].getID();
        msgText = msgs[m].getText();
        System.out.println("    " + msgId + " - " + msgText);
    }
    System.out.println("** Call to QGYGTLE failed. See messages above **");
    System.exit(0);
}
// Return code was true, call to QGYGTLE succeeded

}
}
System.out.println("Number of users returned: " + nbrUsers);

// Call the "Close List" (QGYCLST) API
pcml.setValue("qgyclst.requestHandle", requestHandle);
rc = pcml.callProgram("qgyclst");
}
}
catch(PcmlException e)
{
    System.out.println(e.getLocalizedMessage());
    e.printStackTrace();
    System.out.println("*** Call to QGYOLAUS failed. ***");
    System.exit(0);
}

System.exit(0);
}
}

```

## Example: Retrieving multidimensional data

This example show the PCML source and Java program needed to retrieve a list Network File System (NFS) exports from a server. The API being called is the Retrieve NFS Exports (QZNFRTVE) API. This example illustrates how to access arrays of structures within an array of structures.

This example has two parts:

- [PCML source for calling QZNFRTVE](#)
- [Java program source for calling QZNFRTVE](#)

### PCML source for calling QZNFRTVE

```

<pcml version="1.0">
  <struct name="receiver">
    <data name="lengthOfEntry" type="int" length="4" />
    <data name="dispToObjectPathName" type="int" length="4" />
    <data name="lengthOfObjectPathName" type="int" length="4" />
    <data name="ccsidOfObjectPathName" type="int" length="4" />
    <data name="readOnlyFlag" type="int" length="4" />
    <data name="nosuidFlag" type="int" length="4" />
    <data name="dispToReadWriteHostNames" type="int" length="4" />
    <data name="nbrOfReadWriteHostNames" type="int" length="4" />
    <data name="dispToRootHostNames" type="int" length="4" />
    <data name="nbrOfRootHostNames" type="int" length="4" />
    <data name="dispToAccessHostNames" type="int" length="4" />
    <data name="nbrOfAccessHostNames" type="int" length="4" />
    <data name="dispToHostOptions" type="int" length="4" />
    <data name="nbrOfHostOptions" type="int" length="4" />
    <data name="anonUserID" type="int" length="4" />
    <data name="anonUsrPrf" type="char" length="10" />
    <data name="pathName" type="char" length="lengthOfObjectPathName" />
  </struct>

```

```

        offset="dispToObjectPathName" offsetfrom="receiver" />
<struct name="rwAccessList" count="nbrOfReadWriteHostNames"
    offset="dispToReadWriteHostNames" offsetfrom="receiver">
    <data name="lengthOfEntry" type="int" length="4" />
    <data name="lengthOfHostName" type="int" length="4" />
    <data name="hostName" type="char" length="lengthOfHostName" />
    <data type="byte" length="0"
        offset="lengthOfEntry" />
</struct>

<struct name="rootAccessList" count="nbrOfRootHostNames"
    offset="dispToRootHostNames" offsetfrom="receiver">
    <data name="lengthOfEntry" type="int" length="4" />
    <data name="lengthOfHostName" type="int" length="4" />
    <data name="hostName" type="char" length="lengthOfHostName" />
    <data type="byte" length="0"
        offset="lengthOfEntry" />
</struct>

<struct name="accessHostNames" count="nbrOfAccessHostNames"
    offset="dispToAccessHostNames" offsetfrom="receiver" >
    <data name="lengthOfEntry" type="int" length="4" />
    <data name="lengthOfHostName" type="int" length="4" />
    <data name="hostName" type="char" length="lengthOfHostName" />
    <data type="byte" length="0"
        offset="lengthOfEntry" />
</struct>

<struct name="hostOptions" offset="dispToHostOptions" offsetfrom="receiver"
count="nbrOfHostOptions">
    <data name="lengthOfEntry" type="int" length="4" />
    <data name="dataFileCodepage" type="int" length="4" />
    <data name="pathNameCodepage" type="int" length="4" />
    <data name="writeModeFlag" type="int" length="4" />
    <data name="lengthOfHostName" type="int" length="4" />
    <data name="hostName" type="char" length="lengthOfHostName" />
    <data type="byte" length="0" offset="lengthOfEntry" />
</struct>

<data type="byte" length="0" offset="lengthOfEntry" />
</struct>

<struct name="returnedRcdsFdbkInfo">
    <data name="bytesReturned" type="int" length="4" />
    <data name="bytesAvailable" type="int" length="4" />
    <data name="nbrOfNFSExportEntries" type="int" length="4" />
    <data name="handle" type="int" length="4" />
</struct>

<program name="qznfrtve" path="/QSYS.lib/QZNFRTVE.pgm" parseorder="returnedRcdsFdbkInfo
receiver" >
    <data name="receiver" type="struct" struct="receiver" usage="output"
        count="returnedRcdsFdbkInfo.nbrOfNFSExportEntries" outputsize="receiverLength"/>
    <data name="receiverLength" type="int" length="4" usage="input" init="4096" />
    <data name="returnedRcdsFdbkInfo" type="struct" struct="returnedRcdsFdbkInfo"
usage="output" />
    <data name="formatName" type="char" length="8" usage="input" init="EXPE0100" />
    <data name="objectPathName" type="char" length="lengthObjPathName" usage="input"
init="*FIRST" />
    <data name="lengthObjPathName" type="int" length="4" usage="input" init="6" />
    <data name="ccsidObjectPathName" type="int" length="4" usage="input" init="0" />
    <data name="desiredCCSID" type="int" length="4" usage="input" init="0" />
    <data name="handle" type="int" length="4" usage="input" init="0" />
    <data name="errorCode" type="int" length="4" usage="input" init="0" />
</program>
</pcml>

```

## Java program source for calling QZNFRTVE

```

import com.ibm.as400.data.ProgramCallDocument;
import com.ibm.as400.data.PcmlException;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400Message;

// Example program to call "Retrieve NFS Exports" (QZNFRTVE) API
public class qznfrtve
{

```

```

public static void main(String[] argv)
{
    AS400 as400System; // com.ibm.as400.access.AS400
    ProgramCallDocument pcml; // com.ibm.as400.data.ProgramCallDocument
    boolean rc = false; // Return code from ProgramCallDocument.callProgram()
    String msgId, msgText; // Messages returned from the server
    Object value; // Return value from ProgramCallDocument.getValue()

    System.setErr(System.out);

    // Construct AS400 without parameters, user will be prompted
    as400System = new AS400();

    int[] indices = new int[2]; // Indices for access array value
    int nbrExports; // Number of exports returned
    int nbrOfReadWriteHostNames, nbrOfRWHostNames, nbrOfRootHostNames,
        nbrOfAccessHostnames, nbrOfHostOpts;

    try
    {
        // Uncomment the following to get debugging information
        // com.ibm.as400.data.PcmlMessageLog.setTraceEnabled(true);

        System.out.println("Beginning PCML Example..");
        System.out.println("    Constructing ProgramCallDocument for QZNFRTVE API...");

        // Construct ProgramCallDocument
        // First parameter is system to connect to
        // Second parameter is pcml resource name. In this example,
        // serialized PCML file "qznftrve.pcml.ser" or
        // PCML source file "qznftrve.pcml" must be found in the classpath.
        pcml = new ProgramCallDocument(as400System, "qznftrve");

        // Set input parameters. Several parameters have default values
        // specified in the PCML source. Do not need to set them using Java code.
        System.out.println("    Setting input parameters...");
        pcml.setValue("qznftrve.receiverLength", new
Integer( ( pcml.getOutputSize("qznftrve.receiver"))));

        // Request to call the API
        // User will be prompted to sign on to the system
        System.out.println("    Calling QZNFRTVE API requesting NFS exports.");
        rc = pcml.callProgram("qznftrve");

        if (rc == false)
        {
            // Retrieve list of server messages
            AS400Message[] msgs = pcml.getMessageList("qznftrve");

            // Iterate through messages and write them to standard output
            for (int m = 0; m < msgs.length; m++)
            {
                msgId = msgs[m].getID();
                msgText = msgs[m].getText();
                System.out.println("    " + msgId + " - " + msgText);
            }
            System.out.println("** Call to QZNFRTVE failed. See messages above **");
            System.exit(0);
        }
        // Return code was true, call to QZNFRTVE succeeded
        // Write some of the results to standard output
        else
        {
            nbrExports = pcml.getIntValue("qznftrve.returnedRcdsFdbkInfo.nbrOfNFSEXPRTENTRIES");
            // Iterate through list of exports
            for (indices[0] = 0; indices[0] < nbrExports; indices[0]++)
            {
                value = pcml.getValue("qznftrve.receiver.pathName", indices);
                System.out.println("Path name = " + value);

                // Iterate and write out Read Write Host Names for this export
                nbrOfReadWriteHostNames =
pcml.getIntValue("qznftrve.receiver.nbrOfReadWriteHostNames",
                    indices);
                for(indices[1] = 0; indices[1] < nbrOfReadWriteHostNames; indices[1]++)
                {
                    value = pcml.getValue("qznftrve.receiver.rwAccessList.hostName", indices);
                    System.out.println("    Read/write access host name = " + value);
                }

                // Iterate and write out Root Host Names for this export
                nbrOfRootHostNames = pcml.getIntValue("qznftrve.receiver.nbrOfRootHostNames",

```

```

indices);
    for(indices[1] = 0; indices[1] < nbrOfRootHostNames; indices[1]++)
    {
        value = pcml.getValue("qznfrtve.receiver.rootAccessList.hostName", indices);
        System.out.println("    Root access host name = " + value);
    }

    // Iterate and write out Access Host Names for this export
    nbrOfAccessHostnames = pcml.getIntValue("qznfrtve.receiver.nbrOfAccessHostNames",
                                           indices);
    for(indices[1] = 0; indices[1] < nbrOfAccessHostnames; indices[1]++)
    {
        value = pcml.getValue("qznfrtve.receiver.accessHostNames.hostName", indices);
        System.out.println("    Access host name = " + value);
    }

    // Iterate and write out Host Options for this export
    nbrOfHostOpts = pcml.getIntValue("qznfrtve.receiver.nbrOfHostOptions", indices);
    for(indices[1] = 0; indices[1] < nbrOfHostOpts; indices[1]++)
    {
        System.out.println("    Host options:");
        value = pcml.getValue("qznfrtve.receiver.hostOptions.dataFileCodepage", indices);
        System.out.println("        Data file code page = " + value);
        value = pcml.getValue("qznfrtve.receiver.hostOptions.pathNameCodepage", indices);
        System.out.println("        Path name code page = " + value);
        value = pcml.getValue("qznfrtve.receiver.hostOptions.writeModeFlag", indices);
        System.out.println("        Write mode flag = " + value);
        value = pcml.getValue("qznfrtve.receiver.hostOptions.hostName", indices);
        System.out.println("        Host name = " + value);
    }
} // end for loop iterating list of exports
} // end call to QZNFRTVE succeeded
}
catch(PcmlException e)
{
    System.out.println(e.getLocalizedMessage());
    e.printStackTrace();
    System.exit(-1);
}

System.exit(0);
} // end main()
}

```

## Examples: ReportWriter classes

This section lists the code examples that are provided throughout the documentation of the IBM Toolbox for Java ReportWriter classes.

The following disclaimer applies to all of the IBM Toolbox for Java examples:

### Code example disclaimer

IBM grants you a nonexclusive copyright license to use all programming code examples from which you can generate similar function tailored to your own specific needs.

All sample code is provided by IBM for illustrative purposes only. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

All programs contained herein are provided to you "AS IS" without any warranties of any kind. The implied warranties of non-infringement, merchantability and fitness for a particular purpose are expressly disclaimed.

### Example: Using JSPReportProcessor with PDFContext

This example uses the JSPReportProcessor and the PDFContext classes to obtain data from a specified URL and convert the data to the PDF format. The data is then streamed to a file as a PDF document.

**Note:** Read the [Code example disclaimer](#) for important legal information.

To view the contents of an example JSP source file that you can use with JSPRunReport, see [JSPcust\\_table.jsp](#). You can also [download a ZIP file](#) that contains the JSP example file. The zipped

file also contains XML and XSL example files that you can use with the XSLReportProcessor example (PCLRunReport).

```
////////////////////////////////////
//
// The following example (JSPRunReport) uses the JSPReportProcessor and the
// PDFContext classes to obtain data from a specified URL and convert the data
// to the PDF format. The data is then streamed to a file as a PDF document.
//
// Command syntax:
//   java JSPRunReport <jsp_Url> <output_filename>
//
////////////////////////////////////

import java.lang.*;
import java.awt.*;
import java.io.*;
import java.net.*;
import java.awt.print.*;
import java.awt.event.*;
import java.util.LinkedList;
import java.util.ListIterator;
import java.util.HashMap;

import com.ibm.xsl.composer.flo.*;
import com.ibm.xsl.composer.areas.*;
import com.ibm.xsl.composer.framework.*;
import com.ibm.xsl.composer.java2d.*;
import com.ibm.xsl.composer.prim.*;
import com.ibm.xsl.composer.properties.*;
import com.ibm.as400.util.reportwriter.processor.*;
import com.ibm.as400.util.reportwriter.pdfwriter.*;
import java.io.IOException;
import java.io.Serializable;
import org.xml.sax.SAXException;

public class JSPRunReport
{
    public static void main(String args[])
    {
        FileOutputStream fileout = null;

        /** specify the URL that contains the data you want to use in your report */
        String JSPurl = args[0];
        URL jspurl = null;
        try {
            jspurl = new URL(JSPurl);
        }
        catch (MalformedURLException e)
        {}

        /** get output PDF file name */
        String filename = args[1];
        try {
            fileout = new FileOutputStream(filename);
        }
        catch (FileNotFoundException e)
        {}

        /** set up page format */
        Paper paper = new Paper();
        paper.setSize(612,792);
        paper.setImageableArea(18, 18, 576, 756);
        PageFormat pf = new PageFormat();
        pf.setPaper(paper);

        /** create a PDFContext object and cast FileOutputStream as an OutputStream */
        PDFContext pdfcontext = new PDFContext((OutputStream)fileout, pf);

        System.out.println( Ready to parse XSL document );

        /** create the JSPReportProcessor object and set the template to the specified JSP */
        JSPReportProcessor jspprocessor = new JSPReportProcessor(pdfcontext);
        try {
            jspprocessor.setTemplate(jspurl);
        }
    }
}
```

```

        catch (NullPointerException np){
            String mes = np.getMessage();
            System.out.println(mes);
            System.exit(0);
        }

        /** process the report */
        try {
            jspprocessor.processReport();
        }
        catch (IOException e) {
            String mes = e.getMessage();
            System.out.println(mes);
            System.exit(0);
        }
        catch (SAXException se) {
            String mes = se.getMessage();
            System.out.println(mes);
            System.exit(0);
        }

        System.exit(0);
    }
}

```

## Example: JSPReportProcessor sample JSP file

Use this sample file with the Example: Using JSPReportProcessor with PDFContext topic.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

<?xml version="1.0"?>

<!--
  Copyright (c) 1999 The Apache Software Foundation. All rights reserved.
-->

<%@ page session="false"%>
<%@ page language="java" contentType="text/html" %>
<%@ page import="java.lang.*" %>
<%@ page import="java.util.*" %>

<!-- <jsp:useBean id='cust_table' scope='page' class='table.JSPcust_table' /> -->

<%!
String[][] cust_data = new String [4][5];

public void jspInit()
{
    //cust_record_field [][] cust_data;
    // cust_record holds customer name, customer address, customer city, customer state,
    // customer zip

    String [] cust_record_1 = {"IBM", "3602 4th St", "Rochester", "Mn", "55901"};
    String [] cust_record_2 = {"HP", "400 2nd", "Springfield", "Mo", "33559"};
    String [] cust_record_3 = {"Wolzack", "34 Hwy 52N", "Lansing", "Or", "67895"};
    String [] cust_record_4 = {"Siems", "343 60th", "Salem", "Tx", "12345"};

    cust_data[0] = cust_record_1;
    cust_data[1] = cust_record_2;
    cust_data[2] = cust_record_3;
    cust_data[3] = cust_record_4;
}
%>

<!-- First test of parse and compose. -->
<fo:root xmlns:fo="http://www.w3.org/1999/XSL/Format">
  <fo:layout-master-set>
    <fo:simple-page-master master-name="theMaster" >
      <fo:region-body region-name="theRegion" margin-left=".2in"/>
    </fo:simple-page-master>
    <fo:page-sequence-master master-name="theMaster">
      <fo:single-page-master-reference master-name="thePage"/>
    </fo:page-sequence-master>
  </fo:layout-master-set>
  <fo:page-sequence master-name="theMaster">
    <fo:flow flow-name="theRegion">

```

```

<fo:block>
  <fo:block text-align="center"> NORCAP </fo:block>
  <fo:block space-before=".2in" text-align="center">PAN PACIFIC HOTEL IN SAN FRANCISCO </
fo:block>
  <fo:block text-align="center"> FRIDAY, DECEMBER 8-9, 2000 </fo:block>
</fo:block>
<fo:block space-before=".5in" font-size="8pt">
<fo:table table-layout="fixed">
  <fo:table-column column-width="3in"/>
  <fo:table-column column-width="3in"/>
  <fo:table-column column-width="3in"/>
  <fo:table-column column-width="3in"/>
  <fo:table-column column-width="3in"/>
  <fo:table-body>
    <fo:table-row>
      <fo:table-cell column-number="1">
        <fo:block border-bottom-style="solid">NAME</fo:block>
      </fo:table-cell>
      <fo:table-cell column-number="2">
        <fo:block border-bottom-style="solid">ADDRESS</fo:block>
      </fo:table-cell>
      <fo:table-cell column-number="3">
        <fo:block border-bottom-style="solid">CITY</fo:block>
      </fo:table-cell>
      <fo:table-cell column-number="4">
        <fo:block border-bottom-style="solid">STATE</fo:block>
      </fo:table-cell>
      <fo:table-cell column-number="5">
        <fo:block border-bottom-style="solid">ZIP CODE</fo:block>
      </fo:table-cell>
    </fo:table-row>
  </fo:table-body>
</fo:table>

<%
// add row to table
for(int i = 0; i <= 3; i++)
{
  String[] _array = cust_data[i];
}%>

<fo:table-row>
  <fo:table-cell column-number="1">
    <fo:block space-before=".1in">
      <% if(_array[0].equals("IBM")) { %>
        <fo:inline background-color="blue">
          <% out.print(_array[0]); %>
        </fo:inline>
      <% } else { %>
        <% out.print(_array[0]); %>
      <% } %>
    </fo:block>
  </fo:table-cell>
  <fo:table-cell column-number="2">
    <fo:block space-before=".1in">
      <% out.print(_array[1]); %>
    </fo:block>
  </fo:table-cell>
  <fo:table-cell column-number="3">
    <fo:block space-before=".1in">
      <% out.print(_array[2]); %>
    </fo:block>
  </fo:table-cell>
  <fo:table-cell column-number="4">
    <fo:block space-before=".1in">
      <% out.print(_array[3]); %>
    </fo:block>
  </fo:table-cell>
  <fo:table-cell column-number="5">
    <fo:block space-before=".1in">
      <% out.print(_array[4]); %>
    </fo:block>
  </fo:table-cell>
</fo:table-row>

<%
} // end row while
%>

</fo:table-body>
</fo:table>
</fo:block>
</fo:flow>

```



```
</fo:page-sequence>
</fo:root>
```

## Example: Using XSLReportProcessor with PCLContext

This example should not be used as the XSLReportProcessor class is no longer supported.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// The following example (PCLRunReport) uses the XSLPReportProcessor and the
// PCLContext classes to obtain XML data and convert the data to the PCL format.
// The data is then streamed to a printer OutputQueue.
//
// To view the contents of example XML and XSL source files that you can use
// with PCLRunReport, see realestate.xml and realestate.xsl. You can also
// download a zip file that contains the XML and XSL example files. The zip
// file also contains a JSP example file that you can use with the
// JSPReportProcessor example (JSPRunReport).
//
// Command syntax:
//   java PCLRunReport <xml_file> <xsl_file>
//
////////////////////////////////////

import java.lang.*;
import java.awt.*;
import java.io.*;
import java.awt.print.*;
import java.awt.event.*;
import java.util.LinkedList;
import java.util.ListIterator;
import java.util.HashMap;

import com.ibm.xsl.composer.flo.*;
import com.ibm.xsl.composer.areas.*;
import com.ibm.xsl.composer.framework.*;
import com.ibm.xsl.composer.java2d.*;
import com.ibm.xsl.composer.prim.*;
import com.ibm.xsl.composer.properties.*;
import com.ibm.as400.util.reportwriter.processor.*;
import com.ibm.as400.util.reportwriter.pclwriter.*;
import java.io.IOException;
import java.io.Serializable;
import org.xml.sax.SAXException;
import com.ibm.as400.access.*;

public class PCLRunReport
{
    public static void main(String args[])
    {
        SpooledFileOutputStream fileout = null;
        String xmldocumentName = args[0];
        String xsldocumentName = args[1];

        String sys = "<system>";        /* Insert server name        */
        String user = "<user>";          /* Insert user profile name */
        String pass = "<password>";     /* Insert password          */

        AS400 system = new AS400(sys, user, pass);

        /* Insert output queue */
        String outqname = "/QSYS.LIB/qusrsys.LIB/<outq>.OUTQ";
        OutputQueue outq = new OutputQueue(system, outqname);
        PrintParameterList parms = new PrintParameterList();
        parms.setParameter(PrintObject.ATTR_OUTPUT_QUEUE, outq.getPath());

        try{
            fileout = new SpooledFileOutputStream(system, parms, null, null);
        }
        catch (Exception e)
        {}

        /** set up page format */
        Paper paper = new Paper();
        paper.setSize(612,792);
    }
}
```

```

paper.setImageableArea(18, 36, 576, 720);
PageFormat pf = new PageFormat();
pf.setPaper(paper);

/** create a PCLContext object and case FileOutputStream
    as an OutputStream */
PCLContext pclcontext = new PCLContext((OutputStream)fileout, pf);

System.out.println("Ready to parse XSL document");

/** create the XSLReportProcessor object */
XSLReportProcessor xslprocessor = new XSLReportProcessor(pclcontext);
try {
xslprocessor.setXMLDataSource(xmlfileName);
}
catch (SAXException se) {
    String mes = se.getMessage();
    System.out.println(mes);
    System.exit(0);
}
catch (IOException ioe) {
    String mes = ioe.getMessage();
    System.out.println(mes);
    System.exit(0);
}
catch (NullPointerException np){
    String mes = np.getMessage();
    System.out.println(mes);
    System.exit(0);
}

/** set the template to the specified XML data source */
try {
xslprocessor.setTemplate(xslfileName);
}
catch (NullPointerException np){
    String mes = np.getMessage();
    System.out.println(mes);
    System.exit(0);
}
catch (IOException e) {
    String mes = e.getMessage();
    System.out.println(mes);
    System.exit(0);
}
catch (SAXException se) {
    String mes = se.getMessage();
    System.out.println(mes);
    System.exit(0);
}

/** process the report */
try {
xslprocessor.processReport();
}
catch (IOException e) {
    String mes = e.getMessage();
    System.out.println(mes);
    System.exit(0);
}
catch (SAXException se) {
    String mes = se.getMessage();
    System.out.println(mes);
    System.exit(0);
}

System.exit(0);
}
}

```

## Example: XSLReportProcessor sample XML file

This example should not be used as the XSLReportProcessor class is no longer supported.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

<?xml version="1.0"?>
<RESIDENTIAL-LISTINGS VERSION="061698">

```

```

<RESIDENTIAL-LISTING ID="ID1287" VERSION="061698">
  <GENERAL>
    <TYPE>Apartment</TYPE>
    <PRICE>$110,000</PRICE>
    <STRUCTURE><NUM-BEDS>3</NUM-BEDS><NUM-BATHS>1</NUM-BATHS></STRUCTURE>
    <AGE UNITS="YEARS">15</AGE>
    <LOCATION COUNTRY="USA" STATE="MA" COUNTY="MIDDLESEX" SECURITY="Public">
      <ADDRESS>13 Some Avenue</ADDRESS>
      <CITY>Dorchester</CITY><ZIP>02121</ZIP>
    </LOCATION>
    <IMAGE FORMAT="JPG" WIDTH="300" HEIGHT="150" SRC="house1.jpg"/>
    <MLS>
      <MLS-CODE SECURITY="Restricted">
        30224877
      </MLS-CODE>
      <MLS-SOURCE SECURITY="Public">
        <NAME>Bob the Realtor</NAME>
        <PHONE>1-617-555-1212</PHONE>
        <FAX>1-617-555-1313</FAX>
        <WEB>
          <EMAIL>Bob@bigbucks.com</EMAIL>
          <SITE>www.bigbucks.com</SITE>
        </WEB>
      </MLS-SOURCE>
    </MLS>
    <DATES><LISTING-DATE>3/5/98</LISTING-DATE></DATES>
    <LAND-AREA UNITS="ACRES">0.01</LAND-AREA>
  </GENERAL>

  <FEATURES>
    <DISCLOSURES>
      In your dreams.
    </DISCLOSURES>
    <UTILITIES>
      Yes
    </UTILITIES>
    <EXTRAS>
      Pest control included.
    </EXTRAS>
    <CONSTRUCTION>
      Wallboard and glue
    </CONSTRUCTION>
    <ACCESS>
      Front door.
    </ACCESS>
  </FEATURES>

  <FINANCIAL>
    <ASSUMABLE>
      I assume so.
    </ASSUMABLE>
    <OWNER-CARRY>
      Too heavy.
    </OWNER-CARRY>
    <ASSESSMENTS>
      $150,000
    </ASSESSMENTS>
    <DUES>
      $100
    </DUES>
    <TAXES>
      $2,000
    </TAXES>
    <LENDER>
      Fly by nite mortgage co.
    </LENDER>
    <EARNEST>
      Burt
    </EARNEST>
    <DIRECTIONS>
      North, south, east, west
    </DIRECTIONS>
  </FINANCIAL>

  <REMARKS>
</REMARKS>

  <CONTACTS>
    <COMPANY>
      <NAME>

```

```

    Noplace Realty
  </NAME>
  <ADDRESS>
    12 Main Street
  </ADDRESS>
  <CITY>
    Lowell, MA
  </CITY>
  <ZIP>
    34567
  </ZIP>
</COMPANY>
<AGENT>
  <NAME>
    Mary Jones
  </NAME>
  <ADDRESS>
  </ADDRESS>
  <CITY>
  </CITY>
  <ZIP>
  </ZIP>
</AGENT>
<OWNER>
  <NAME>
  </NAME>
  <ADDRESS>
  </ADDRESS>
  <CITY>
  </CITY>
  <ZIP>
  </ZIP>
</OWNER>
<TENANT>
  Yes.
</TENANT>
<COMMISSION>
  15%
</COMMISSION>
</CONTACTS>
</RESIDENTIAL-LISTING>
<RESIDENTIAL-LISTING VERSION="061698" ID="ID1289">
  <GENERAL>
    <IMAGE FORMAT="JPG" WIDTH="300" HEIGHT="150" SRC="house2.jpg">
    </IMAGE>
    <MLS>
      <MLS-CODE SECURITY="Restricted">
        30298877
      </MLS-CODE>
      <MLS-SOURCE SECURITY="Public">
        <NAME>
          Mary the Realtor
        </NAME>
        <PHONE>
          1-617-555-3333
        </PHONE>
        <FAX>
          1-617-555-4444
        </FAX>
        <WEB>
          <EMAIL>
            Mary@somebucks.com
          </EMAIL>
          <SITE>
            www.bigbucks.com
          </SITE>
        </WEB>
      </MLS-SOURCE>
    </MLS>
    <TYPE>
      Home
    </TYPE>
    <PRICE>
      $200,000
    </PRICE>

```

```

    <AGE UNITS="MONTHS">
    3
  </AGE>

  <LOCATION COUNTRY="USA" STATE="CO" COUNTY="MIDDLESEX" SECURITY="Public">
    <ADDRESS>
      1 Main Street
    </ADDRESS>
    <CITY>
      Boulder
    </CITY>
    <ZIP>
      11111
    </ZIP>
  </LOCATION>

  <STRUCTURE>
    <NUM-BEDS>
      2
    </NUM-BEDS>
    <NUM-BATHS>
      2
    </NUM-BATHS>
  </STRUCTURE>

  <DATES>
    <LISTING-DATE>
      4/3/98
    </LISTING-DATE>
  </DATES>

  <LAND-AREA UNITS="ACRES">
    0.01
  </LAND-AREA>

</GENERAL>

<FEATURES>
  <DISCLOSURES>
    In your dreams.
  </DISCLOSURES>
  <UTILITIES>
    Yes
  </UTILITIES>
  <EXTRAS>
    Pest control included.
  </EXTRAS>
  <CONSTRUCTION>
    Wallboard and glue
  </CONSTRUCTION>
  <ACCESS>
    Front door.
  </ACCESS>
</FEATURES>

<FINANCIAL>
  <ASSUMABLE>
    I assume so.
  </ASSUMABLE>
  <OWNER-CARRY>
    Too heavy.
  </OWNER-CARRY>
  <ASSESSMENTS>
    $150,000
  </ASSESSMENTS>
  <DUES>
    $100
  </DUES>
  <TAXES>
    $2,000
  </TAXES>
  <LENDER>
    Fly by nite mortgage co.
  </LENDER>
  <EARNEST>
    Burt
  </EARNEST>
  <DIRECTIONS>
    North, south, east, west
  </DIRECTIONS>
</FINANCIAL>

```

```

<REMARKS>
</REMARKS>

<CONTACTS>
  <COMPANY>
    <NAME>
      Noplace Realty
    </NAME>
    <ADDRESS>
      12 Main Street
    </ADDRESS>
    <CITY>
      Lowell, MA
    </CITY>
    <ZIP>
      34567
    </ZIP>
  </COMPANY>
  <AGENT>
    <NAME>
      Mary Jones
    </NAME>
    <ADDRESS>
    </ADDRESS>
    <CITY>
    </CITY>
    <ZIP>
    </ZIP>
  </AGENT>
  <OWNER>
    <NAME>
    </NAME>
    <ADDRESS>
    </ADDRESS>
    <CITY>
    </CITY>
    <ZIP>
    </ZIP>
  </OWNER>
  <TENANT>
    Yes.
  </TENANT>
  <COMMISSION>
    15%
  </COMMISSION>
</CONTACTS>

</RESIDENTIAL-LISTING>
<RESIDENTIAL-LISTING VERSION="061698" ID="ID1290">
  <GENERAL>

  <IMAGE FORMAT="JPG" WIDTH="300" HEIGHT="150" SRC="house3.jpg">
  </IMAGE>

  <MLS>
    <MLS-CODE SECURITY="Restricted">
      20079877
    </MLS-CODE>
    <MLS-SOURCE SECURITY="Public">
      <NAME>
        Bob the Realtor
      </NAME>
      <PHONE>
        1-617-555-1212
      </PHONE>
      <FAX>
        1-617-555-1313
      </FAX>
      <WEB>
        <EMAIL>
          Bob@bigbucks.com
        </EMAIL>
        <SITE>
          www.bigbucks.com
        </SITE>
      </WEB>
    </MLS-SOURCE>
  </MLS>

  <TYPE>
    Apartment
  </TYPE>

```

```

<PRICE>
  $65,000
</PRICE>

  <AGE UNITS="YEARS">
    30
  </AGE>

  <LOCATION COUNTRY="USA" STATE="MA" COUNTY="MIDDLESEX" SECURITY="Public">
    <ADDRESS>
      25 Which Ave.
    </ADDRESS>
    <CITY>
      Cambridge
    </CITY>
    <ZIP>
      02139
    </ZIP>
  </LOCATION>

  <STRUCTURE>
    <NUM-BEDS>
      3
    </NUM-BEDS>
    <NUM-BATHS>
      1
    </NUM-BATHS>
  </STRUCTURE>

  <DATES>
    <LISTING-DATE>
      3/5/97
    </LISTING-DATE>
  </DATES>

  <LAND-AREA UNITS="ACRES">
    0.05
  </LAND-AREA>

</GENERAL>

<FEATURES>
  <DISCLOSURES>
    In your dreams.
  </DISCLOSURES>
  <UTILITIES>
    Yes
  </UTILITIES>
  <EXTRAS>
    Pest control included.
  </EXTRAS>
  <CONSTRUCTION>
    Wallboard and glue
  </CONSTRUCTION>
  <ACCESS>
    Front door.
  </ACCESS>
</FEATURES>

<FINANCIAL>
  <ASSUMABLE>
    I assume so.
  </ASSUMABLE>
  <OWNER-CARRY>
    Too heavy.
  </OWNER-CARRY>
  <ASSESSMENTS>
    $150,000
  </ASSESSMENTS>
  <DUES>
    $100
  </DUES>
  <TAXES>
    $2,000
  </TAXES>
  <LENDER>
    Fly by nite mortgage co.
  </LENDER>
  <EARNEST>
    Burt
  </EARNEST>

```

```

<DIRECTIONS>
  North, south, east, west
</DIRECTIONS>
</FINANCIAL>

<REMARKS>
</REMARKS>

<CONTACTS>
  <COMPANY>
    <NAME>
      Noplace Realty
    </NAME>
    <ADDRESS>
      12 Main Street
    </ADDRESS>
    <CITY>
      Lowell, MA
    </CITY>
    <ZIP>
      34567
    </ZIP>
  </COMPANY>
  <AGENT>
    <NAME>
      Mary Jones
    </NAME>
    <ADDRESS>
    </ADDRESS>
    <CITY>
    </CITY>
    <ZIP>
    </ZIP>
  </AGENT>
  <OWNER>
    <NAME>
    </NAME>
    <ADDRESS>
    </ADDRESS>
    <CITY>
    </CITY>
    <ZIP>
    </ZIP>
  </OWNER>
  <TENANT>
    Yes.
  </TENANT>
  <COMMISSION>
    15%
  </COMMISSION>
</CONTACTS>

</RESIDENTIAL-LISTING>
<RESIDENTIAL-LISTING VERSION="061698" ID="ID1291">
  <GENERAL>

  <IMAGE FORMAT="JPG" WIDTH="300" HEIGHT="150" SRC="house4.jpg">
</IMAGE>

  <MLS>
    <MLS-CODE SECURITY="Restricted">
      29389877
    </MLS-CODE>
    <MLS-SOURCE SECURITY="Public">
      <NAME>
        Mary the Realtor
      </NAME>
      <PHONE>
        1-617-555-3333
      </PHONE>
      <FAX>
        1-617-555-4444
      </FAX>
      <WEB>
        <EMAIL>
          Mary@somebucks.com
        </EMAIL>
        <SITE>
          www.bigbucks.com
        </SITE>
      </WEB>
    </MLS-SOURCE>

```



```

</MLS>

<TYPE>
  Home
</TYPE>

<PRICE>
  $449,000
</PRICE>

  <AGE UNITS="YEARS">
    7
  </AGE>

  <LOCATION COUNTRY="USA" STATE="MA" COUNTY="MIDDLESEX" SECURITY="Public">
    <ADDRESS>
      100 Any Road
    </ADDRESS>
    <CITY>
      Lexington
    </CITY>
    <ZIP>
      02421
    </ZIP>
  </LOCATION>

  <STRUCTURE>
    <NUM-BEDS>
      7
    </NUM-BEDS>
    <NUM-BATHS>
      3
    </NUM-BATHS>
  </STRUCTURE>

  <DATES>
    <LISTING-DATE>
      6/8/98
    </LISTING-DATE>
  </DATES>

  <LAND-AREA UNITS="ACRES">
    2.0
  </LAND-AREA>

</GENERAL>

<FEATURES>
  <DISCLOSURES>
    In your dreams.
  </DISCLOSURES>
  <UTILITIES>
    Yes
  </UTILITIES>
  <EXTRAS>
    Pest control included.
  </EXTRAS>
  <CONSTRUCTION>
    Wallboard and glue
  </CONSTRUCTION>
  <ACCESS>
    Front door.
  </ACCESS>
</FEATURES>

<FINANCIAL>
  <ASSUMABLE>
    I assume so.
  </ASSUMABLE>
  <OWNER-CARRY>
    Too heavy.
  </OWNER-CARRY>
  <ASSESSMENTS>
    $300,000
  </ASSESSMENTS>
  <DUES>
    $100
  </DUES>
  <TAXES>
    $2,000
  </TAXES>
  <LENDER>

```

```

    Fly by nite mortgage co.
  </LENDER>
  <EARNEST>
    Burt
  </EARNEST>
  <DIRECTIONS>
    North, south, east, west
  </DIRECTIONS>
</FINANCIAL>

<REMARKS>
</REMARKS>

<CONTACTS>
  <COMPANY>
    <NAME>
      Noplace Realty
    </NAME>
    <ADDRESS>
      12 Main Street
    </ADDRESS>
    <CITY>
      Lowell, MA
    </CITY>
    <ZIP>
      34567
    </ZIP>
  </COMPANY>
  <AGENT>
    <NAME>
      Mary Jones
    </NAME>
    <ADDRESS>
    </ADDRESS>
    <CITY>
    </CITY>
    <ZIP>
    </ZIP>
  </AGENT>
  <OWNER>
    <NAME>
    </NAME>
    <ADDRESS>
    </ADDRESS>
    <CITY>
    </CITY>
    <ZIP>
    </ZIP>
  </OWNER>
  <TENANT>
    Yes.
  </TENANT>
  <COMMISSION>
    15%
  </COMMISSION>
</CONTACTS>

</RESIDENTIAL-LISTING>

</RESIDENTIAL-LISTINGS>

```

## Example: XSLReportProcessor sample XSL file

This example should not be used as the XSLReportProcessor class is no longer supported.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

<?xml version="1.0"?>

<!-- Sample of styling an imagined real estate document. -->
<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  xmlns:fo="http://www.w3.org/1999/XSL/Format" >

  <xsl:template match="RESIDENTIAL-LISTINGS">
    <fo:root>
      <fo:layout-master-set>
        <fo:simple-page-master master-name="theMaster">
          <fo:region-body region-name="theRegion"/>
        </fo:simple-page-master>

```

```

<fo:page-sequence-master master-name="theMaster">
  <fo:single-page-master-reference master-name="thePage" />
</fo:page-sequence-master>
</fo:layout-master-set>
<fo:page-sequence master-name="theMaster">
  <fo:flow flow-name="theRegion">
    <xsl:apply-templates/>
  </fo:flow>
</fo:page-sequence>
</fo:root>
</xsl:template>
<xsl:template match="RESIDENTIAL-LISTING">

  <fo:block font-family="Times New Roman" font-weight="normal" font-size="24pt"
    background-color="silver" padding-before="5px" padding-after="5px"
    padding-start="5px" padding-end="5px" border-before-style="solid"
    border-before-color="blue" border-after-style="solid" border-after-color="blue"
    border-start-style="solid" border-start-color="blue" border-end-style="solid"
    border-end-color="blue">

    <fo:character character="y" background-color="blue" border-before-style="solid"
      border-before-color="yellow" border-after-style="solid" border-after-color="yellow"
      border-start-style="solid" border-start-color="yellow" border-end-style="solid"
      border-end-color="yellow" />
  </fo:block>

</xsl:template>
</xsl:stylesheet>

```

## Examples: RFML

This section lists the code examples that are provided throughout the documentation of the IBM Toolbox for Java RFML component.

- [Example: Using RFML compared to using IBM Toolbox for Java Record classes](#)
- [Example: RFML source file](#)

The following disclaimer applies to all of the IBM Toolbox for Java examples:

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### Example: RFML source file

This example RFML source file defines the format of customer records as used in the RFML example Using RFML compared to using IBM Toolbox for Java Record classes.

This RFML source file might be a text file named qcustcdt.rfml.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<!DOCTYPE rfml SYSTEM "rfml.dtd">

<rfml version="4.0" ccsid="819">

  <recordformat name="cusrec">

    <data name="cusnum" type="zoned" length="6" precision="0" init="0"/>
    <data name="lstnam" type="char" length="8" ccsid="37" init="A"/>
    <data name="init" type="char" length="3" ccsid="37" init="B"/>

```

```

<data name="street" type="char" length="13" ccsid="37" init="C"/>
<data name="city" type="char" length="6" ccsid="37" init="D"/>
<data name="state" type="char" length="2" ccsid="37" init="E"/>
<data name="zipcod" type="zoned" length="5" init="1"/>
<data name="cdtlmt" type="zoned" length="4" init="2"/>
<data name="chgcod" type="zoned" length="1" init="3"/>
<data name="baldue" type="zoned" length="6" precision="2" init="4"/>
<data name="cdtdue" type="zoned" length="6" precision="2" init="5"/>

</recordformat>

<recordformat name="cusrec1">

  <data name="cusnum" type="zoned" length="6" precision="0" init="0"/>
  <data name="lstnam" type="char" length="8" ccsid="37" init="A"/>
  <data name="init" type="char" length="3" ccsid="37" init="B"/>
  <data name="street" type="char" length="13" ccsid="37" init="C"/>
  <data name="city" type="char" length="6" ccsid="37" init="D"/>
  <data name="state" type="char" length="2" ccsid="37" init="E"/>
  <data name="zipcod" type="zoned" length="5" init="1"/>
  <data name="cdtlmt" type="zoned" length="4" init="2"/>
  <data name="chgcod" type="zoned" length="1" init="3"/>
  <data name="baldue" type="struct" struct="balance"/>
  <data name="cdtdue" type="struct" struct="balance"/>

</recordformat>

<recordformat name="cusrecAscii">

  <data name="cusnum" type="zoned" length="6" precision="0" init="0"/>
  <data name="lstnam" type="char" length="8" init="A"/>
  <data name="init" type="char" length="3" init="B"/>
  <data name="street" type="char" length="13" init="C"/>
  <data name="city" type="char" length="6" init="D"/>
  <data name="state" type="char" length="2" init="E"/>
  <data name="zipcod" type="zoned" length="5" init="1"/>
  <data name="cdtlmt" type="zoned" length="4" init="2"/>
  <data name="chgcod" type="zoned" length="1" init="3"/>
  <data name="baldue" type="zoned" length="6" precision="2" init="4"/>
  <data name="cdtdue" type="zoned" length="6" precision="2" init="5"/>

</recordformat>

<struct name="balance">
  <data name="amount" type="zoned" length="6" precision="2" init="7"/>
</struct>

</rfml>

```

## Related reference

“[Example: Using RFML compared to using IBM Toolbox for Java Record classes](#)” on page 302

This example illustrates the differences between using RFML and using the IBM Toolbox for Java Record classes.

## Example: Using a profile token credential to swap the IBM i thread identity

The following code example shows you how to use a profile token credential to swap the IBM i thread identity and perform work on behalf of a specific user.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

// Create a single-use ProfileTokenCredential with a 60 second timeout.
AS400 system = new AS400();
ProfileTokenCredential pt = new ProfileTokenCredential();
pt.setSystem(system);
pt.setTimeoutInterval(60);
pt.setTokenType(ProfileTokenCredential.TYPE_SINGLE_USE);

// A valid user ID and password must be substituted.
pt.setTokenExtended("user", "password");

// Swap the OS/400 thread identity, retrieving a credential to
// Swap back to the original identity later.
AS400Credential cr = pt.swap(true);

// Create a second AS400 object

```

```

AS400 system2 = new AS400();
CommandCall cmd = new CommandCall(system);

// Perform work under the swapped identity at this point.

// Swap back to the original OS/400 thread identity.
cr.swap();

// Clean up the credentials.
cr.destroy();
pt.destroy();

system.disconnectAllServices();
system2.disconnectAllServices();

```

## Examples from the servlet classes

The following examples show you some of the ways that you can use the servlet classes.

- [Example: Using the ListRowData class](#)
- [Example: Using the RecordListRowData class](#)
- [Example: Using the SQLResultSetRowData class](#)
- [Example: Using the HTMLFormConverter class](#)
- [Example: Using the ListMetaData class](#)
- [Example: Using the SQLResultSetMetaData class](#)
- [Example: Presenting a resource list in a servlet](#)

You can also use the servlet and [HTML](#) classes together, like in this [example](#).

### Code example disclaimer

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### Example: Using ListRowData

The three parts of this example illustrate using the ListRowData class to generate and display HTML.

This example has three parts:

- [“Java source that shows how the ListRowData class works” on page 485](#)
- [“HTML source generated from the Java source by the using HTMLTableConverter” on page 486](#)
- [“How a browser displays the generated HTML” on page 486](#)

### Java source that shows how the ListRowData class works

```

// Access an existing non-empty data queue
KeyedDataQueue dq = new KeyedDataQueue(systemObject_, "/QSYS.LIB/MYLIB.LIB/MYDQ.DTAQ");

// Create a metadata object.
ListMetaData metaData = new ListMetaData(2);

// Set first column to be the customer ID.
metaData.setColumnName(0, "Customer ID");
metaData.setColumnLabel(0, "Customer ID");

```

```

metaData.setColumnType(0, RowMetaData.Type.STRING_DATA_TYPE);

// Set second column to be the order to be processed.
metaData.setColumnName(1, "Order Number");
metaData.setColumnLabel(1, "Order Number");
metaData.setColumnType(1, RowMetaData.Type.STRING_DATA_TYPE);

// Create a ListRowData object.
ListRowData rowData = new ListRowData();
rowData.setMetaData(metaData);

// Get the entries off the data queue.
KeyedDataQueueEntry data = dq.read(key, 0, "EQ");
while (data != null)
{
    // Add queue entry to row data object.
    Object[] row = new Object[2];
    row[0] = new String(key);
    row[1] = new String(data.getData());
    rowData.addRow(row);

    // Get another entry from the queue.
    data = dq.read(key, 0, "EQ");
}

// Create an HTML converter object and convert the rowData to HTML.
HTMLTableConverter conv = new HTMLTableConverter();
conv.setUseMetaData(true);
HTMLTable[] html = conv.convertToTables(rowData);

// Display the output from the converter.
System.out.println(html[0]);

```

## HTML source generated from the Java source by the using HTMLTableConverter

Using the [“HTMLTableConverter class” on page 227](#) in the Java source example above generates the following HTML code.

```

<table>
<tr>
<th>Customer ID</th>
<th>Order Number</th>
</tr>
<tr>
<td>777-53-4444</td>
<td>12345-XYZ</td>
</tr>
<tr>
<td>777-53-4444</td>
<td>56789-ABC</td>
</tr>
</table>

```

## How a browser displays the generated HTML

The following table shows how the HTML source code looks when viewed in a browser.

Customer ID	Order Number
777-53-4444	12345-XYZ
777-53-4444	56789-ABC

## Example: Using RecordListRowData

This example shows how the RecordListRowData class works, shows HTML source generated by using the HTMLTableConverted class, and also shows how a browser displays the generated HTML.

This example has three parts:

- [Java source](#) that shows how the RecordListRowData class works
- [HTML source](#) generated from the Java source by the using [HTMLTableConverter](#)

- [How a browser displays the generated HTML](#)

### Java source that shows how the RecordListRowData class works

```

// Create a server object.
AS400 mySystem = new AS400 ("mySystem.myComp.com", "UserId", "Password");

// Get the path name for the file.
QSYSObjectPathName file = new QSYSObjectPathName(myLibrary, myFile, "%first%", "mbr");
String ifspath = file.getPath();

// Create a file object that represents the file.
SequentialFile sf = new SequentialFile(mySystem, ifspath);

// Retrieve the record format from the file.
AS400FileRecordDescription recordDescription = new
AS400FileRecordDescription(mySystem, ifspath);
RecordFormat recordFormat = recordDescription.retrieveRecordFormat()[0];

// Set the record format for the file.
sf.setRecordFormat(recordFormat);

// Get the records in the file.
Record[] records = sf.readAll();

// Create a RecordListRowData object and add the records.
RecordListRowData rowData = new RecordListRowData(recordFormat);

for (int i=0; i < records.length; i++)
{
    rowData.addRow(records[i]);
}

// Create an HTML converter object and convert the rowData to HTML.
HTMLTableConverter conv = new HTMLTableConverter();
conv.setMaximumTableSize(3);
HTMLTable[] html = conv.convertToTables(rowData);

// Display the first HTML table generated by the converter.
System.out.println(html[0]);

```

### HTML source generated from the Java source by the using HTMLTableConverter

Using the [HTMLTableConverter](#) class in the Java source example above generates the following HTML code.

```

<table>
<tr>
<th>CNUM</th>
<th>LNAM</th>
<th>INIT</th>
<th>STR</th>
<th>CTY</th>
<th>STATE</th>
<th>ZIP</th>
<th>CTLMT</th>
<th>CHGCOD</th>
<th>BDUE</th>
<th>CTDUE</th>
</tr>
<tr>
<td>938472</td>
<td>Henning </td>
<td>G K</td>
<td>4859 Elm Ave </td>
<td>Dallas</td>
<td>TX</td>
<td align="right">75217</td>
<td align="right">5000</td>
<td align="right">3</td>
<td align="right">37.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>839283</td>
<td>Jones </td>
<td>B D</td>
<td>21B NW 135 St</td>

```

```

<td>Clay </td>
<td>NY</td>
<td align="right">13041</td>
<td align="right">400</td>
<td align="right">1</td>
<td align="right">100.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>392859</td>
<td>Vine </td>
<td>S S</td>
<td>PO Box 79 </td>
<td>Broton</td>
<td>VT</td>
<td align="right">5046</td>
<td align="right">700</td>
<td align="right">1</td>
<td align="right">439.00</td>
<td align="right">0.00</td>
</tr>
</table>

```

### How a browser displays the generated HTML

The following table shows how the HTML source code looks when viewed in a browser.

CNUM	LNAM	INIT	STR	CTY	STATE	ZIP	CTLMT	CHGCOD	BDUE	CTDUE
93847 2	Henning	G K	4859 Elm Ave	Dallas	TX	75217	5000	3	37.00	0.00
83928 3	Jones	B D	21B NW 135 St	Clay	NY	13041	400	1	100.00	0.00
39285 9	Vine	S S	PO Box 79	Broton	VT	5046	700	1	439.00	0.00

### Example: Using SQLResultSetRowData

This example shows how the SQLResultSetRowData class works, shows the generated HTML source, and also shows how a browser displays the generated HTML.

This example has three parts:

- [Java source](#) that shows how the SQLResultSetRowData class works
- [HTML source](#) generated from the Java source by the using HTMLTableConverter
- [How a browser displays the generated HTML](#)

#### Java source that shows how the SQLResultSetRowData class works

```

// Create a server object.
AS400 mySystem = new AS400 ("mySystem.myComp.com", "UserId", "Password");

// Register and get a connection to the database.
DriverManager.registerDriver(new com.ibm.as400.access.AS400JDBCdriver());
Connection connection = DriverManager.getConnection("jdbc:as400://" +
mySystem.getSystemName());

// Execute an SQL statement and get the result set.
Statement statement = connection.createStatement();
statement.execute("select * from qiws.qcustcdt");
ResultSet resultSet = statement.getResultSet();

// Create the SQLResultSetRowData object and initialize to the result set.
SQLResultSetRowData rowData = new SQLResultSetRowData(resultSet);

// Create an HTML table object to be used by the converter.
HTMLTable table = new HTMLTable();

// Set descriptive column headers.
String[] headers = {"Customer Number", "Last Name", "Initials",
"Street Address", "City", "State", "Zip Code",
"Credit Limit", "Charge Code", "Balance Due",
"Credit Due"};

table.setHeader(headers);

```



```

// Set several formatting options within the table.
table.setBorderWidth(2);
table.setCellSpacing(1);
table.setCellPadding(1);

// Create an HTML converter object and convert the rowData to HTML.
HTMLTableConverter conv = new HTMLTableConverter();
conv.setTable(table);
HTMLTable[] html = conv.convertToTables(rowData);

// Display the HTML table generated by the converter.
System.out.println(html[0]);

```

### HTML source generated from the Java source by the using HTMLTableConverter

Using the [HTMLTableConverter](#) class in the Java source example above generates the following HTML code.

```

<table border="2" cellpadding="1" cellspacing="1">
<tr>
<th>Customer Number</th>
<th>Last Name</th>
<th>Initials</th>
<th>Street Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
<th>Credit Limit</th>
<th>Charge Code</th>
<th>Balance Due</th>
<th>Credit Due</th>
</tr>
<tr>
<td>938472</td>
<td>Henning </td>
<td>G K</td>
<td>4859 Elm Ave </td>
<td>Dallas</td>
<td>TX</td>
<td align="right">75217</td>
<td align="right">5000</td>
<td align="right">3</td>
<td align="right">37.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>839283</td>
<td>Jones </td>
<td>
>B D</td>
<td>21B NW 135 St</td>
<td>Clay </td>
<td>NY</td>
<td align="right">13041</td>
<td align="right">400</td>
<td align="right">1</td>
<td align="right">100.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>392859</td>
<td>Vine </td>
<td>S S</td>
<td>PO Box 79 </td>
<td>Broton</td>
<td>VT</td>
<td align="right">5046</td>
<td align="right">700</td>
<td align="right">1</td>
<td align="right">439.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>938485</td>
<td>Johnson </td>
<td>J A</td>
<td>3 Alpine Way </td>
<td>Helen </td>
<td>GA</td>
<td align="right">30545</td>

```

```

<td align="right">9999</td>
<td align="right">2</td>
<td align="right">3987.50</td>
<td align="right">33.50</td>
</tr>
<tr>
<td>397267</td>
<td>Tyron </td>
<td>W E</td>
<td>13 Myrtle Dr </td>
<td>Hector</td>
<td>NY</td>
<td align="right">14841</td>
<td align="right">1000</td>
<td align="right">1</td>
<td align="right">0.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>389572</td>
<td>Stevens </td>
<td>K L</td>
<td>208 Snow Pass</td>
<td>Denver</td>
<td>CO</td>
<td align="right">80226</td>
<td align="right">400</td>
<td align="right">1</td>
<td align="right">58.75</td>
<td align="right">1.50</td>
</tr>
<tr>
<td>846283</td>
<td>Alison </td>
<td>J S</td>
<td>787 Lake Dr </td>
<td>Isle </td>
<td>MN</td>
<td align="right">56342</td>
<td align="right">5000</td>
<td align="right">3</td>
<td align="right">10.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>475938</td>
<td>Doe </td>
<td>J W</td>
<td>59 Archer Rd </td>
<td>Sutter</td>
<td>CA</td>
<td align="right">95685</td>
<td align="right">700</td>
<td align="right">2</td>
<td align="right">250.00</td>
<td align="right">100.00</td>
</tr>
<tr>
<td>693829</td>
<td>Thomas </td>
<td>A N</td>
<td>3 Dove Circle</td>
<td>Casper</td>
<td>WY</td>
<td align="right">82609</td>
<td align="right">9999</td>
<td align="right">2</td>
<td align="right">0.00</td>
<td align="right">0.00</td>
</tr>
<tr>
<td>593029</td>
<td>Williams</td>
<td>E D</td>
<td>485 SE 2 Ave </td>
<td>Dallas</td>
<td>TX</td>
<td align="right">75218</td>
<td align="right">200</td>
<td align="right">1</td>
<td align="right">25.00</td>
<td align="right">0.00</td>

```

```

</tr>
<tr>
<td>192837</td>
<td>Lee      </td>
<td>F L</td>
<td>5963 Oak St  </td>
<td>Hector</td>
<td>NY</td>
<td align="right">14841</td>
<td align="right">700</td>
<td align="right">2</td>
<td align="right">489.50</td>
<td align="right">0.50</td>
</tr>
<tr>
<td>583990</td>
<td>Abraham </td>
<td>M T</td>
<td>392 Mill St  </td>
<td>Isle  </td>
<td>MN</td>
<td align="right">56342</td>
<td align="right">9999</td>
<td align="right">3</td>
<td align="right">500.00</td>
<td align="right">0.00</td>
</tr>
</table>

```

### How a browser displays the generated HTML

The following table shows how the HTML source code looks when viewed in a browser.

Customer Number	Last Name	Initials	Street Address	City	State	Zip Code	Credit Limit	Charge Code	Balance Due	Credit Due
938472	Henning	G K	4859 Elm Ave	Dallas	TX	75217	5000	3	37.00	0.00
839283	Jones	B D	21B NW 135 St	Clay	NY	13041	400	1	100.00	0.00
392859	Vine	S S	PO Box 79	Broton	VT	5046	700	1	439.00	0.00
938485	Johnson	J A	3 Alpine Way	Helen	GA	30545	9999	2	3987.50	33.50
397267	Tyron	W E	13 Myrtle Dr	Hector	NY	14841	1000	1	0.00	0.00
389572	Stevens	K L	208 Snow Pass	Denver	CO	80226	400	1	58.75	1.50
846283	Alison	J S	787 Lake Dr	Isle	MN	56342	5000	3	10.00	0.00
475938	Doe	J W	59 Archer Rd	Sutter	CA	95685	700	2	250.00	100.00
693829	Thomas	A N	3 Dove Circle	Casper	WY	82609	9999	2	0.00	0.00
593029	Williams	E D	485 SE 2 Ave	Dallas	TX	75218	200	1	25.00	0.00
192837	Lee	F L	5963 Oak St	Hector	NY	14841	700	2	489.50	0.50

Customer Number	Last Name	Initials	Street Address	City	State	Zip Code	Credit Limit	Charge Code	Balance Due	Credit Due
583990	Abraham	MT	392 Mill St	Isle	MN	56342	9999	3	500.00	0.00

## Example: Using HTMLFormConverter

While running a web server with servlet support, compile and run the following example to see how the HTMLFormConverter works.

```
import java.awt.Color;
import java.io.IOException;
import java.io.PrintWriter;
import java.sql.DriverManager;
import java.sql.Connection;
import java.sql.ResultSet;
import java.sql.Statement;
import java.util.Enumeration;
import java.util.Hashtable;
import javax.servlet.*;
import javax.servlet.http.*;

import com.ibm.as400.util.html.GridLayoutFormPanel;
import com.ibm.as400.util.html.HTMLConstants;
import com.ibm.as400.util.html.HTMLForm;
import com.ibm.as400.util.html.HTMLTable;
import com.ibm.as400.util.html.HTMLTableCaption;
import com.ibm.as400.util.html.HTMLText;
import com.ibm.as400.util.html.LabelFormElement;
import com.ibm.as400.util.html.LineLayoutFormPanel;
import com.ibm.as400.util.html.SubmitFormInput;
import com.ibm.as400.util.html.TextFormInput;

import com.ibm.as400.util.servlet.HTMLFormConverter;
import com.ibm.as400.util.servlet.ResultSetRowData;

import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400JDBCdriver;

/**
 * An example of using the HTMLFormConverter class in a servlet.
 */
public class HTMLFormConverterExample extends HttpServlet
{
    private String userId_ = "myUserId";
    private String password_ = "myPwd";
    private AS400 system_;

    private Connection databaseConnection_;

    // Perform cleanup before returning to the main HTML form.
    public void cleanup()
    {
        try
        {
            // Close the database connection.
            if (databaseConnection_ != null)
            {
                databaseConnection_.close();
                databaseConnection_ = null;
            }
        }
        catch (Exception e)
        {
            e.printStackTrace ();
        }
    }

    // Convert the row data to formatted HTML.
    private HTMLTable[] convertRowData(ResultSetRowData rowData)
    {
```

```

try
{
    // Create the converter, which will generate HTML from
    // the result set that comes back from the database query.
    HTMLFormConverter converter = new HTMLFormConverter();

    // Set the form attributes.
    converter.setBorderWidth(3);
    converter.setCellPadding(2);
    converter.setCellSpacing(4);

    // Convert the row data to HTML.
    HTMLTable[] htmlTable = converter.convertToForms(rowData);
    return htmlTable;
}
catch (Exception e)
{
    e.printStackTrace ();
    return null;
}
}

// Return the response to the client.
public void doGet(HttpServletRequest request, HttpServletResponse response)
    throws IOException, ServletException
{
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();

    out.println(showHtmlMain());
    out.close();
}

// Handle the data posted to the form.
public void doPost (HttpServletRequest request, HttpServletResponse response)
    throws ServletException, IOException
{
    SQLResultSetRowData rowData = new SQLResultSetRowData();
    HTMLTable[] htmlTable = null;

    // Get the current session object or create one if needed.
    HttpSession session = request.getSession(true);

    ServletOutputStream out = response.getOutputStream();

    response.setContentType("text/html");

    Hashtable parameters = getRequestParameters (request);

    // Retrieve the row data and HTML table values for this session.
    rowData = (SQLResultSetRowData) session.getValue("sessionRowData");
    htmlTable = (HTMLTable[]) session.getValue("sessionHtmlTable");

    // if this is the first time through, show first record
    if (parameters.containsKey("getRecords"))
    {
        rowData = getAllRecords(parameters, out);

        if (rowData != null)
        {
            // Set the row data value for this session.
            session.putValue("sessionRowData", rowData);

            // Position to the first record.
            rowData.first();

            // Convert the row data to formatted HTML.
            htmlTable = convertRowData(rowData);

            if (htmlTable != null)
            {
                rowData.first();
                session.putValue("sessionHtmlTable", htmlTable);
                out.println(showHtmlForRecord(htmlTable, 0));
            }
        }
    }

    // If the "Return To Main" button was pressed,
    // go back to the main HTML form

```

```

else if (parameters.containsKey("returnToMain"))
{
    session.invalidate();
    cleanup();
    out.println(showHtmlMain());
}
// if the "First" button was pressed, show the first record
else if (parameters.containsKey("getFirstRecord"))
{
    rowData.first();
    out.println(showHtmlForRecord(htmlTable, 0));
}
// if the "Previous" button was pressed, show the previous record
else if (parameters.containsKey("getPreviousRecord"))
{
    if (!rowData.previous())
    {
        rowData.first();
    }
    out.println(showHtmlForRecord(htmlTable, rowData.getCurrentPosition()));
}
// if the "Next" button was pressed, show the next record
else if (parameters.containsKey("getNextRecord"))
{
    if (!rowData.next())
    {
        rowData.last();
    }
    out.println(showHtmlForRecord(htmlTable, rowData.getCurrentPosition()));
}
// if the "Last" button was pressed, show the last record
else if (parameters.containsKey("getLastRecord"))
{
    rowData.last();
    out.println(showHtmlForRecord(htmlTable, rowData.getCurrentPosition()));
}
// if none of the above, there must have been an error
else
{
    out.println(showHtmlForError("Internal error occurred. Unexpected parameters."));
}

// Save the row data value for this session so the current position
// is updated in the object associated with this session.
session.putValue("sessionRowData", rowData);

// Close the output stream
out.close();
}

// Get all the records from the file input by the user.
private ResultSetRowData getAllRecords(Hashtable parameters, ServletOutputStream out)
throws IOException
{
    ResultSetRowData records = null;

    try
    {
        // Get the system, library and file name from the parameter list.
        String sys = ((String) parameters.get("System")).toUpperCase();
        String lib = ((String) parameters.get("Library")).toUpperCase();
        String file = ((String) parameters.get("File")).toUpperCase();
        if ((sys == null || sys.equals("")) ||
            (lib == null || lib.equals("")) ||
            (file == null || file.equals("")))
        {
            out.println(showHtmlForError("Invalid system, file or library name."));
        }
    }
    else
    {
        // Get the connection to the server.
        getDatabaseConnection(sys, out);
        if (databaseConnection_ != null)
        {
            Statement sqlStatement = databaseConnection_.createStatement();

            // Query the database to get the result set.
            String query = "SELECT * FROM " + lib + "." + file;
            ResultSet rs = sqlStatement.executeQuery(query);

            boolean rsHasRows = rs.next(); // position cursor to first row

```

```

        // Show error message if the file contains no record;
        // otherwise, set row data to result set data.
        if (!rsHasRows)
        {
            out.println(showHtmlForError("No records in the file."));
        }
        else
        {
            records = new SQLResultSetRowData (rs);
        }

        // Don't close the Statement before we're done using
        // the ResultSet or bad things may happen.
        sqlStatement.close();
    }
}
}
catch (Exception e)
{
    e.printStackTrace ();
    out.println(showHtmlForError(e.toString()));
}

return records;
}

// Establish a database connection.
private void getDatabaseConnection (String sysName, ServletOutputStream out)
throws IOException
{
    if (databaseConnection_ == null)
    {
        try
        {
            databaseConnection_ =
                DriverManager.getConnection("jdbc:as400://sysName,userId_,password_ ");
        }
        catch (Exception e)
        {
            e.printStackTrace ();
            out.println(showHtmlForError(e.toString()));
        }
    }
}

// Gets the parameters from an HTTP servlet request.
private static Hashtable getRequestParameters (HttpServletRequest request)
{
    Hashtable parameters = new Hashtable ();
    Enumeration enum = request.getParameterNames();
    while (enum.hasMoreElements())
    {
        String key = (String) enum.nextElement();
        String value = request.getParameter (key);
        parameters.put (key, value);
    }
    return parameters;
}

// Get the servlet information.
public String getServletInfo()
{
    return "HTMLFormConverterExample";
}

// Perform initialization steps.
public void init(ServletConfig config)
{
    try
    {
        super.init(config);

        // Register the JDBC driver
        try
        {
            DriverManager.registerDriver(new AS400JDBCdriver());
        }
    }
}

```

```

        catch (Exception e)
        {
            System.out.println("JDBC Driver not found");
        }
    }
    catch (Exception e)
    {
        e.printStackTrace();
    }
}

// Set the page header info.
private String showHeader(String title)
{
    StringBuffer page = new StringBuffer();
    page.append("<html><head><title>" + title + "</title>");
    page.append("</head><body bgcolor=\"blanchedalmond\">");
    return page.toString ();
}

// Show the HTML page with the appropriate error information.
private String showHtmlForError(String message)
{
    String title = "Error";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));
    try
    {
        // Create the HTML Form object
        HTMLForm errorForm = new HTMLForm("HTMLFormConverterExample");

        // Set up so that doPost() gets called when the form is submitted.
        errorForm.setMethod(HTMLForm.METHOD_POST);

        // Create a single-column panel to which the
        // HTML elements will be added.
        GridLayoutFormPanel grid = new GridLayoutFormPanel();

        // Create the text element for the error and add it to the panel.
        HTMLText text = new HTMLText(message);
        text.setBold(true);
        text.setColor(Color.red);
        grid.addElement(text);

        // Create the button to return to main and add it to the panel.
        grid.addElement(new SubmitFormInput("returnToMain", "Return to Main"));

        // Add the panel to the HTML form.
        errorForm.addElement(grid);

        page.append(errorForm.toString());
    }
    catch (Exception e)
    {
        e.printStackTrace ();
    }
    page.append("</body></html>");
    return page.toString();
}

// Show the HTML form for an individual record.
private String showHtmlForRecord(HTMLTable[] htmlTable, int position)
{
    String title = "HTMLFormConverter Example";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    page.append("<h1>" + title + "</h1>");

    try
    {
        // Create the HTML Form object
        HTMLForm recForm = new HTMLForm("HTMLFormConverterExample");

        // Set up so that doPost() gets called when the form is submitted.
        recForm.setMethod(HTMLForm.METHOD_POST);

        // Set up a single-column panel layout, within which to arrange
        // the generated HTML elements.
    }
}

```



```

GridLayoutFormPanel grid = new GridLayoutFormPanel();

// Create and add a table caption that keeps track
// of the current record.
HTMLText recNumText = new HTMLText("Record number: " + (position + 1));
recNumText.setBold(true);
grid.addElement(recNumText);

// Set up a two-column panel layout, within which to arrange
// the table and text to comment on the converter output.
GridLayoutFormPanel tableGrid = new GridLayoutFormPanel(2);
tableGrid.addElement(htmlTable[position]);
HTMLText comment = new HTMLText(" <---- Output from the HTMLFormConverter class");
comment.setBold(true);
comment.setColor(Color.blue);
tableGrid.addElement(comment);

// Add the table line to the panel.
grid.addElement(tableGrid);

// Set up a single-row panel layout, within which to arrange
// the buttons for moving through the record list.
LinearLayoutFormPanel buttonLine = new LinearLayoutFormPanel();
buttonLine.addElement(new SubmitFormInput("getFirstRecord", "First"));
buttonLine.addElement(new SubmitFormInput("getPreviousRecord", "Previous"));
buttonLine.addElement(new SubmitFormInput("getNextRecord", "Next"));
buttonLine.addElement(new SubmitFormInput("getLastRecord", "Last"));

// Set up another single-row panel layout for the
// Return To Main button.
LinearLayoutFormPanel returnToMainLine = new LinearLayoutFormPanel();
returnToMainLine.addElement(new SubmitFormInput("returnToMain", "Return to Main"));

// Add the lines containing the buttons to the grid panel.
grid.addElement(buttonLine);
grid.addElement(returnToMainLine);

// Add the panel to the form.
recForm.addElement(grid);

// Add the form to the HTML page.
page.append(recForm.toString());
}
catch (Exception e)
{
    e.printStackTrace ();
}

page.append("</body></html>");
return page.toString();
}

// Show the main HTML form (request input for system, file,
// and library name).
private String showHtmlMain()
{
    String title = "HTMLFormConverter Example";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    page.append("<h1> " + title + "</h1>");

    // Create the HTML Form object
    HTMLForm mainForm = new HTMLForm("HTMLFormConverterExample");

    try
    {
        // Set up so that doPost() gets called when the form is submitted.
        mainForm.setMethod(HTMLForm.METHOD_POST);

        // Add a brief description to the form.
        HTMLText desc =
            new HTMLText("<P>This example uses the HTMLFormConverter class " +
                "to convert data retrieved from a server " +
                "file. The converter produces an array of HTML " +
                "tables. Each entry in the array is a record from " +
                "the file. " +
                "Records are displayed one at a time, " +
                "giving you buttons to move forward or backward " +
                "through the list of records.</P>");
        mainForm.addElement(desc);
    }
}

```

```

// Add instructions to the form.
HTMLText instr =
    new HTMLText("<P>Please input the name of the server, " +
        "and the file and library name for the file you " +
        "wish to access. Then push the Show Records " +
        "button to continue.</P>");
mainForm.addElement(instr);

// Create a grid layout panel and add the system, file
// and library input fields.
GridLayoutFormPanel panel = new GridLayoutFormPanel(2);

LabelFormElement sysPrompt = new LabelFormElement("Server: ");
TextFormInput system = new TextFormInput("System");
system.setSize(10);

LabelFormElement filePrompt = new LabelFormElement("File name: ");
TextFormInput file = new TextFormInput("File");
file.setSize(10);

LabelFormElement libPrompt = new LabelFormElement("Library name: ");
TextFormInput library = new TextFormInput("Library");
library.setSize(10);

panel.addElement(sysPrompt);
panel.addElement(system);
panel.addElement(filePrompt);
panel.addElement(file);
panel.addElement(libPrompt);
panel.addElement(library);

// Add the panel to the form.
mainForm.addElement(panel);

// Create the submit button and add it to the form.
mainForm.addElement(new SubmitFormInput("getRecords", "Show Records"));
}
catch (Exception e)
{
    e.printStackTrace ();
}

page.append(mainForm.toString());
page.append("</body></html>");

return page.toString();
}
}

```

The HTML generated by the above example looks like this:

```

<table border="0">
<tr>
<td><b>Record number: 1</b></td>
</tr>
<tr>
<td><table border="0">
<tr>
<td><table border="3" cellpadding="2" cellspacing="4">
<tr>
<th>CUSNUM</th>
<td>839283</td>
</tr>
<tr>
<th>LSTNAM</th>
<td>Jones </td>
</tr>
<tr>
<th>INIT</th>
<td>B D</td>
</tr>
<tr>
<th>STREET</th>
<td>21B NW 135 St</td>
</tr>
<tr>
<th>CITY</th>

```

```

<td>Clay </td>
</tr>
<tr>
<th>STATE</th>
<td>NY</td>
</tr>
<tr>
<th>ZIPCOD</th>
<td>13041</td>
</tr>
<tr>
<th>CDTLMT</th>
<td>400</td>
</tr>
<tr>
<th>CHGCOD</th>
<td>1</td>
</tr>
<tr>
<th>BALDUE</th>
<td>100.00</td>
</tr>
<tr>
<th>CDTDUE</th>
<td>0.00</td>
</tr>
</table>
</td>
<td><font color="#0000ff"> <b><!-- Output from the HTMLFormConverter class-->
</b></font></td>
</tr>
</table>
</td>
</tr>
<tr>
<td>
<form>
<td><input type="submit" name="getFirstRecord" value="First" />
<input type="submit" name="getPreviousRecord" value="Previous" />
<input type="submit" name="getNextRecord" value="Next" />
<input type="submit" name="getLastRecord" value="Last" />
<br />
</td>
</tr>
<tr>
<td><input type="submit" name="returnToMain" value="Return to Main" />
<br />
</td>
</tr>
</table>
</form>

```

## Lights On example for the HTML and servlet classes

This example shows you how the HTML and servlet classes work. It is a general overview. To view this example, compile and run it with a webserver and browser running.

```

import java.io.IOException;
import java.io.CharArrayWriter;
import java.io.PrintWriter;
import java.sql.*;
import java.util.Enumeration;
import java.util.Hashtable;
import javax.servlet.*;
import javax.servlet.http.*;

import com.ibm.as400.util.html.*;
import com.ibm.as400.util.servlet.*;
import com.ibm.as400.access.*;

/*
An example of using IBM Toolbox for Java classes in a servlet.

Schemas of SQL databases on the server:

File . . . . . LICENSES
Library . . . . . LIGHTSON

Field          Type          Length  Nulls
LICENSE        CHARACTER      10      NOT NULL

```

USER_ID	CHARACTER	10	NOT NULL WITH DEFAULT
E_MAIL	CHARACTER	20	NOT NULL
WHEN_ADDED	DATE		NOT NULL WITH DEFAULT
TIME_STAMP	TIMESTAMP		NOT NULL WITH DEFAULT

```
File . . . . . REPORTS
Library . . . LIGHTSON
```

Field	Type	Length	Nulls
LICENSE	CHARACTER	10	NOT NULL
REPORTER	CHARACTER	10	NOT NULL WITH DEFAULT
DATE_ADDED	DATE		NOT NULL WITH DEFAULT
TIME_ADDED	TIME		NOT NULL WITH DEFAULT
TIME_STAMP	TIMESTAMP		NOT NULL WITH DEFAULT
LOCATION	CHARACTER	10	NOT NULL
COLOR	CHARACTER	10	NOT NULL
CATEGORY	CHARACTER	10	NOT NULL

```
*/
```

```
public class LightsOn extends javax.servlet.http.HttpServlet
{
    private AS400 system_;
    private String password_; // password for the server and for the SQL database
    private java.sql.Connection databaseConnection_;

    public void destroy (ServletConfig config)
    {
        try {
            if (databaseConnection_ != null) {
                databaseConnection_.close();
            }
        }
        catch (Exception e) { e.printStackTrace (); }
    }

    public void doGet (HttpServletRequest request,
        HttpServletResponse response)
        throws IOException, ServletException
    {
        HttpSession session = request.getSession();

        response.setContentType("text/html");
        PrintWriter out = response.getWriter();

        out.println(showHtmlMain());

        out.close();
    }

    public void doPost (HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException
    {
        HttpSession session = request.getSession(true);
        ServletOutputStream out = response.getOutputStream();
        response.setContentType("text/html");

        Hashtable parameters = getRequestParameters (request);

        if (parameters.containsKey("askingToReport"))
            out.println (showHtmlForReporting ());
        else if (parameters.containsKey("askingToRegister"))
            out.println (showHtmlForRegistering ());
        else if (parameters.containsKey("askingToUnregister"))
            out.println(showHtmlForUnregistering());
        else if (parameters.containsKey("askingToListRegistered"))
            out.println (showHtmlForListingAllRegistered ());
        else if (parameters.containsKey("askingToListReported"))
            out.println (showHtmlForListingAllReported ());
        else if (parameters.containsKey("returningToMain"))
            out.println (showHtmlMain ());

        else { // None of the above, so assume the user has filled out a form
            // and is submitting information. Grab the incoming info
            // and do the requested action.

            if (parameters.containsKey("submittingReport")) {
                String acknowledgement = reportLightsOn (parameters, out);
            }
        }
    }
}
```

```

        out.println (showAcknowledgement(acknowledgement));
    }

    else if (parameters.containsKey("submittingRegistration")) {
        String acknowledgement = registerLicense (parameters, out);
        out.println (showAcknowledgement(acknowledgement));
    }

    else if (parameters.containsKey("submittingUnregistration")) {
        String acknowledgement = unregisterLicense (parameters, out);
        out.println (showAcknowledgement(acknowledgement));
    }

    else {
        out.println (showAcknowledgement("Error (internal): " +
            "Neither Report, Register, " +
            "Unregister, ListRegistered, or ListReported."));
    }
}

out.close(); // Close the output stream.
}

// Gets the parameters from an HTTP servlet request, and packages them
// into a hashtable for convenience.
private static Hashtable getRequestParameters (HttpServletRequest request)
{
    Hashtable parameters = new Hashtable ();
    Enumeration enum = request.getParameterNames();
    while (enum.hasMoreElements()) {
        String key = (String) enum.nextElement();
        String value = request.getParameter (key);
        parameters.put (key, value);
    }
    return parameters;
}

// Removes blanks and hyphens from a String, and sets it to all uppercase.
private static String normalize (String oldString)
{
    if (oldString == null || oldString.length() == 0) return null;
    StringBuffer newString = new StringBuffer ();
    for (int i=0; i<oldString.length(); i++) {
        if (oldString.charAt(i) != ' ' && oldString.charAt(i) != '-')
            newString.append (oldString.charAt(i));
    }
    return newString.toString().toUpperCase();
}

// Composes a list of single-quoted strings.
private static String quoteList (String[] inList)
{
    StringBuffer outList = new StringBuffer();
    for (int i=0; i<inList.length; i++)
    {
        outList.append ("\" + inList[i] + "\"");
        if (i<inList.length-1)
            outList.append (",");
    }
    return outList.toString();
}

public String getServletInfo ()
{
    return "Lights-On Servlet";
}

private AS400 getSystem ()
{
    try
    {
        if (system_ == null)
        {
            system_ = new AS400();

            // Note: It would be better to get these values
            // from a properties file.
            String sysName = "MYSYSTEM"; // TBD
            String userId = "MYUSERID"; // TBD
        }
    }
}

```

```

        String password = "MYPASSWD";    // TBD

        system_.setSystemName(sysName);
        system_.setUserId(userId);
        system_.setPassword(password);
        password_ = password;

        system_.connectService(AS400.DATABASE);
        system_.connectService(AS400.FILE);
        system_.addPasswordCacheEntry(sysName, userId, password_);
    }
}
catch (Exception e) { e.printStackTrace (); system_ = null; }
return system_;
}

public void init (ServletConfig config)
{
    boolean rc;

    try {
        super.init(config);

        // Register the JDBC driver.
        try {
            java.sql.DriverManager.registerDriver(new com.ibm.as400.access.AS400JDBCDriver());
        }
        catch (Exception e)
        {
            System.out.println("JDBC Driver not found");
        }

    }
    catch (Exception e) { e.printStackTrace(); }
}

private void getDatabaseConnection ()
{
    if (databaseConnection_ == null) {
        try {
            databaseConnection_ = java.sql.DriverManager.getConnection(
                "jdbc:as400://" + getSystem().getSystemName() + "/" +
                "LIGHTSON", getSystem().getUserId(), password_ );
        }
        catch (Exception e) { e.printStackTrace (); }
    }
}

private String registerLicense (Hashtable parameters, ServletOutputStream out)
{
    String licenseNum = normalize ((String)parameters.get("licenseNum"));
    String emailAddress = (String)parameters.get("eMailAddress");
    StringBuffer acknowledgement = new StringBuffer();

    if (licenseNum == null || licenseNum.length() == 0)
        acknowledgement.append ("Error: License number not specified.\n");

    if (eMailAddress == null || eMailAddress.length() == 0)
        acknowledgement.append ("Error: Notification e-mail address not specified.\n");

    if (acknowledgement.length() == 0)
    {
        try
        {
            // Insert the new license number and e-mail address into the database.
            getDatabaseConnection ();
            Statement sqlStatement = databaseConnection_.createStatement();

            // Issue the request.
            String cmd = "INSERT INTO LICENSES (LICENSE, E_MAIL) VALUES (" +
                quoteList(new String[] {licenseNum, emailAddress}) + ")";
            sqlStatement.executeUpdate(cmd);
            sqlStatement.close();

            // Acknowledge the request.
            acknowledgement.append ("License number " + licenseNum + " has been registered.");
            acknowledgement.append ("Notification e-mail address is: " + emailAddress);
        }
    }
}

```

```

    }
    catch (Exception e) { e.printStackTrace (); }
    }
    return acknowledgement.toString();
}

private String unregisterLicense (Hashtable parameters, ServletOutputStream out)
{
    String licenseNum = normalize ((String)parameters.get("licenseNum"));
    StringBuffer acknowledgement = new StringBuffer();

    if (licenseNum == null || licenseNum.length() == 0)
        acknowledgement.append ("Error: License number not specified.\n");

    if (acknowledgement.length() == 0)
    {
        try
        {
            // Remove the specified license number and e-mail address from database.
            getDatabaseConnection ();
            Statement sqlStatement = databaseConnection_.createStatement();

            // Delete the row(s) from the LICENSES database.
            String cmd = "DELETE FROM LICENSES WHERE LICENSE = '" + licenseNum + "'";
            sqlStatement.executeUpdate(cmd);
            sqlStatement.close();

            // Acknowledge the request.
            acknowledgement.append ("License number " + licenseNum + " has been unregistered.");
        }
        catch (Exception e) { e.printStackTrace (); }
    }
    return acknowledgement.toString();
}

private String reportLightsOn (Hashtable parameters, ServletOutputStream out)
{
    String licenseNum = normalize ((String)parameters.get("licenseNum"));
    String location = (String)parameters.get("location");
    String color = (String)parameters.get("color");
    String category = (String)parameters.get("category");
    StringBuffer acknowledgement = new StringBuffer();
    if (licenseNum == null || licenseNum.length() == 0)
        acknowledgement.append ("Error: License number not specified.");

    if (acknowledgement.length() == 0)
    {
        try
        {
            // Report "lights on" for a specified vehicle.
            getDatabaseConnection ();
            Statement sqlStatement = databaseConnection_.createStatement();

            // Add an entry to the REPORTS database.
            String cmd = "INSERT INTO REPORTS (LICENSE, LOCATION, COLOR, CATEGORY) VALUES (" +
                quoteList(new String[] {licenseNum, location, color, category}) + ")";
            sqlStatement.executeUpdate(cmd);
            sqlStatement.close();

            // Acknowledge the request.
            acknowledgement.append ("License number " + licenseNum + " has been reported.
Thanks!");
        }
        catch (Exception e) { e.printStackTrace (); }
    }
    return acknowledgement.toString();
}

private String showHeader (String title)
{
    StringBuffer page = new StringBuffer();
    page.append("<html><head><title>" + title + "</title>");
    page.append("</head><body bgcolor=\"blanchedalmond\">");
    return page.toString ();
}

private String showAcknowledgement (String acknowledgement)
{

```

```

String title = "Acknowledgement";
StringBuffer page = new StringBuffer();
page.append (showHeader (title));

try {
    HTMLForm form = new HTMLForm("LightsOn");
    GridLayoutFormPanel grid = new GridLayoutFormPanel();
    HTMLText text = new HTMLText(acknowledgement);
    if (acknowledgement.startsWith("Error"))
        text.setBold(true);
    grid.addElement(text);
    grid.addElement(new SubmitFormInput("returningToMain", "Home"));
    form.addElement(grid);
    page.append(form.toString());
}
catch (Exception e) { e.printStackTrace (); }
page.append("</body></html>");
return page.toString();
}

private String showHtmlMain ()
{
    String title = "Lights-On tool";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    page.append("<h1>" + title + "</h1>");

    // Create the HTML Form object.
    HTMLForm mainForm = new HTMLForm("LightsOn");
    GridLayoutFormPanel grid = new GridLayoutFormPanel();

    try {
        // Set up so that doPost() gets called when the form is submitted.
        mainForm.setMethod(HTMLForm.METHOD_POST);

        // Create some buttons.
        grid.addElement(new SubmitFormInput("askingToReport", "Report a vehicle with lights on"));
        grid.addElement(new SubmitFormInput("askingToRegister", "Register my license number"));
        grid.addElement(new SubmitFormInput("askingToUnregister", "Unregister my license
number"));
        grid.addElement(new SubmitFormInput("askingToListRegistered", "List all registered
licenses"));
        grid.addElement(new SubmitFormInput("askingToListReported", "List all vehicles with
lights on"));

        mainForm.addElement(grid);
    }
    catch (Exception e) { e.printStackTrace (); }

    page.append(mainForm.toString());
    page.append("</body></html>");

    return page.toString();
}

private String showHtmlForReporting ()
{
    String title = "Report a vehicle with lights on";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    page.append("<h1>" + title + "</h1>");

    // Create the HTML Form object.
    HTMLForm reportForm = new HTMLForm("LightsOn");
    GridLayoutFormPanel grid = new GridLayoutFormPanel(2);

    try {
        // Set up so that doPost() gets called when the form is submitted.
        reportForm.setMethod(HTMLForm.METHOD_POST);

        TextFormInput licenseNum = new TextFormInput("licenseNum");
        licenseNum.setSize(10);
        licenseNum.setMaxLength(10);

        // Add elements to the line form
        grid.addElement(new LabelFormElement("Vehicle license number:"));
        grid.addElement(licenseNum);
    }
}

```



```

// Create a radio button group and add the radio buttons.
RadioFormInputGroup colorGroup = new RadioFormInputGroup("color");

colorGroup.add("color", "white", "white", true);
colorGroup.add("color", "black", "black", false);
colorGroup.add("color", "gray", "gray", false);
colorGroup.add("color", "red", "red", false);
colorGroup.add("color", "yellow", "yellow", false);
colorGroup.add("color", "green", "green", false);
colorGroup.add("color", "blue", "blue", false);
colorGroup.add("color", "brown", "brown", false);

// Create a selection list for category of vehicle.
SelectFormElement category = new SelectFormElement("category");
category.addOption("sedan", "sedan", true);
category.addOption("convertible", "convertibl"); // 10-char field in DB
category.addOption("truck", "truck");
category.addOption("van", "van");
category.addOption("SUV", "SUV");
category.addOption("motorcycle", "motorcycle");
category.addOption("other", "other");

// Create a selection list for vehicle location (building number).
SelectFormElement location = new SelectFormElement("location");
location.addOption("001", "001", true);
location.addOption("002", "002");
location.addOption("003", "003");
location.addOption("005", "005");
location.addOption("006", "006");
location.addOption("015", "015");

grid.addElement(new LabelFormElement("Color:"));
grid.addElement(colorGroup);

grid.addElement(new LabelFormElement("Vehicle type:"));
grid.addElement(category);

grid.addElement(new LabelFormElement("Building:"));
grid.addElement(location);

grid.addElement(new SubmitFormInput("submittingReport", "Submit report"));
grid.addElement(new SubmitFormInput("returningToMain", "Home"));

reportForm.addElement(grid);
}
catch (Exception e) { e.printStackTrace (); }

page.append(reportForm.toString());

page.append("</body></html>");

return page.toString();
}

private String showHtmlForRegistering ()
{
String title = "Register my license number";
StringBuffer page = new StringBuffer();
page.append (showHeader (title));

page.append("<h1>" + title + "</h1>");

// Create the HTML Form object.
HTMLForm registrationForm = new HTMLForm("LightsOn");

// Set up a two-column panel layout, within which to arrange
// the generated HTML elements.
GridLayoutFormPanel grid = new GridLayoutFormPanel(2);

try {
// Set up so that doPost() gets called when the form is submitted.
registrationForm.setMethod(HTMLForm.METHOD_POST);

TextFormInput licenseNum = new TextFormInput("licenseNum");
licenseNum.setSize(10);
licenseNum.setMaxLength(10);

TextFormInput emailAddress = new TextFormInput("eMailAddress");
emailAddress.setMaxLength(20);

```

```

        grid.addElement(new LabelFormElement("License number:"));
        grid.addElement(licenseNum);

        grid.addElement(new LabelFormElement("E-mail notification address:"));
        grid.addElement(eMailAddress);

        grid.addElement(new SubmitFormInput("submittingRegistration", "Register"));
        grid.addElement(new SubmitFormInput("returningToMain", "Home"));

        registrationForm.addElement(grid);
    }
    catch (Exception e) { e.printStackTrace (); }

    page.append(registrationForm.toString());

    page.append("</body></html>");

    return page.toString();
}

private String showHtmlForUnregistering ()
{
    String title = "Unregister my license number";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    page.append("<h1>" + title + "</h1>");

    // Create the HTML Form object.
    HTMLForm unregistrationForm = new HTMLForm("LightsOn");
    GridLayoutFormPanel grid = new GridLayoutFormPanel(2);

    try {
        // Set up so that doPost() gets called when the form is submitted.
        unregistrationForm.setMethod(HTMLForm.METHOD_POST);

        // Create the LineLayoutFormPanel object.
        TextFormInput licenseNum = new TextFormInput("licenseNum");
        licenseNum.setSize(10);
        licenseNum.setMaxLength(10);

        grid.addElement(new LabelFormElement("Vehicle license number:"));
        grid.addElement(licenseNum);

        grid.addElement(new SubmitFormInput("submittingUnregistration", "Unregister"));
        grid.addElement(new SubmitFormInput("returningToMain", "Home"));

        unregistrationForm.addElement(grid);
    }
    catch (Exception e) {
        e.printStackTrace ();
        CharArrayWriter cWriter = new CharArrayWriter();
        PrintWriter pWriter = new PrintWriter (cWriter, true);
        e.printStackTrace (pWriter);
        page.append (cWriter.toString());
    }

    page.append(unregistrationForm.toString());

    page.append("</body></html>");

    return page.toString();
}

private String showHtmlForListingAllRegistered ()
{
    String title = "All registered licenses";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    try
    {
        // Create the HTML Form object.
        HTMLForm mainForm = new HTMLForm("LightsOn");

        // Set up a single-column panel layout, within which to arrange
        // the generated HTML elements.
        GridLayoutFormPanel grid = new GridLayoutFormPanel();

        // Specify the layout for the generated table.

```

```

HTMLTable table = new HTMLTable();
table.setAlignment(HTMLConstants.LEFT);
table.setBorderWidth(3);

// Create and add the table caption and header.
HTMLTableCaption caption = new HTMLTableCaption();
caption.setAlignment(HTMLConstants.TOP);
caption.setElement(title);
table.setCaption(caption);
table.setHeader(new String[] { "License", "Date added" } );

// Create the converter, which will generate table HTML from
// the result set that comes back from the database query.
HTMLTableConverter converter = new HTMLTableConverter();
converter.setTable(table);

getConnection ();
Statement sqlStatement = databaseConnection_.createStatement();

// First pre-query the database to verify that it's not empty.
String query = "SELECT COUNT(*) FROM LICENSES";
ResultSet rs = sqlStatement.executeQuery (query);
rs.next(); // position cursor to first row
int rowCount = rs.getInt(1);

if (rowCount == 0) {
    page.append("<font size=4 color=red>No vehicles have been reported.</font>");
}
else {
    query = "SELECT LICENSE,WHEN_ADDED FROM LICENSES";
    rs = sqlStatement.executeQuery (query);
    SQLResultSetRowData rowData = new SQLResultSetRowData (rs);
    HTMLTable[] generatedHtml = converter.convertToTables(rowData);
    grid.addElement(generatedHtml[0]);
}
sqlStatement.close();
// Note: Mustn't close statement before we're done using result set.

grid.addElement(new SubmitFormInput("returningToMain", "Home"));

mainForm.addElement(grid);
page.append(mainForm.toString());
}
catch (Exception e) { e.printStackTrace (); }
page.append("</body></html>");
return page.toString();
}

private String showHtmlForListingAllReported ()
{
    String title = "All vehicles with lights on";
    StringBuffer page = new StringBuffer();
    page.append (showHeader (title));

    try
    {
        // Create the HTML Form object.
        HTMLForm form = new HTMLForm("LightsOn");

        // Set up a single-column panel layout, within which to arrange
        // the generated HTML elements.
        GridLayoutFormPanel grid = new GridLayoutFormPanel();

        // Specify the layout for the generated table.
        HTMLTable table = new HTMLTable();
        table.setAlignment(HTMLConstants.LEFT);
        table.setBorderWidth(3);

        // Create and add the table caption and header.
        HTMLTableCaption caption = new HTMLTableCaption();
        caption.setAlignment(HTMLConstants.TOP);
        caption.setElement(title);
        table.setCaption(caption);
        table.setHeader(new String[] { "License", "Color", "Category", "Date", "Time" } );

        // Create the converter, which will generate table HTML from
        // the result set that comes back from the database query.
        HTMLTableConverter converter = new HTMLTableConverter();
        converter.setTable(table);

        getConnection ();

```

```

Statement sqlStatement = databaseConnection_.createStatement();

// First pre-query the database to verify that it's not empty.
String query = "SELECT COUNT(*) FROM REPORTS";
ResultSet rs = sqlStatement.executeQuery (query);
rs.next(); // position cursor to first row
int rowCount = rs.getInt(1);

if (rowCount == 0) {
    page.append("<font size=4 color=red>No vehicles have been reported.</font>");
}
else {
    query = "SELECT LICENSE,COLOR,CATEGORY,DATE_ADDED,TIME_ADDED FROM REPORTS";
    rs = sqlStatement.executeQuery (query);
    SQLResultSetRowData rowData = new SQLResultSetRowData (rs);
    HTMLTable[] generatedHtml = converter.convertToTables(rowData);
    grid.addElement(generatedHtml[0]);
}
sqlStatement.close();
// Note: Mustn't close statement before we're done using result set.

grid.addElement(new SubmitFormInput("returningToMain", "Home"));
form.addElement(grid);
page.append(form.toString());
}
catch (Exception e) { e.printStackTrace (); }
page.append("</body></html>");
return page.toString();
}
}

```

## Simple programming examples

These examples show some of the ways you can begin to code your own Java programs using the IBM Toolbox for Java classes. Meant for programmers just beginning to use IBM Toolbox for Java classes, these examples include detailed explanations about key lines in the code.

If you want some help getting started, see [Writing your first IBM Toolbox for Java program](#).

For links to many of the other examples provided in the IBM Toolbox for Java information, see [Code examples](#).

Use the following list to view the simple programming examples:

- [Calling commands](#)
- [Using message queues](#)
- [Using record-level access](#)
- [Using JDBC classes to create and populate a table](#)

The following disclaimer applies to all of the IBM Toolbox for Java examples:

### Code example disclaimer

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## Writing your first IBM Toolbox for Java program

To begin this simple exercise, you must have installed Java on your workstation.

You can decide which version you want to install by reviewing [Requirements for running Java applications](#).

After you have Java installed on your client, complete the following tasks:

1. Copy jt400.jar to the workstation.
2. Add jt400.jar to the CLASSPATH on your workstation by appending the full path of the JAR file to the CLASSPATH. For example, when the jt400.jar file resides in the c:\lib directory on your workstation (running Windows), add the following to the end of your CLASSPATH statement:

```
;c:\lib\jt400.jar
```

3. Open a text editor and type the [first simple programming example](#)

**Note:** Make sure to leave out the text that refers to the Notes (for example, Note 1, Note 2, and so on). Save the new document with the name CmdCall.java.

4. Start a command session on your workstation and use the following command to compile the simple programming example:

```
javac CmdCall.java
```

5. In the command session, type the following command to run the simple programming example:

```
java CmdCall
```

[ [Simple programming examples](#) ]

## Example: Using CommandCall

This example uses the IBM Toolbox for Java access class CommandCall.

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////  
//  
// This source is an example of "Job List".  
//  
////////////////////////////////////  
//  
// The access classes are in the com.ibm.as400.access.package.  
// Import this package to use the IBM Toolbox for Java classes.  
//  
////////////////////////////////////  
  
import com.ibm.as400.access.*;  
  
public class CmdCall  
{  
    public static void main(String[] args)  
    {  
        // Like other Java classes, IBM Toolbox for Java classes  
        // throw exceptions when something goes wrong. These must  
        // be caught by programs that use IBM Toolbox for Java.  
        try Note 1  
        {  
            AS400 system = new AS400();  
  
            CommandCall cc = new CommandCall(system); Note 2  
  
            cc.run("CRTLIB MYLIB"); Note 3  
  
            AS400Message[] ml = cc.getMessageList(); Note 4  
  
            for (int i=0; i<ml.length; i++)  
            {  
                System.out.println(ml[i].getText()); Note 5  
            }  
        }  
        catch (Exception e)  
        {  
            e.printStackTrace();  
        }  
  
        System.exit(0);  
    }  
}
```

```
}  
}
```

1. IBM Toolbox for Java uses the "AS400" object to identify the target server. If you construct the AS400 object with no parameters, IBM Toolbox for Java prompts for the system name, userid and password. The AS400 class also includes a constructor that takes the system name, userid and password.
2. Use the IBM Toolbox for Java CommandCall object to send commands to the server. When you create the CommandCall object, you pass it an AS400 object so that it knows which server is the target of the command.
3. Use the run() method on the command call object to run a command.
4. The result of running a command is a list of IBM i messages. IBM Toolbox for Java represents these messages as AS400Message objects. When the command is complete, you get the resulting messages from the CommandCall object.
5. Print the message text. Also available are the message ID, message severity, and other information. This program prints only the message text.

### Example: Using message queues (part 1 of 3)

This source is an example of IBM Toolbox for Java message queue.

[ [Next part](#) ]

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////  
//  
// Example using the Message Queue function of the IBM Toolbox for Java  
//  
// This source is an example of IBM Toolbox for Java "Message Queue".  
//  
////////////////////////////////////  
  
package examples; Note 1  
  
import java.io.*;  
import java.util.*;  
  
import com.ibm.as400.access.*; Note 2  
  
public class displayMessages extends Object  
{  
  
    public static void main(String[] parameters) Note 3  
    {  
        displayMessages me = new displayMessages();  
        me.Main(parameters); Note 4  
  
        System.exit(0); Note 5  
    }  
  
    void displayMessage()  
    {  
    }  
  
    void Main(String[] parms)  
    {  
        try Note 6  
        {  
  
            // IBM Toolbox for Java code goes here  
  
        }  
        catch (Exception e)  
        {  
            e.printStackTrace(); Note 7  
        }  
    }  
}
```

1. This class is in the 'examples' package. Java uses packages to avoid name conflicts between Java class files.
2. This line makes all of the IBM Toolbox for Java classes in the access package available to this program. The classes in the access package have the common prefix **com.ibm.as400**. By using an import statement, the program can refer to a class using just its name, not its fully-qualified name. For example, you can reference the AS400 class by using AS400, instead of com.ibm.as400.AS400.
3. This class has a **main** method; therefore, it can be run as an application. To invoke the program, you run **java examples.displayMessages**. Note that case must match when running the program. Because an IBM Toolbox for Java class is used, jt400.zip must be in the classpath environment variable.
4. The main method mentioned in Note 3 is static. One of the restrictions of static methods is that static methods can call only other static methods in their class. To avoid this restriction, many java programs create an object, and then do initialization processing in a method called **Main**. The Main() method can call any other method in the displayMessages object.
5. The IBM Toolbox for Java creates threads on behalf of the application to carry out IBM Toolbox for Java activity. If the program does not issue **System.exit(0)** at termination time, the program may not terminate normally. For example, suppose this program was run from a Windows 95 DOS prompt. Without this line, the command prompt does not return when the program finished. The user has to enter Ctrl-C to get a command prompt.
6. The IBM Toolbox for Java code throws exceptions that your program must catch.
7. This program displays the text of the exception while the program is performing error processing. Exceptions thrown by the IBM Toolbox for Java are translated, so the text of the exception will be the same as the language of the workstation.

[ [Next part](#) ]

## Example: Using message queues (part 2 of 3)

This source is an example of IBM Toolbox for Java message queue.

[ [Previous part](#) | [Next part](#) ]

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example using the Message Queue function of the IBM Toolbox for Java
//
// This source is an example of IBM Toolbox for Java "Message Queue".
//
////////////////////////////////////

package examples;

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class displayMessages extends Object
{
    public static void main(String[] parameters)
    {
        displayMessages me = new displayMessages();
        me.Main(parameters);
        System.exit(0);
    }

    void displayMessage()
    {
    }

    void Main(String[] parms)

```

```

    {
        try
        {
            AS400 system = new AS400(); Note 1

            if (parms.length > 0)
                system.setSystemName(parms[0]); Note 2

        }
        catch (Exception e)
        {
            e.printStackTrace();
        }
    }
}

```

1. A program uses the **AS400** object to designate which server to connect to. With one exception, all programs that need resources from a server must have an AS400 object. The exception is JDBC. If your program uses JDBC, then the IBM Toolbox for Java JDBC driver creates the AS400 object for the program.
2. This program assumes the first command line parameter is the name of the server. If a parameter is passed to the program, the **setSystemName** method of the AS400 object is used to set the system name. The AS400 object also needs server sign-on information:
  - If the program is running on a workstation, the IBM Toolbox for Java program prompts the user for a user ID and password. **Note:** If a system name is not specified as a command line parameter, the AS400 object also prompts for the system name.
  - If the program is running on the IBM i JVM, then the user ID and password of the user running the Java program is used. In this case, the user does not specify a system name, but lets the system name default to the name of the system that the program is running on.

[ [Previous part](#) | [Next part](#) ]

## Example: Using message queues (part 3 of 3)

This source is an example of IBM Toolbox for Java message queue.

[ [Previous part](#) ]

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Example using the Message Queue function of the IBM Toolbox for Java
//
// This source is an example of IBM Toolbox for Java "Message Queue".
//
////////////////////////////////////

package examples;

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class displayMessages extends Object
{
    public static void main(String[] parameters)
    {
        displayMessages me = new displayMessages();

        me.Main(parameters);

        System.exit(0);
    }

    void displayMessage()
    {

```





```

public class RLSequentialAccessExample
{
    public static void main(String[] parameters)
    {
        BufferedReader inputStream = new BufferedReader(new InputStreamReader(System.in),1);

        String systemName = "";
        String library = "";
        String file = "";
        String member = "";

        System.out.println();
        try
        {
            System.out.print("System name: ");
            systemName = inputStream.readLine();

            System.out.print("Library in which the file exists: ");
            library = inputStream.readLine();

            System.out.print("File name: ");
            file = inputStream.readLine();

            System.out.print("Member name (press enter for first member): ");
            member = inputStream.readLine();
            if (member.equals(""))
            {
                member = "*FIRST";
            }

            System.out.println();
        }
        catch (Exception e)
        {
            System.out.println("Error obtaining user input.");
            e.printStackTrace();
            System.exit(0);
        }

        AS400 system = new AS400(systemName); Note 1
        try
        {
            system.connectService(AS400.RECORDACCESS);
        }
        catch(Exception e)
        {
            System.out.println("Unable to connect for record level access.");
            System.out.println("Check the programmer's guide setup file for
            special instructions regarding record level access");
            e.printStackTrace();
            System.exit(0);
        }

        QSYSObjectPathName filePathName = new QSYSObjectPathName(library, file, member, "MBR");
Note 2

        SequentialFile theFile = new SequentialFile(system, filePathName.getPath()); Note 3

        AS400FileRecordDescription recordDescription =
            new AS400FileRecordDescription(system, filePathName.getPath());
        try
        {
            RecordFormat[] format = recordDescription.retrieveRecordFormat(); Note 4

            theFile.setRecordFormat(format[0]); Note 5

            theFile.open(AS400File.READ_ONLY, 100, AS400File.COMMIT_LOCK_LEVEL_NONE); Note 6

            System.out.println("Displaying file " + library.toUpperCase() + "/" +
            file.toUpperCase() + "(" + theFile.getMemberName().trim() + ")");

            Record record = theFile.readNext(); Note 7
            while (record != null)
            {
                System.out.println(record);
                record = theFile.readNext();
            }
        }
    }
}

```

```

    }
    System.out.println();

    theFile.close(); Note 8

    system.disconnectService(AS400.RECORDACCESS); Note 9
}
catch (Exception e)
{
    System.out.println("Error occurred attempting to display the file.");
    e.printStackTrace();

    try
    {
        // Close the file
        theFile.close();
    }
    catch(Exception x)
    {
    }
}

    system.disconnectService(AS400.RECORDACCESS);
    System.exit(0);
}

// Make sure that the application ends; see readme for details
System.exit(0);
}
}
}

```

1. This line of code creates an AS400 object and connects to the record-level access service.
2. This line creates a QSYSObjectPathName object that obtains the integrated file system path name form of the object to be displayed.
3. This statement creates an object that represents an existing sequential file on the server you are connected to. This sequential file is the file that will be displayed.
4. These lines retrieve the record format of the file.
5. This line sets the record format for the file.
6. This line opens the selected file for reading. It will read 100 records at a time, when it is possible.
7. This line of code reads each record in sequence.
8. This line closes the file.
9. This line disconnects from the record-level access service.

[ [Next part](#) ]

## Example: Using record-level access (part 2 of 2)

This example demonstrates the use of record level access.

[ [Previous part](#) ]

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// Record level access example.
//
// Calling syntax: java RLACreateExample
//
////////////////////////////////////

import java.io.*;
import java.util.*;
import com.ibm.as400.access.*;

public class RLACreateExample
{

```

```

public static void main(String[] args)
{
    AS400 system = new AS400(args[0]);
    String filePathName = "/QSYS.LIB/MYLIB.LIB/MYFILE.FILE/MBR1.MBR"; Note 1

    try
    {
        SequentialFile theFile = new SequentialFile(system, filePathName);

        // Begin Note Two
        CharacterFieldDescription lastNameField =
            new CharacterFieldDescription(new AS400Text(20), "LNAME");
        CharacterFieldDescription firstNameField =
            new CharacterFieldDescription(new AS400Text(20), "FNAME");
        BinaryFieldDescription yearsOld =
            new BinaryFieldDescription(new AS400Bin4(), "AGE");

        RecordFormat fileFormat = new RecordFormat("RF");
        fileFormat.addFieldDescription(lastNameField);
        fileFormat.addFieldDescription(firstNameField);
        fileFormat.addFieldDescription(yearsOld);

        theFile.create(fileFormat, "A file of names and ages"); Note 2
        // End Note Two

        theFile.open(AS400File.READ_WRITE, 1, AS400File.COMMIT_LOCK_LEVEL_NONE);

        // Begin Note Three
        Record newData = fileFormat.getNewRecord();
        newData.setField("LNAME", "Doe");
        newData.setField("FNAME", "John");
        newData.setField("AGE", new Integer(63));

        theFile.write(newData); Note 3
        // End Note Three

        theFile.close();
    }
    catch(Exception e)
    {
        System.out.println("An error has occurred: ");
        e.printStackTrace();
    }

    system.disconnectService(AS400.RECORDACCESS);
    System.exit(0);
}
}

```

1. (args[0]) in the previous line and MYFILE.FILE are pieces of code that are prerequisites for the rest of the example to run. The program assumes that the library MYLIB exists on the server and that the user has access to it.
2. The text within the Java comments labeled "Begin Note Two" and "End Note Two" shows how to create a record format yourself instead of getting the record format from an existing file. The last line in this block creates the file on the server.
3. The text within the Java comments labeled "Begin Note Three" and "End Note Three" shows a way to create a record and then write it to a file.

[ [Previous part](#) ]

## Example: Using JDBC classes to create and populate a table (part 1 of 2)

This program uses the IBM Toolbox for Java JDBC driver to create and populate a table.

[ [Next part](#) ]

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////
//
// JDBCPopulate example. This program uses the IBM Toolbox for Java JDBC driver

```

```

// to create and populate a table.
//
// Command syntax:
//   JDBCPopulate system collectionName tableName
//
// For example,
//   JDBCPopulate MySystem MyLibrary MyTable
//
// This source is an example of IBM Toolbox for Java JDBC driver.
//
//
/////////////////////////////////////////////////////////////////

import java.sql.*;

public class JDBCPopulate
{
    private static final String words[]
        = { "One",      "Two",      "Three",    "Four",    "Five",
          "Six",      "Seven",   "Eight",   "Nine",   "Ten",
          "Eleven",  "Twelve", "Thirteen", "Fourteen", "Fifteen",
          "Sixteen", "Seventeen", "Eighteen", "Nineteen", "Twenty" };

    public static void main (String[] parameters)
    {
        if (parameters.length != 3) {
            System.out.println("");
            System.out.println("Usage:");
            System.out.println("");
            System.out.println("   JDBCPopulate system collectionName tableName");
            System.out.println("");
            System.out.println("");
            System.out.println("For example:");
            System.out.println("");
            System.out.println("");
            System.out.println("   JDBCPopulate MySystem MyLibrary MyTable");
            System.out.println("");
            return;
        }

        String system      = parameters[0];
        String collectionName = parameters[1];
        String tableName   = parameters[2];

        Connection connection = null;

        try {
            DriverManager.registerDriver(new com.ibm.as400.access.AS400JDBCDriver()); Note 1

            connection = DriverManager.getConnection ("jdbc:as400://"
                + system + "/" + collectionName); Note 2

            try {
                Statement dropTable = connection.createStatement ();
                dropTable.executeUpdate ("DROP TABLE " + tableName); Note 3
            }
            catch (SQLException e) {
            }

            Statement createTable = connection.createStatement ();
            createTable.executeUpdate ("CREATE TABLE " + tableName
                + " (I INTEGER, WORD VARCHAR(20), SQUARE INTEGER, "
                + " SQUAREROOT DOUBLE)"); Note 4

            PreparedStatement insert = connection.prepareStatement ("INSERT INTO "
                + tableName + " (I, WORD, SQUARE, SQUAREROOT) "
                + " VALUES (?, ?, ?, ?)"); Note 5

            for (int i = 1; i <= words.length; ++i) {
                insert.setInt (1, i);
                insert.setString (2, words[i-1]);
                insert.setInt (3, i*i);
                insert.setDouble (4, Math.sqrt(i));
                insert.executeUpdate (); Note 6
            }

            System.out.println ("Table " + collectionName + "." + tableName
                + " has been populated.");
        }
    }
}

```

```

    }
    catch (Exception e) {
        System.out.println ();
        System.out.println ("ERROR: " + e.getMessage());
    }
    finally {
        try {
            if (connection != null)
                connection.close (); Note 7
        }
        catch (SQLException e) {
            // Ignore.
        }
    }
    System.exit (0);
}
}

```

1. This line loads the IBM Toolbox for Java JDBC driver. A JDBC driver is necessary to mediate between JDBC and the database you are working with.
2. This statement connects to the database. A prompt will appear for the user ID and password. A default SQL schema is provided so that you will not need to qualify the table name in SQL statements.
3. These lines delete the table if it already exists.
4. These lines create the table.
5. This line prepares a statement that will insert rows into the table. Because you will be executing this statement several times, you should use a PreparedStatement and parameter markers.
6. This block of code populates the table for you; every time the loop is executed, it inserts a row into the table.
7. Now that the table has been created and filled in, this statement closes the connection to the database.

[ [Next part](#) ]

## Example: Using JDBC classes to create and populate a table (part 2 of 2)

This program uses the IBM Toolbox for Java JDBC driver to query a table and output its contents.

[ [Previous part](#) ]

Use the following as an example for your program.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//
// JDBCQuery example. This program uses the IBM Toolbox for Java JDBC driver to
// query a table and output its contents.
//
// Command syntax:
//   JDBCQuery system collectionName tableName
//
// For example,
//   JDBCQuery MySystem qiws qcustcdt
//
// This source is an example of IBM Toolbox for Java JDBC driver.
//
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

import java.sql.*;

public class JDBCQuery
{
    // Format a string so that it has the specified width.
    private static String format (String s, int width)
    {
        String formattedString;

        // The string is shorter than specified width,

```

```

// so we need to pad with blanks.
if (s.length() < width) {
    StringBuffer buffer = new StringBuffer (s);
    for (int i = s.length(); i < width; ++i)
        buffer.append (" ");
    formattedString = buffer.toString();
}

// Otherwise, we need to truncate the string.
else
    formattedString = s.substring (0, width);

return formattedString;
}

public static void main (String[] parameters)
{
    // Check the input parameters.
    if (parameters.length != 3) {
        System.out.println("");
        System.out.println("Usage:");
        System.out.println("");
        System.out.println("  JDBCQuery system collectionName tableName");
        System.out.println("");
        System.out.println("");
        System.out.println("For example:");
        System.out.println("");
        System.out.println("");
        System.out.println("  JDBCQuery mySystem qiws qcustcdt");
        System.out.println("");
        return;
    }

    String system          = parameters[0];
    String collectionName = parameters[1];
    String tableName       = parameters[2];

    Connection connection = null;

    try {

        DriverManager.registerDriver(new com.ibm.as400.access.AS400JDBCDriver()); Note 1

        // Get a connection to the database. Since we do not
        // provide a user id or password, a prompt will appear.
        connection = DriverManager.getConnection ("jdbc:as400://" + system);
        DatabaseMetaData dmd = connection.getMetaData (); Note 2

        // Execute the query.
        Statement select = connection.createStatement ();
        ResultSet rs = select.executeQuery ("SELECT * FROM "
            + collectionName + dmd.getCatalogSeparator() + tableName); Note 3

        // Get information about the result set. Set the column
        // width to whichever is longer: the length of the label
        // or the length of the data.
        ResultSetMetaData rsmd = rs.getMetaData ();
        int columnCount = rsmd.getColumnCount (); Note 4
        String[] columnLabels = new String[columnCount];
        int[] columnWidths = new int[columnCount];
        for (int i = 1; i <= columnCount; ++i) {
            columnLabels[i-1] = rsmd.getColumnLabel (i);
            columnWidths[i-1] = Math.max (columnLabels[i-1].length(),
                rsmd.getColumnDisplaySize (i)); Note 5
        }

        // Output the column headings.
        for (int i = 1; i <= columnCount; ++i) {
            System.out.print (format (rsmd.getColumnLabel(i), columnWidths[i-1]));
            System.out.print (" ");
        }
        System.out.println ();

        // Output a dashed line.
        StringBuffer dashedLine;
        for (int i = 1; i <= columnCount; ++i) {
            for (int j = 1; j <= columnWidths[i-1]; ++j)
                System.out.print ("-");
            System.out.print (" ");
        }
        System.out.println ();
    }
}

```

```

// Iterate through the rows in the result set and output
// the columns for each row.
while (rs.next ()) {
    for (int i = 1; i <= columnCount; ++i) {
        String value = rs.getString (i);
        if (rs.isNull ())
            value = "<null>"; Note 6
        System.out.print (format (value, columnWidths[i-1]));
        System.out.print (" ");
    }
    System.out.println ();
}

catch (Exception e) {
    System.out.println ();
    System.out.println ("ERROR: " + e.getMessage());
}

finally {
    // Clean up.
    try {
        if (connection != null)
            connection.close ();
    }
    catch (SQLException e) {
        // Ignore.
    }
}

System.exit (0);
}
}

```

1. This line loads the IBM Toolbox for Java JDBC driver. A JDBC driver mediates between JDBC and the database with which you are working.
2. This line retrieves the connection's meta data, an object that describes many of the characteristics of the database.
3. This statement executes the query on the specified table.
4. These lines retrieve information about the table.
5. These lines set the column width to either the length of the label or the length of the data, whichever is longer.
6. This block of code iterates through all of the rows in the table and displays the contents of each column in each row.

[ [Previous part](#) ]

## Examples: Tips for programming

This topic lists the code examples that are provided throughout the documentation of IBM Toolbox for Java tips for programming.

### Managing connections

- [Example: Making a connection to the system with a CommandCall object](#)
- [Example: Making two connections to the system with a CommandCall object](#)
- [Example: Creating CommandCall and IFSFileInputStream objects with an AS400 object](#)
- [Example: Using AS400ConnectionPool to preconnect to the system](#)
- [Example: Using AS400ConnectionPool to preconnect to a specific service on the system, then reuse the connection](#)



## Starting and ending connections

- [Example: How a Java program preconnects to the system](#)
- [Example: How a Java program disconnects from the system](#)
- [Example: How a Java program disconnects and reconnects to the system with disconnectService\(\) and run\(\)](#)
- [Example: How a Java program disconnects from the system and fails to reconnect](#)

## Exceptions

- [Example: Using exceptions](#)

## Trace

- [Example: Using trace](#)
- [Example: Using setTraceOn\(\)](#)
- [Example: Using component trace](#)

## Optimization

- [Example: Creating two AS400 objects](#)
- [Example: Using an AS400 object to represent a second server](#)

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## Examples: Utility classes

This topic lists the code examples that are provided throughout the documentation of the IBM Toolbox for Java utility classes.

### AS/400ToolboxJarMaker

- [Example: Extracting AS400.class and all its dependent classes from jt400.jar](#)
- [Example: Splitting jt400.jar into a set of 300KB files](#)
- [Example: Removing unused files from a JAR file](#)
- [Example: Creating a 400KB smaller JAR file by omitting the conversion tables with the -ccsid parameter](#)

### CommandPrompter

- [Example: Using CommandPrompter to prompt for and run a command](#)

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## Example: Using CommandPrompter

This example program uses the CommandPrompter, CommandCall, and AS400Message classes to prompt for a command, run the command, and display any messages returned if the command does not run.

**Note:** Read the [Code example disclaimer](#) for important legal information.

```
////////////////////////////////////
//
// CommandPrompter example. This program uses CommandPrompter, CommandCall, and
// AS400Message to prompt for a command, run the command, and display any
// messages returned if the command does not run.
//
// Command syntax:
//   Prompter commandString
//
////////////////////////////////////

import com.ibm.as400.ui.util.CommandPrompter;
import com.ibm.as400.access.AS400;
import com.ibm.as400.access.AS400Message;
import com.ibm.as400.access.CommandCall;
import javax.swing.JFrame;
import java.awt.FlowLayout;
public class Prompter
{
public static void main ( String args[] ) throws Exception
{
    JFrame frame = new JFrame();
    frame.getContentPane().setLayout(new FlowLayout());
    AS400 system = new AS400("mySystem", "myUserId", "myPasswd");
    String cmdName = args[0];

    // Launch the CommandPrompter
    CommandPrompter cp = new CommandPrompter(frame, system, cmdName);
    if (cp.showDialog() == CommandPrompter.OK)
    {
        String cmdString = cp.getCommandString();
        System.out.println("Command string: " + cmdString);

        // Run the command that was built in the prompter.
        CommandCall cmd = new CommandCall(system, cmdString);
        if (!cmd.run())
        {
            AS400Message[] msgList = cmd.getMessageList();
            for (int i = 0; i < msgList.length; ++i)
            {
                System.out.println(msgList[i].getText());
            }
        }
    }
    System.exit(0);
}
}
```

## Examples: XPCML

This section lists the code examples that are provided throughout the documentation of the IBM Toolbox for Java XPCML component.

- [“Example: Condensing an existing XPCML document” on page 528](#)

- [“Example: Condensing an existing XPCML document, including Java code” on page 528](#)
- [“Example: Using condensed XPCML to create a ProgramCallDocument object” on page 531](#)
- [“Example: Obtaining program call results as condensed XPCML ” on page 531](#)
- [“Example: Retrieving program call results as XPCML ” on page 523](#)
- [“Example: Passing in parameter values as XPCML” on page 525](#)
- [“Examples: Passing in arrays of parameter values as XPCML” on page 526](#)
- [“Example: Converting a PCML document to an XPCML document” on page 332](#)

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### **Example: Retrieving program call results as XPCML**

The following example shows how you can construct an XPCML ProgramCallDocument, call an IBM i program, and retrieve the results of the program call as XPCML.

The example supposes the following components:

- XPCML document qgyolaus.xpcml, which defines the program and parameter specifications with input values
- Java code that constructs a ProgramCallDocument object, uses the XPCML file, and then calls program QGYOLAUS
- Results of the program call, which the Java code generates as XPCML and stores in file XPCMLOut.xpcml

Notice how array data is specified in the original and the generated XPCML. The element qgyolaus.receiver, an output parameter, is an XPCML arrayOfStructParm with an attribute that sets the count to listInfo.rcdsReturned. The following example code includes only part of the QGYOLAUS output. If the example included all the output, the code might list 89 users under the <arrayOfStructParm> XPCML tag.

For arrays of structs, XPCML uses the <struct\_i> XPCML tag to delimit each structParm element. Each <struct\_i> tag indicates that the data enclosed within it is one element of type autu0150 struct. The index attribute of the <struct\_i> tag specifies the element of the array for the struct.

For arrays of simple types, such as arrayOfStringParm, arrayOfIntParm, and so on, the <i> XPCML tag lists array elements.

### **XPCML document qgyolaus.xpcml**

```
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">
  <!-- XPCML source for calling "Open List of Authorized Users" -->
  <!-- (QGYOLAUS) API -->

  <!-- Format AUTU0150 - Other formats are available -->
  <struct name="autu0150">
    <stringParm name="name" length="10"/>
    <stringParm name="userOrGroup" length="1"/>
    <stringParm name="groupMembers" length="1"/>
  </struct>
</xpcml>
```

```

    <stringParm name="description" length="50"/>
  </struct>

  <!-- List information structure (common for "Open List" type APIs) -->
  <struct name="listInfo">
    <intParm name="totalRcds"/>
    <intParm name="rcdsReturned">0</rcdsReturned>
    <hexBinaryParm name="rqsHandle" totalBytes="4"/>
    <intParm name="rcdLength"/>
    <stringParm name="infoComplete" length="1"/>
    <stringParm name="dateCreated" length="7"/>
    <stringParm name="timeCreated" length="6"/>
    <stringParm name="listStatus" length="1"/>
    <hexBinaryParm totalBytes="1"/>
    <unsignedIntParm name="lengthOfInfo"/>
    <intParm name="firstRecord"/>
    <hexBinaryParm totalBytes="40"/>
  </struct>

  <!-- Program QGYOLAUS and its parameter list for retrieving -->
  <!-- AUTU0150 format -->

  <program name="QGYOLAUS" path="/QSYS.lib/QGY.lib/QGYOLAUS.pgm"
    parseOrder="listInfo receiver">
    <parameterList>
      // Output values --- array of the autu0150 struct
      <arrayOfStructParm name="receiver" count="listInfo.rcdsReturned"
        passDirection="out" outputSize="receiverLength" struct="autu0150"/>
      // Input values
      <intParm name="receiverLength" passDirection="in">16384</intParm>
      <structParm name="listInfo" passDirection="out" struct="listInfo"/>
      // Input values
      <intParm name="rcdsToReturn" passDirection="in">264</intParm>
      <stringParm name="format" passDirection="in" length="10">
        AUTU0150</stringParm>
      <stringParm name="selection" passDirection="in" length="10">
        *USER</stringParm>
      <stringParm name="member" passDirection="in" length="10">
        *NONE</stringParm>
      <intParm name="errorCode" passDirection="in">0</intParm>
    </parameterList>
  </program>

```

## Java code that constructs the ProgramCallDocument object and uses the XPCML to call program QGYOLAUS

```

system = new AS400();
// Create a ProgramCallDocument into which to parse the file.
ProgramCallDocument xpcmlDoc =
    new ProgramCallDocument(system, "QGYOLAUS.xpcml");

// Call QGYOLAUS
boolean rc = xpcmlDoc.callProgram("QGYOLAUS");

// Obtain program call results as XPCML and store them
// in file XPCMLOut.xpcml
if (rc) // Program was successful
    xpcmlDoc.generateXPCML("QGYOLAUS", "XPCMLOut.xpcml");

```

## Results of the program call, generated as XPCML and stored in file XPCMLOut.xpcml

```

<?xml version="1.0" ?>
<xpcml version="4.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation='xpcml.xsd' >

  <program name="QGYOLAUS" path="/QSYS.lib/QGY.lib/QGYOLAUS.pgm"
    parseOrder="listInfo receiver">
    <parameterList>
      <arrayOfStructParm name="receiver" passDirection="out"
        count="listInfo.rcdsReturned" outputSize="receiverLength"
        struct="autu0150">
        <struct_i index="0">
          <stringParm name="name" length="10">JANEDOW</stringParm>
          <stringParm name="userOrGroup" length="1">0</stringParm>
          <stringParm name="groupMembers" length="1">0</stringParm>

```

```

        <stringParm name="description" length="50">
            Jane Doe</stringParm>
    </struct_i>
    <struct_i index="1">
        <stringParm name="name" length="10">BOBS</stringParm>
        <stringParm name="userOrGroup" length="1">0</stringParm>
        <stringParm name="groupMembers" length="1">0</stringParm>
        <stringParm name="description" length="50">
            Bob Smith</stringParm>
    </struct_i>

    <!-- More records here depending on how many users output. -->
    <!-- In this case 89 user records are listed here. -->

</ArrayOfStructParm>    <!-- End of user array -->
<intParm name="receiverLength" passDirection="in">
    16384</intParm>
<structParm name="listInfo" passDirection="out"
    struct="listInfo">
    <intParm name="totalRcds">89</intParm>
    <intParm name="rcdsReturned">89</intParm>
    <hexBinaryParm name="rqsHandle" totalBytes="4">
        00000001</hexBinaryParm>
    <intParm name="rcdLength">62</intParm>
    <stringParm name="infoComplete" length="1">C</stringParm>
    <stringParm name="dateCreated" length="7">
        1030321</stringParm>
    <stringParm name="timeCreated" length="6">
        120927</stringParm>
    <stringParm name="listStatus" length="1">2</stringParm>
    <hexBinaryParm totalBytes="1"></hexBinaryParm>
    <unsignedIntParm name="lengthOfInfo">
        5518</unsignedIntParm>
    <intParm name="firstRecord">1</intParm>
</structParm>
<intParm name="rcdsToReturn" passDirection="in">264</intParm>
<stringParm name="format" passDirection="in" length="10">
    AUTU0150</stringParm>
<stringParm name="selection" passDirection="in" length="10">
    *USER</stringParm>
<stringParm name="member" passDirection="in" length="10">
    *NONE</stringParm>
<intParm name="errorCode" passDirection="in">0</intParm>
</parameterList>
</program>
</xpcml>

```

## Example: Passing in parameter values as XPCML

Program parameter values can be set in the XPCML source file. When the XPCML is read in and parsed, the ProgramCallDocument setValue method is called automatically for each parameter whose value has been passed in as XPCML. This relieves the user from having to write Java code to set the values of complicated structures and arrays.

In the following examples, the XPCML calls two different programs, prog1 and prog2. Both programs use the input parameter s1Ref. The first example sets different values for s1Ref for each program call. The second example specifies the same value for s1Ref for each program call, which illustrates a useful way to set constant data values for input parameters.

## Example: Passing in different values for input paramters

In the following example, after the XML parser reads in and parses the document, the value of element prog1.s1Ref.s2Ref.s2p1[0] is prog1Val\_1 and the value of element prog1.s1Ref.s2Ref.s2p1[1] is prog1Val\_2.

```

<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">

    <struct name="s1">
        <stringParm name="s1p1"/>
        <structParm name="s2Ref" struct="s2"/>
    </struct>

    <struct name="s2">

```

```

    <stringParm name="s2p1" length="10"/>
  <ArrayOfStringParm name="parm1" count="2"/>
</struct>

<program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
  <parameterList>
    <structParm name="s1Ref" struct="s1" passDirection="in" >
      <stringParm name="s1p1">prog1Val</stringParm>
      <structParm name="s2Ref" struct="s2">
        <stringParm name="s2p1" length="10">prog1Val</stringParm>
        <ArrayOfStringParm name="parm1" count="2">
          <i>prog1Val_1</i>
          <i>prog1Val_2</i>
        </ArrayOfStringParm>
      </structParm>
    </structParm>
  </parameterList>
</program>

<program name="prog2" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
  <parameterList>
    <structParm name="s1Ref" struct="s1" passDirection="in" >
      <stringParm name="s1p1">prog2Val</stringParm>
      <structParm name="s2Ref" struct="s2">
        <stringParm name="s2p1" length="10">prog2Val</stringParm>
        <ArrayOfStringParm name="parm1" count="2">
          <i>prog2Val_1</i>
          <i>prog2Val_2</i>
        </ArrayOfStringParm>
      </structParm>
    </structParm>
  </parameterList>
</program>
</xpcml>

```

### Example: Passing in constant values for input paramters

In the following example, after the XML parser reads in and parses the document, the value of element prog1.s1Ref.s2Ref.s2p1[0] is constantVal\_1 and the value of element prog1.s1Ref.s2Ref.s2p1[1] is constantVal\_2.

```

<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">

  <struct name="s1" >
    <stringParm name="s1p1">constantVal</stringParm>
    <structParm name="s2Ref" struct="s2"/>
  </struct>

  <struct name="s2">
    <stringParm name="s2p1" length="10">constantVal</stringParm>
    <ArrayOfStringParm name="parm1" count="2">
      <i>constantVal_1</i>
      <i>constantVal_2</i>
    </ArrayOfStringParm>
  </struct>

  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <structParm name="s1Ref" struct="s1" passDirection="in" />
    </parameterList>
  </program>

  <program name="prog2" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <structParm name="s1Ref" struct="s1" passDirection="in" />
    </parameterList>
  </program>
</xpcml>

```

### Examples: Passing in arrays of parameter values as XPCML

The following example illustrates how to pass in arrays of parameter values by using structParm array data and an array of structs.

When using XPCML to pass in array data, you must use the count attribute:

- Specify the count attribute on the array element
- Set the count attribute to the number of elements that the array contains at the time you parse the document

```

<?xml version="1.0" encoding="UTF-8"?>
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">

  <struct name="s1" >
    <stringParm name="s1p1"/>
    <struct name="s1Array">
      <stringParm name="s1Ap1"/>
    </struct>
  </struct>

  <struct name="s2">
    <stringParm name="s2p1"/>
  </struct>

  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <structParm name="s1Ref" struct="s1" passDirection="in" >
        <stringParm name="s1p1">Value 1</stringParm>
        <arrayOfStruct name="s1Array" count="2">
          <struct_i>
            <stringParm name="s1Ap1">Value 1</stringParm>
          </struct_i>
          <struct_i>
            <stringParm name="s1Ap1">Value 2</stringParm>
          </struct_i>
        </arrayOfStruct>
      </structParm>
      <arrayOfStructParm name="s2Ref" struct="s2" count="2" passDirection="in" >
        <struct_i>
          <stringParm name="s2p1">Value 1</stringParm>
        </struct_i>
        <struct_i>
          <stringParm name="s2p1">Value 2</stringParm>
        </struct_i>
      </arrayOfStructParm>
    </parameterList>
  </program>
</xpcml>

```

For example, the following XPCML specifies an array of 3 intParms and sets the first element to 12, the second to 100, and the third to 4:

```

<?xml version="1.0" ?>
<xpcml version="4.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation='xpcml.xsd' >
  <program name="prog1" path="/QSYS.lib/MYLIB.lib/PROG1.pgm">
    <parameterList>
      <arrayOfIntParm name="intArray" count="3">
        <i>12</i>
        <i>100</i>
        <i>4</i>
      </arrayOfIntParm>
    </parameterList>
  </program>
</xpcml>

```

## Using the index attribute of the <i> and <struct\_i> tags to set array values

You can use the index attribute of the <i> and <struct\_i> tags to help you set array values. In the following example, the XPCML sets the first element of the array to 4, the second to 100, and the third to 12.

```

<?xml version="1.0" ?>
<xpcml version="4.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation='xpcml.xsd' >

  <program name="prog1" path="/QSYS.lib/MYLIB.lib/PROG1.pgm">
    <parameterList>
      <arrayOfIntParm name="intArray" count="3">
        <i index="2">12</i>
        <i index="1">100</i>
      </arrayOfIntParm>
    </parameterList>
  </program>
</xpcml>

```

```

        <i index="0">4</i>
    </arrayOfIntParm>
</parameterList>
</program>
</xpcml>

```

## Example: Condensing an existing XPCML document

The following example illustrates how to condense an existing XPCML document. The example includes original XPCML source, the resulting condensed XPCML, and the extended schema.

### Original XPCML source

```

<?xml version="1.0" encoding="UTF-8"?>
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">
  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <stringParm name="parm1" passDirection="in" passMode="value"
        minvrm="V5R2M0" ccsid="37" length="10">Value 1</stringParm>
    </parameterList>
  </program>
</xpcml>

```

### Condensed XPCML source

```

<?xml version="1.0" encoding="UTF-8"?>
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="myXSD.xsd" version="4.0">
  <program name="prog1" path="/QSYS.LIB/W95LIB.LIB/PROG1.PGM">
    <parameterList>
      <parm1_>Value 1</parm1_>
    </parameterList>
  </program>
</xpcml>

```

### Generated schema

```

<!-- parm1's XSD definition -->
<xs:schema xmlns:xs='http://www.w3.org/2001/XMLSchema'>
  <!-- Link back to XPCML.xsd -->
  <xs:include schemaLocation='xpcml.xsd' />
  <xs:element name="parm1_" substitutionGroup="stringParmGroup" >
    <xs:complexType>
      <xs:simpleContent>
        <xs:restriction base="stringParmType">
          <!-- Attributes defined for parm1 -->
          <xs:attribute name="name" type="string50" fixed="parm1" />
          <xs:attribute name="length" type="xs:string" fixed="10" />
          <xs:attribute name="passMode" type="xs:string" fixed="value" />
          <xs:attribute name="ccsid" type="xs:string" fixed="37" />
          <xs:attribute name="minvrm" type="xs:string" fixed="V5R2M0" />
        </xs:restriction>
      </xs:simpleContent>
    </xs:complexType>
  </xs:element>
</schema>

```

## Example: Condensing an existing XPCML document, including Java code

The following example illustrates how to condense an existing XPCML document. The example includes original XPCML source, the resulting condensed XPCML, the Java code that calls `condenseXPCML()`, and a few of the newly generated type definitions in the extended schema.

### Original XPCML source

```

<!-- Fully specified XPCML source -->
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

```



```

        xsi:noNamespaceSchemaLocation="xpcml.xsd" version="4.0">
<struct name="qualifiedJobName">
  <stringParm name="jobName" length="10">*</stringParm>
  <stringParm name="userName" length="10"/>
  <stringParm name="jobNumber" length="6"/>
</struct>

<struct name="jobi0100">
  <intParm name="numberOfBytesReturned"/>
  <intParm name="numberOfBytesAvailable"/>
  <structParm name="qualifiedJobName" struct="qualifiedJobName"/>
  <hexBinaryParm name="internalJobIdentifier" totalBytes="16"/>
  <stringParm name="jobStatus" length="10"/>
  <stringParm name="jobType" length="1"/>
  <stringParm name="jobSubtype" length="1"/>
  <stringParm length="2"/>
  <intParm name="runPriority"/>
  <intParm name="timeSlice"/>
  <intParm name="defaultWait"/>
  <stringParm name="purge" length="10"/>
</struct>

<program name="qusrjobi_jobi0100" path="/QSYS.LIB/QUSRJOBI.PGM">
  <parameterList>
    <structParm name="receiverVariable" passDirection="out"
      outputSize="lengthOfReceiverVariable" struct="jobi0100"/>
    <intParm name="lengthOfReceiverVariable" passDirection="in">86</intParm>
    <stringParm name="formatName" passDirection="in" length="8">JOBi0100</stringParm>
    <structParm name="qualifiedJobName" passDirection="in" struct="qualifiedJobName"/>
    <hexBinaryParm name="internalJobIdentifier"
      passDirection="in" totalBytes="16"> </hexBinaryParm>
    <intParm name="errorCode" passDirection="in">0</intParm>
  </parameterList>
</program>
</xpcml>

```

## Java code to condense the original XPCML source

```

try {
    FileInputStream fullStream = new FileInputStream("myXPCML.xpcml");
    FileOutputStream condensedStream = new FileOutputStream("myCondensedXPCML.xpcml");
    FileOutputStream xsdStream = new FileOutputStream("myXSD.xsd");
    ProgramCallDocument.condenseXPCML(fullStream, xsdStream, condensedStream, "myXSD.xsd");
}
catch (Exception e) {
    System.out.println("error: - "+e.getMessage());
    e.printStackTrace();
}

```

## Condensed XPCML source: myCondensedXPCML.xpcml

```

<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="myXSD.xsd" version="4.0">
<struct name="qualifiedJobName">
  <jobName_>*</jobName_>
  <userName_/>
  <jobNumber_/>
</struct>

<struct name="jobi0100">
  <numberOfBytesReturned_/>
  <numberOfBytesAvailable_/>
  <structParm name="qualifiedJobName" struct="qualifiedJobName"/>
  <internalJobIdentifier_/>
  <jobStatus_/>
  <jobType_/>
  <jobSubtype_/>
  <stringParm length="2"/>
  <runPriority_/>
  <timeSlice_/>
  <defaultWait_/>
  <purge_/>
</struct>

```

```

<program name="qusrjobi_jobi0100" path="/QSYS.LIB/QUSRJOBI.PGM">
  <parameterList>
    <structParm name="receiverVariable" passDirection="out"
      outputSize="lengthOfReceiverVariable" struct="jobi0100"/>
    <lengthOfReceiverVariable_>86</lengthOfReceiverVariable_>
    <formatName_>JOB0100</formatName_>
    <structParm name="qualifiedJobName" passDirection="in" struct="qualifiedJobName"/>
    <internalJobIdentifier_> </internalJobIdentifier_>
    <errorCode_>0</errorCode_>
  </parameterList>
</program>
</xpcml>

```

## Some type definitions from the generated schema: myXSD.xsd

```

<xs:schema xmlns:xs='http://www.w3.org/2001/XMLSchema'>
<xs:include schemaLocation='xpcml.xsd' />

<xs:element name="jobName_" substitutionGroup="stringParmGroup" >
  <xs:complexType>
    <xs:simpleContent>
      <xs:restriction base="stringParmType">
        <xs:attribute name="name" type="string50" fixed="jobName" />
        <xs:attribute name="length" type="xs:string" fixed="10" />
      </xs:restriction>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>

<xs:element name="userName_" substitutionGroup="stringParmGroup" >
  <xs:complexType>
    <xs:simpleContent>
      <xs:restriction base="stringParmType">
        <xs:attribute name="name" type="string50" fixed="userName" />
        <xs:attribute name="length" type="xs:string" fixed="10" />
      </xs:restriction>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>

<xs:element name="jobNumber_" substitutionGroup="stringParmGroup" >
  <xs:complexType>
    <xs:simpleContent>
      <xs:restriction base="stringParmType">
        <xs:attribute name="name" type="string50" fixed="jobNumber" />
        <xs:attribute name="length" type="xs:string" fixed="6" />
      </xs:restriction>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>

<xs:element name="lengthOfReceiverVariable_" substitutionGroup="intParmGroup" >
  <xs:complexType>
    <xs:simpleContent>
      <xs:restriction base="intParmType">
        <xs:attribute name="name" type="string50" fixed="lengthOfReceiverVariable" />
        <xs:attribute name="passDirection" type="passDirectionType" fixed="in" />
      </xs:restriction>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>

<xs:element name="formatName_" substitutionGroup="stringParmGroup" >
  <xs:complexType>
    <xs:simpleContent>
      <xs:restriction base="stringParmType">
        <xs:attribute name="name" type="string50" fixed="formatName" />
        <xs:attribute name="length" type="xs:string" fixed="8" />
        <xs:attribute name="passDirection" type="passDirectionType" fixed="in" />
      </xs:restriction>
    </xs:simpleContent>
  </xs:complexType>
</xs:element>

<!-- More type definitions for each newly defined type follow here -->
</xs:schema>

```

## Example: Using condensed XPCML to create a ProgramCallDocument object

Some ProgramCallDocument constructors accept a condensedXPCML source file and corresponding schema (.xsd file). This enables you to use condensed XPCML to create a ProgramCallDocument object.

The previously mentioned constructors require that you provide the following parameters:

- A String that specifies a condensed XPCML file
- An InputStream that contains the type definitions created by running condenseXPCML()

Using these constructors loads and parses a condensed XPCML file. Additionally, the process logs any parse errors. After completing the parse, the constructor creates a ProgramCallDocument object.

The following Java code example uses condensed XPCML to create a ProgramCallDocument object. The example code assumes the following

- The name of the condensed XPCML file is myCondensedXPCML.xpcml
- The name of the extended schema is myXSD.xsd

The code then uses the ProgramCallDocument object to run program qusrjobi\_job0100.

```
AS400 system = new AS400();
// Create a ProgramCallDocument and parse the file.
ProgramCallDocument xpcmlDoc =
    new ProgramCallDocument(system,
        "myCondensedXPCML.xpcml",
        new FileInputStream("myXSD.xsd"));
boolean rc = xpcmlDoc.callProgram("qusrjobi_job0100");
```

**Note:** The XPCML code that you use to call the program (after creating the ProgramCallDocument object) is the same as the code you would use with PCML.

## Example: Obtaining program call results as condensed XPCML

You use the same process to obtain the results of a program call as condensed XPCML or noncondensed XPCML by calling ProgramCallDocument.generateXPCML().

Use setXsdName() to specify the name of the extended schema, which generateXPCML() uses to generate the noNamespaceSchemaLocation attribute of the <xpcml> tag in the condensed XPCML.

Using setXsdName() is important when you want to use the program call results (in condensed XPCML) as source for another ProgramCallDocument object. You must specify the name of the extended schema so that the parser knows which schema file to use when parsing.

For example, the following code obtains the results from a program call and generates condensed XPCML.

```
AS400 system = new AS400();

// Create a ProgramCallDocument and parse the file.
ProgramCallDocument xpcmlDoc =
    new ProgramCallDocument(system, "myCondensedXPCML.xpcml", new
FileInputStream("myXSD.xsd"));

boolean rc = xpcmlDoc.callProgram("qusrjobi_job0100");

if (rc)    // Program was successful
{
    xpcmlDoc.setXsdName("myXSD.xsd");
    xpcmlDoc.generateXPCML("qusrjobi_job0100", "XPCMLOut.xpcml");
}
```

The following code shows an example of obtaining program call results as condensed XPCML:

```
<xpcml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="myXSD.xsd" version="4.0">

<program name="qusrjobi_job0100" path="/QSYS.LIB/QUSRJOBI.PGM">
  <parameterList>
    <structParm name="receiverVariable" passDirection="out"
        outputSize="lengthOfReceiverVariable" struct="job0100"/>
  </parameterList>
</program>
```

```

        <numberOfBytesReturned_>100</numberOfBytesReturned_>
        <numberOfBytesAvailable_>100</numberOfBytesAvailable_>
        <structParm name="qualifiedJobName"
            struct="qualifiedJobName">
            <jobName_>*</jobName_>
            <userName_>/>
            <jobNumber_>/>
        </structParm>
        <internalJobIdentifier_>/>
        <jobStatus_>ACTIVE</jobStatus_>
        <jobType_>PJ</jobType_>
        <jobSubtype_>/>
        <stringParm length="2"/>
        <runPriority_>5</runPriority_>
        <timeSlice_>/>
        <defaultWait_>10</defaultWait_>
        <purge_>/>
    </structParm>
    <lengthOfReceiverVariable_>86</lengthOfReceiverVariable_>
    <formatName_>JOB10100</formatName_>
    <structParm name="qualifiedJobName" passDirection="in" struct="qualifiedJobName"/>
    <internalJobIdentifier_> </internalJobIdentifier_>
    <errorCode_>0</errorCode_>
</parameterList>
</program>
</xpcml>

```

## Example: Presenting a resource list in a servlet

Use the ResourceListRowData class in conjunction with the HTMLFormConverter or HTMLTableConverter class to present a resource list in a servlet.

- HTMLFormConverter displays the contents of the resource list as a series of forms, where each form contains attribute values for a resource in the resource list.
- HTMLTableConverter displays the contents of the resource list as a table, with each row contains information about a resource in the resource list.

The columns for a ResourceListRowData object are specified as an array of column attribute IDs while each row represents a resource object.

```

// Create the resource list. This example creates
// a list of all messages in the current user's message
// queue.
AS400 system = new AS400("MYSYSTEM", "MYUSERID", "MYPASSWORD");
RMessageQueue messageQueue = new RMessageQueue(system, RMessageQueue.CURRENT);

// Create the ResourceListRowData object. In this example,
// there are four columns in the table. The first column
// contains the icons and names for each message in the
// message queue. The remaining columns contain the text,
// severity, and type for each message.
ResourceListRowData rowdata = new ResourceListRowData(messageQueue,
    new Object[] { null, RQueuedMessage.MESSAGE_TEXT, RQueuedMessage.MESSAGE_SEVERITY,
        RQueuedMessage.MESSAGE_TYPE } );

// Create HTMLTable and HTMLTableConverter objects to
// use for generating and customizing the HTML tables.
HTMLTable table = new HTMLTable();
table.setCellSpacing(6);
table.setBorderWidth(8);

HTMLTableConverter converter = new HTMLTableConverter();
converter.setTable(table);
converter.setUseMetaData(true);

// Generate the HTML table.
String[] html = converter.convert(rowdata);
System.out.println(html[0]);

```




## Related information for IBM Toolbox for Java

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The following list includes Web sites and Information Center topics that relate to the IBM Toolbox for Java information.



### IBM Toolbox for Java resources

Use the following sites to learn more about the IBM Toolbox for Java:



- [IBM Toolbox for Java and JTOpen](#) : Offers information about service packs, performance tips, examples, and much more. You can also download a zipped package of this information, including the Javadocs.
- [IBM Toolbox for Java Frequently Asked Questions \(FAQ\)](#) : Provides answers to questions about performance, troubleshooting, JDBC, and more.
- [IBM Toolbox for Java and JTOpen forum](#) : Offers an effective way to communicate with the community of Java programmers who use IBM Toolbox for Java and the IBM Toolbox for Java developers themselves.

### Java

Java is a programming language that allows you to develop portable object-oriented applications and applets. Use the following sites to learn more about Java:

- [IBM developerWorks® Java technology zone](#) : Offers information, education, and tool to help you use Java, IBM products, and other technologies to create business solutions.
- [The Source for Java Developers](#) : Offers information about the various uses for Java, including new technologies.

### Java Naming and Directory Interface


- [Java Naming and Directory Interface \(JNDI\)](#) : Offers an overview of JNDI, technical information, examples, and a list of available service providers.
- [IBM i LDAP](#) : Provides information about LDAP (Lightweight Directory Access Protocol) on IBM i.

### Java Secure Socket Extension

- [Java SE Security](#) : Offers a brief overview of JSSE and links to more information.


### Servlets


Servlets are small Java programs that run on a server and mediate requests from one or many clients (each of which runs in a browser) to one or more databases. Because servlets are programmed in Java, they can execute requests as multiple threads within a single process, thereby saving system resources. Use the following sites to learn more about servlets:

- [Java Servlet technology](#) : Provides technical information, instructions, and tools to help you understand and use servlets.

### XHTML






XHTML is touted as the successor to HTML 4.0. It is based on HTML 4.0, but incorporates the extensibility of XML. Use following sites to learn more about XHTML:

- [The Web Developer's Virtual Library](#) : Offers an introduction to XHTML, including examples and links to additional information.





- [W3C](#) : Provides technical information about XHTML standards and recommendations.

## XML

Extensible Markup Language (XML) is a metalanguage that allows you to describe and organize information in ways that are easily understandable by both humans and computers. A metalanguage allows you to define a document markup language and its structure. Use the following sites to learn more about XML:

- [IBM developerWorks XML zone](#) : Provides a site dedicated to the work IBM does with XML and how it works to facilitate e-commerce
- [W3C XML](#) : Offers technical resources for XML developers.
- [XML.com](#) : Offers updated information about XML in the computer industry
- [XML.org](#) : Provides news and information about the XML community, including industry news, calendars of events, and more.
- [XML Cover Pages](#) : Provides a comprehensive online reference work for XML, SGML, and related XML standards, like XSL and XSLT.

## Other references

- [IBM HTTP Server for i](#) : Provides information, resources, and tips about the IBM HTTP Server for i.
- [IBM i Access](#) : Offers information about IBM i Access, including downloads, FAQs, and links to additional sites.
- [IBM WebSphere® Host On-Demand](#) : Provides information about the browser-based emulator that offers support for S/390®, IBM i, and DEC/Unix emulation.
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