

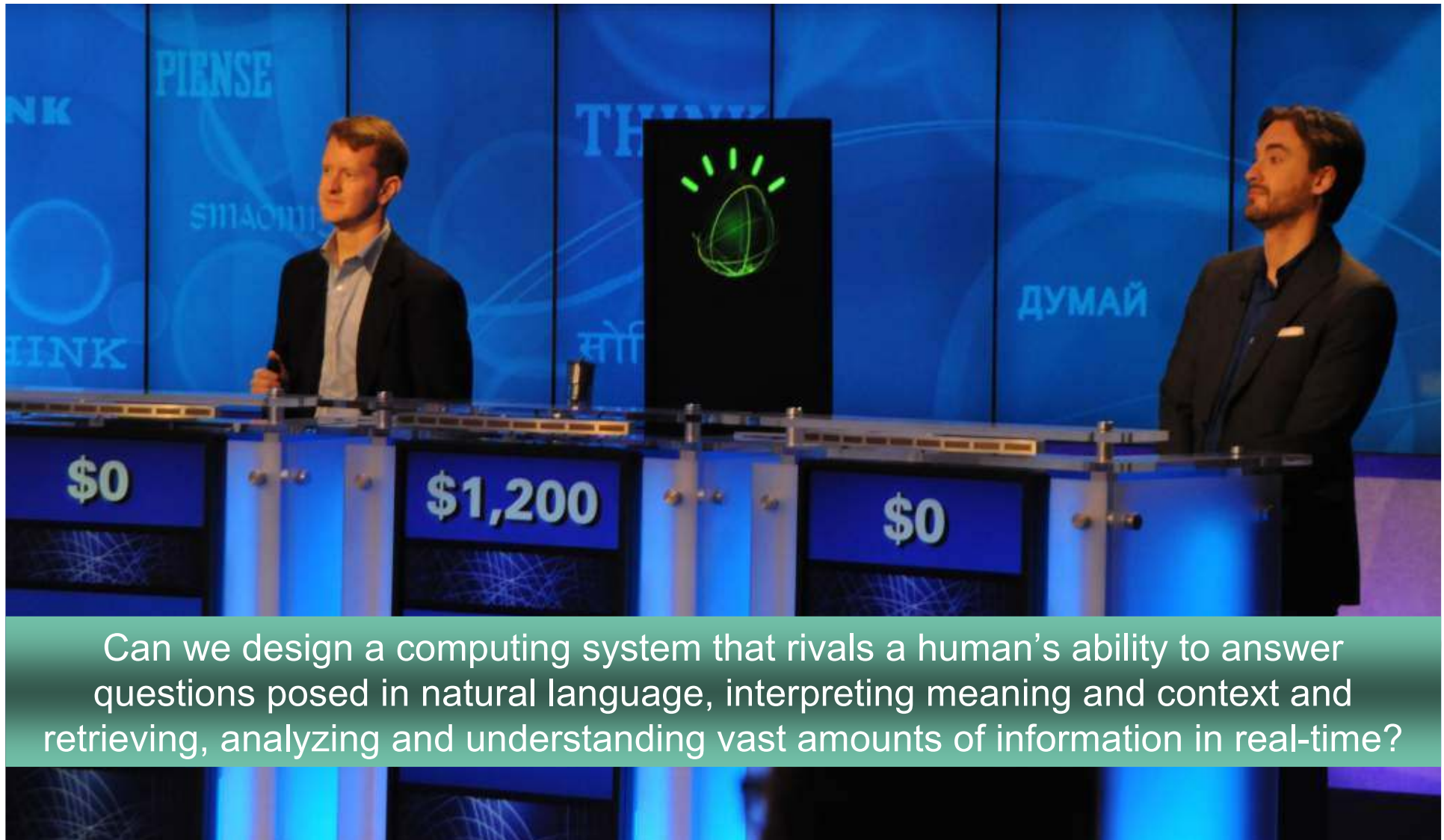
# Building *Watson*

*What Impact will Watson Have on the Use of Analytics in Business?*

Crispin Keable  
HPC Systems Architect @ IBM UK



# Watson answers a grand challenge



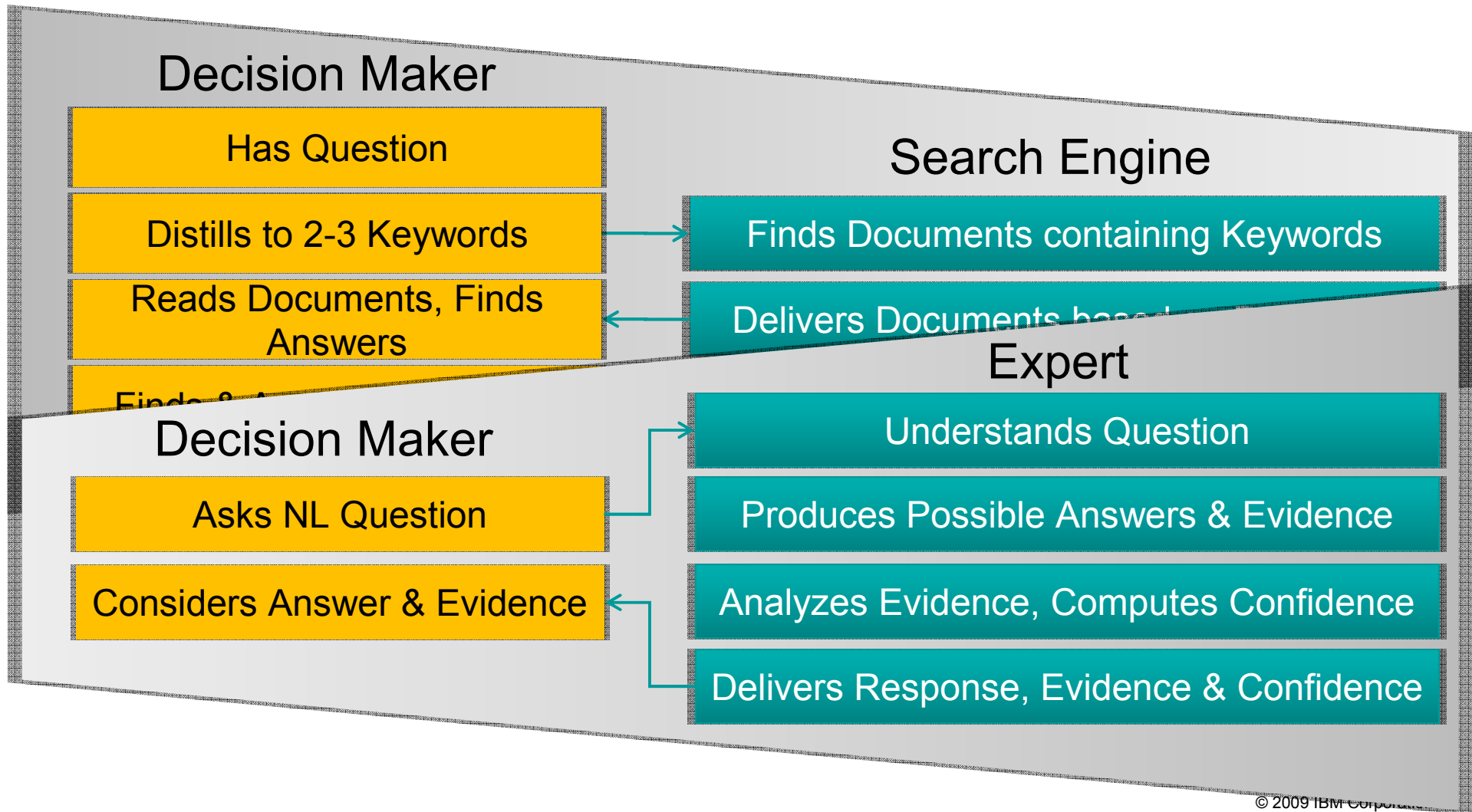
Can we design a computing system that rivals a human's ability to answer questions posed in natural language, interpreting meaning and context and retrieving, analyzing and understanding vast amounts of information in real-time?

## A Grand Challenge Opportunity

- Capture the imagination
  - The Next *Deep Blue*
- Chess
  - A finite, mathematically well-defined search space
  - Limited number of moves and states
  - All the symbols are completely grounded in the mathematical rules of the game
- Human Language
  - Words themselves have no meaning
  - Only grounded in human cognition
  - Words navigate, align and communicate an infinite space of intended meaning
  - Computers can not ground words to human experiences to derive meaning



# Informed Decision Making: Search vs. Expert Q&A



# What Computers Find Easier (and Hard)

$$\ln((12,546,798 * \pi)^2) / 34,567.46 = 0.00885$$

Select *Payment* where *Owner*="David Jones" and *Type(Product)*="Laptop",

Owner	Serial Number
David Jones	45322190-AK

Invoice #	Vendor	Payment
INV10895	MyBuy	\$104.56

Serial Number	Type	Invoice #
45322190-AK	LapTop	INV10895

David Jones  
 ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓  
 David Jones

=

Dave Jones  
 ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓  
 David Jones ≠



## What Computers Find Hard

Computer programs are natively **explicit**, **fast** and **exacting** in their calculation over numbers and symbols....But **Natural Language** is implicit, highly contextual, ambiguous and often imprecise.

Person	Birth Place
A. Einstein	ULM

Structured

Unstructured

### ■ Where was X born?

*One day, from among his city views of Ulm, Otto chose a water color to send to Albert Einstein as a remembrance of Einstein's birthplace.*

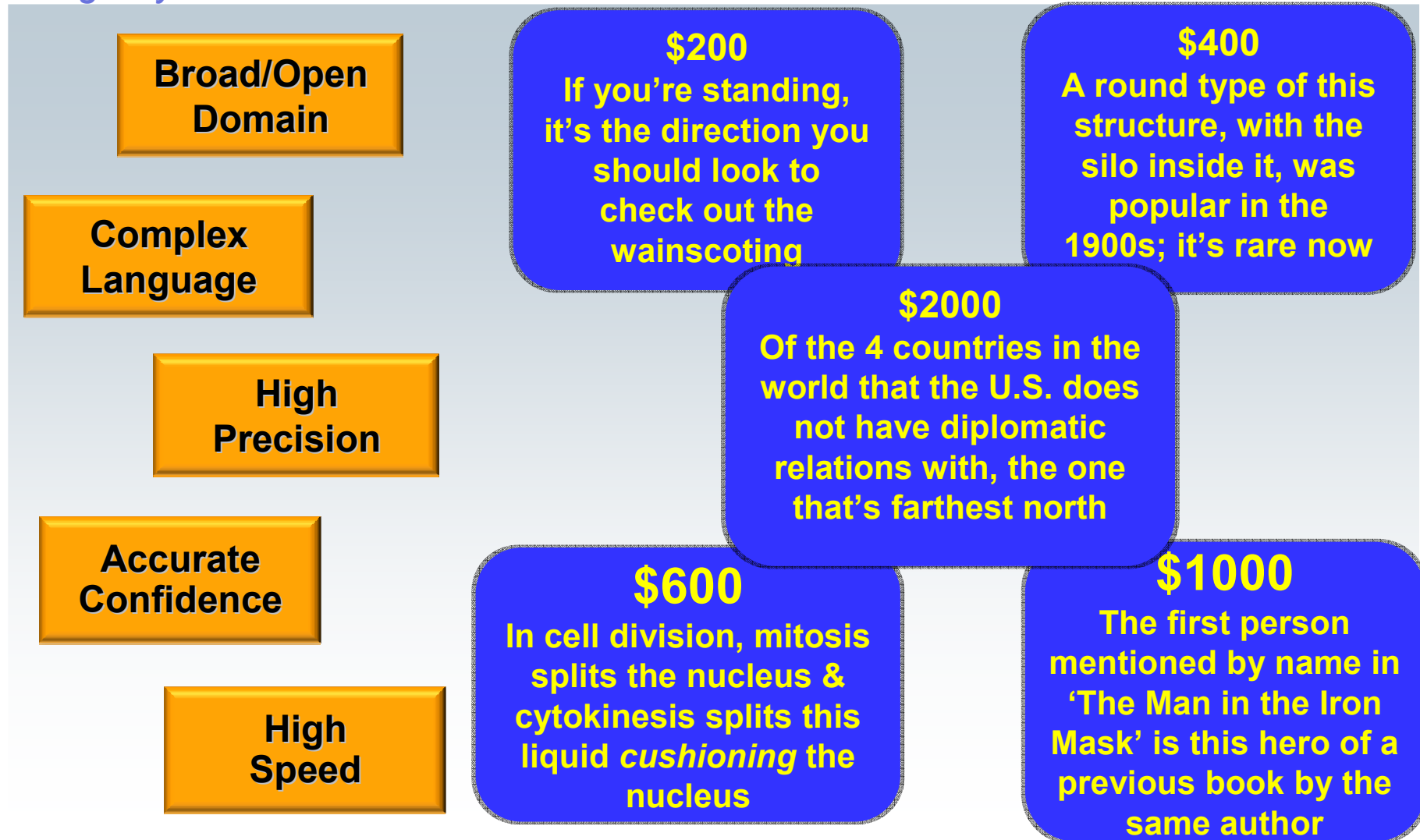
Person	Organization
J. Welch	GE

### ■ X ran this?

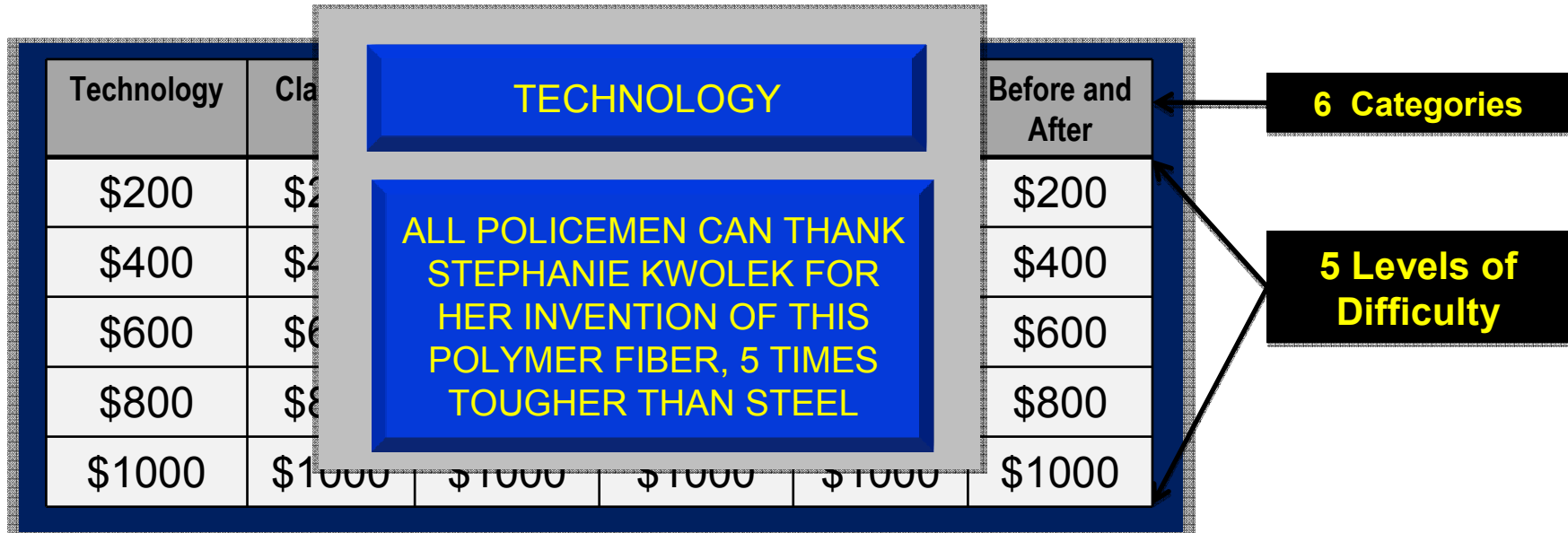
*If leadership is an art then surely Jack Welch has proved himself a master painter during his tenure at GE.*

# The Jeopardy! Challenge

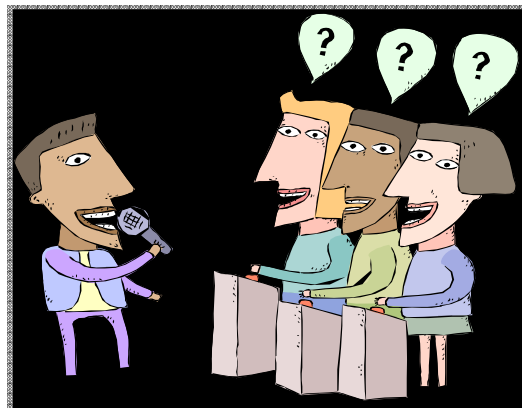
*A palpable, compelling and notable way to drive the technology of Question Answering along Key Dimensions*



# Basic Game Play



- ❑ 1 of 3 Players Selects a Clue
- ❑ Host reads Clue out loud
- ❑ All Players compete to answer
- ❑ 1<sup>st</sup> to buzz-in gets to answer



- ❑ **IF correct**
  - earns \$ value
  - selects Next Clue
- ❑ **IF wrong**
  - loses \$ value
  - other players buzz again (rebounds)

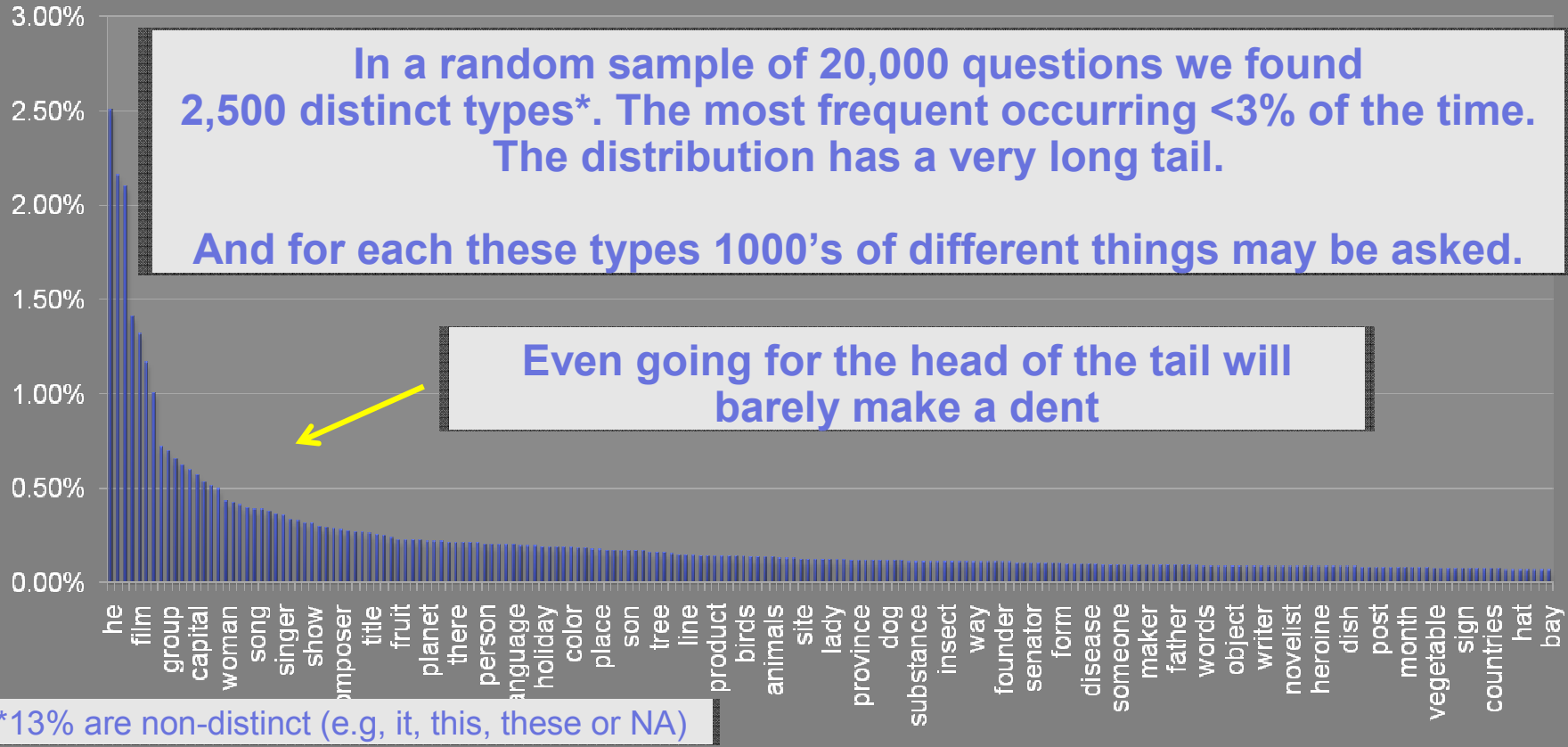
- ❑ Two Rounds Per Game + Final Question
- ❑ ONE Daily Double in First Round, TWO in 2<sup>nd</sup> Round



# Broad Domain

**We do NOT attempt to anticipate all questions and build databases.**

**We do NOT try to build a formal model of the world**



**Our Focus is on reusable NLP technology for analyzing vast volumes of *as-is* text. Structured sources (DBs and KBs) provide background knowledge for interpreting the text.**



## Evaluating Possibilities and Their Evidence

In cell division, mitosis splits the nucleus & cytokinesis splits this **liquid** cushioning the nucleus.

- *Organelle*
- *Vacuole*
- *Cytoplasm*
- *Plasma*
- *Mitochondria*
- *Blood ...*

- Many candidate answers (CAs) are generated from many different searches
- Each possibility is evaluated according to **different dimensions of evidence**.
- **Just One** piece of evidence is if the CA is of the right type. In this case a “liquid”.

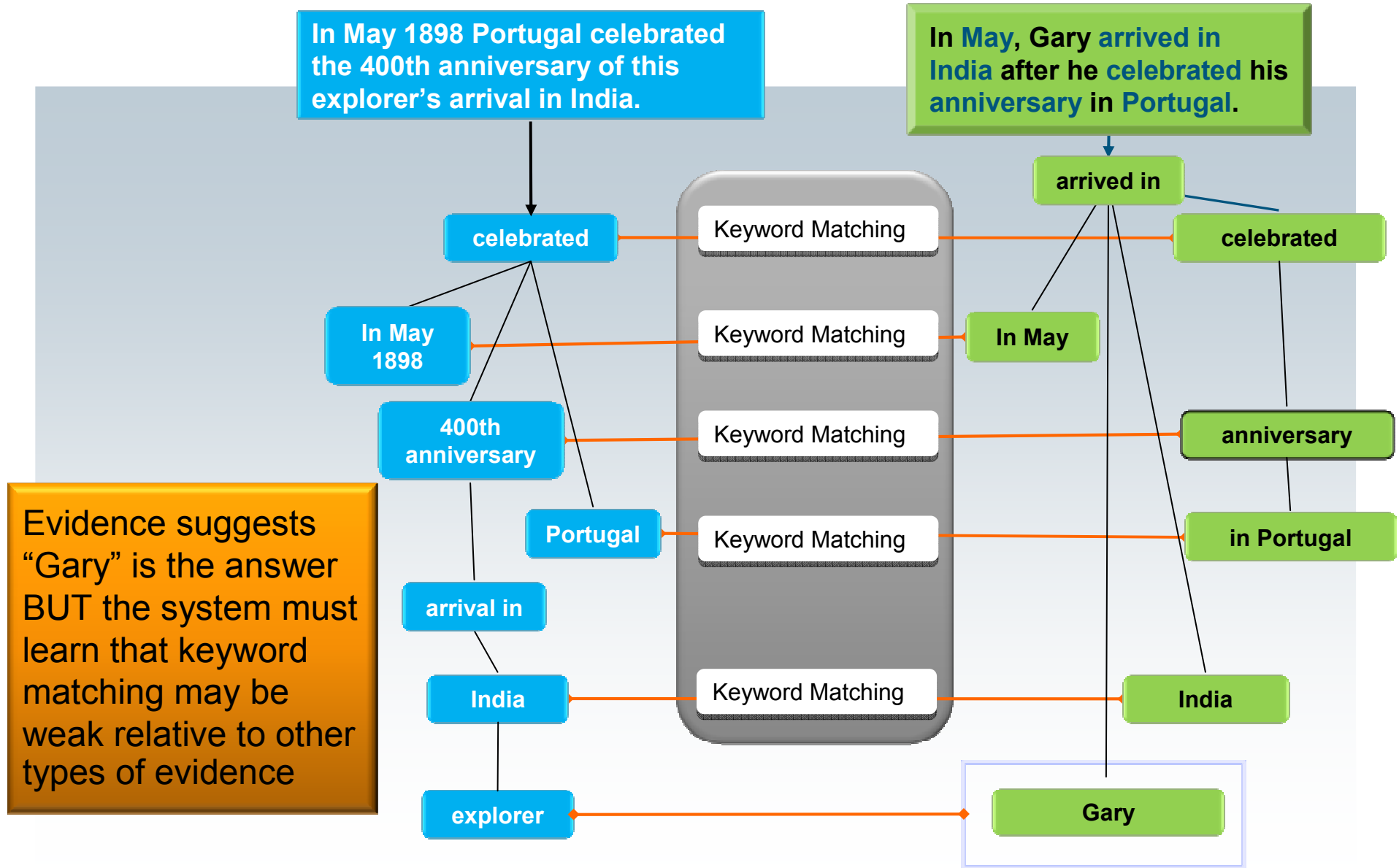
Is(“Cytoplasm”, “liquid”) = 0.2↑  
 Is(“organelle”, “liquid”) = 0.1  
 Is(“vacuole”, “liquid”) = 0.2  
 Is(“plasma”, “liquid”) = 0.7

“Cytoplasm is a **fluid** surrounding the nucleus...”

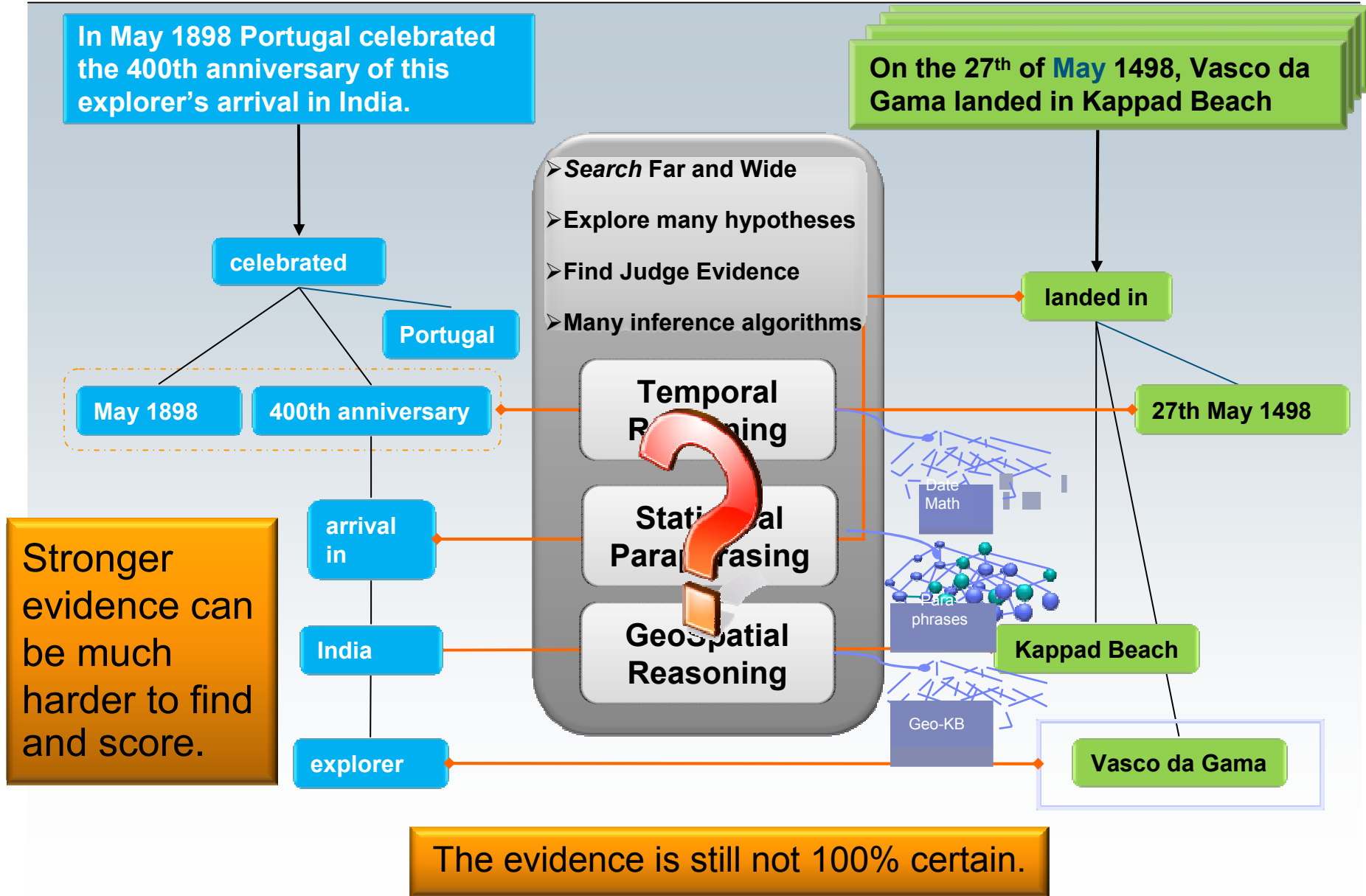
Wordnet → Is\_a(Fluid, Liquid) → ?

Learned → Is\_a(Fluid, Liquid) → yes.

# Different Types of Evidence: Keyword Evidence



# Different Types of Evidence: Deeper Evidence



# Not *Just* for Fun

Some Questions require Decomposition and Synthesis

A long, tiresome speech delivered by a frothy pie topping

Diatribes

Harangues

Whipped Cream

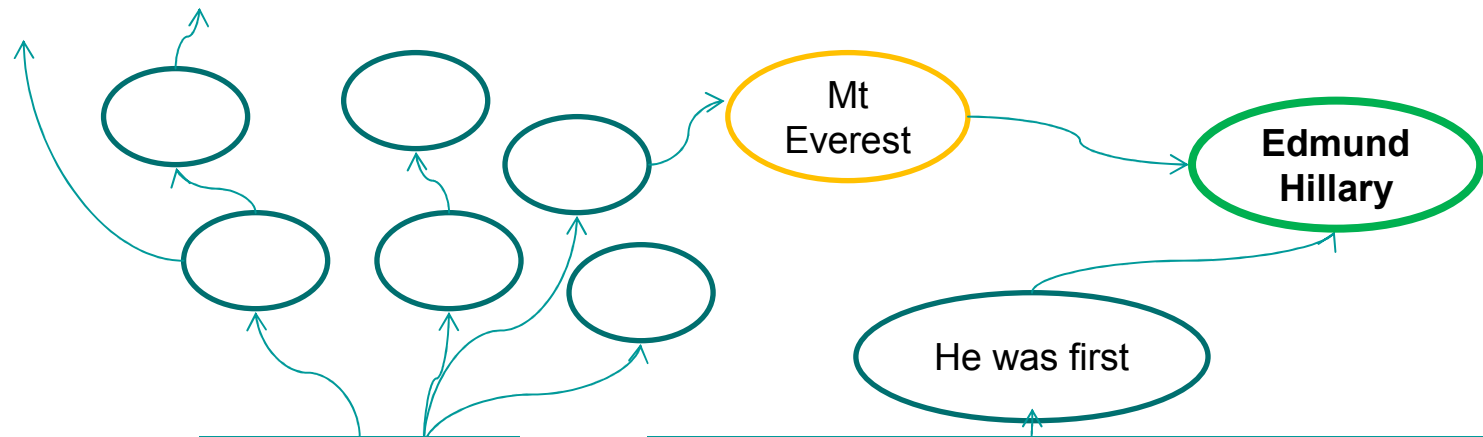
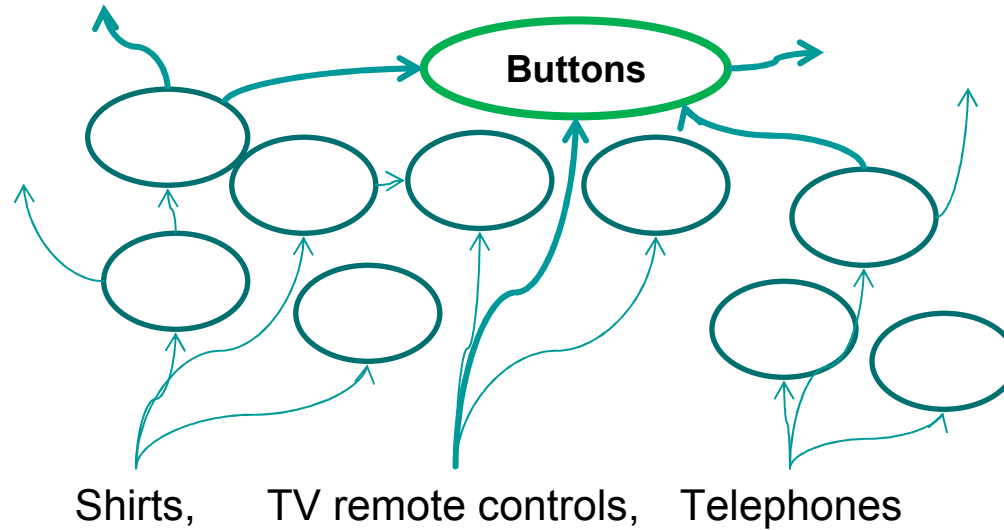
Meringues

Answer: Meringue Harangue

Category: Edible Rhyme Time



# Missing Links



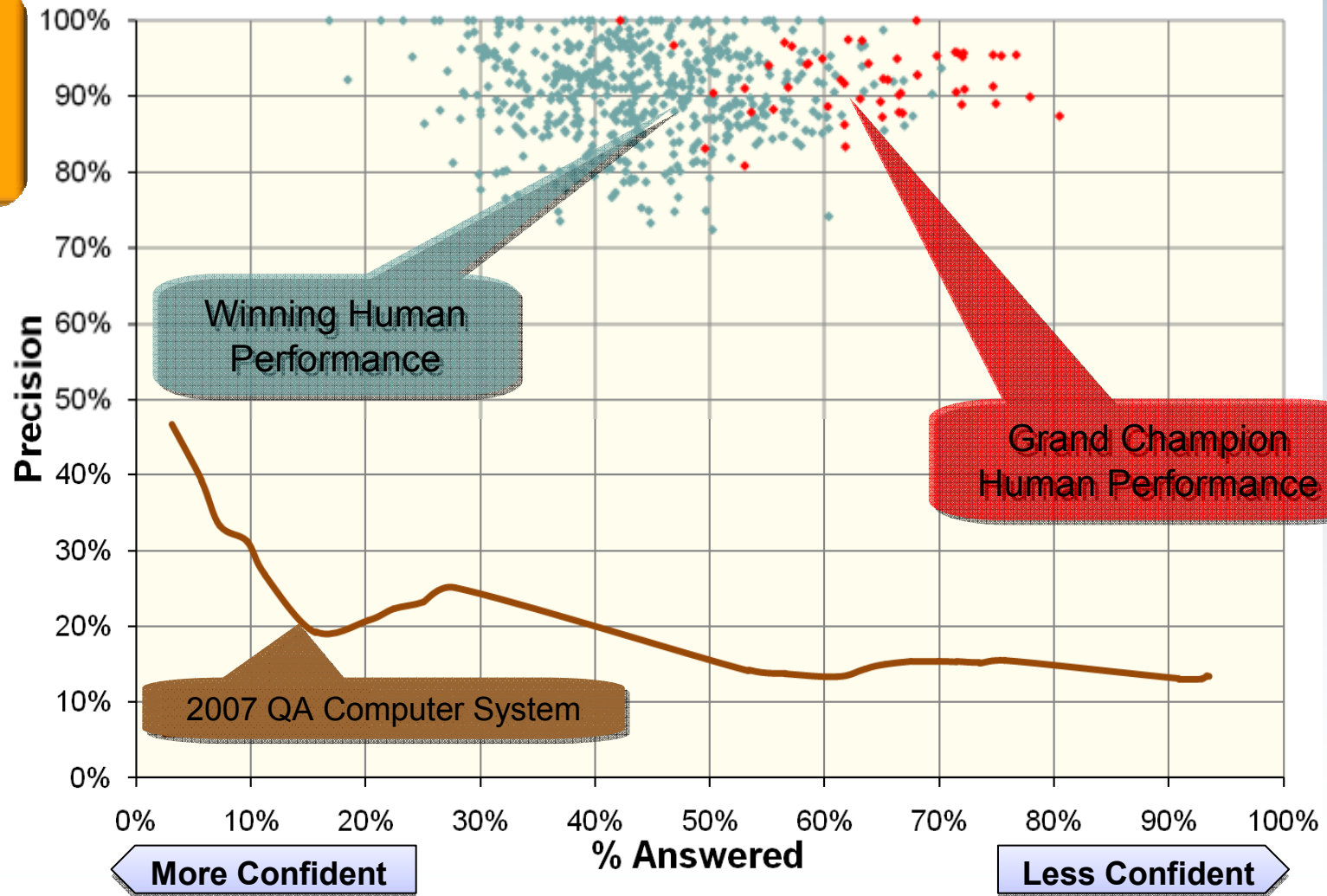
On hearing of the discovery of **George Mallory's** body, **he** told reporters he still thinks he was first.

# What It Takes to compete against Top Human Jeopardy! Players

*Our Analysis Reveals the Winner's Cloud*

**Top human players are remarkably good.**

Each dot – actual historical human Jeopardy! games

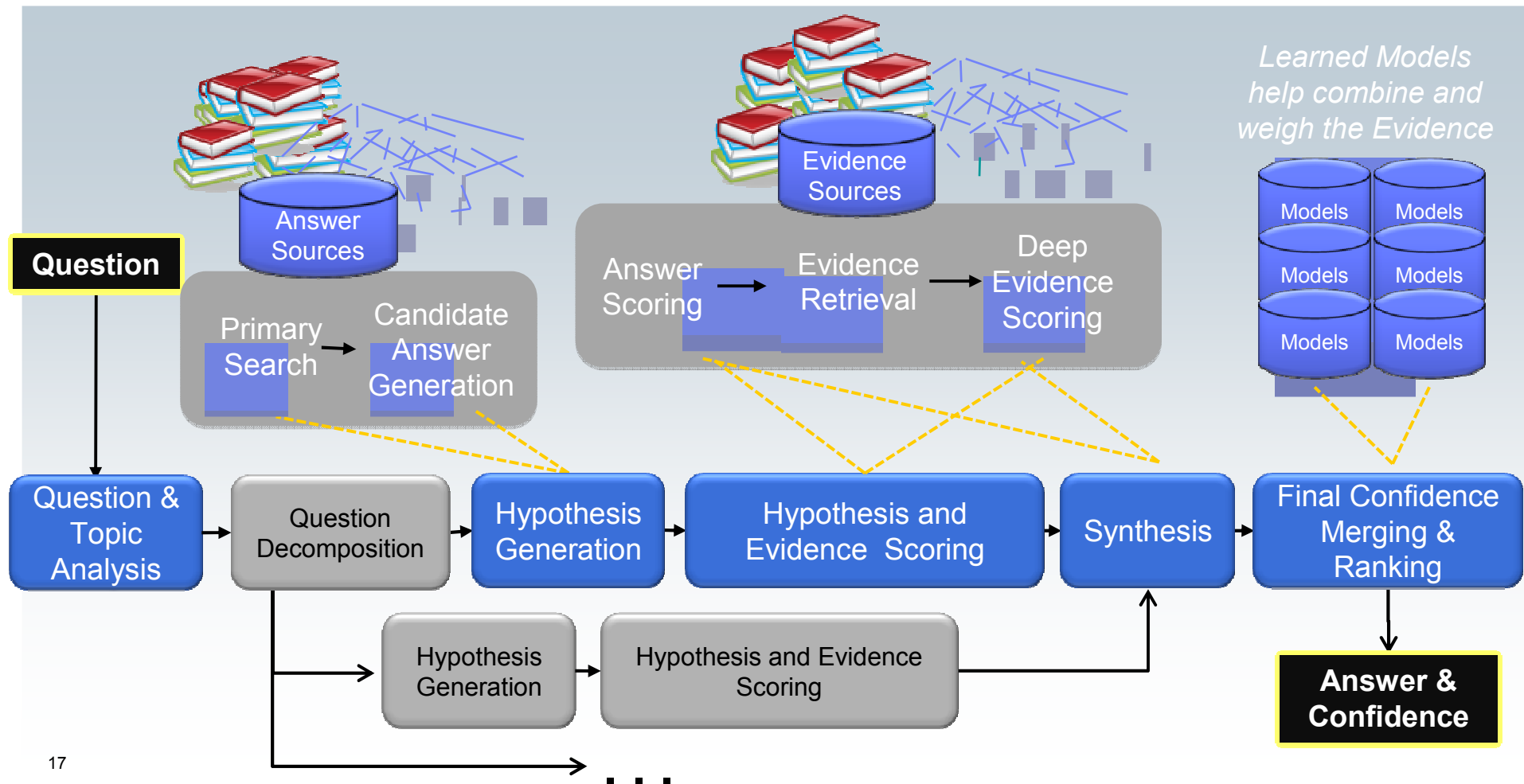


# DeepQA: The Technology Behind Watson



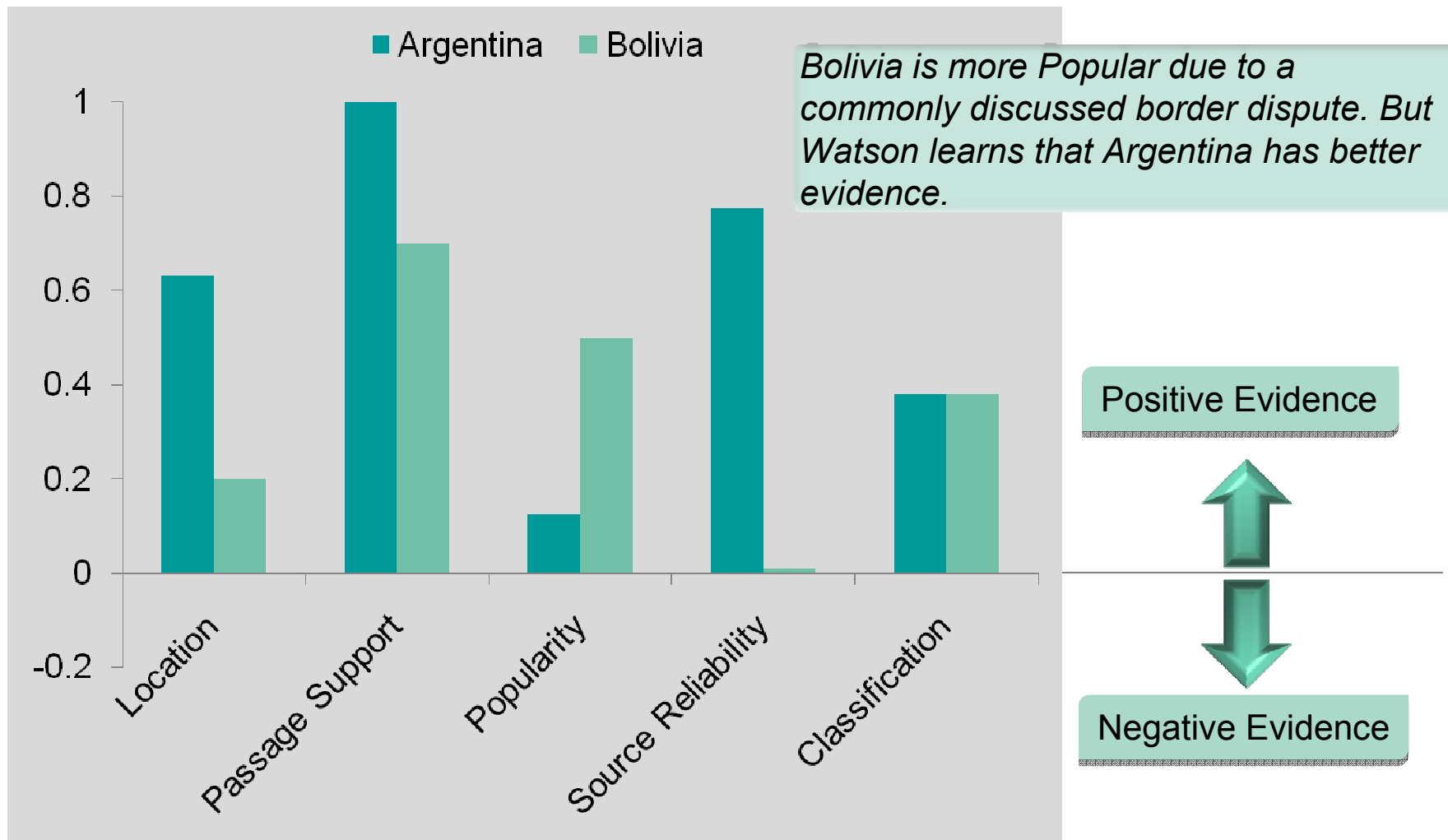
## Massively Parallel Probabilistic Evidence-Based Architecture

DeepQA generates and scores many hypotheses using an extensible collection of **Natural Language Processing, Machine Learning and Reasoning Algorithms**. These gather and weigh evidence over both unstructured and structured content to determine the answer with the best confidence.



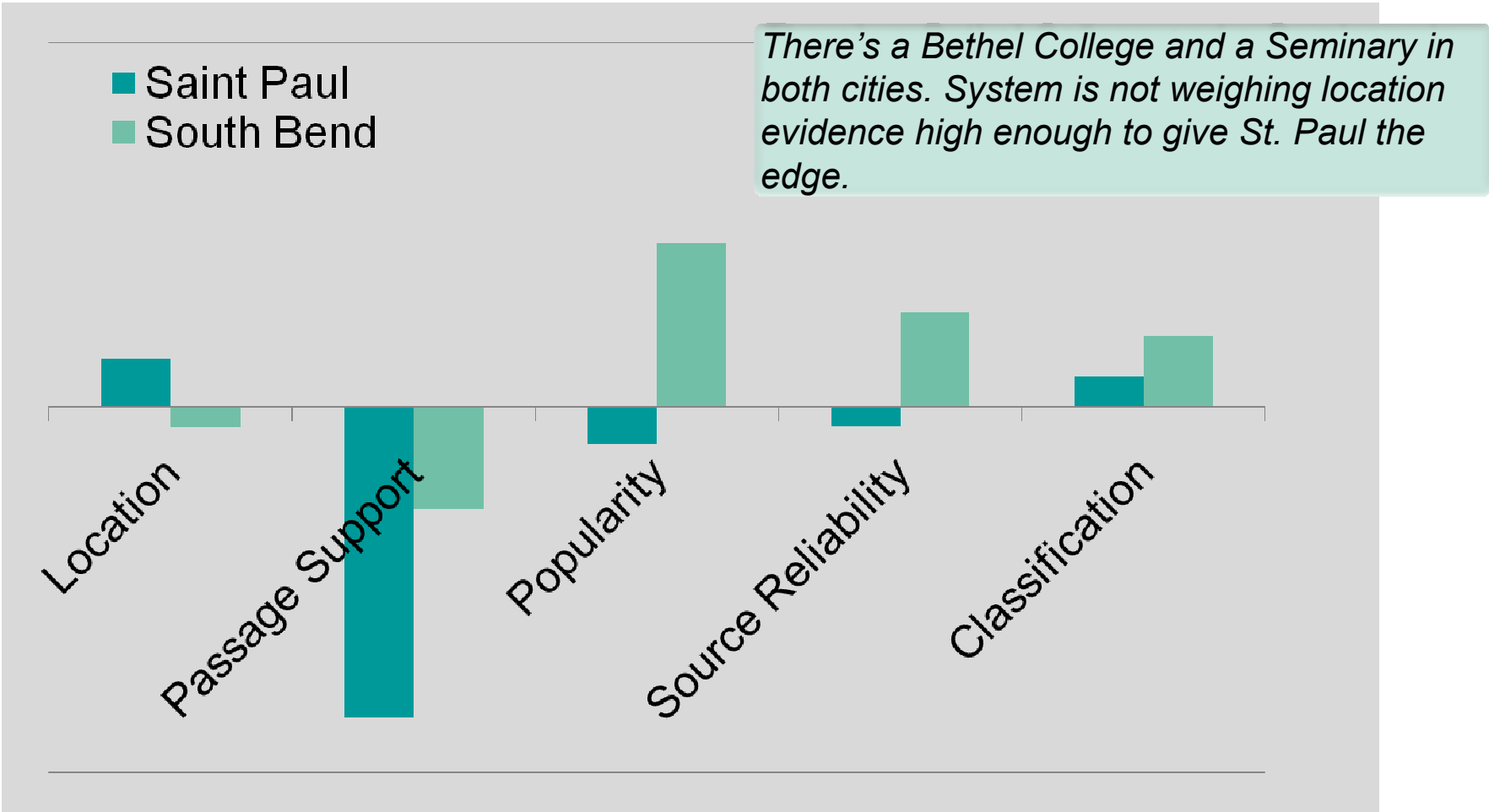
## Grouping features to produce Evidence Profiles

**Clue:** Chile shares its longest land border with this country.



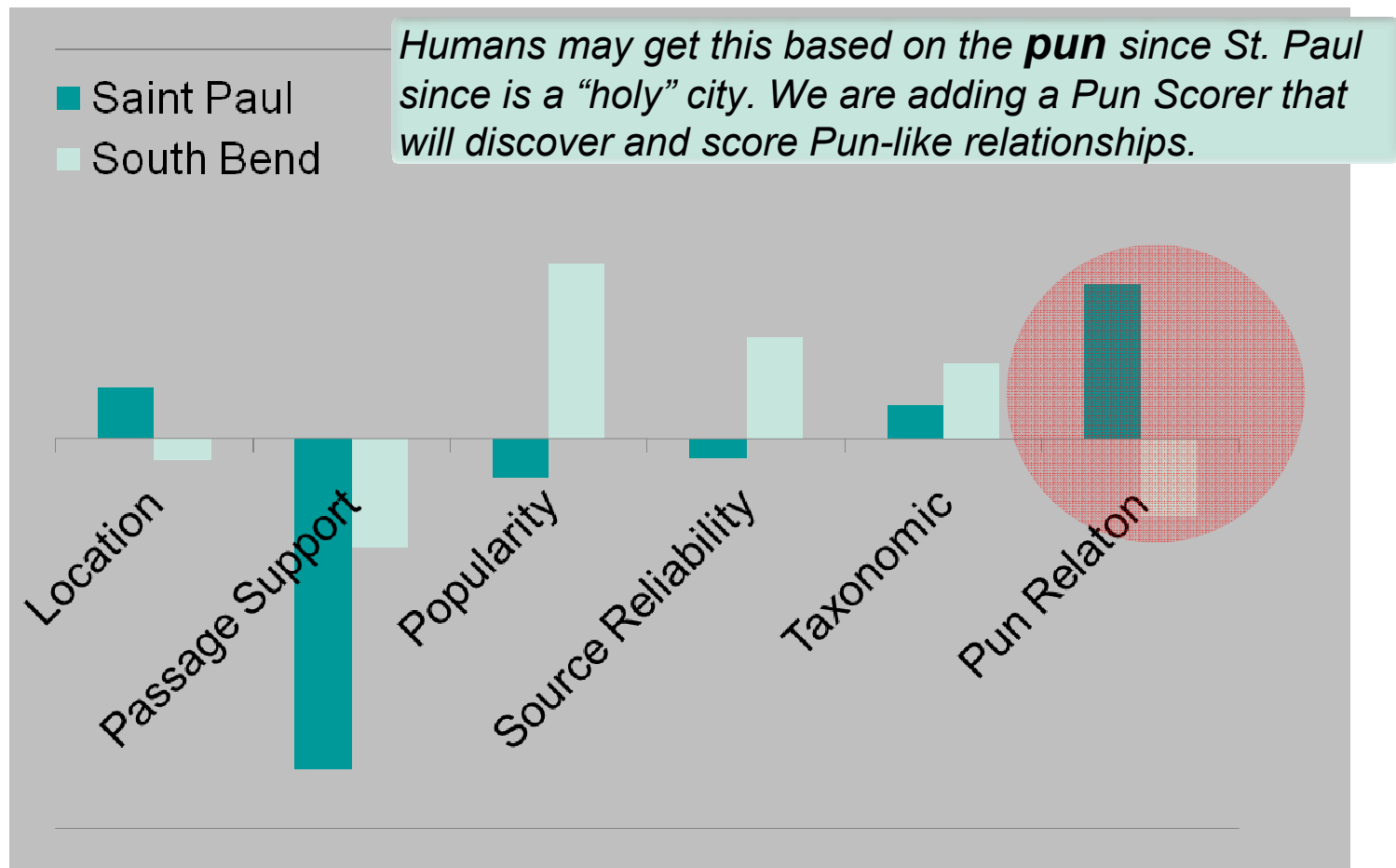
## Evidence: Time, Space, Source, Type etc.

**Clue:** You'll find Bethel College and a Seminary in this "holy" Minnesota city.



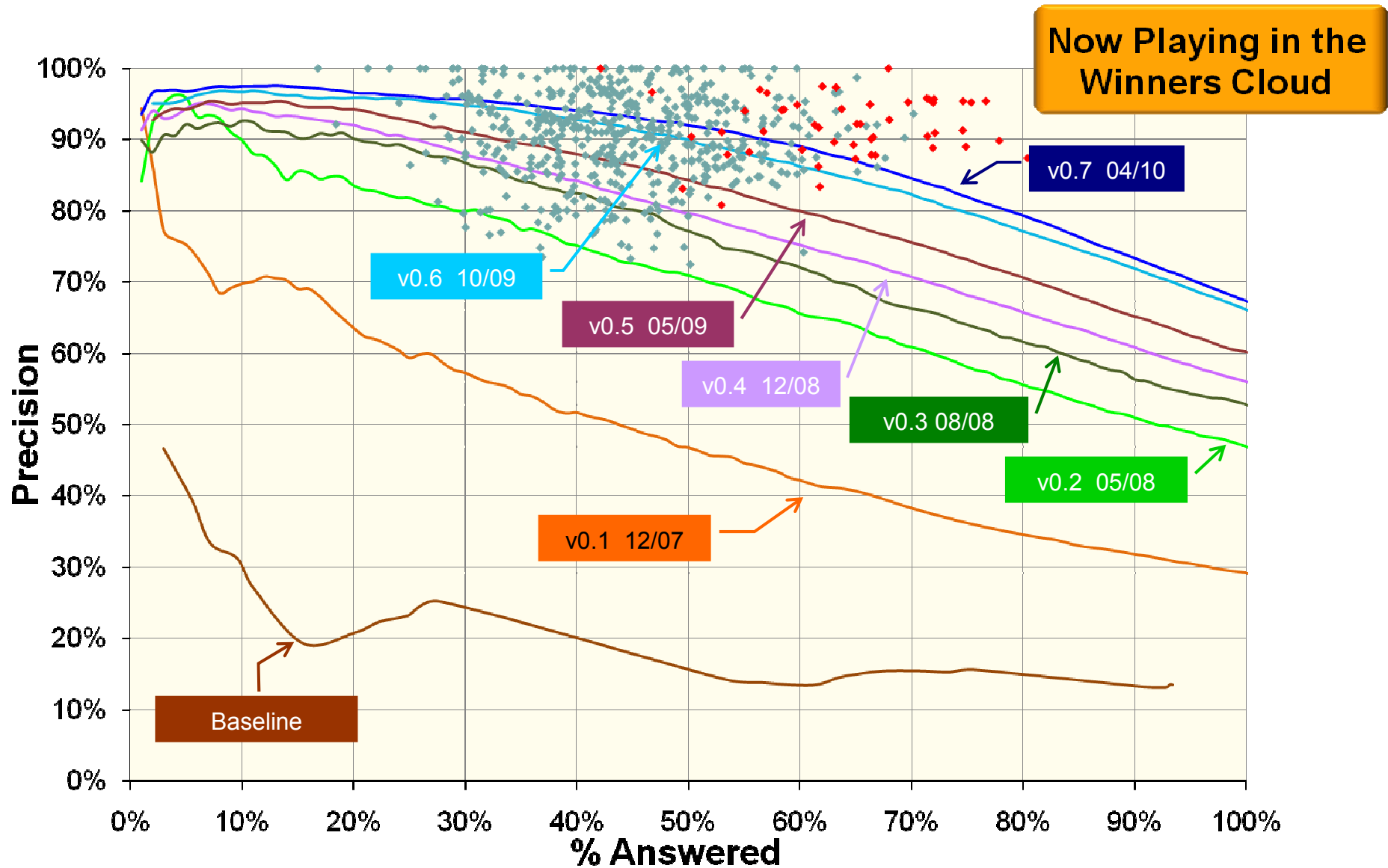
## Evidence: Puns

**Clue:** You'll find Bethel College and a Seminary in this "holy" Minnesota city.

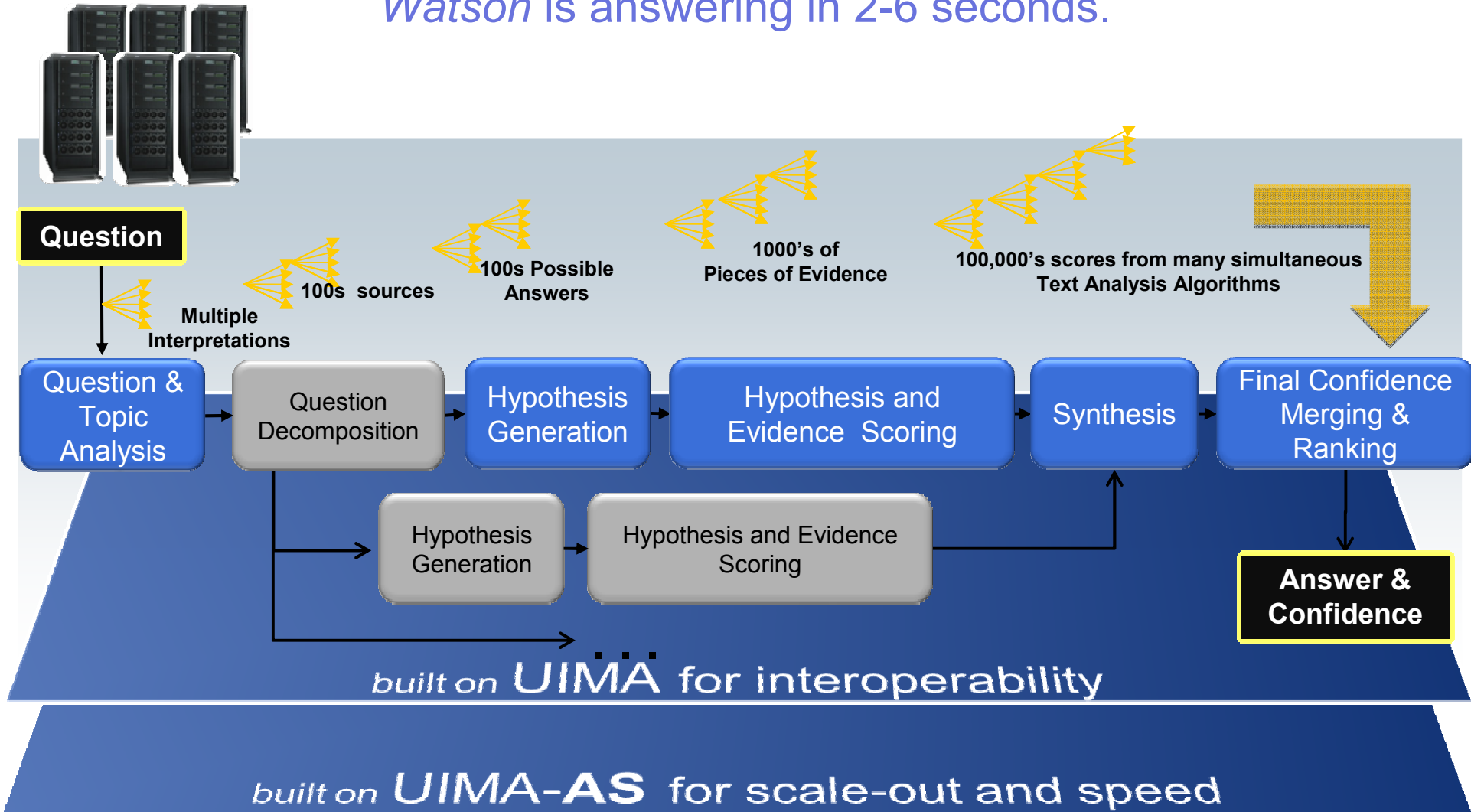




# DeepQA: Incremental Progress in Answering Precision: 6/2007-4/2010

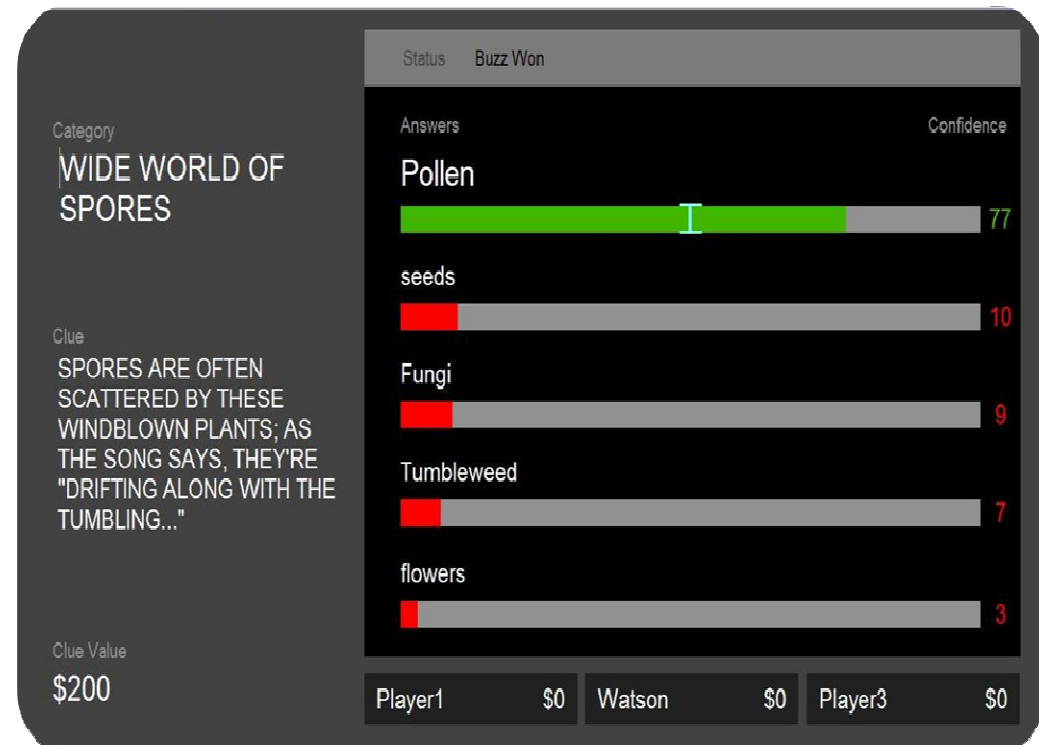


One Jeopardy! question can take 2 hours on a single 2.6Ghz Core  
Optimized & Scaled out on 3000-Core IBM HPC using UIMA-AS,  
*Watson* is answering in 2-6 seconds.



## Confidence is King

- All questions are not equal – some take longer, some are less certain than others
- Watson ring-ins ONLY IF it can compute a confidence fast enough
- It considers the category, question and a self-assessment of its own algorithms
- Uses confidence to **make betting decisions** and **manage the risk** associated with possibly getting wrong answers



# Potential Business Applications



**Healthcare / Life Sciences:** Diagnostic Assistance, Evidenced-Based, Collaborative Medicine

**Tech Support:** Help-desk, Contact Centers



**Enterprise Knowledge Management and Business Intelligence**

**Government:** Improved Information Sharing and Security





# Institute for Business Value

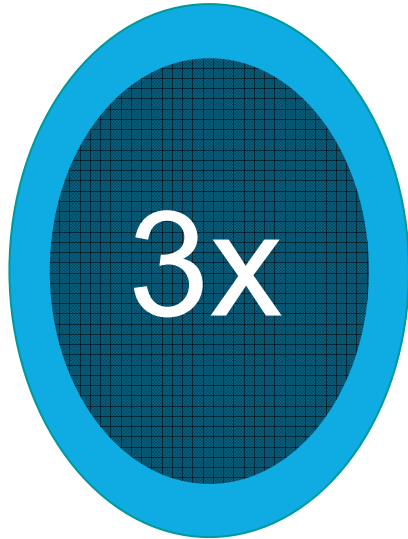
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**MIT Sloan**  
Management Review

# Key finding 1



## Analytics correlates to performance



Organizations that lead in analytics outperform those who are just beginning to adopt analytics



Top Performers are more likely to use an analytic approach over intuition\*

Source: Analytics: The New Path to Value, a joint MIT Sloan Management Review and IBM Institute of Business Value study. Copyright © Massachusetts

<sup>2</sup>Institute of Technology 2010.

<sup>6</sup>\*within business processes

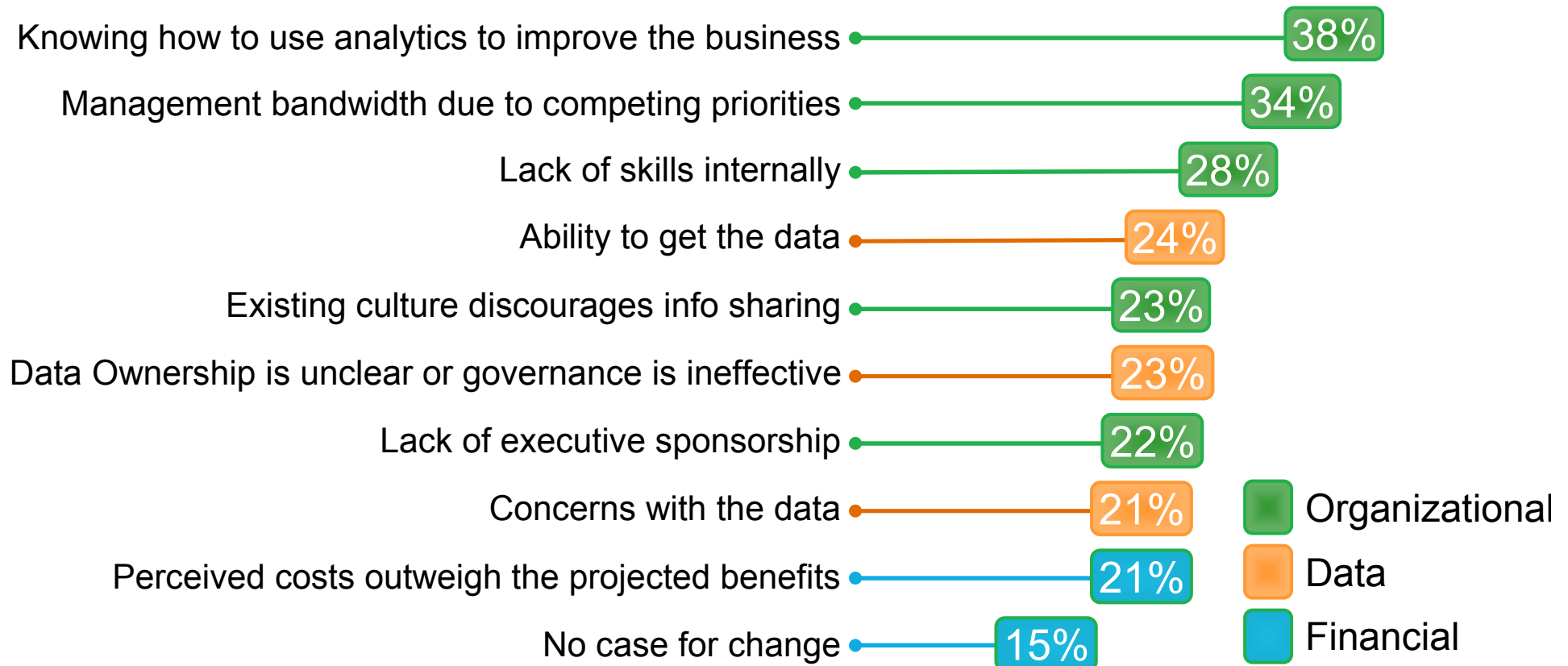


## Key finding 2



# Organizational, not data or financial concerns, are holding back adoption

### Primary obstacles to widespread analytics adoption



# Key finding 3



## Organizations want to “see” insights more clearly and act on them

Analytic techniques providing the most value:

Today

Historic trend analysis and forecasting

Standardized reporting

Data visualization

In 24 months

Data visualization

Simulations and scenario development

Analytics applied within business processes

- Increased or sustained value
- Decreased in value

**Imagine if you had all the answers you need to win**  
***IBM Business Analytics and Optimization solutions can ensure that you do***

Watson represents a culmination of IBM's century-long dedication to research and innovation.

This same investment in research is driving the creation of new **Business Analytics and Optimization** capabilities, allowing the innovations from Watson to be applied to solve business and societal problems – for example, diagnosing disease, handling online technical support questions, and parsing vast tracts of legal documents - and to drive progress across many industries.



# Any questions?

[ibm.com/Watson](http://ibm.com/Watson)

[ibm.com/BAO](http://ibm.com/BAO)

