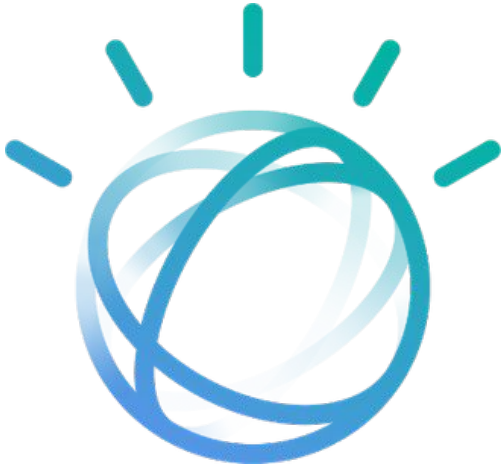


IBM Watson: how does it work (in healthcare)?



Overview

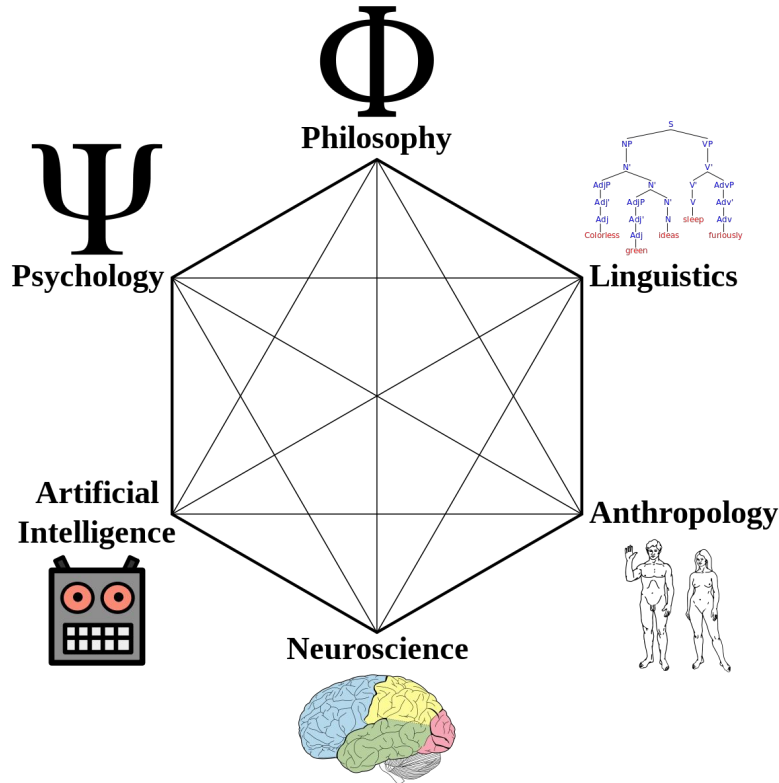
- Introduction
- Software & Hardware
- Expert System & Knowledge
- Question Answering & Jeopardy!
- Demo
- IBM Watson in Healthcare

What is IBM Watson?

Cognitive computing

Cognitive computer

Cognitive Computing



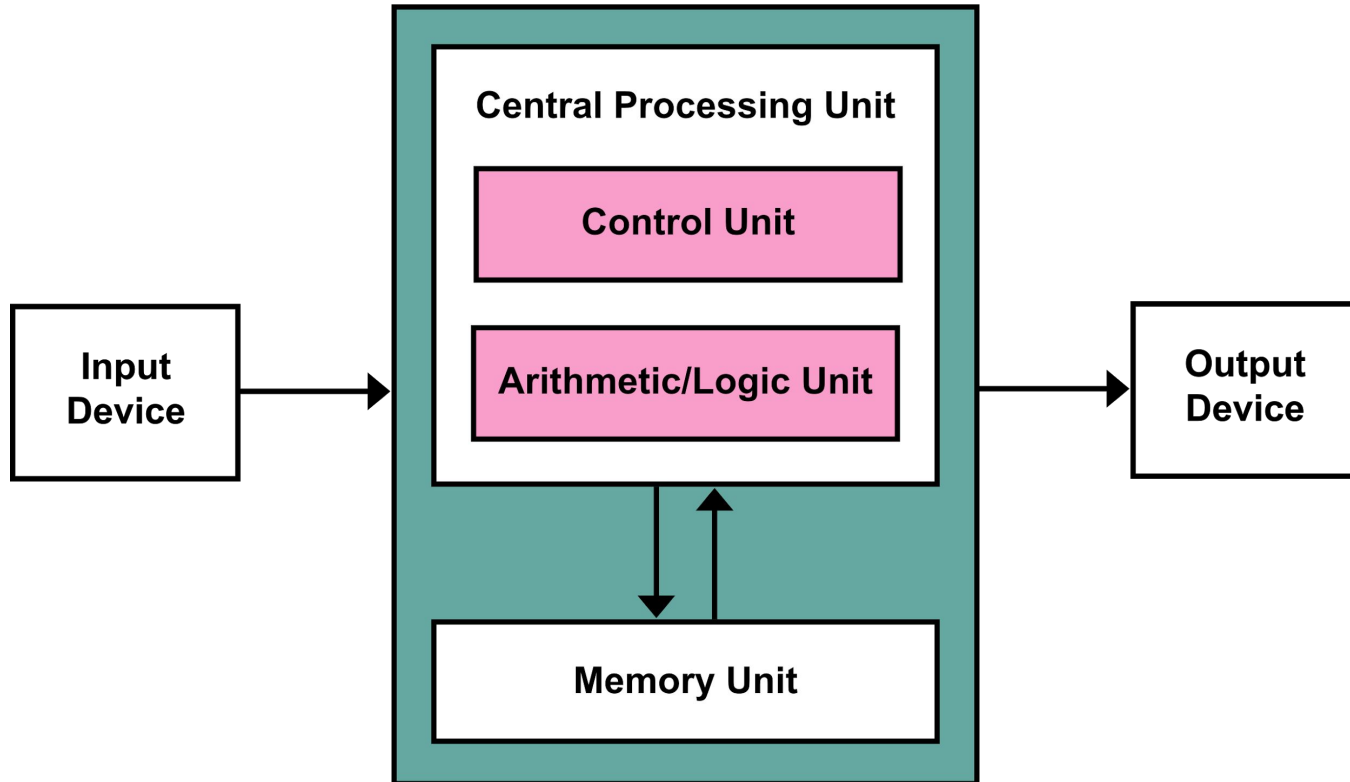
adaptive

Interactive

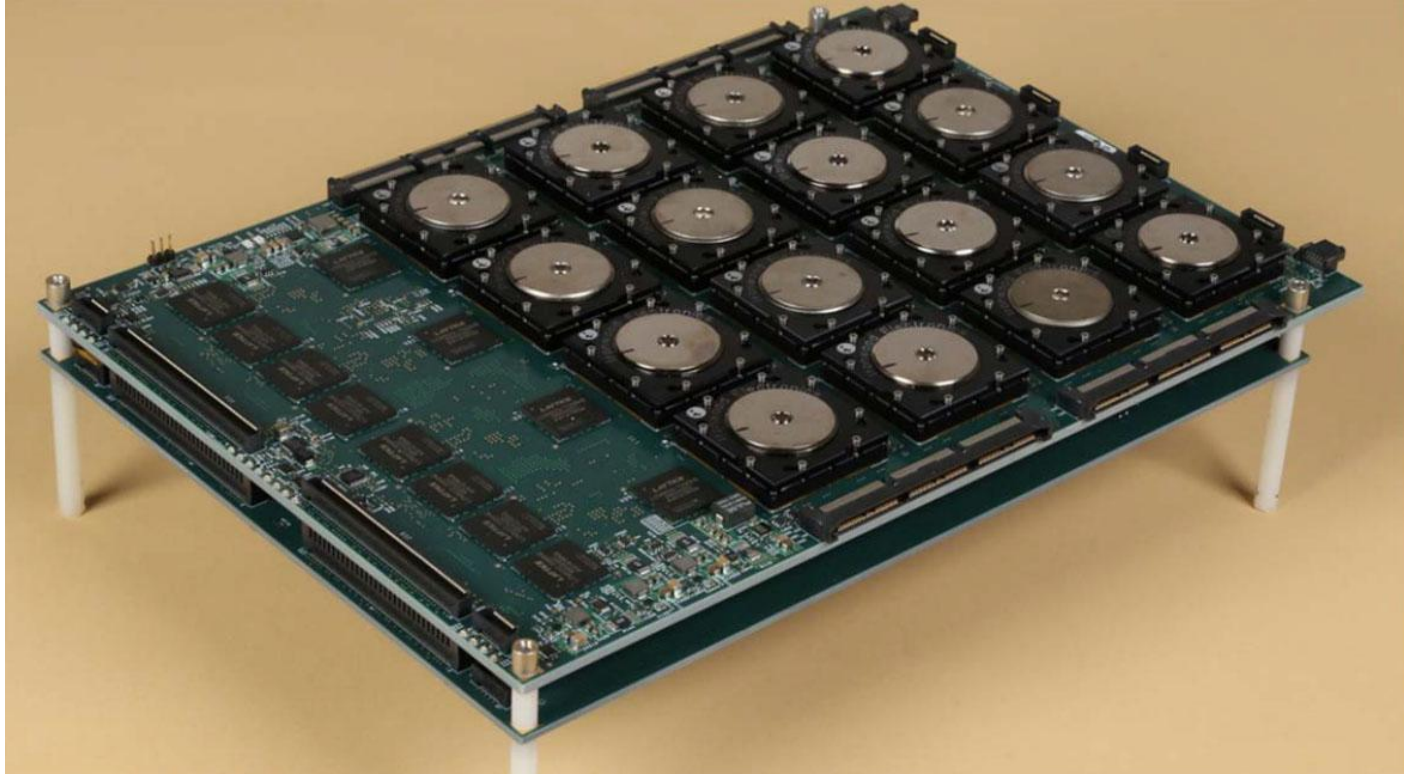
Iterative & Stateful

Contextual

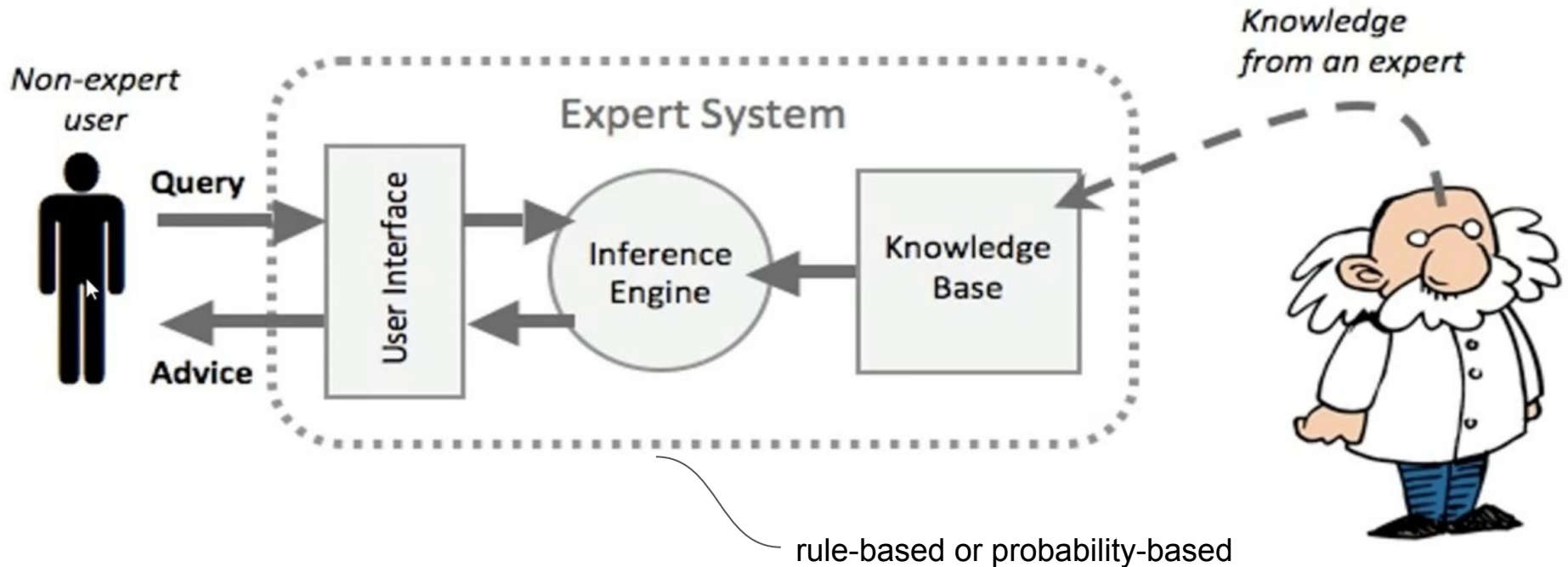
Cognitive Computer - Von Neumann architecture



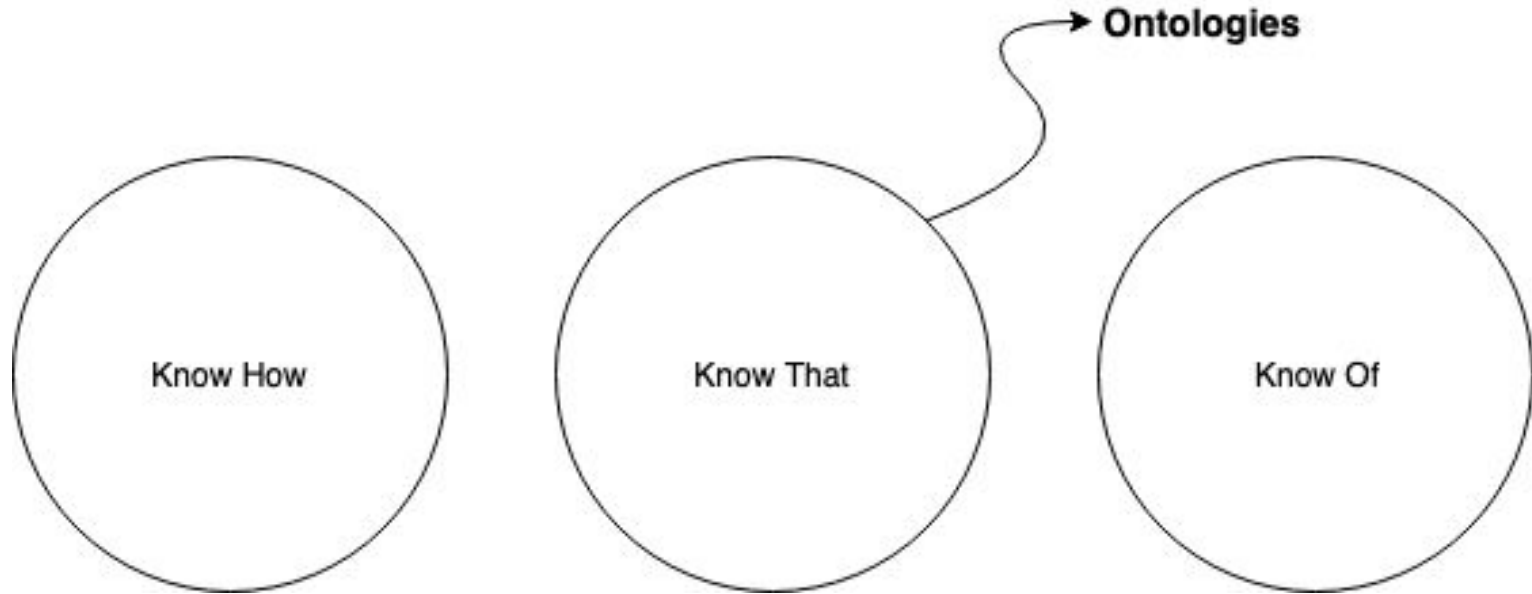
Cognitive Computer - IBM TrueNorth chip



Expert System

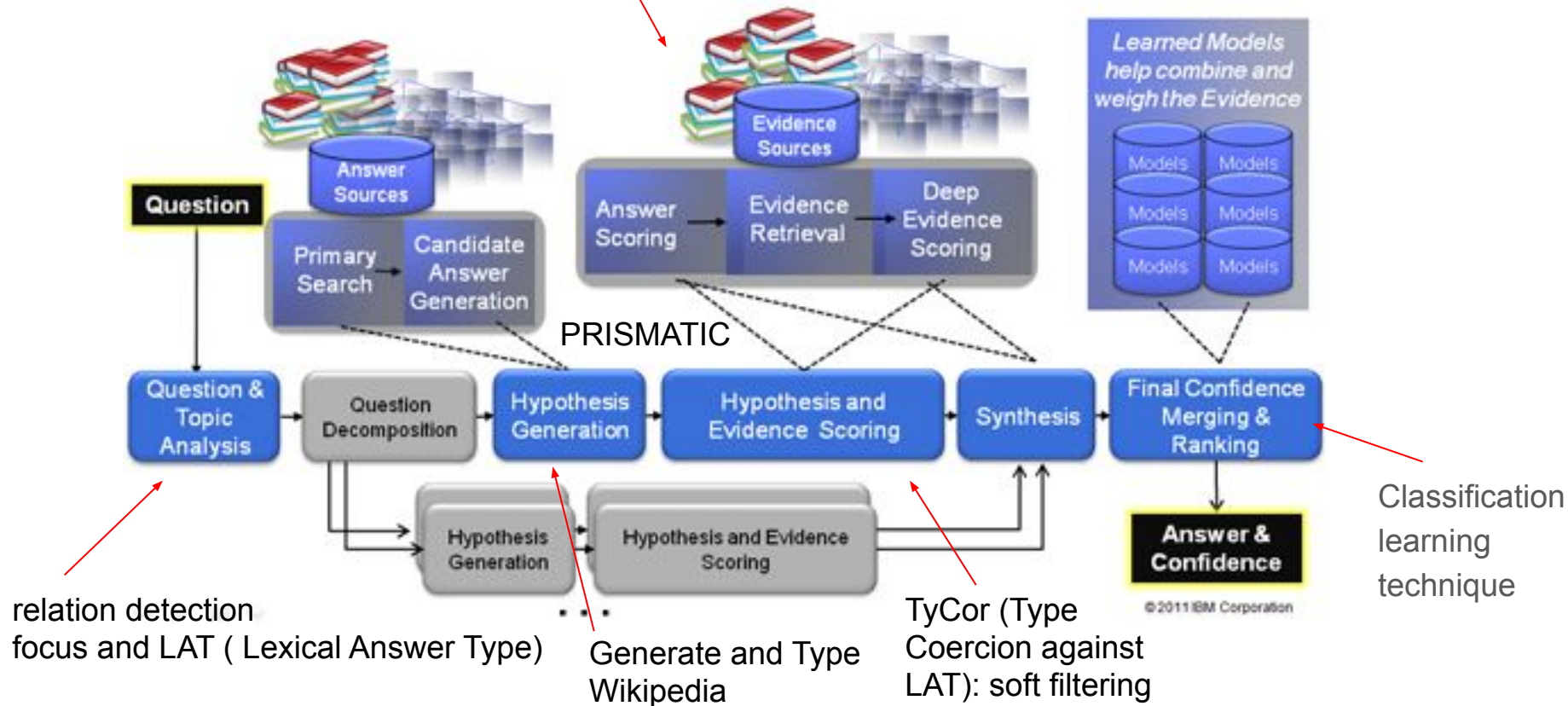


Knowledge



QA

Information Retrieval
(TF*IDF (Term Frequency * Inverse Document Frequency))



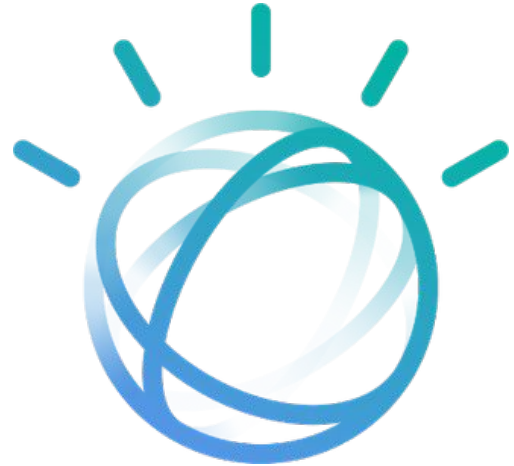
After Jeopardy

Mechanisms for retrieving information and data mining: no longer Jeopardy!, but new application domains:

- weather forecasting
- advertising
- ...

In November 2013, IBM announced it would make Watson's API available to software application providers, enabling them to build apps and services that are embedded in Watson's capabilities.

Watson demo's



Demo's

- Watson exist of a lot of products
- Natural language understanding
 - Relates to LAT
- Visual recognition
 - Insurance
 - Health care

Natural language understanding

- "You have stolen my dreams and my childhood with your empty words. And yet I'm one of the lucky ones. People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction, and all you can talk about is money and fairy tales of eternal economic growth. How dare you!" - Greta Thunberg
- Category
 - Science
 - ecology
- Emotion
 - Angry
- <https://natural-language-understanding-demo.ng.bluemix.net/>

Natural language understanding

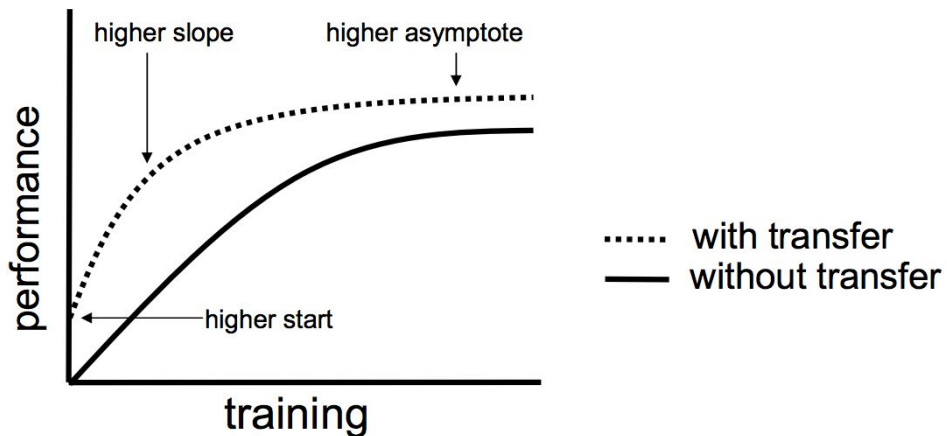
- With the abilities of Artificial Intelligence we can help people who are sick and ill. This prospect gives us great joy and makes us happy for the future.
- Category
 - Artificial Intelligence
 - Health
- Emotion
 - Happy
- <https://natural-language-understanding-demo.ng.bluemix.net/>

Visual recognition

- Insurance
 - Car damage
- Health care
 - "For the first time we compared a CNN's diagnostic performance with a large international group of 58 dermatologists, including 30 experts. Most dermatologists were outperformed by the CNN. Irrespective of any physicians' experience, they may benefit from assistance by a CNN's image classification." [10]
 - No product yet [11]
- <https://www.ibm.com/watson/services/visual-recognition/demo/#demo>

Summary of demo's

- Recognition
 - Text
 - Image
- Models
 - Create own models
 - Transfer learning
- Health care
 - Research but no product yet



IBM Watson in Healthcare

- Opportunities for Watson in Healthcare
- Implementation
- Hurdles (lack of success)









Why is there a role for watson in healthcare?

- Cost
 - Healthcare costs in the Netherlands next year: 82.2 billion (27% of the entire budget)
- Volume of (new) published research available
- Start new (drug) research
- Increasing availability of healthcare data

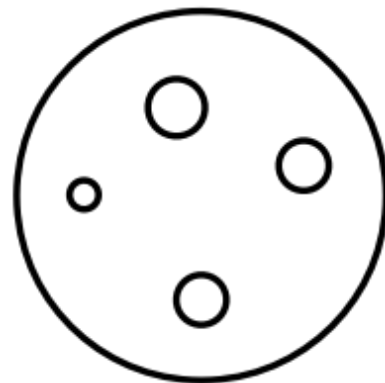


IBM Watson Health' focus areas

- **Oncology and genomics** 
 - Allowing cancer patients to benefit from cognitive knowledge
- **Imaging** 
 - Expanding the role of medical imaging for better patient care
- **Life sciences** 
 - Accelerating targeted and effective therapies
- **Value-based care** 
 - Reducing costs and addressing quality
- **Government** 
 - Improving the value of health and human services
- **Consumer** 
 - Empowering individuals to be proactive and self advocate for healthier lives

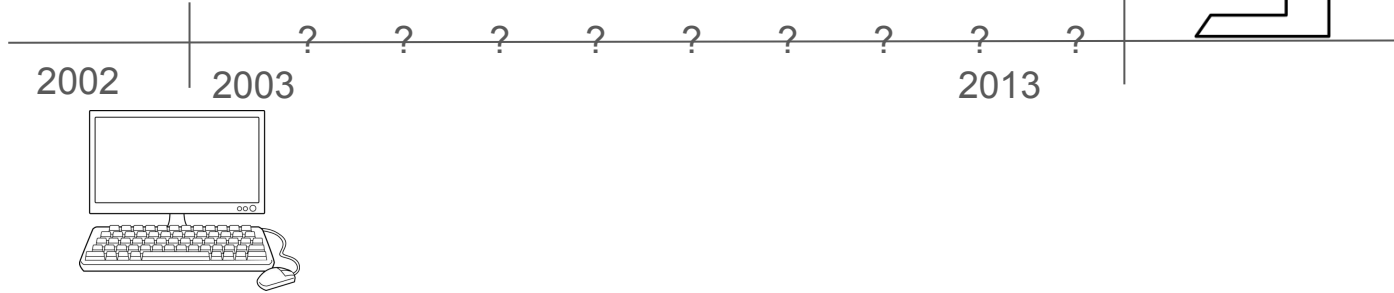
In the clinic

- Treatment decisions in cancer care
 - Trained on (latest) medical literature
 - Input all of the patients' clinical information
 - Watson will recommend treatment options based on the latest evidence and guidelines



In research

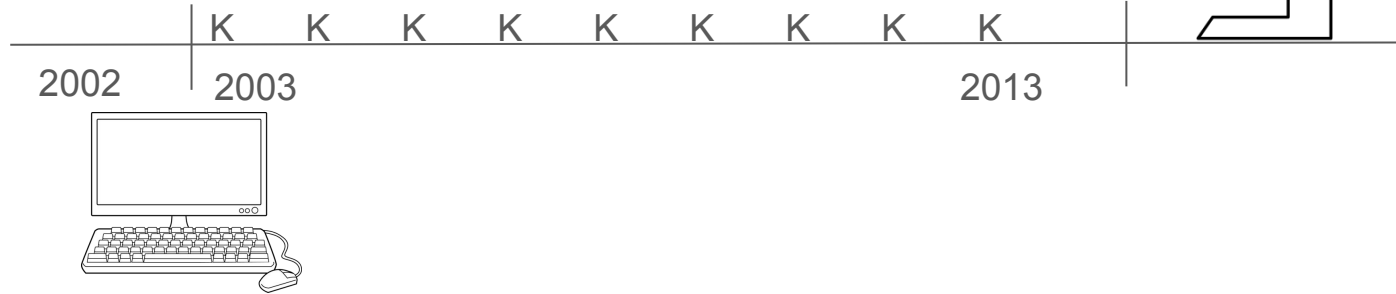
- A Retrospective and Prospective Exploration of Kinases
 - Predict kinases that might phosphorylate the P53 protein



In research

- A Retrospective and Prospective Exploration of Kinases

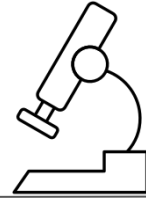
- Predict kinases that might phosphorylate the P53 protein
- Watson technology identified 9 potential kinases in 2002
-



In research

- A Retrospective and Prospective Exploration of Kinases

- Predict kinases that might phosphorylate the P53 protein
- Watson technology identified 9 potential kinases in 2002
- From 2003: 7 had in fact been discovered



- Watson could accelerate discovery of relationships between biological entities for which there was yet no explicit evidence of their existence

Hurdles

- Data

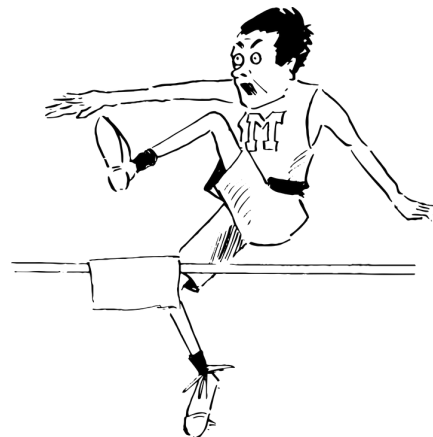
- Unstructured data
 - Variation of nonstandard terminology or acronyms
- Scores bad on time dependent data, like therapy timelines

- System

- Sharing of data
- Different systems in different hospitals

- Doctors

- Finding patterns in medical records, isn't considered as evidence based
- "Doctors trust their own judgment and don't need Watson tell them what to do"



Summary

- IBM Watson is basically a QA computing system which exploits the most powerful techniques of data mining, machine learning and much more.
- Demo's
 - Natural language understanding
 - Relates to LAT
 - Visual recognition
 - Insurance
 - Health care
- IBM Watson in Healthcare
 - There are opportunities for Watson in Healthcare
 - Some systems have been found useful
 - More hurdles came up than expected

Literature

1. <http://web.b.ebscohost.com.proxy.library.uu.nl/ehost/pdfviewer/pdfviewer?vid=1&sid=4198d02e-31ea-46cc-9d94-4d771c650ca8%40pdc-v-sessmgr02>
2. Chen Y, Elenee Argentinis JD, Weber G, (2016), IBM Watson: How Cognitive Computing Can Be Applied to Big Data Challenges in Life Sciences Research
3. <https://www.ibm.com/watson-health/products>
4. <https://nos.nl/op3/artikel/2302121-interactieve-miljoenennota-zo-wordt-het-geld-in-2020-verdeeld.html>
5. <https://www.ibm.com/nl-en/marketplace/clinical-decision-support-oncology>
6. <https://spectrum.ieee.org/biomedical/diagnostics/how-ibm-watson-overpromised-and-underdelivered-on-ai-health-care>
7. <http://theoncologist.alphamedpress.org/content/early/2018/11/16/theoncologist.2018-0257.long>
8. <http://theoncologist.alphamedpress.org/content/23/2/179.long>
9. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, Wang Y, Dong Q, Shen H, WangY, (2017), Artificial intelligence in healthcare: past, present and future
10. <https://www.ncbi.nlm.nih.gov/pubmed/29846502>
11. https://researcher.watson.ibm.com/researcher/view_group.php?id=4384
12. <https://www.merge.com/Blogs/Enterprise-Imaging-Blog/July-2018/Introducing-IBM-Watson-Imaging-Patient-Synopsis.-a.aspx>

Literature

J. William Murdock and Gerald Tesauro, IBM TJ Watson Research Center, (2012),
Statistical Approaches to Question Answering in Watson,

Ferrucci, D, et al. (2010) “Building Watson: An Overview of the DeepQA Project”