Help Wanted:
Creating a New Era of
Computing

For AAAI Fall Symposium
November 2014

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Cognitive-science.info

1
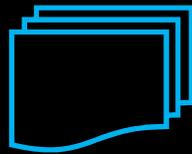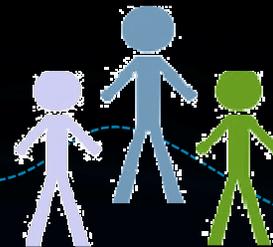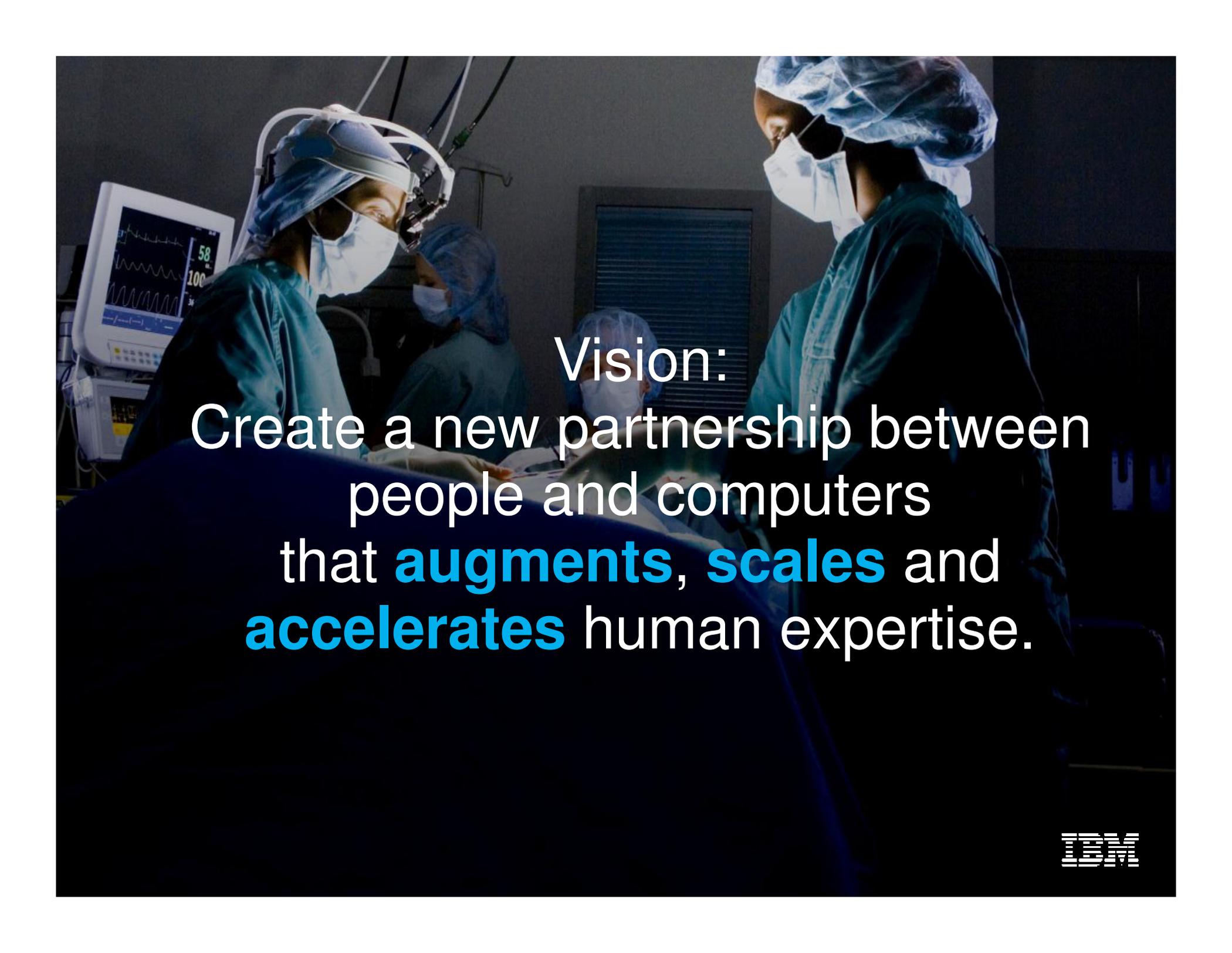
Vision:
Create a new partnership between people and computers
that **augments**, **scales** and **accelerates** human expertise.

IBM

Help Wanted: Collaborators on Creating Cognitive Assistants

TO AUGMENT AND SCALE HUMAN EXPERTISE

HOME   RESEARCH CHALLENGES   INFORMATION   INTERACT   INVEST   IBM COGNITIVE AWARD RECIPIENTS

Introduction to the Cognitive Systems Institute

Enter search term...

Search

Join us for discussions at the Cognitive Systems Institute LinkedIn Group

Cognitive Systems Institute

The Cognitive Systems Institute, a new set of IBM university programs launched in conjunction with IBM Research and the Watson Business Unit, focuses faculty collaborators on building and evaluating cognitive assistants for every profession. The Cognitive Systems Institute centers on professional cognitive assistants that exhibit the three L's – language, learning, and levels to augment and scale human expertise.

Agenda

- The Start of a New Era of Computing

- IBM Watson – What we've been up to

- Cognitive Assistance Vision

- Audience Discussion and Input

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IBM

IBM Research
– Innovation that matters – for our company, for the world

1945 – 1980's

Established hardware/system labs near major universities

1990's – Today

Expand to software and services, globalize labs, deep client engagements

2014 – Future

Leading IBM's future growth
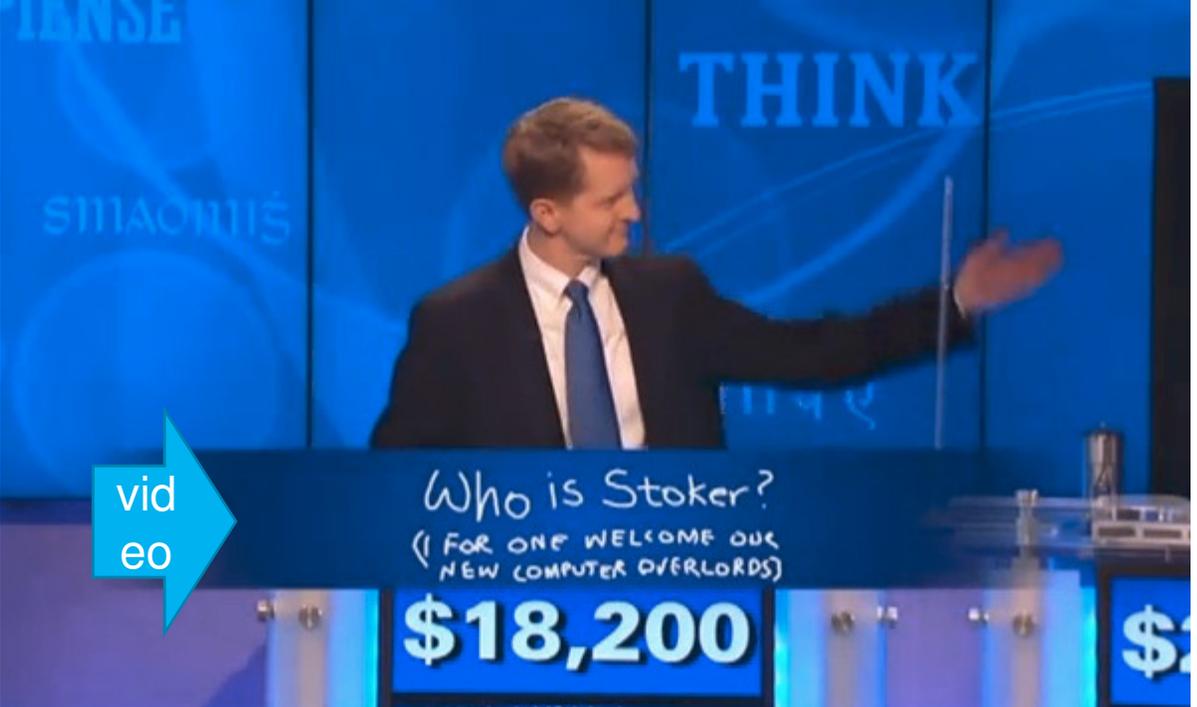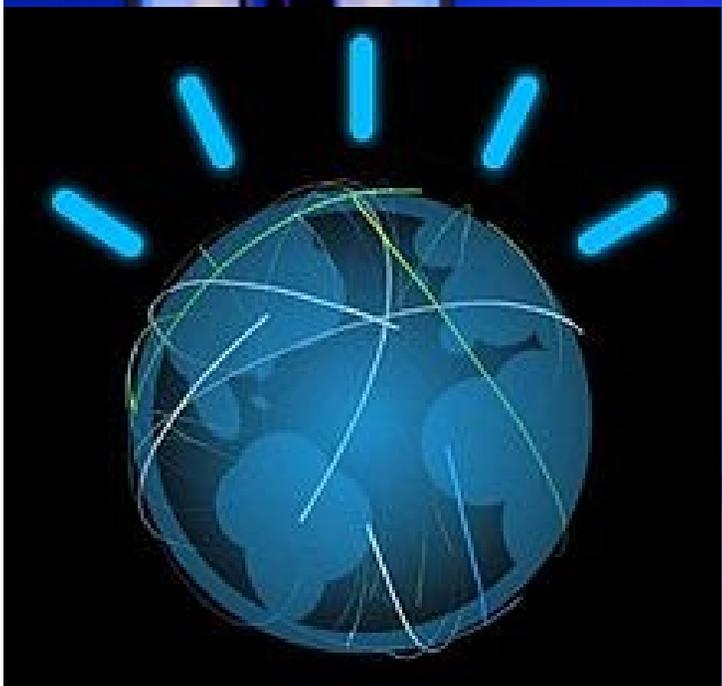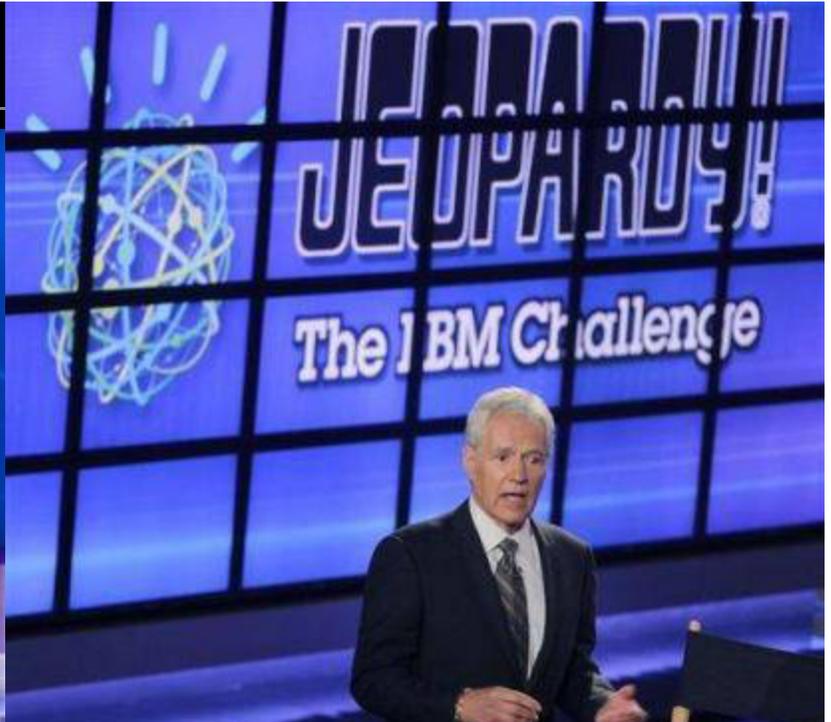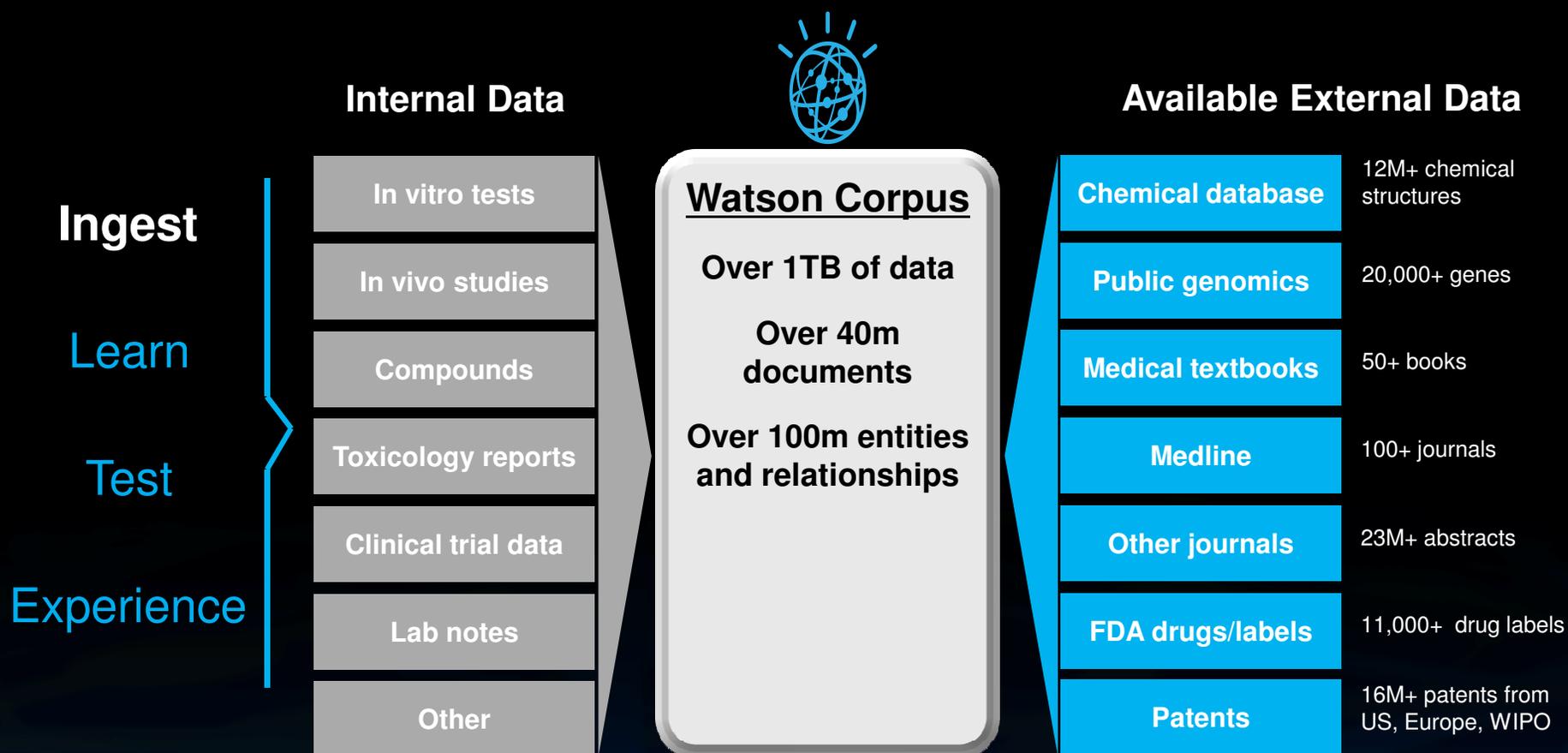
Annotators allow Watson to read and extract appropriate information

> …*doxorubicin results in extracellular signal-regulated kinase (ERK)2 activation, which in turn phosphorylates p53 on a previously uncharacterized site, Thr55…*

Ingest

Learn

Test

Experience

ERK2 - - - ▶ Extracts Entities
- ERK2 = Protein, P53 = Protein, Thr55 = Amino Acid

phosphorylates - - - ▶ Extracts Verb
- Maps to domain of Post Translational Modification
- Recognizes subject / object relationships

p53 - - - ▶ Extracts Entities
- ERK2 = Protein, P53 = Protein, Thr55 = Amino Acid

on - - - ▶ Extracts Preposition
- Recognizes preposition location on Thr55

Thr55 - - - ▶ Extracts Entities
- ERK2 = Protein, P53 = Protein, Thr55 = Amino Acid

Watson evaluates supporting evidence

| Question | Search Corpus | Extract Evidence | Score & Weigh |

Ingest

Learn

Test

Experience

What genes contribute to developing colon cancer?

- Side Effects
- Lab Notes
- Genes
- Publications
- Drugs
- Animal Models
- Clinical Trial Data

- Quantity
- Proximity
- Relationship
- Domain Truths/ Business Rules
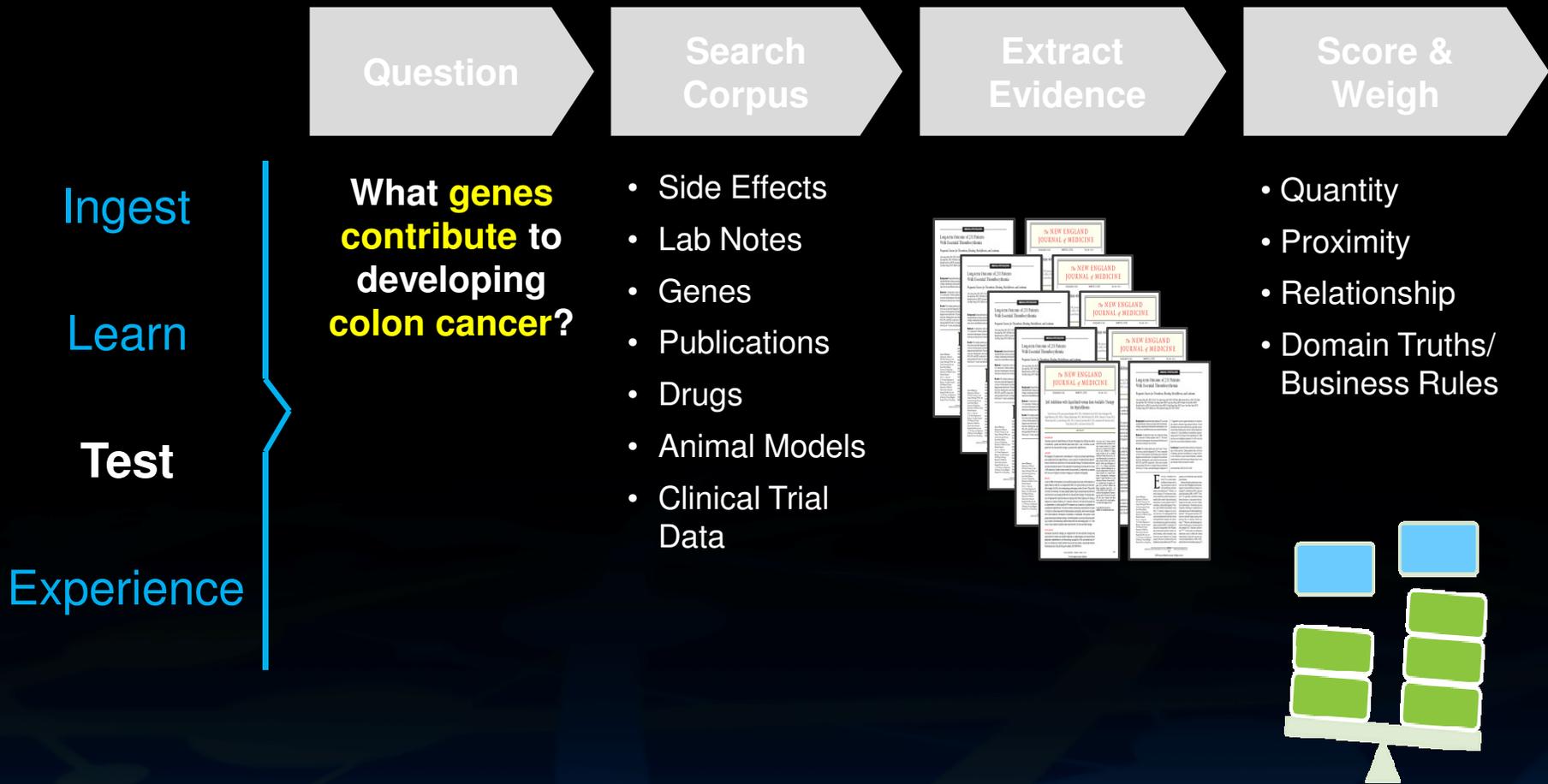
What we learned in Jeopardy!

▪ The DeepQA approach can accurately answer single sentence queries with confidence & speed.

▪Highly dependent on content, content quality, content formats

▪Need a combination of technologies to get satisfactory performance: Semantic Technology, machine learning, information retrieval/search technology, databases, and high performance computing techniques.

▪Both structured and unstructured content need to be combined for best results.

▪Need to extend Watson to handle richer interactions and continuous training/learning
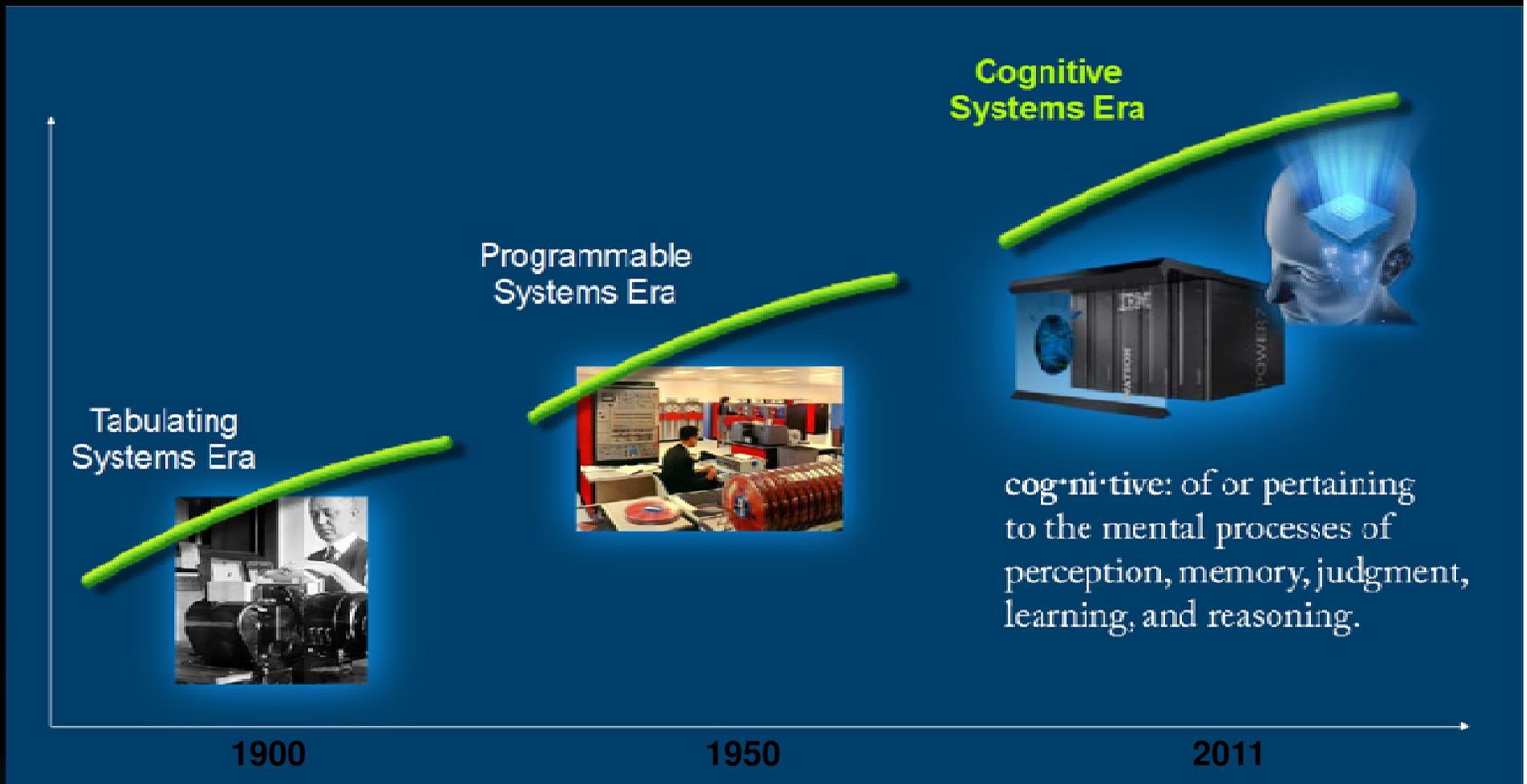
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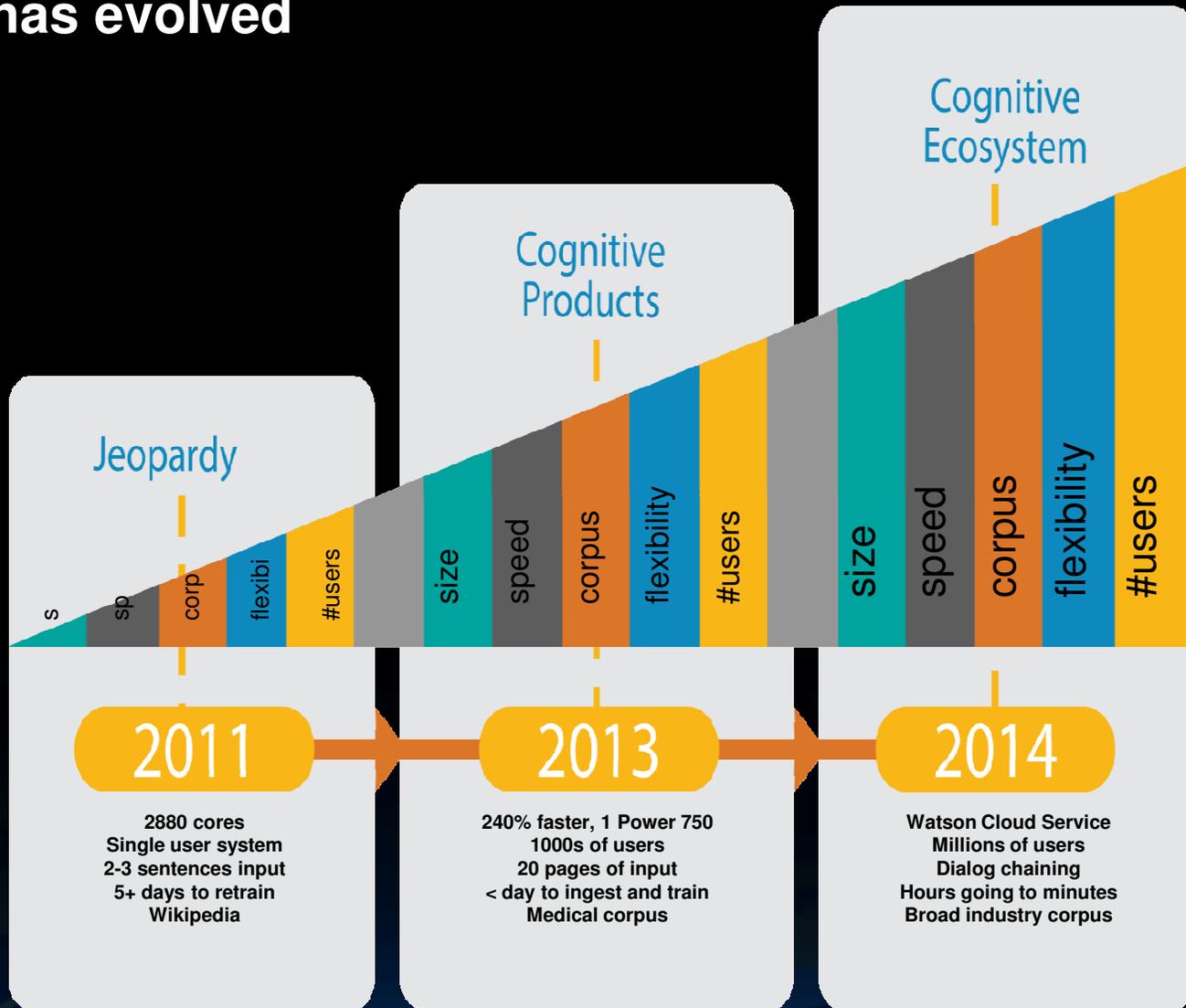
Current Watson Solutions

Engagement

IBM Watson Engagement Advisor

Customers

Transform Customer Experiences

Discovery

IBM Watson Discovery Advisor

Analysts, Acacemics

Accelerate Research and Insights

Decisions

IBM Watson Policy Advisor

Interactive Care Guide & Reviewer

Health Plans & Providers

Streamline authorization of procedures

Interactive Care & Insights for Oncology

Clinicians

Improve Diagnosis and Treatment

Watson Engagement Advisor

Delivering the next wave of customer engagement

What it does

- Automates customer interaction to increase customer engagement in sales and service

- Transforms customer engagement by knowing, engaging and empowering clients

- Develops customer relationships through a transformative user experience

How it does it

- Provides answers not links and webpages

- Answers with evidence not guesses

- Not restricted to a predefined question-answer set

- Learns from every interaction

Watson Discovery Advisor

Accelerate the discovery of new insights by synthesizing information in seconds

- Take advantage of massive sources of data

- Move beyond keyword search

- Find answers to questions that have not been asked yet or answered before

- Find insights into hidden relationships and dig deeper

- Generate leads to valuable insights and provide evidence to substantiate new claims

- Stay current

Helps organizations improve how they answer their clients' needs

Watson Discovery Advisor success stories

	Baylor College of Medicine Genomics Researcher	Large Pharma Infectious Disease Researcher	Large Pharma Toxicologist	Janssen Outcomes Researcher
Expert	Baylor College of Medicine Genomics Researcher	Large Pharma Infectious Disease Researcher	Large Pharma Toxicologist	Janssen Outcomes Researcher
Challenge	Explore New Ways to Target P53	Find Potential in Approved Drugs to Treat Malaria	Identify Safety Issues Faster	Compare Treatments Across thousands of Studies
What Watson Did	Watson analyzed: • thousands of articles instantly • hundreds of kinases	Watson saw: • a universe of complex relationships • connected known MOAs to disease pathways	Watson extracted: • insights from hundreds of toxicology reports	Watson will compare: • many treatments quickly and simultaneously
Result	7 New Potential Targets	11 Drug Candidates	Safety Assessment Time Shortened	Discover Key Differences Faster

Watson Discovery Advisor for Oncologists

Evidence-based test and treatment suggestions

Drawn from 600K+ pieces of evidence and 2M pages of text from 42 publications

Expert training by Memorial Sloan Kettering Oncologists

5000+ physician and analyst training hours

Evolves with the fast-changing field

Improves over time as a learning system with usage and training

Full transparency into sources behind suggestions

Including journal articles, physicians' notes, NCCN guidelines and best practices
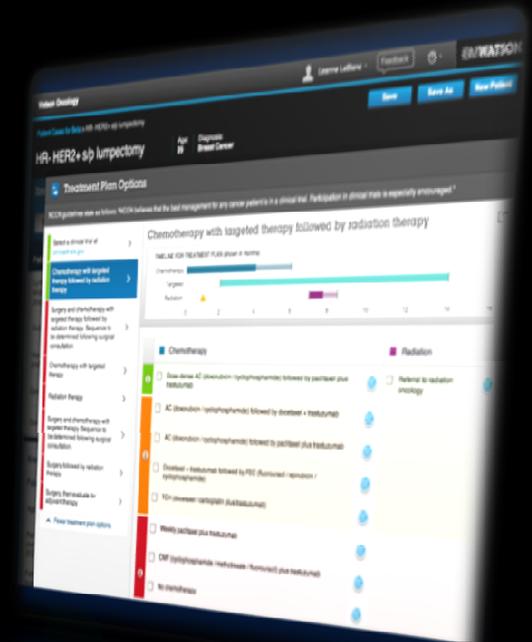
Watson Decision Advisor for Oncology in action

video

Reusable services form the basis for Watson cognitive solutions

IBM Watson Advisors

Cross Industry Editions
- Engagement
- Discovery
- Decision
- Policy

Target Industry Editions
- Oncology
- Wealth Mgmt.
- Intelligence
- Cooking

Core Offerings — Watson Analytics — Watson Explorer

IBM Watson App Store

Powered by Watson Offerings

Industry Aligned	Market Aligned
Healthcare	Call Center
Travel	Research
⋮	⋮
Financial Svc.	User Profiling

IBM Watson Developers Cloud

Specialties
- Models
- Visualize
- Content

Cognitive Services (APIs)

Tooling
- Assemble
- Design
- Train
- Deploy
- Admin

Data Services — Extract — Ingest — Curate — Annotate

The same services are used by business partners, customers, and IBM Developers.

Watson Beta services are available through Watson Developer Cloud hosted on IBM Bluemix
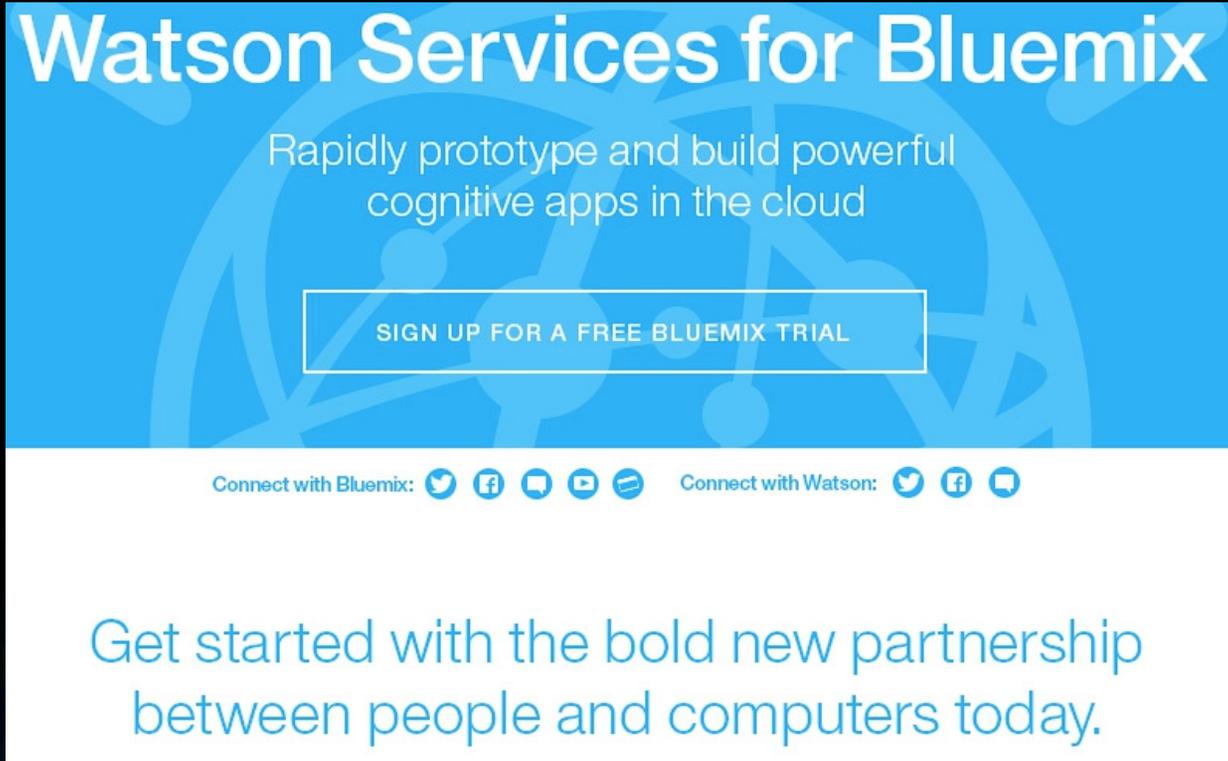
30 day trial is free and is followed by standard Bluemix rates

Watson Beta services available now with more in plan

Available today

Coming

User Modeling
Personality profiling to help engage users on their own terms.

Message Resonance
Communicate with people with a style and words that suits them

Concept Expansion
Maps euphemisms to more commonly understood phrases

Relationship Extraction
Intelligently finds relationships between sentences components

Machine Translation
Translate text from one language to another.

Question and Answer
Direct responses to users inquiries fueled by primary document sources

Visualization Rendering
Graphical representations of data analysis for easier understanding

Language Identification
Identifies the language in which text is written

- Concept Analytics
- Question Generation
- Speech Recognition
- Text to Speech
- Tradeoff Analytics
- Medical Information Extraction
- Semantic Expansion
- Policy Knowledge
- Ontology Creation
- Q&A in other languages
- Policy Evaluation
- Inference detection
- Social Resonance
- Answer Assembler
- Relationship identification
- Dialog
- Machine Translation (French)
- Smart Metadata
- Visual Recommendation
- Industry accelerators

Question and Answer Service

What is it?

Direct responses to users inquiries fueled by primary document sources

How does it work?

Interprets and answers user questions directly based on primary data sources (brochures, web pages, manuals, records, etc.) that have been selected and gathered into a body of data or 'corpus'. The service returns candidate responses with associated confidence levels and links to supporting evidence. The current data corpora on BlueMix focuses on the Travel and Healthcare industries.

Use Cases-

Healthcare: What is a stroke? What is the cause of Wilson Disease?

Travel: Where is the best place to stay in Prague?

Asks a question

Understands question

Produces possible answers and evidence

Analyzes evidence

Computes confidence

Delivers response, evidence and confidence

Considers response and evidence

User Modeling

What is it?

Personality profiling to help engage users on their own terms.

How does it work?

The user Modeling service uses linguistic analytics to extract a set of personality and social traits from the way a person communicates. The service can analyze any communication the user makes available such as their text messages, tweets, posts, email, and more. Users of the service can understand, connect, and communicate with people on a more personally tailored level by analyzing personality and social traits

Use Cases-

The service can analyze text based on a customer's twitter stream to help a travel agency decide between leading with a budget or luxury trip offer

Anywhere improving a customer engagement can help create an organization differentiate itself.

Language Identification

What is it?

Identifies the language in which text is written

How does it work?

The Language Identification service detects the language in which text is written. This helps inform next steps such as translation, voice to text, or direct analysis. The service can be used in tandem with the Machine Translation service. Today, the service can identify 15 languages – Arabic; Chinese (Simplified); Chinese (Traditional); Cyrillic; Danish; Dutch; English; Farsi; Finnish; French; German; Greek; Hebrew; Hindi; Icelandic; Italian; Japanese; Korean; Norwegian (Bokmal); Norwegian (Nynorsk); Portuguese; Spanish; Swedish; Turkish; Urdu

Use Cases-

A building block for Machine Translation and future tech

Launch Demo

Detecting the language of input text

英国利物浦约翰·穆尔斯大学学者威尔金森在研究报告中说，根据一个简单的数学模型显示，蜥脚类恐龙体内微生物制造的甲烷数量可能对中生代气候产生重要影响。

Submit

zh-CN

Machine Translation

What is it?

Globalize on the fly. Translate text from one language to another.

How does it work?

The Machine Translation service converts text input in one language into a destination language for the end user. Translation is available among English, Brazilian Portuguese, Spanish and French.

Use Cases-

A French speaking help desk representative is assisting a Portuguese speaking customer through a chat session and is able to interact through the translation service

Translate your text

Select translation language: English to Spanish ▼ Submit

Message Resonance

What is it?

Communicate with people with a style and words that suits them

How does it work?

The message resonance service analyzes draft content and scores how well it is likely to be received by a specific target audience. This analysis is based on content that's been written by the target audience itself such as fans of a specific sports team or new parents. Today, analysis can be done against people active in cloud computing or discussions but future versions will let users provide their own community data.

Use Cases-

Among people active in cloud computing discussions, option A content is likely to resonate very well, option B poorly, and option C moderately well.
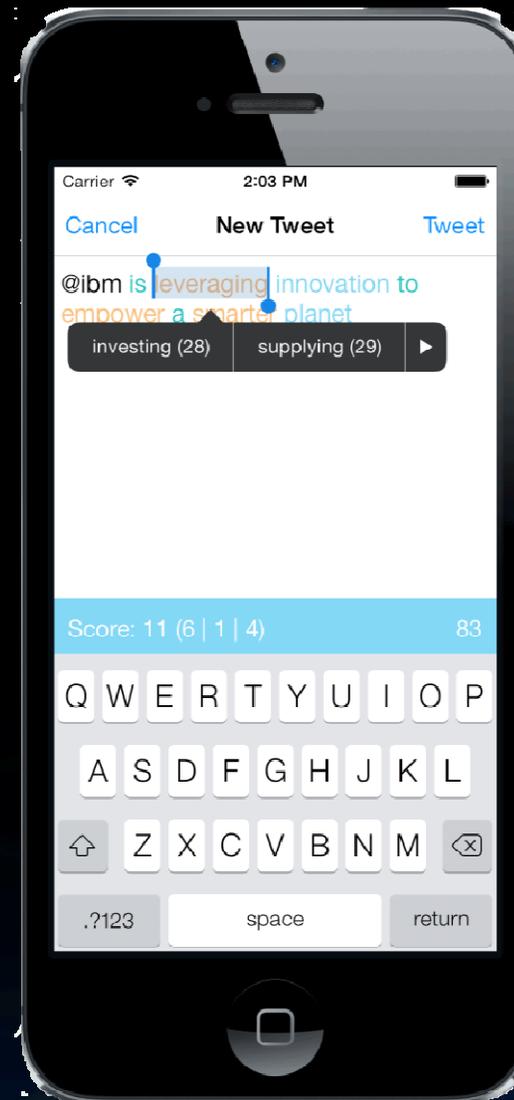
Carrier 2:03 PM

Cancel **New Tweet** Tweet

@ibm is leveraging innovation to empower a smarter planet

investing (28)   supplying (29)   ▶

Score: 11 (6 | 1 | 4)   83

Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
.?123   space   return

Visionary mobile protoype

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Concept Expansion

What is it?

Maps euphemisms or colloquial terms to more commonly understood phrases

How does it work?

The Concept Expansion service analyses text and interprets its meaning based on usage in other similar contexts. For example, it could interpret "The Big Apple" as meaning "New York City". It can be used to create a dictionary of related words and concepts so that euphemisms, colloquialisms, or otherwise unclear phrases can be better understood and analyzed.

Use Cases-

"drugs" can be expanded to:

start seed terms → motrin, aspirin, Keflex

post expansion → allegra, lisinopril, metformin, aspirin, equagesic, cimetidine, fiorinal, vancomycin, avelox, protonix, glimepiride,

Concept Expansion Sample

Label: drugs

Corpus: ● Medical Transcriptions
http://www.mtsamples.com
○ Social Media - WARNING: Might take a couple minutes depending on seed list

Seeds:
motrin
tylenol
aspirin

Submit

Ouput:

Prevalence	Result
24	multivitamin daily , aspirin
19	tricor 145 mg daily , aspirin
14	penicillin
14	abilify 5 mg daily , motrin
12	venom - bee / wasp
12	adhesive tape
10	aspirin , plavix
10	aspirin one tablet daily , tylenol
9	hydrocodone / acetaminophen tablets and motrin
7	insulin sliding scale , tylenol
7	aricept 5 mg daily , tylenol
6	oxazepam 15 mg daily ; aspirin
6	a beta blocker , aspirin
6	nkda . medications : tylenol
6	plenty of fluids . tylenol
6	antiinflammatories or aspirin
6	2 . tylenol
6	d . 2 . tylenol
6	lasix on a
6	none . medications : tylenol
6	plan : 1 . aspirin
5	aspirin . dr
5	sublingual nitro
5	lunesta 2 mg
5	5 . aspirin
5	motrin , lotensin
5	and aspirin
5	advair 250 as needed , aspirin
5	ibuprofen
5	d . 5 . aspirin
5	he may see dr . xyz
5	daily . 17 . aspirin
5	tylenol . now resolved . 2
5	tylenol . now resolved
5	plan : 1 . motrin
5	cardura

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Relationship Extraction

The United States House of Representatives is one of the two houses of the United States Congress (a bicameral legislature). It is frequently referred to as The House. The other house is the Senate.

The composition and powers of the House are established in Article One of the United States Constitution. The major power of the House is to pass federal legislation that affects the entire country, although its bills must also be passed by the Senate and further agreed to by the U.S. President before becoming law (unless both the House and Senate re-pass the legislation with a two-thirds majority in each chamber). The House has some exclusive powers: the power to initiate revenue bills,[1] to impeach officials (impeached officials are subsequently tried in the Senate),[2] and to elect the U.S. President in case there is no majority in the Electoral College.[3]

Each U.S. state is represented in the House in proportion to its population as measured in the census, but every state is entitled to at least one representative. The most populous state, California, currently has 53 representatives. On the other end of the spectrum, there are seven states with only one representative each (Alaska, Delaware, Montana, North Dakota, South Dakota, Vermont, and Wyoming). The total number of voting representatives is fixed by law at 435.[4] Each representative serves for a two-year term. The Speaker of the House, who presides over the chamber, is elected by the members of the House, and is therefore traditionally the leader of the House Democratic Caucus or the House Republican Conference, whichever party has more voting members. The House meets in the south wing of the United States Capitol.

What is it?

Intelligently finds relationships between sentences components (nouns, verbs, subjects, objects, etc.)

How does it work?

Parses sentences into their various components and detects relationships between the components. It can process new terms (like people's names in a news feed) it has never analyzed before through contextual analysis. Sentence components include parts of speech (noun, verb, adjective, conjunction, etc.) and functions (subjects, objects, predicates, etc.). The service maps the relationships between the components so that users or analytics engines can more easily understand the meaning of individual sentences and documents.

Use Cases-

The service can analyze a news article and pull out the relevant people, organization, event type, date/time, or location of actions taken. It then can relate the components such as what adjective describes what noun and what action a subject takes upon what object.

GPE EVENT_COMMUNICATION PEOPLE ORGANIZATION TIME PERSON FACILITY CARDINAL LOCATION DATE EVENT_VIOLENCE

Ukraine said that dozens of pro-Russian separatists were killed in fighting around a regional airport that continued for a second day on Tuesday, forcing schools to close and residents to flee.

Rebel fighters took over Donetsk International Airport early Monday.

prompting the military to deploy helicopters, fighter jets and paratroopers to regain control of the main terminal.

The Journal's reporters have been posting photos to social media from Ukraine as the country has fallen into turmoil.

See the photos.

Follow the continuing conflict in and around eastern Ukraine.

"The airport is under our full control," Interior Minister Arsen Avakov said on Tuesday.

"The enemy suffered serious losses and we have lost none."

He estimated that dozens of separatist fighters had been killed, and said the combat operation was continuing to drive out the remnants of the pro-Russian forces.

PERSON

Visualization Rendering

What is it?

Graphical representations of data analysis for easier understanding

How does it work?

The service takes input data and graphically renders it as an interactive visualization which can range from a common business chart to more advanced layouts. The visualizations can be easily modified to match user needs, visual styling, and types of data being analyzed.

Use Cases-

The service could represent neighborhood demographic data as mini pie charts showing income levels centered on geographic locations on maps, or as tree maps that can switch from looking at income by age to house size or by education level.
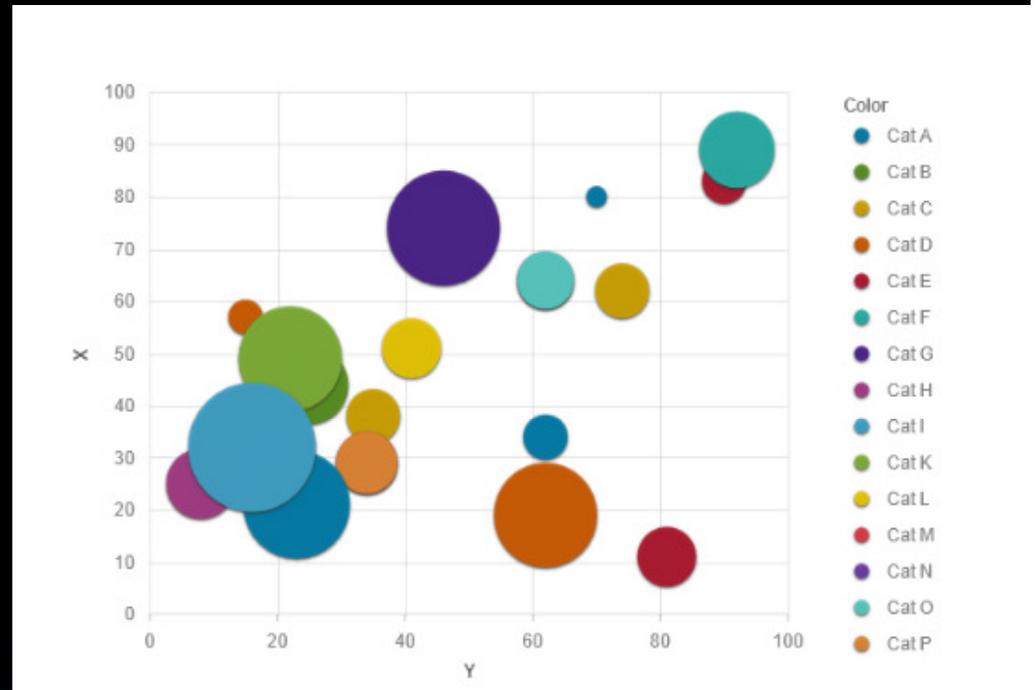
Watson APIs will be available on Bluemix Development Environment

- Get a Bluemix account

- Try the Watson services free of charge for 30 days

- Take the next step toward further development or production deployment
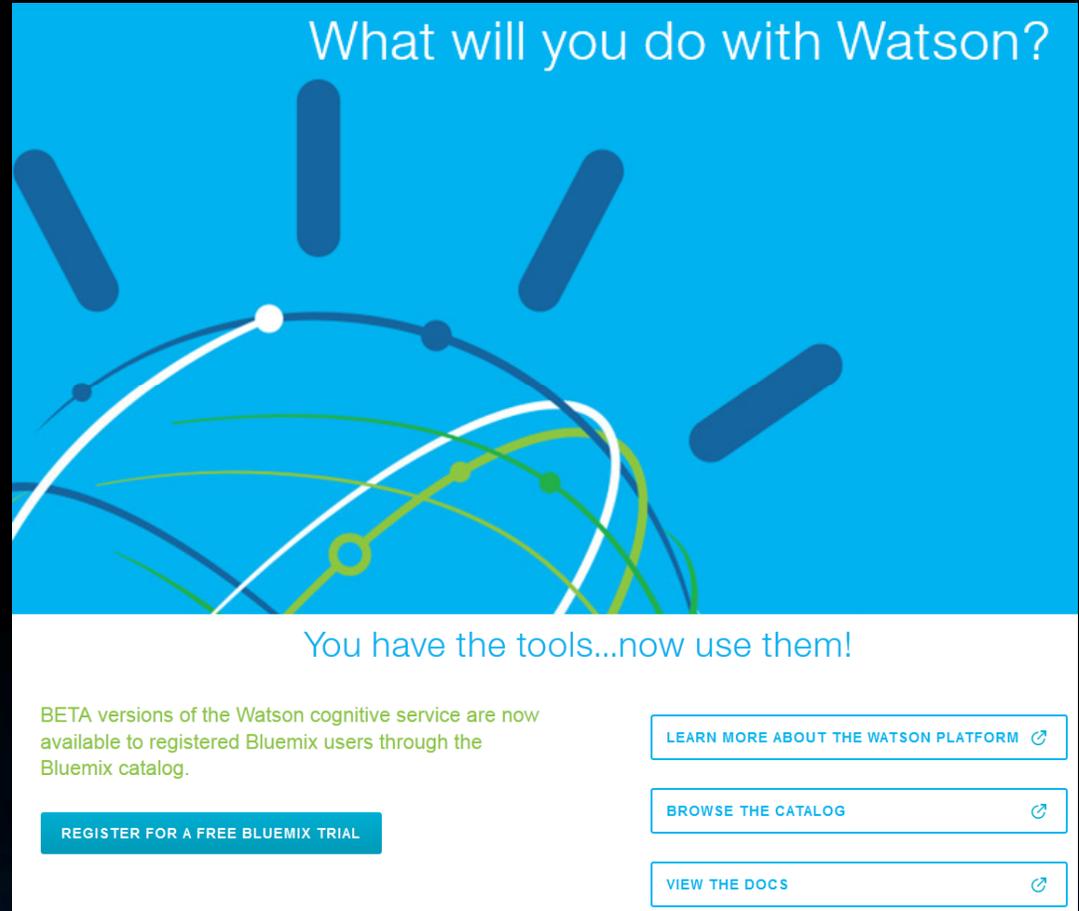
What will you do with Watson?

You have the tools...now use them!

BETA versions of the Watson cognitive service are now available to registered Bluemix users through the Bluemix catalog.

REGISTER FOR A FREE BLUEMIX TRIAL

LEARN MORE ABOUT THE WATSON PLATFORM

BROWSE THE CATALOG

VIEW THE DOCS

DARPA SyNAPSE: Disruptive Architecture that complements von Neumann architecture

TrueNorth Chip (2014)
- 1M Neurons
- 250M synapses
- 70mWatts
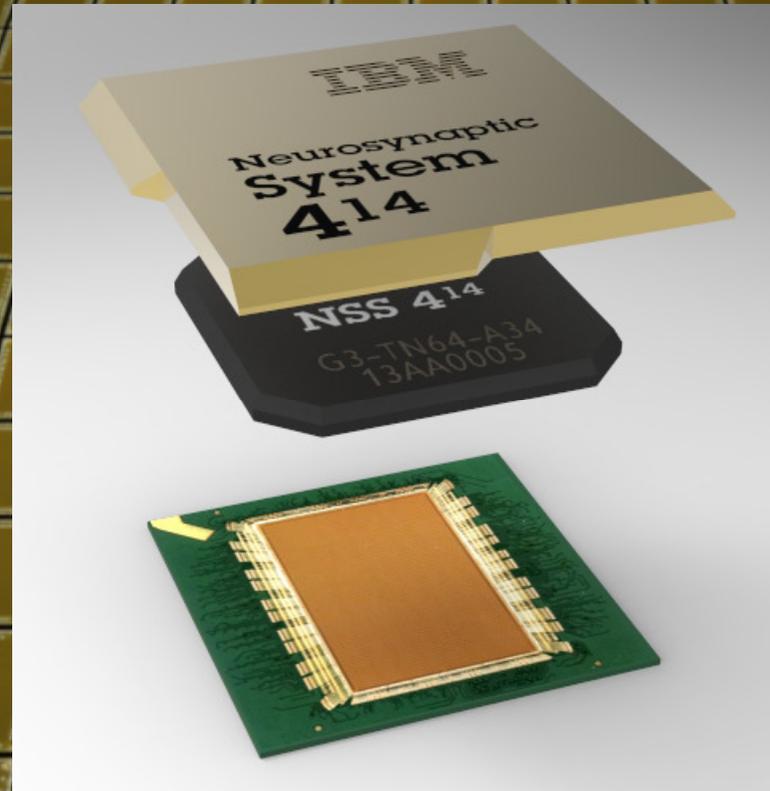
Create a new Partnership for Professionals :
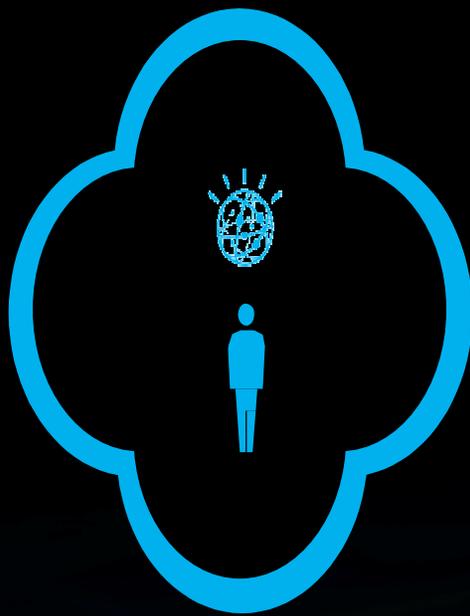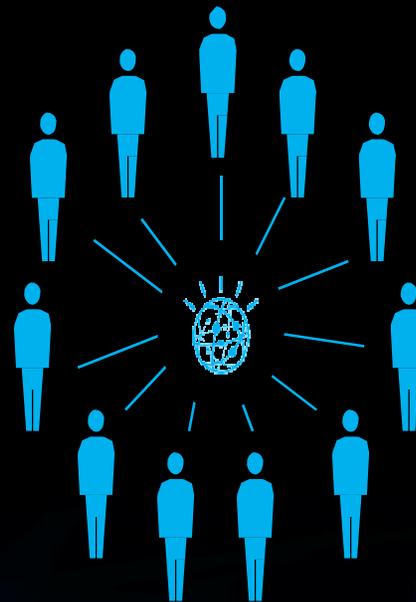
Augmenting   **Scaling**   **Accelerating**
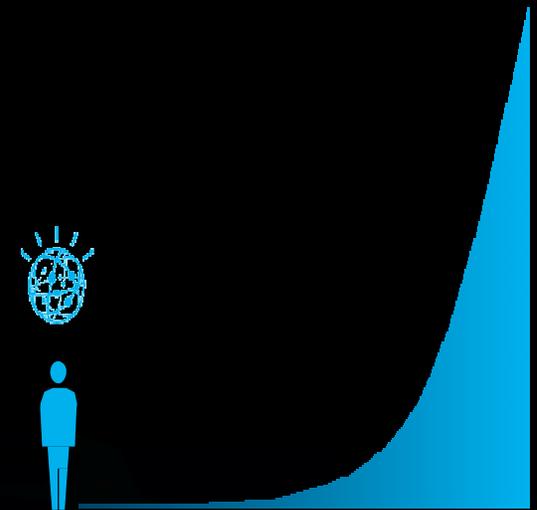
Human Expertise and Knowledge with a cognitive assistant
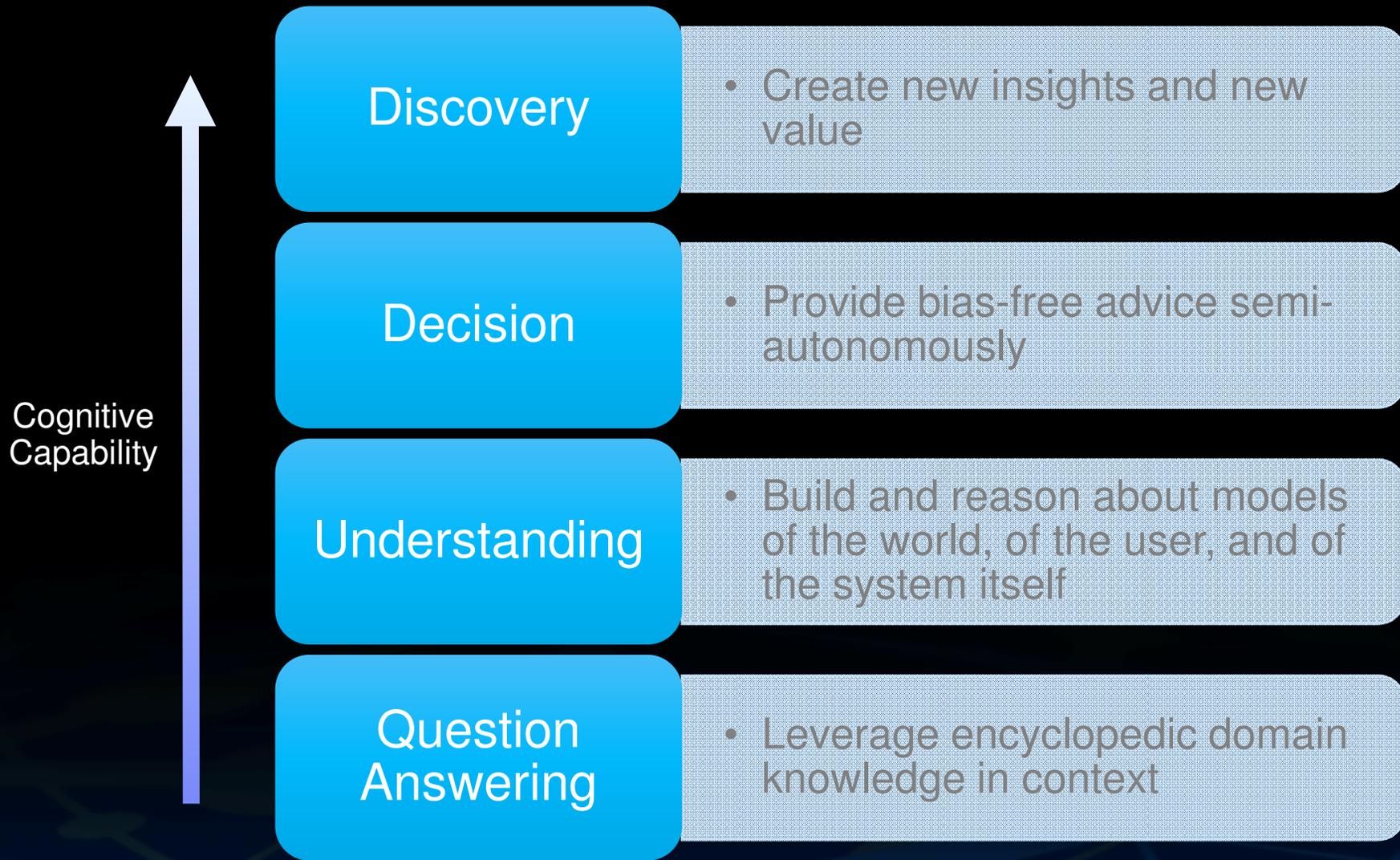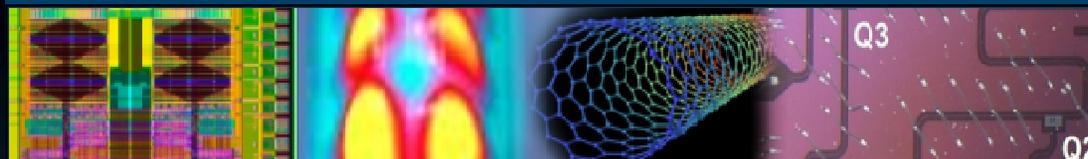
Future Learning Systems

Society **Nature** **Institutions** **Archives**

(Natural Interfaces)

Active Learning

Training and Learning Engines
To Build Models and Define Insight

Policy Engine
Business, Legal
and Ethical Rules

Verification Engines
(e.g. Simulations)

Hypothesis Engines
To Understand and Plan Actions

Outcome Engine
Actuation and Validation
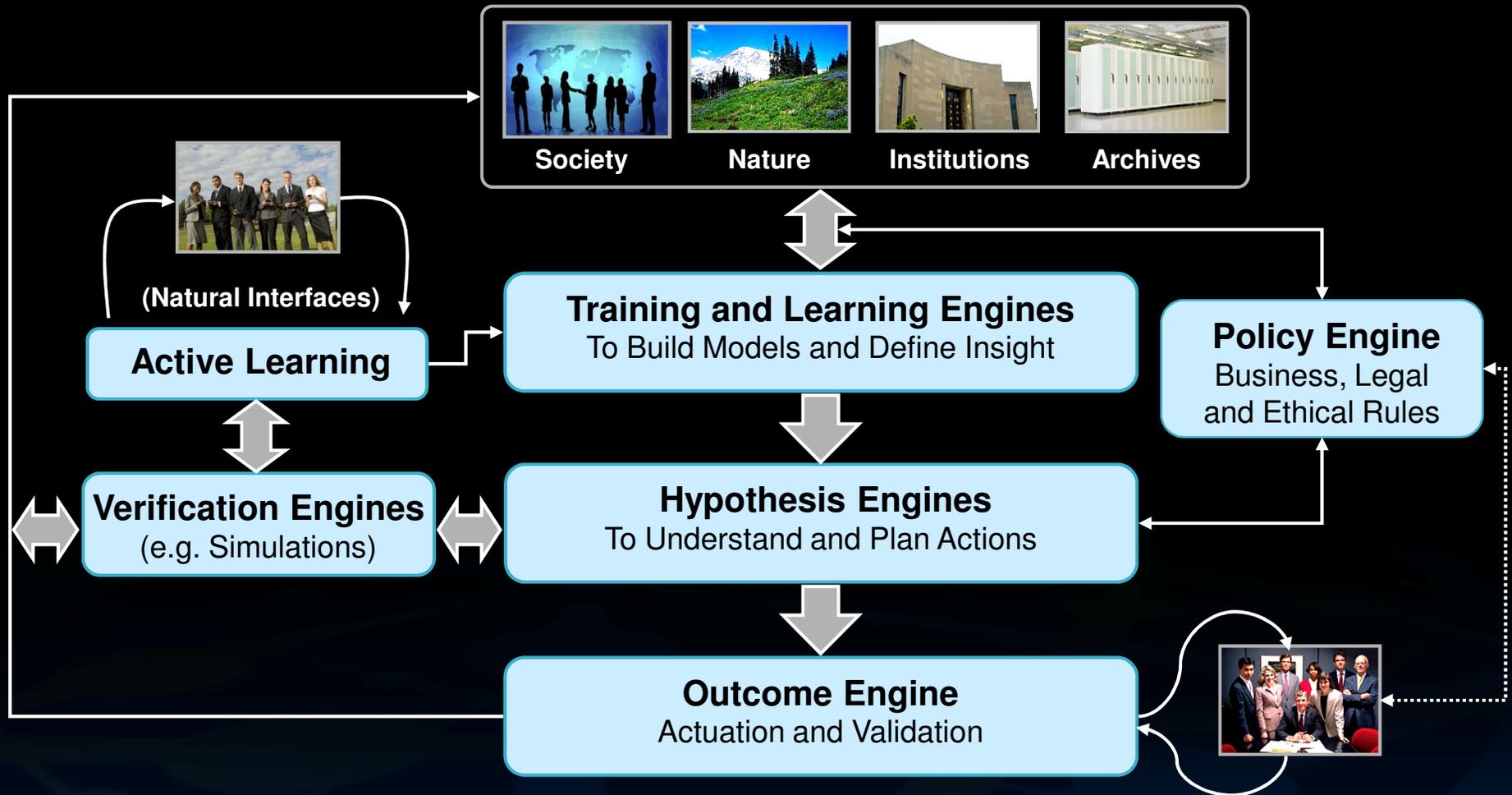
IBM Cognitive Assistant Efforts

- Cognitive Assistance for various professions: (in progress)
  - Oncology Expert Advisor
  - Watson Electronic Medical Records (EMR) Assistant
  - On-line shopping Advisor
  - Chef Watson
  - New Hire Chatbot
  - IBM Sales Assistant

- Cognitive Work Assistant in IBM Research
  - Focused on helping with office and work task, processing information surrounding a worker in the work environment, and offering intelligent suggestions and proactively/reactively acting on behalf of the person it is representing
  - Using NLP, knowledge management, machine learning and cognitive computing techniques

Watson @Bon Appetit – Chef Watson
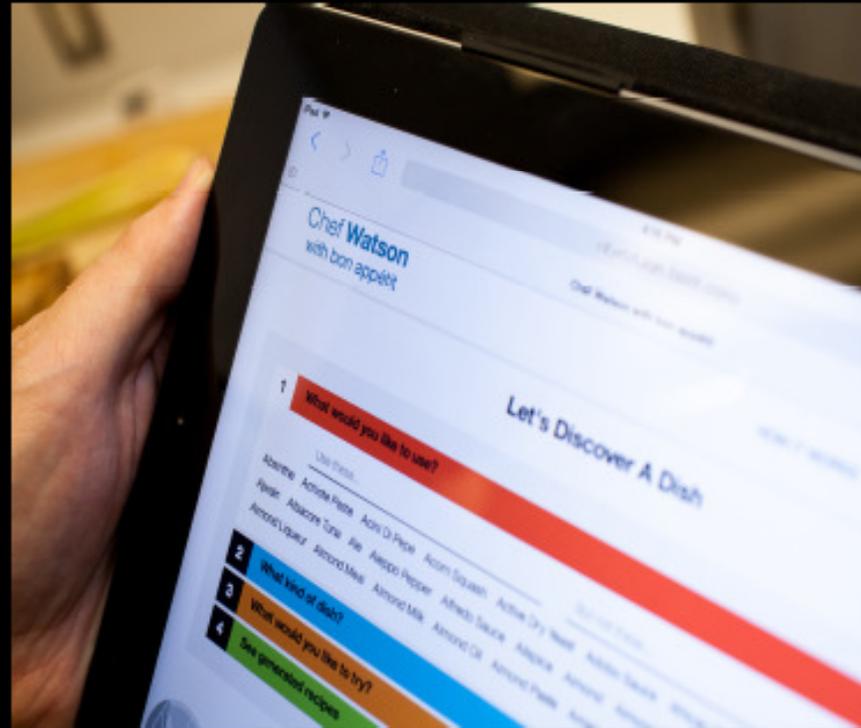
Concept: Start with Task Definitions for Standard Occupations
(courtesy of O*net Job Library)

Summary Report for:

17-2199.01 - Biochemical Engineers

Updated 2011
Bright Outlook
green

Develop usable, tangible products, using knowledge of biology, chemistry, or engineering. Solve problems related to materials, systems, or processes that interact with humans, plants, animals, microorganisms, or biological materials.

Sample of reported job titles: Engineering Director, Process Engineer

View report:	Summary	Details	Custom

Tasks | Tools & Technology | Knowledge | Skills | Abilities | Work Activities | Work Context | Job Zone | Education | Credentials | Interests | Work Styles | Work Values | Related Occupations | Wages & Employment | Job Openings

Tasks

- Devise scalable recovery, purification, or fermentation processes for producing proteins or other biological substances for human or animal therapeutic use, food production or processing, biofuels, or effluent treatment. 🍃
- Read current scientific or trade literature to stay abreast of scientific, industrial, or technological advances.
- Design or conduct studies to determine optimal conditions for cell growth, protein production, or protein or virus expression or recovery, using chromatography, separation, or filtration equipment, such as centrifuges or bioreactors.
- Develop biocatalytic processes to convert biomass to fuels or fine chemicals, using enzymes of bacteria, yeast, or other microorganisms. 🍃
- Prepare technical reports, data summary documents, or research articles for scientific publication, regulatory submissions, or patent applications.
- Confer with research and biomanufacturing personnel to ensure the compatibility of design and production.
- Design or direct bench or pilot production experiments to determine the scale of production methods that optimize product yield and minimize production costs.
- Develop methodologies for transferring procedures or biological processes from laboratories to commercial-scale manufacturing production.
- Design or conduct follow-up experimentation, based on generated data, to meet established process objectives.
- Maintain databases of experiment characteristics or results.

Building a Society of Cognitive Agents

Systems of cognitive agents that collaborate effectively with one another

Cognitive agents that collaborate effectively with people through natural user interfaces

A nucleus from which an internet-scale cognitive computing cloud can be built
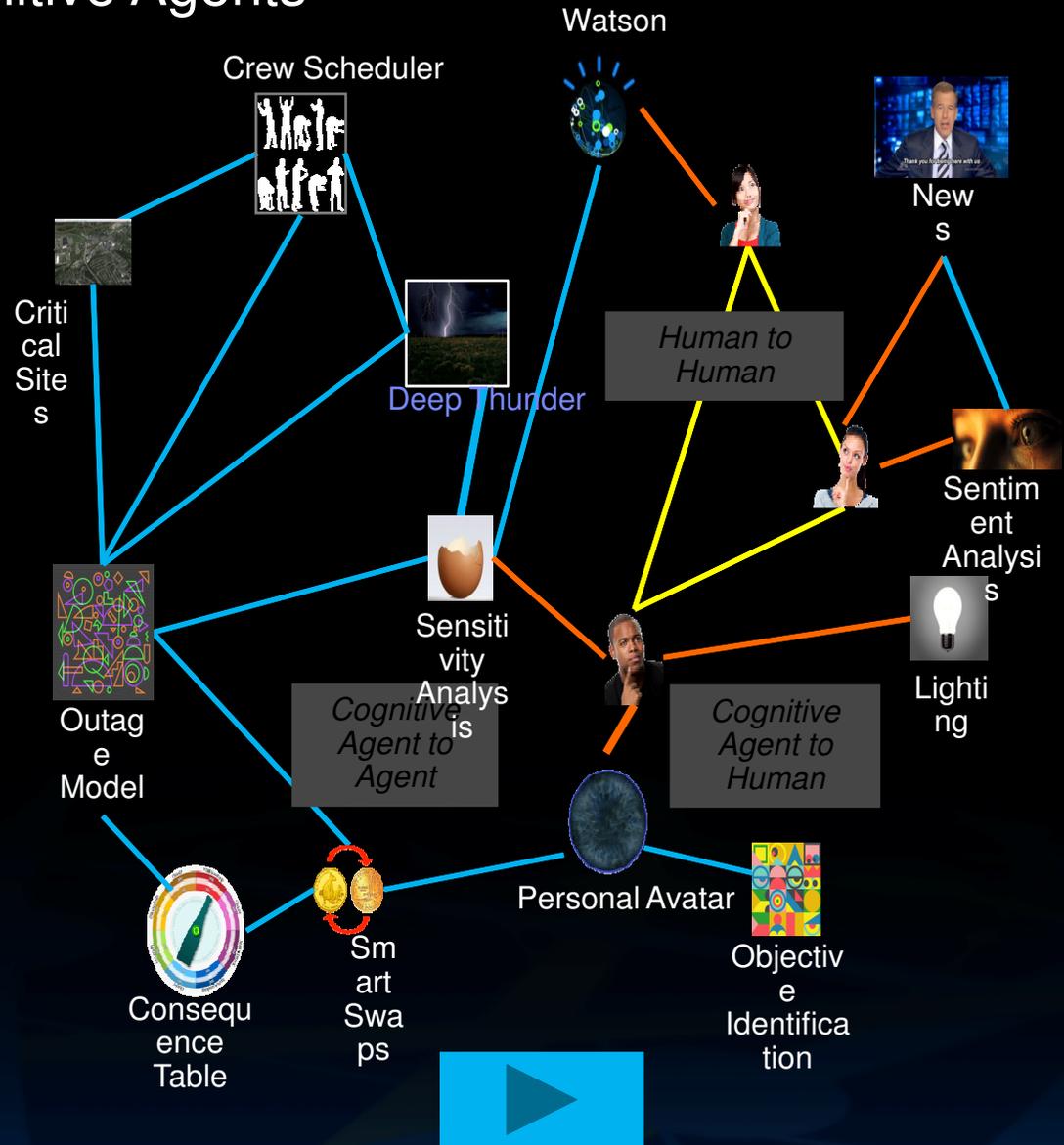
Cognitive Systems Institute

- Vision: Augment and scale human expertise
  - Website (cognitive-science.info)
  - LinkedIn Group

- Platforms: Cognition as a Service
  - BlueMix & SoftLayer & CCAMSS
  - DEEPQA Semantic Technologies
  - Watson Developer Cloud
  - Watson Platform Next (IBM Research)
  - Corelet Programming & TrueNorth

- Researchers in Residence
  - Grand Challenges
  - Co-Create Grant Proposals
  - Publications, Guest Lectures
  - Recruiting Interns, Co-ops, etc.
  - Conferences & Cognitive Colloquia
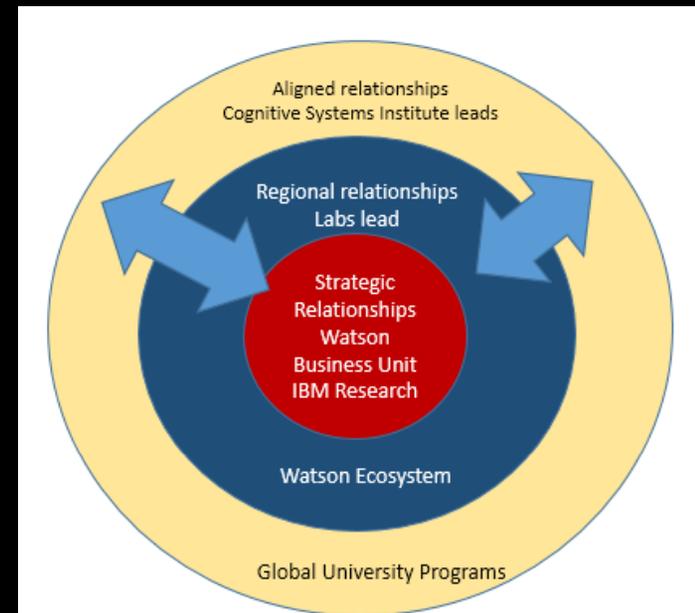
Aligned relationships
Cognitive Systems Institute leads

Regional relationships
Labs lead

Strategic Relationships
Watson
Business Unit
IBM Research

Watson Ecosystem

Global University Programs

Cognition as a Service
SOFTLAYER®

Analytics Solution Center
Washington, DC

Agenda

- The Start of a New Era of Computing

- IBM Watson – What we've been up to

- Cognitive Assistance Vision

- Audience Discussion and Input

Help Wanted Areas

- User Interface
- Learning and Training
- Task and Cognitive Modeling
- Test and Evaluation
- System Issues

User Interface

1. How does the User Train the Cog?

2. How does the User Delegate specific tasks to the Cog?

3. User interface issues related to acceptance & trust

   ▪ Can I trust that the Cog did what I told/taught/think the Cog did?

4. On what conditions should the Cog ask for help from User?

5. Modeling User behavior and preferred modes of interaction

6. Cog understanding Human biases and how to counter?

7. How can Cog communicate results to achieve User trust – explaining & showing statistical correlations, providing assumptions and evidence (what if Cog uses techniques it learned that are beyond what Users do?)

8. Cog understanding of figures, graphs, lab notes, pictures, videos, xrays…

Learning and Training

1. How do we train the Cog so that it is reliable?
2. Does the User train the Cog (personal assistant) vs. Enterprise (Organization trains with best practices) ?
3. Training by demonstration
4. Training by ingesting documentation, training manuals, text books,
5. Interactive Learning – Cog asks questions of Trainer/User
6. Teaching the Cog Goals – Cog improves over time towards defined goals
7. Adaptation to environmental changes, new data sources, etc
8. Can Cog understand what is Routine and how to automate without User training?
9. Can the Cog train new Users? Other Cogs?

Task and Cognitive Modeling

1. Task & Subtask composition and reuse
   - What data sources to use for each task
   - Next steps based on results
2. Initiating actions based on incoming data
3. Modeling the world of the user being served, including all context around the work/task, and being able to use the contextual and environmental awareness to proactively and reactively act on behalf of the user
4. User definition of persistent tasks (e.g., persistent search of incoming information)
5. Information Restrictions – Could Cog access PII (HIPPA) data that User couldn't? Does Cog have same access authority as User for classified data?

Testing & Evaluation

1. Testing the value provided to the User
   - How to do controlled experiments?
   - Is it possible to simulate the complexity in a lab environment?
2. How do we test the reliability of the Cog and the combined H-C system?
3. Can we develop some Challenge problems to test the User/Cog system?
   - How to judge results? Answer or Approach? Use of right data?
4. Metrics for a Cog/User system:
   - User Adoption, Speed to result, Accuracy, Precision, Stability, Robustness, Finding Results the User didn't find alone, Transparency, resource usage

System Issues

1. How to build cooperative cogs working as a team with teams of Users?

2. Symbiosis Questions – What is best for the Cog to do and what is best for the User to do? How to assign appropriately?

3. Methodology – How to build an iterative approach of build/test to quickly evolve ?

So what should universities
be asking themselves?

By 2017, 10 percent of computers will be learning rather than processing.

Gartner

Top predictions for IT organizations and IT users for 2014 and beyond.

- Will your researchers, faculty, students be benefitting from cognition as a service?