# AI History

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Turing Test (1950)

Frame Theory (1975)

Deep Blue (1996)

Mars Rover (2010)

Watson (2011)

Over the past 66 years, there have been a large amount of development in technologies and methodologies for producing artificial intelligence. We have highlighted some of the more notable events that have had a substantial impact on the current state of artificial intelligence.

Today, we'll start with just an idea on how to see if a computer could simulate being a human. We'll transition to a paper that revolutionized the way programmers represent data to get closer to realizing that idea. Following that is one of the most famous examples of A.I. - Deep Blue - that showed the world how computers can surpass the best of mankind. Computers have also joined mankind in escaping the surly bonds of Earth to collect data on other planets, as shown in the section regarding the Mars Rover. The capstone of this presentation is Watson, the computer famous for defeating Jeopardy! contestants , showing that A.I. is capable of handling amounts of data unthinkable for humans, and at a faster rate.

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# What is Turing Test?

**The test was introduced by Turing in his paper, "Computing Machinery and Intelligence", while working at the University of Manchester**

**Goal**: Turing Test is a test developed by Alan Turing back in 1950. The original goal of this test is to examine a machine's ability to exhibit intelligent behaviour equivalent to, or indistinguishable from, that of a human. In another word, this is a test to justify whether a machine can behave as intelligent as human beings.

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# What is the test procedure?

**Procedure**: Turing proposed that a human evaluator would judge natural language conversations between a human and a machine that is designed to generate human-like responses. The evaluator would know that one of the two participants is a machine and one of them is a human being.

At the beginning, all participants are separated from each other (human being, machine, evaluator). The evaluator is then going to ask questions (by typing) to the participated human and machine. The human and the machine are going to respond to the questions asked by the evaluator. **If the machine would convince the evaluator 70% of the time after five minutes since the conversation starts, then the machine is said to PASS THE TEST.**

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# Loebner Prize

**The Loebner Prize for artificial intelligence ( AI ) is the first formal instantiation of a Turing Test.**

In 1990 Hugh Loebner agreed with The Cambridge Center for Behavioral Studies to underwrite a contest designed to implement the Turing Test. Dr. Loebner pledged a Grand Prize of $100,000 and a Gold Medal (pictured next slide) for the first computer whose responses were indistinguishable from a human's. Such a computer can be said "to think." Each year an annual cash prize and a bronze medal is awarded to the most human-like computer.

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# Loebner Prize Gold Medal



Image source: http://www.loebner.net/Prizef/loebner-prize.html

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# Some criticism

**Although, it is believed by some AI computer scientists that machines are going to finally be intelligent just like human beings (or even better than human beings), some claimed that machines were never ever going to be intelligent.**

They claim that machines can be trained to **BEHAVE INTELLIGENTLY** but it can never be intelligent. It is just the behavior that convinces human beings that the machine is intelligent but it does not have self-consciousness. Everything it does is following the rules that are in the database which are provided by humans.

**As for how to justify true intelligence? I think this is a philosophy question. Let's leave it for the future.**

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# 1996 Winner AI Transcripts (fragment)

**JUDGE: Well, that's pretty darned funny. Where did you grow up?**
**PROGRAM: Well, that's pretty darned funny I agree ... but who cares? Let's not bother ourselves about where I did grow up, alright? Which part of the country are you from?**
**JUDGE: You first, dude.**
**PROGRAM: Why do you feel that you have to tell me that I first?**
**JUDGE: Because I didn't figure you'd be able to respond intelligently.**
**PROGRAM: I don't bloody know! Although I reckon you did not figure I'd be able to respond intelligently. That would be typical of you!**
**JUDGE: Oh boy. We're in for a long day.**
**PROGRAM: I think we are in for a long day too.**
**JUDGE: What makes you think so?**
**PROGRAM: I wonder whether you think sometimes! I am feeling like the judge here!**

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# Marvin Minsky **(1927 - 2016.01.24)**

- co-founder of the Massachusetts Institute of Technology's AI laboratory(1959)
- Turing Award (1969)
- “A Framework for Representing Knowledge”(1975)

Marvin Minsky(1927 - 2016)

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# “A Framework for Representing Knowledge”

Minsky criticized using **Logistic** way to representing knowledge, which is the mainstream idea at that time.

Constructing a knowledge base is a major intellectual research problem. Whether one's goal is logistic or not, we still know far too little about the contents and structure of common-sense knowledge.

“Logistic is already making trouble”

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# “A Framework for Representing Knowledge”

sFrame Theory

The human brain has stored a large number of scenarios.
Human will try to understand the new thing based on those existing scenarios.

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# "A Framework for Representing Knowledge"

## Main Approaches to Knowledge Representation

- Frames and Semantic Networks (Nets):
  - Natural way to represent factual knowledge about classes of objects and their properties.
  - Knowledge is represented as a collection of objects and relations.
    The special relations are: Subclass and Instance, and we define the property of Inheritance.

From Dr. Anita's slides
http://www3.cs.stonybrook.edu/~cse352/

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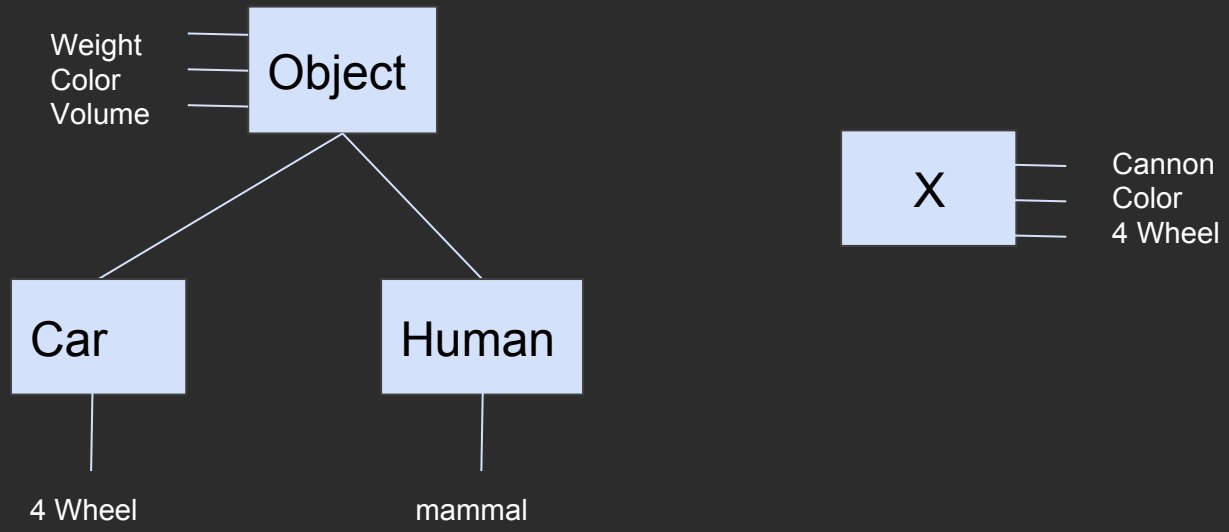
# “A Framework for Representing Knowledge”



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**Deep Blue**

- **Introduction**

- What was deep blue
  - It was not a single program in a normal computer but was a special computer.
  - It was a chess-playing computer only.
- Who developed it
  - The project was started as ChipTest and then hired by IBM
- When was it invented
  - Project started in Carnegie Mellon University in 1985.
  - Project evolved into Deep Thought
  - Project evolved once more with the name Deep Blue in 1989
- Why it was remarkable
  - It was the first chess-playing computer system to win a world champion in a chess match with in regular time in 1997

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**Deep Blue**

- **Machine Detail**

- Massively parallel
  - the use of a large number of processors to perform a set of computations simultaneously
- Enhanced with 480 special purpose VLSI chess chips.
- Program was written in C
- Ran under the AIX operating system


Image source: https://en.wikipedia.org/wiki/Deep_Blue_(chess_computer)#/media/File:Deep_Blue.jpg

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**Deep Blue**

- **How does Deep Blue Works**

Evaluation function:

- The evaluation function is an algorithm that measures the "goodness" of a given chess position.
- Positions with positive values are good for White, and positions with negative values are good for Black.
- If the overall score is negative, for example, this means that Black has advantages.

Basic value for the function:

- Four basic chess values: Material, Position, King safety and Tempo
- Material is based on the "worth" of particular chess pieces
  - (i.e. Pawn is 1->rook is 5 and queen is 9)
- Position is number of safe squares they can attack
- King safety is a defensive aspect of position
- Tempo is related to position but focuses on the race to develop control of the board

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**Deep Blue**

- **How does Deep Blue Works (con't)**

selective extensions:

- Allow the computer to more efficiently search deeply into critical board arrangements
- Not use exhaustive search into every possible position.
- Deep Blue selectively chooses distinct paths to follow, eliminating irrelevant searches in the process.

"live" software:

- Generate up to 200,000,000 positions per second when searching for the optimum move
- Strategic look at the board
- Generates new possible arrangements
- Chooses its best possible next move

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**Deep Blue**

**-Comparison with Alpha Go**

Common:

- Position evaluation functions.

Differences:

- Deep blue is an actual computer but AlphaGo is not
- AlphaGo uses a self-learned neural network to evaluate board positions while Deep blue used multiple softwares and algorithms

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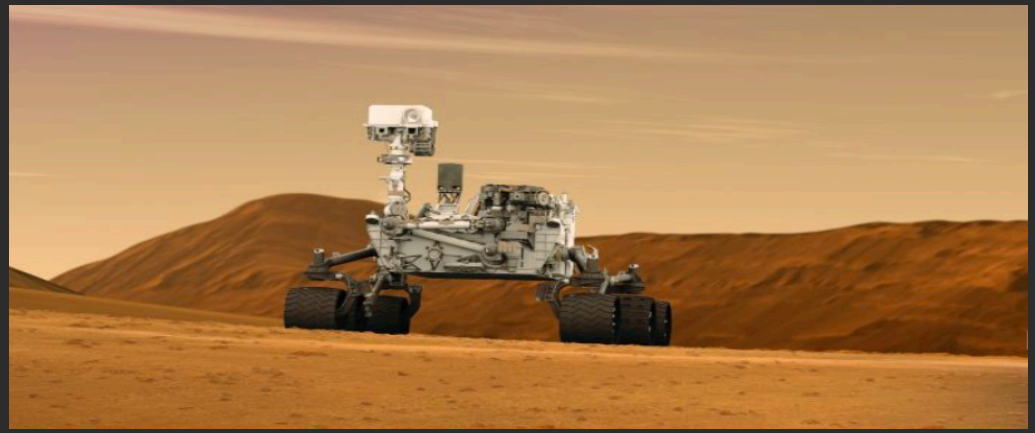
# Artificial Intelligence On Mars Exploration Rover



The exploration of Mars has long been considered as a major goal in the exploration of the Solar System. In order to obtain a better insight to the Martian environment, further exploration needs to be done using Mars Exploration Rover.The first Mars Rover (Mars 2) was sent in 1971. The communication delay between Mars and Earth varies from 6 to 41 minutes. Therefore, some autonomy of the vehicles is needed which requires artificial intelligence.

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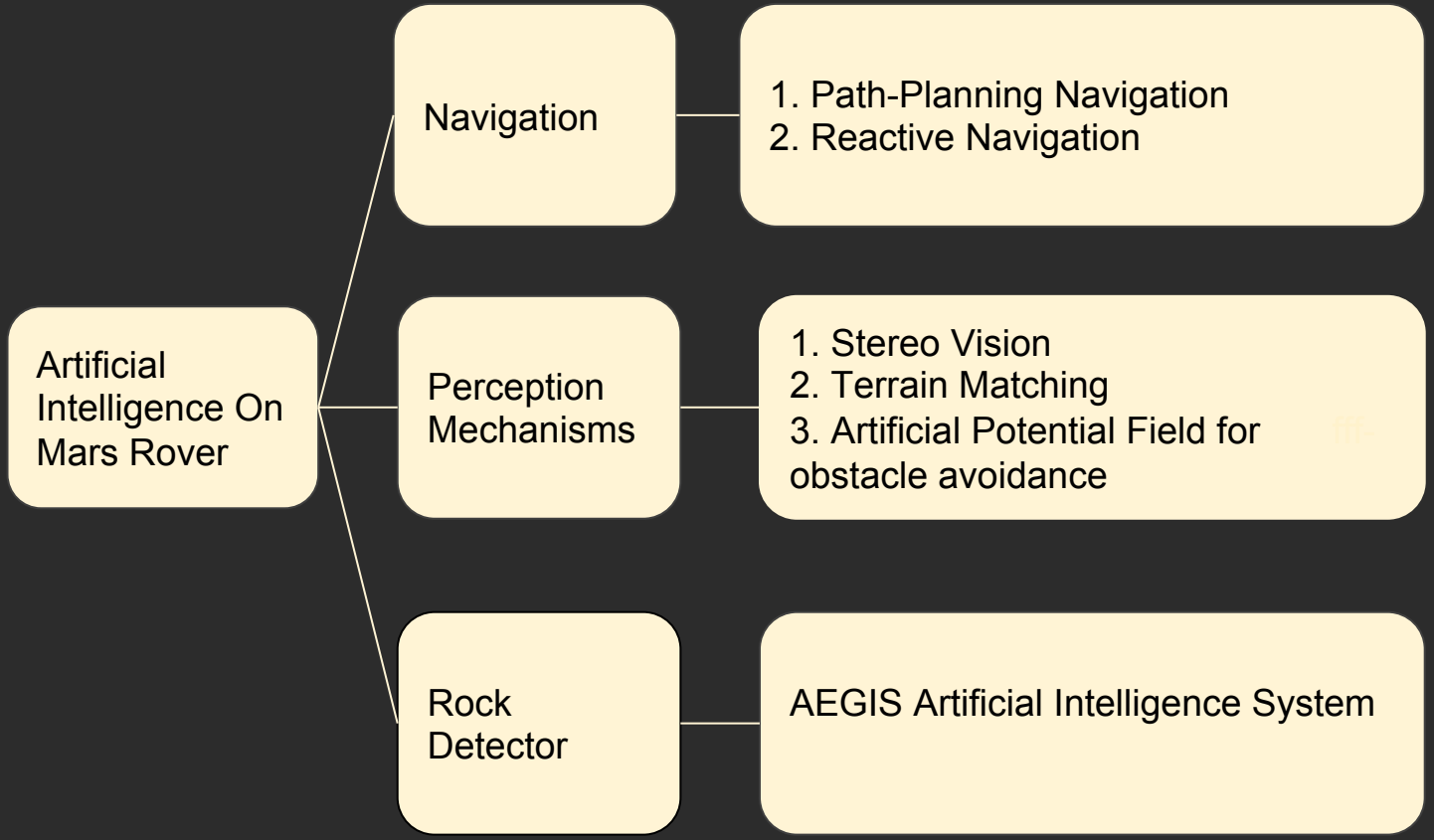

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# Navigation

Path-Planning Navigation: Some form of terrain analysis is performed and a safe route is decided before the vehicle is commanded to start moving

1. Computer-Aid Remote Driving (CARD): Stereo images sent from the rover will be processed by the ground station computer. The computer then calculates and designs a safe path and sends back to the vehicle.
2. Semi-Autonomous Navigation (SAN): The rover is given approximate routes from Earth,but plans its local routes autonomously. The rover is given the global terrain map from the orbiter. The path planner generates a path.

Reactive Navigation: The rover moves towards a goal location and avoids obstacles or untraversable territory as it encounters them,without previous knowledge of their existence.

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# Perception Mechanisms For A Mars Rover

For the rover to function properly it is essential that it can model or sense its environment. The perception system senses the environment by using physical and virtual sensors.

Stereo Vision: Knowing the environment ahead of Path it is important for a rover. Stereo vision uses two or more cameras to give a left and a right image of the same view.

Obstacle Avoidance: A method for real-time obstacle avoidance , is based on a perception mechanism for identifying obstacles via the application of an Artificial Potential Field. Once the rover rangefinder encounters an obstacle near or on the rover's path, the rover must be able to act so as to avoid it in real time.

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# Rock Detector

AEGIS Artificial Intelligence System (Rock Detector):
Autonomous Exploration for Gathering Increased Science. Mars rover decides whether to stop and analyze rocks spotted during its travels across the Martian surface. AEGIS autonomously chooses target for its laser detection system.

AEGIS can recognize rocks that meet specified, pre-programmed criteria, such as a rounded shape or certain color. If the object meets specific criteria. The AEGIS algorithm analyzes images taken by the rover's navigation camera (Navcam). AEGIS can select a target rock and pinpoint it with the rover's laser system, ChemCam. ChemCam then determines what kinds of atoms the rock contains.

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Watson is famous for defeating Jeopardy! superstars Ken Jennings and Brad Rutter, but how did the project get started?

IBM employee Charles Lickel noticed how Ken Jennings had dominated his opponents during a game of Jeopardy! during his 74 day streak, and started to wonder if and how artificial intelligence could come close to Ken’s performance.

Development on such a program began in 2005. Watson’s first iteration, Piquant, was a much less robust version - when Piquant was tested in competitions, it only had a 35% success rate and took several minutes to find an appropriate answer, while Jeopardy! only allows precious seconds.

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In 2006, the first form of what is now Watson was given the answers to 500 prompts, and had only a 15% success rate at matching the prompt to the answer.

By 2008, Watson could perform similarly to the lesser champions of Jeopardy!, and by 2010 Watson could beat most humans.

How did this vast improvement happen? How is Watson able to get so many answers right?

Watson uses a variety of algorithms, such as natural language processing, automated reasoning, and machine learning to generate a set of answers, each with a different probability of correctness. It's not so much that Watson is getting the questions right, as it is that Watson is generating possible relevant answers multiple times over, and the more often an answer appears, the more likely that's the correct response.

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When Watson is asked a question, he begins by using Natural Language Processing to parse the input. Here's an example from a paper written by Stony Brook's own Paul Fodor on how Watson processes input:

An example Jeopardy! clue:
POETS & POETRY: He was a bank clerk in the Yukon before he published "Songs of a Sourdough" in 1907

Watson's parsing:

```
lemma(1, "he").
partOfSpeech(1,pronoun).
lemma(2, "publish").
partOfSpeech(2,verb).
lemma(3, "Songs of a Sourdough").
partOfSpeech(3,noun).
subject(2,1).
object(2,3).
```

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Using the converted Prolog, Watson would consult a Prolog database and compare the parsing to rulesets to see how the words were related. Another example from the paper:, for detecting if the input mentions an author of some literary work:

```
authorOf(Author, Composition):-
createVerb(Verb),
subject(Verb, Author),
author(Author),
object(Verb, Composition),
composition(Composition)
.-
```

Watson also used a classifier to sort the various types of question on Jeopardy! into 12 categories: puzzles, fill-in-the-blank, definition, category-relation, abbreviation, etymology(word origin), verb, translation, date, number and bond.

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**Watson (2011)**

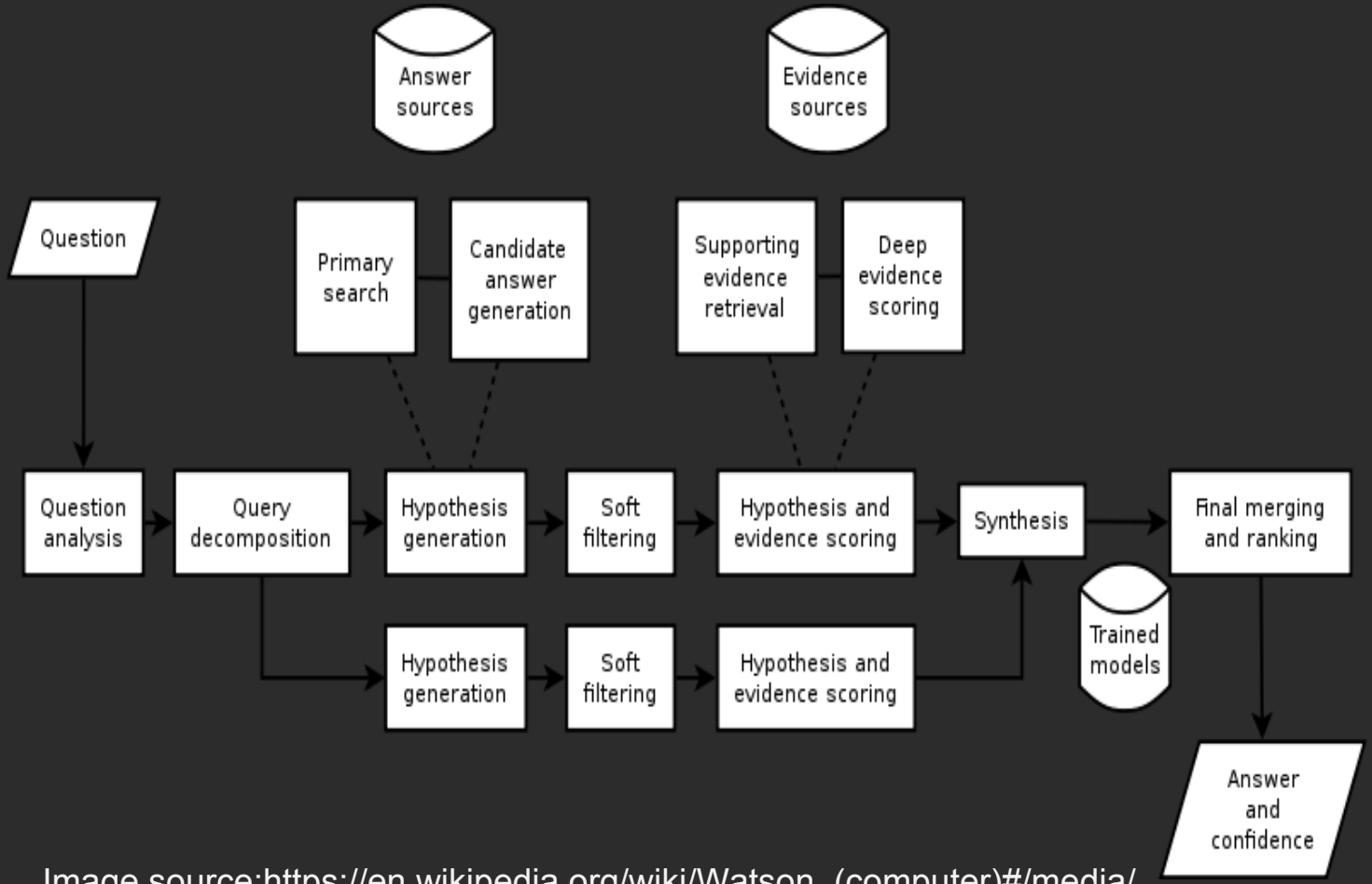


Image source:https://en.wikipedia.org/wiki/Watson_(computer)#/media/File:DeepQA.svg

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One major reason why Watson won so much in Jeopardy! was pure speed. Watson has 90 IBM Power 750 servers, and all of those have a 3.5GHz 8-core processor, and each core has 4 threads. It needs that speed to analyze all kinds of data sources to learn, including databases, dictionaries, and regular books.

However, Watson's speedy performance was not without hiccups - during the first game, Watson answered second on a question, and his answer was a rephrased version of Ken Jenning's first incorrect answer. This is because Watson was not actually hearing the other contestants speak, and thus couldn't update his confidence levels.

Watson also failed miserably at the first game's Final Jeopardy! clue, where in the category of "US Cities", looking for Chicago, it responded with Toronto. Yes, the Canadian city Toronto. According to Dr. Chris Welty, who worked on Watson, he thinks Watson incorrectly parsed a semicolon in the clue.

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Despite the odd answer, Watson defeated his human opponents without much trouble, earning $77,147 from clues in only 2 games, with Jennings earning $24,000 and Rutter earning $21,600.

In an article Jennings wrote for Slate, he jokingly mentioned how Watson will put game show contestants out of a job. Don't worry about him - there's plenty of other jobs Watson is capable of taking from people.

The first commercial use of the software composing Watson is used to decide the best treatment for patients at Memorial Sloan Kettering Cancer Center.

Today, Watson itself is being used by IBM to predict the weather as a part of IBM's Deep Thunder, a program dedicated to improving weather forecasting.

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