A New Era of Computing

John Kelly
Senior Vice President and Director, Research
IBM Research: The world is our lab
IBM Research: *Global and vertically integrated*

- **industry expertise**
- **analytics**
- **services tools & assets**
- **cloud**
- **future systems**
- **processors/storage /switching**
- **nanotechnologies**

© 2012 International Business Machines Corporation
Impact: *Services contributions by IBM Research*

100s of tools and solutions delivered

**Productivity + Quality**
- Migration to Cloud
- Automated Test Planning and Optimization
- CoBRA- Corporate Brand Analysis
- Solution Definition Manager
- Workbench for Packaged Applications
- Global Delivery Framework Productivity
- Predictive Analytics for Delivery Excellence
- Server & Storage Management Automation
- Many more

**New Client Value**
- Application Assembly Optimization
- Secure ID Card Solutions
- Component Business Modeling
- Intelligent Document Gateway
- Smarter City Resource Management
- Global Expense Reporting System
- Healthcare Benefit Analyzer
- Workforce Management Analytics
- Voice of the Customer Analytics
- Many more
Automated software testing for increased services revenue and margin

- Defect prevention
  - Improved Review Process and Tools
  - Document Analytics
- Improved test effectiveness
  - Use Case Analysis and Test Case Generation
  - Code Analysis
- Improved test efficiency
  - Coverage-Based Test Selection
  - Change-Based Test Selection
  - Test Script Generation from Natural Language
  - Application Virtualization
  - CTD Test Selection
  - CTD Test Data Selection
  - CTD Test Generation
  - CTD Test Enhancement
  - Change-Based Test Enhancement
  - Coverage-Based Test Enhancement

© 2012 International Business Machines Corporation
Leading IBM: *Eras of computing*

- Tabulating Systems Era
- Programmable Systems Era
- Cognitive Systems Era
Cognitive Systems: A new era of computing

Programmable Systems Era
- Processor-centric
- Fixed calculation
- Scale up/out
- Manual systems management

Cognitive Systems Era
- Data-centric
- Statistical analytics
- Scale in
- Automated systems/workload management
Big Data: *Why we must move to a new era of computing*

**Uncertain data on the rise**
- Sensors & Devices
- Social Media
- VoIP
- Enterprise Data

**Dimensions of data growth**
- **Volume**: Terabytes to exabytes of existing data to process
- **Velocity**: Streaming data, milliseconds to seconds to respond
- **Variety**: Structured, unstructured, text, multimedia
- **Veracity**: Uncertainty from inconsistency, ambiguities, etc.

**Volume in Exabytes**
- 2010: 2500
- 2015: 9000

**Sectors**
- Sensors & Devices
- Social Media
- VoIP
- Enterprise Data

**Media Types**
- Social Media
- Enterprise Data
- Sensors & Devices
- VoIP

**Uncertainty**
- Inconsistency
- Ambiguities

© 2012 International Business Machines Corporation
An Analytical System: **Taking Watson beyond Jeopardy!™**

**Current**

- **Specific questions**
- **Batch training**
- **Statistical analytics**
- **Statistical ranking**

**Future**

- **Rich problem scenarios**
- **Interactive dialogue**
- **Continuous learning**
- **Evidence profiles**

*This poet wrote to a friend, “We are by September and yet my flowers are as bold as June. Amherst has gone to Eden.”*
Progress in the Programmable Systems Era

- **Scale up**
- **Scale out**
- **Scale down**

© 2012 International Business Machines Corporation
A New Paradigm for Cognitive Systems

Cognitive Systems Attributes
- Embedded analytics
- Automated systems/workload management
- Optimized for big/fast data
- True cloud-in-a-box

Storage
Switching
Memory
Processor

© 2012 International Business Machines Corporation
A New Paradigm for Cognitive Systems
A New Paradigm for Cognitive Systems
Scale-in: Automated system/workload management

**Scale up/out**

- **Past**
  - Applications
  - Multiple VMs
- **Present**
  - Smart Workload Deployer
  - Workload building blocks
  - Patterns
  - Expertise
  - Open
- **Future + IBM Pure System**
  - Workload Building Blocks
  - Infrastructure Building Blocks
  - Servers

**Scale in**

- Workload building blocks
- Patterns
- Expertise
- Open
Exploring the Future of Cognitive Systems

Cognitive Systems Era

Far-reaching research

Applications

Architectures

Core Technology
Cognitive Systems: *Atomic storage*

Atomic limits of magnetic storage

96 iron atoms store one byte of data

IBM Research explores the boundaries of science and technology
Cognitive Systems: Quantum computing

Extraordinary capabilities are expected…factoring a 3,000 digit number $10^{40}$ faster than today.

Superconducting qubits use established manufacturing techniques for silicon technology. Potential for dramatic advances in cryptanalysis, database sorting, pharmaceutical research. IBM is the world leader in this technology.
Cognitive Systems: SyNAPSE

- “Neuron” and “synapse” -like computing model
- Systems learn through analytics/experience
- Advantages: Ultra energy-efficient, flexible, learning
Social Business

Human and knowledge capital analytics
Optimize sales through insights about sellers, teams, deals, clients, and performance.

Sensor Networks

Transmission line
Feeder line
Electric car
Intelligent building
Automated meters
Substation

Millions of end points
100K+ elements, 10ms latency
Multiple feedback time-scales

Watson

Smarter Cities

Social / Demographic
Technological
Environmental
Economic

Social Business

Watson

Future Technologies and New Industries
(2012 - 2015)

Specific questions
Interactive dialogue
Problem scenarios

Question-in, answer-out
Precise answers
Evidence profiles

Batch ‘training’
Continuous learning

IBM Research Project (2006)
Jeopardy! Grand Challenge (Feb 2011)
R&D
Demonstration
Industry Expansion
Commercialization

IBM Investor Briefing
Cognitive Systems: Applications
Mark G. Kris, MD
Chief, Thoracic Oncology Service
William and Joy Ruane Chair in Thoracic Oncology
Memorial Sloan-Kettering Cancer Center
IBM Research

Leadership
Impact
The World is Our Lab
Certain comments made in the presentation may be characterized as forward looking under the Private Securities Litigation Reform Act of 1995. Those statements involve a number of factors that could cause actual results to differ materially. Additional information concerning these factors is contained in the Company’s filings with the SEC. Copies are available from the SEC, from the IBM web site, or from IBM Investor Relations. Any forward-looking statement made during this event or in these presentation materials speaks only as of the date on which it is made. The Company assumes no obligation to update or revise any forward-looking statements. These charts and the associated remarks and comments are integrally related, and they are intended to be presented and understood together.

In an effort to provide additional and useful information regarding the Company’s financial results and other financial information as determined by generally accepted accounting principles (GAAP), certain materials presented during this event include non-GAAP information. The rationale for management’s use of this non-GAAP information, the reconciliation of that information to GAAP, and other related information is included in supplemental materials entitled “Non-GAAP Supplemental Materials” that are posted on the Company’s investor relations web site at http://www.ibm.com/investor/events/investor0512. The Non-GAAP Supplemental Materials are also included as Attachment II to the Company’s Form 8-K dated May 9, 2012.
IBM Investor Briefing