This Research Made Watson Possible

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Want to Play Chess or Just Chat?

- **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 by 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
Hard Questions or Hard Answers or both? Depends on the Evidence.

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.

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 compelling and notable way to drive and measure the technology of automatic Question Answering along 5 Key Dimensions

- Broad/Open Domain
- Complex Language
- High Precision
- Accurate Confidence
- High Speed

$200
If you're standing, it's the direction you should look to check out the wainscoting.

$1000
The first person mentioned by name in ‘The Man in the Iron Mask’ is this hero of a previous book by the same author.

$600
In cell division, mitosis splits the nucleus & cytokinesis splits this liquid cushioning the nucleus.

$2000
Of the 4 countries in the world that the U.S. does not have diplomatic relations with, the one that’s farthest north.
### Broad Domain

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

In a random sample of 20,000 questions we found 2,500 distinct types*. The most frequent occurring <3% of the time. The distribution has a very long tail.

And for each these types 1000’s of different things may be asked.

Even going for the head of the tail will barely make a dent

*13% are non-distinct (e.g., it, this, these or NA)

Our Focus is on reusable NLP technology for analyzing volumes of *as-is* text. Structured sources (DBs and KBs) are used to help interpret the text.
LINCOLN BLOGS
TREASURY SECY. CHASE
JUST SUBMITTED THIS
TO ME FOR THE THIRD
TIME — GUESS WHAT,
PAL. THIS TIME I'M
ACCEPTING IT

RESIGNATION?

FRIEND REQUEST?

Treasury Secy. Chase wants to be friends with you.
Treasury Secy. Chase
279 friends · 52 photos · 21 groups

Confirm Friend Request
Inducing Meaning

Volumes of Text → Syntactic Frames → Semantic Frames

- Inventors patent inventions (.8)
- Officials Submit Resignations (.7)
- People earn degrees at schools (0.9)
- Fluid is a liquid (.6)
- Liquid is a fluid (.5)
- Vessels Sink (0.7)
- People sink 8-balls (0.3)
  (pool game (0.8))
In cell division, mitosis splits the nucleus & cytokinesis splits this **liquid** cushioning the nucleus.

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.
In May 1898 Portugal celebrated the 400th anniversary of this explorer’s arrival in India.

In May, Gary arrived in India after he celebrated his anniversary in Portugal.

This evidence suggests “Gary” is the answer BUT the system must learn that keyword matching may be weak relative to other types of evidence.
In May 1898 Portugal celebrated the 400th anniversary of this explorer’s arrival in India.

On the 27th of May 1498, Vasco da Gama landed in Kappad Beach.

This system must learn this is better evidence.

The evidence is still not 100% certain.
DeepQA: The architecture underlying Inside Watson

Generates many hypotheses, collects a wide range of evidence and balances the combined confidences of over 100 different analytics that analyze the evidence from different dimensions.
The team that built Watson
With Precision, Accurate Confidence and Speed, the rest was History
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
Meaning and Expression in Healthcare

(many different expressions, meaning highly dependent on context)

- Food would “get stuck” when she was swallowing
  - Swallowing difficulty...
  - Food gets held-up...

Causation
- Can cause food to move slowly in the esophagus.

Terminology

Chronology
- Sudden onset of chills
  - Cold
  - Chills
  - Coryza

Terminology

Magnitude
- High Temperature

Terminology

Causation
- Fever after acute symptoms subside...
  - Fever
  - Temperature

Location
- Abdomen pain
  - Urination pain
  - Pneumaturia
  - Bubbles in the urine
  - Abdomen pain exacerbated by exercise

Terminology

Location
- Flank pain
  - Kidney pain
  - Lower back pain

Location

Chronology
- Productive cough after nonproductive cough
  - Productive cough
**Teach Watson** -- technology generates questions to enhance understanding and acquire new knowledge – used in dialog or crowd-sourcing opportunities

*Watson considers…*

**What would have to be true for seizure disorder to be correct?**

What neurological condition contraindicates the use of bupropion?

*Automatically generates Learning Questions…*

- Does *contraindicates the use of bupropion* mean *should not use* bupropion?
- Does “*contraindicates the use of*” mean “*should not use*” in general?

Patients with preexisting *seizure disorder* should not use bupropion due to a higher-than-proportional increase in the possibility of having a seizure as the dose is increased.
Q: What diagnosis explains the patient’s condition?

Behcet’s Disease 45%
Sarcoidosis 32%
Lyme Disease 1%

The first symptom of Lyme disease (also called Lyme’s) is a small, red bull’s-eye rash, called erythema migrans, at the site of an infected tick bite. Other early, acute Lyme symptoms are flu-like—fatigue, achy muscles or joints, fever, chills, stiff neck, swollen glands, and a headache.

Lyme disease can affect different body systems, such as the nervous system, joints, skin, and heart. Symptoms are often described as happening in three stages (although not everyone experiences all three):

1. A circular rash, typically within 1-2 weeks of infection, often is the first sign of infection. Lyme disease is caused by the bacterium Borrelia burgdorferi and is transmitted to humans through the bite of infected blacklegged ticks. Typical symptoms include high temperature, headache, fatigue, and a characteristic skin rash called erythema migrans.

2. Along with the rash, a person may have flu-like symptoms such as swollen lymph nodes, fatigue, headache, and muscle aches.

Absent Factors
✓ Circular rash
✓ Fatigue
✓ Headache

Present Factors
✓ Red, painful eye
✓ Blurred vision
✓ Family history of arthritis
It's all about the evidence

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Family History</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sources</strong></td>
<td><strong>Factors</strong></td>
<td></td>
</tr>
<tr>
<td>Present Factors</td>
<td>Absent Factors</td>
<td></td>
</tr>
<tr>
<td>Red eye</td>
<td>Patient has low visibility</td>
<td></td>
</tr>
<tr>
<td>Eye pain</td>
<td>Patient has loss of hearing</td>
<td></td>
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<tr>
<td>Eye inflammation</td>
<td>Patient wears prescription lenses</td>
<td></td>
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<tr>
<td>Blurred vision</td>
<td>Patient has yellow eyes</td>
<td></td>
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<tr>
<td>Floating spots</td>
<td>Patient has pus in eyes</td>
<td></td>
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<tr>
<td>Sensitivity to light</td>
<td>Patient is allergic to pollen</td>
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THANK YOU