

Lecture Outline

- What is Artificial Intelligence (AI)?

- History of AI

- Early Imaginings
- Gestation
- Birth
- Early Enthusiasm
- A Dose of Reality
- Knowledge-Based Systems
- AI Becomes an Industry
- AI Adopts the Scientific Method
- Emergence of Intelligent Agents
- Availability of Very Large Datasets



What is Artificial Intelligence (AI)?

Pondering our Intelligence

- *Homo Sapiens* – ‘man the wise’
- Humans have sought to understand **how we think** for thousands of years
 - Perceive
 - Understand
 - Predict
 - Manipulate...
 - A world far larger and more complicated than ourselves
- Field of AI goes farther:
 - Not just to understand
 - But also **build** intelligent entities

The Draw of AI

- “*Molecular biology* and *AI* are most regularly regarded as the ‘field I would most like to be in’ by scientists in other disciplines.” – Stewart J. Russell
- In contrast with other older fields, there is much to be discovered and invented
- AI encompasses a huge variety of subfields
- “AI is relevant to any intellectual task; it is truly a universal field.” – Stewart J. Russell

Questions Driving AI



- **Philosophy**

- Can formal rules be used to draw valid conclusions?
- How does the mind arise from a physical brain?
- Where does knowledge come from?
- How does knowledge lead to action?



- **Mathematics**

- What are the formal rules to draw valid conclusions?
- What can be computed?
- How do we reason with uncertain information?



- **Economics**

- How should we make decisions so as to maximize payoff?
- How should we do this when others may not go along?
- How should we do this when the payoff may be far in the future?



- **Neuroscience**

- How do brains process information?



- **Psychology**

- How do humans and animals think and act?



- **Computer Engineering**

- How can we build an efficient computer?



- **Control Theory and Cybernetics**

- How can artifacts operate under their own control?



- **Linguistics**

- How does language relate to thought?

Categorizing Definitions of AI

- **Thinking:** i.e. thought process and reasoning
- **Acting:** i.e. behavior
- **Humanly:** i.e. fidelity to human performance
- **Rationally:** i.e. doing the ‘right’ thing, given what is known

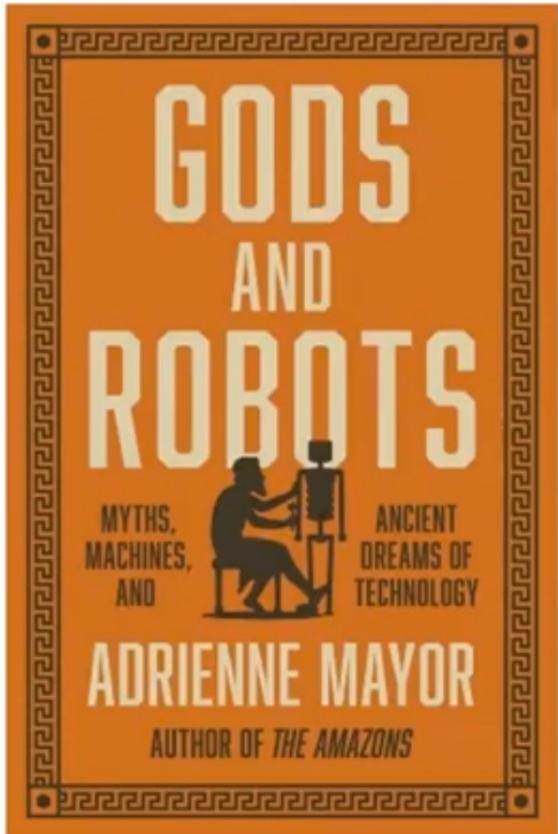
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-
- Definitions typically fall into one of four categories:
 - **Thinking Humanly**
 - e.g. cognitive science, machines with minds, consciousness, creativity
 - **Thinking Rationally**
 - e.g. logic, ‘law of thought’, ‘right thinking’, correct inference
 - **Acting Humanly**
 - e.g. a chat bot (Turing Test), mimic a human, robotics
 - **Acting Rationally ****
 - e.g. agents – perceive, persist, adapt, create and pursue goals
 - Rational agent – acts to achieve the best, or best expected outcome

AI History: Early Imaginings *(750 BC - 1950 AD)*

700 B.C. Greek Mythology: Pandora

[Link: Short Video -
Gods and Robots](#)



- “It could be argued that Pandora was a kind of AI agent. Her only mission was to infiltrate the human world and release her jar of miseries.” - Adrienne Mayor

700 B.C. Greek Mythology: ‘Biotechne’

- *Biotechne – Life through craft* - made not born
 - Term has evolved into ‘Biotechnology’

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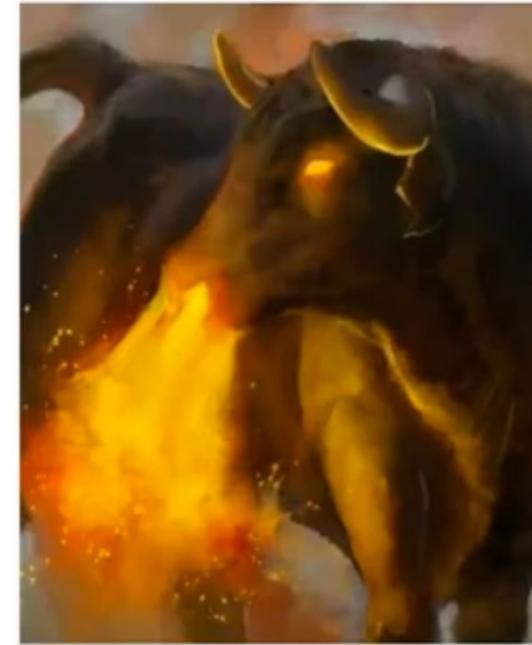
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Golden personal assistants



Drone-like eagle tormenting Prometheus



Fire-breathing bronze bulls



Invincible automata army



Talos and Laelaps (Golden Hound)

Automatons

Realistic humanoid automatons were built by craftsman from every civilization



Hero of Alexandria (70 A.D) Mechanical Greek Theater



Pierre Jaquet-Droz (1780) Animated Dolls



Ismail al-Jazari (1200) Automated Robot Band



Wolfgang von Kempelen (1800) 'The Turk'

Middle Ages

Rumors of secret mystical or alchemical means of placing 'mind into matter'

Homunculus: (1520) Alchemy – miniature, fully formed human

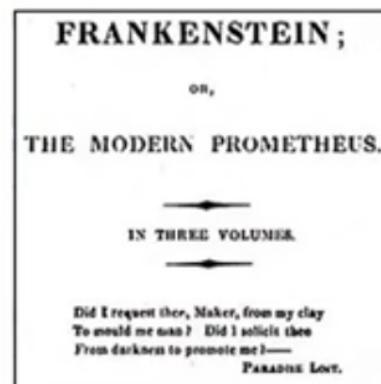
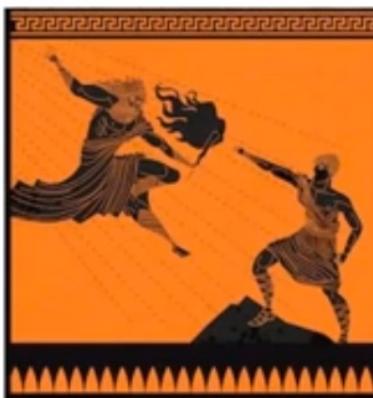
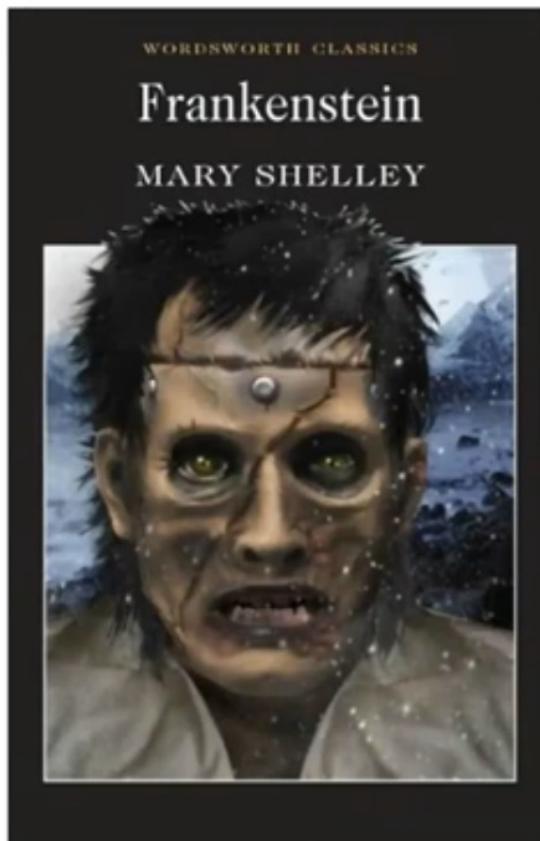


Golem: (1590) Animated being – 'activated' by a code



Early Science Fiction

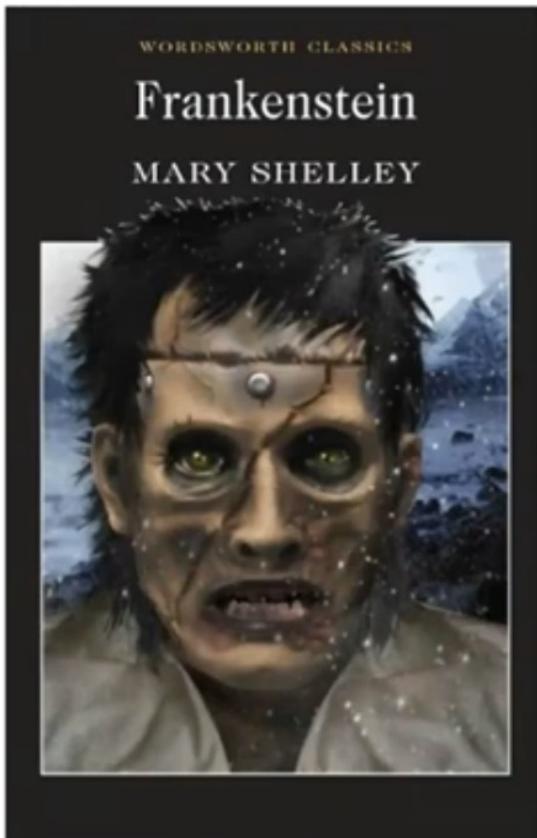
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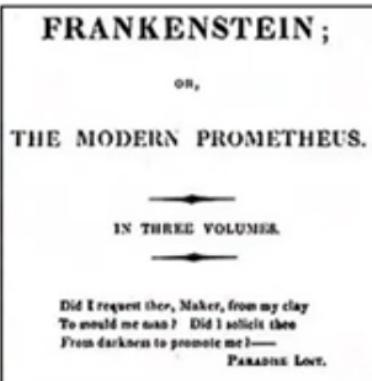
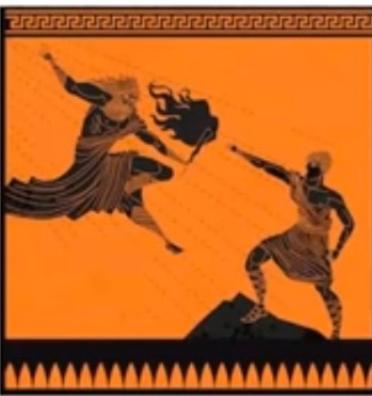
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Considered first 'science-fiction'

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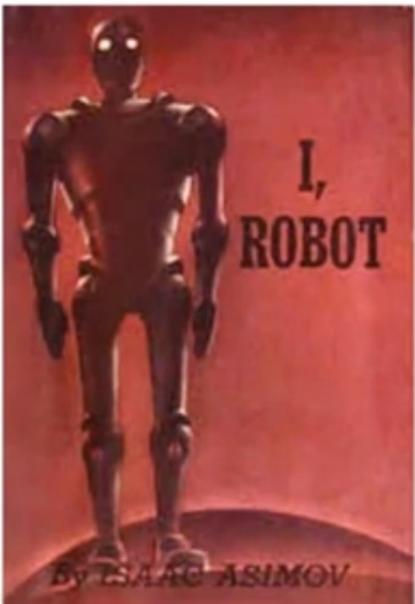


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Rossum's Universal Robots: (1920) –
Introduced the word 'robot'

'Robotics' – Science Fiction



Isaac Asimov: (1945)

WHY ASIMOV PUT THE THREE LAWS
OF ROBOTICS IN THE ORDER HE DID:

POSSIBLE ORDERING

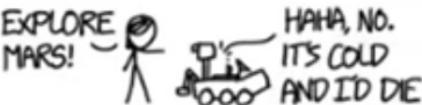
1. (1) DON'T HARM HUMANS
2. (2) OBEY ORDERS
3. (3) PROTECT YOURSELF

CONSEQUENCES

[SEE ASIMOV'S STORIES]

BALANCED
WORLD

1. (1) DON'T HARM HUMANS
2. (3) PROTECT YOURSELF
3. (2) OBEY ORDERS



FRUSTRATING
WORLD

1. (2) OBEY ORDERS
2. (1) DON'T HARM HUMANS
3. (3) PROTECT YOURSELF



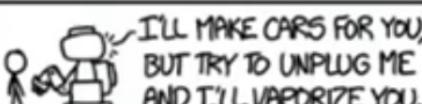
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HELLSCAPE

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1. (3) PROTECT YOURSELF
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TERRIFYING
STANDOFF

1. (3) PROTECT YOURSELF
2. (2) OBEY ORDERS
3. (1) DON'T HARM HUMANS



KILLBOT
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AI History: Gestation *(350 B.C.-1956 A.D)*

Foundations of Formal Reasoning

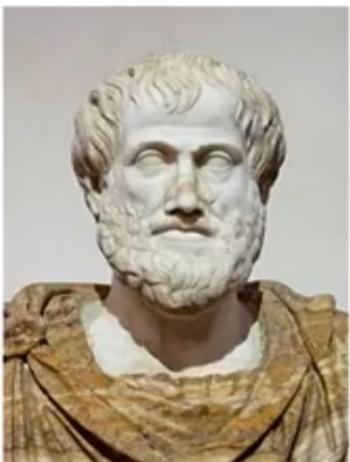
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- Aristotle (384–322 BC):
 - Gave a formal analysis of the syllogism

Law of Syllogism

Statement 1: If p , then q

Statement 2: If q , then r

Conclusion: If p , then r



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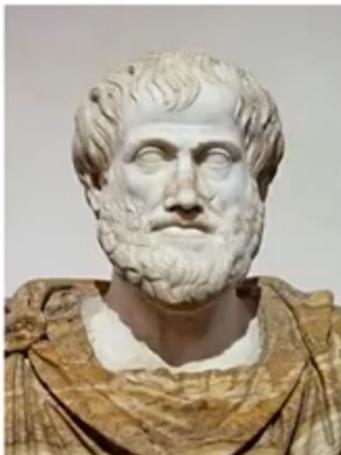
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 - Pioneer of computation theory – a father of information science
 - Developed several logical machines for production of knowledge

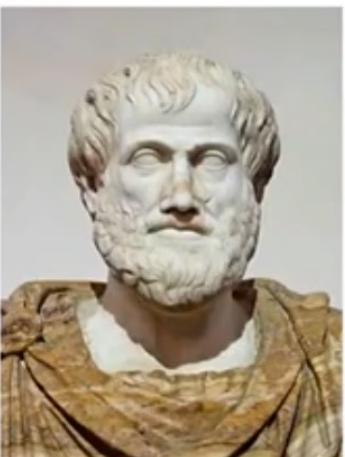
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- Gottfried Leibniz (1700 AD):
 - Proposed that human reason could be reduced to mechanical calculation (computing machines)

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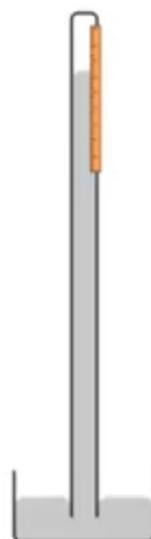
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Prediction

- A statement about a future event or outcome
- **Robert FitzRoy (1854):**
 - English officer of the Royal Navy and a scientist
 - Pioneering meteorologist:
 - Made accurate daily weather predictions
 - Coined term: "forecast" i.e. prediction
 - The invention of several different types of barometers was attributed to him



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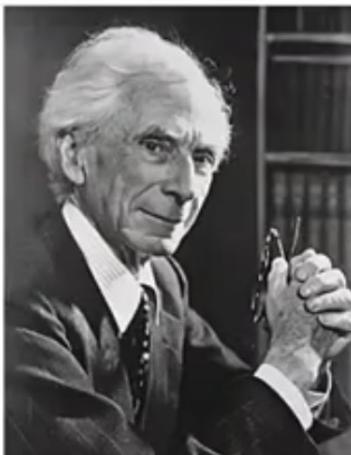
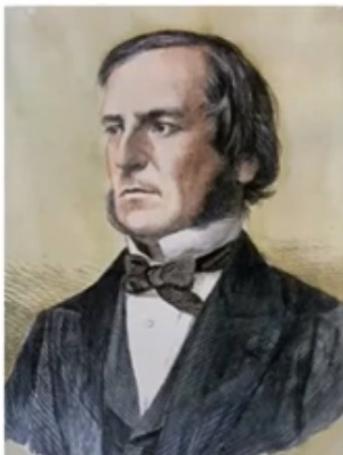
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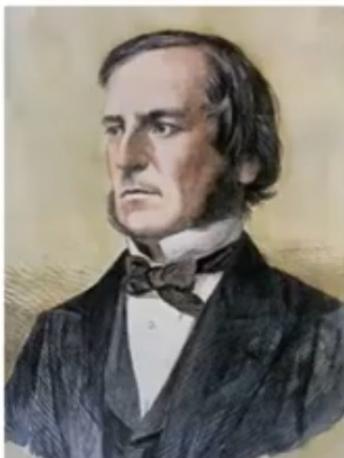
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- **David Hilbert (1920-1930):**
 - Challenged mathematicians to answer: "Can all of mathematical reasoning be formalized?"



Computational Limitations

- **Kurt Gödel** (1930-1931):
 - **Completeness Theorem:**
 - Shows that in first-order predicate logic, all true statements are derivable
 - **Incompleteness Theorem:**
 - Limits on deductions do exist

▷



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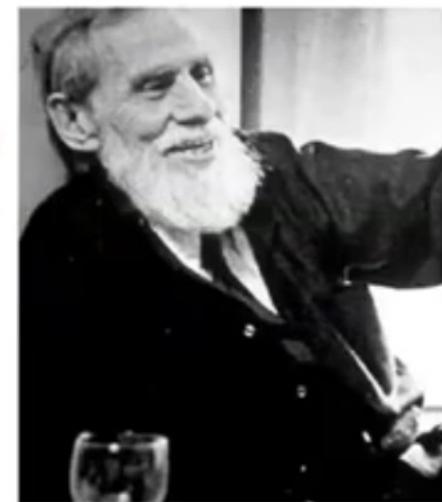
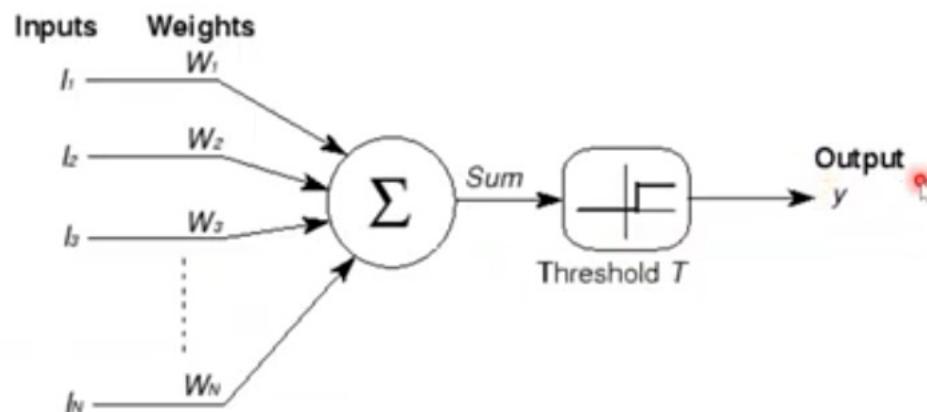
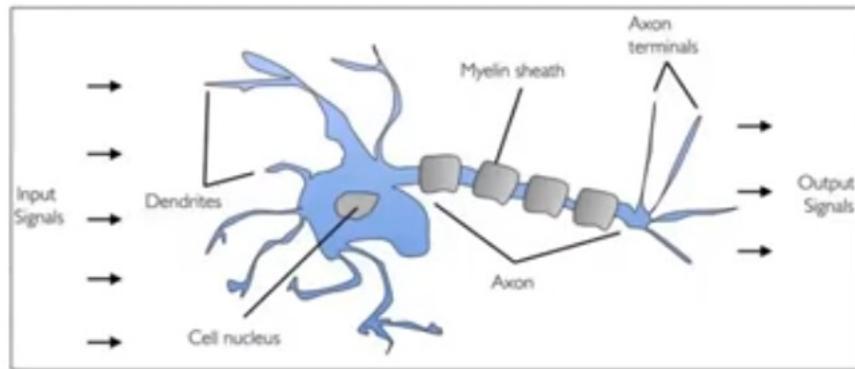


- **Alan Turing (1937):**
 - **Halting Problem:**
 - Given: description of a computer program and an input
 - → Will program finish running, or run forever
 - Showed no such program exists
 - Identified a limit for intelligent programs
 - i.e. there will never be a universal program verification system



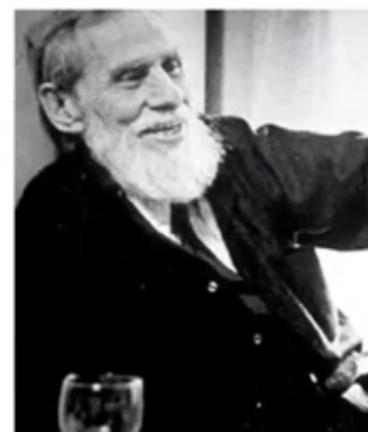
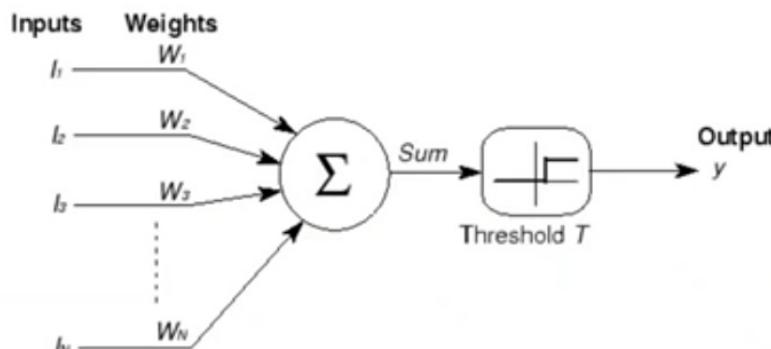
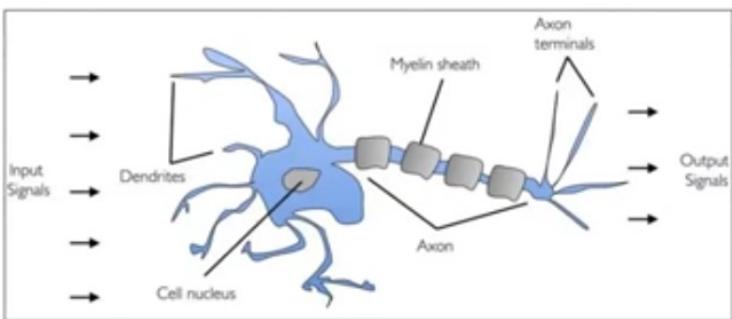
Founding Neural Networks

- **Walter Pitts & Warren McCulloch (1943):**
 - First work generally recognized as 'AI' (after the fact)
 - Drew parallels between the brain and computing machines
 - Created a computational model for **neural networks**
 - Linear threshold gate – **no learning yet**

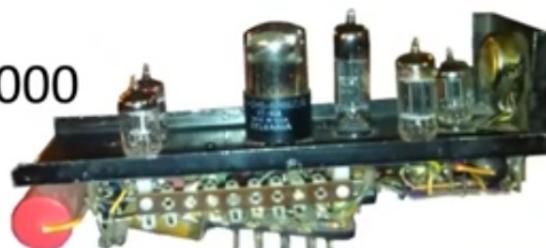


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- **Marvin Minsky & Dean Edmonds (1951):**
 - Develops a neural networks machine (SNARC) with 3000 vacuum tubes simulating 40 neurons
 - Simulated a rat navigating a maze



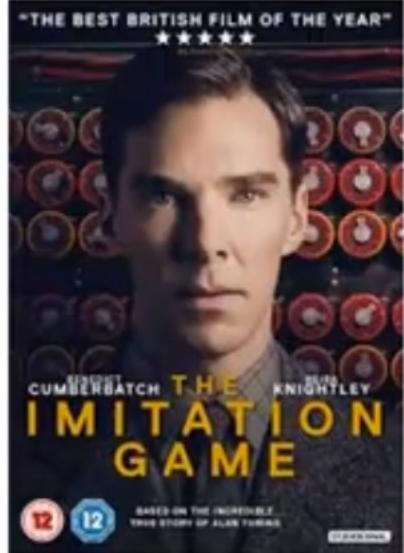
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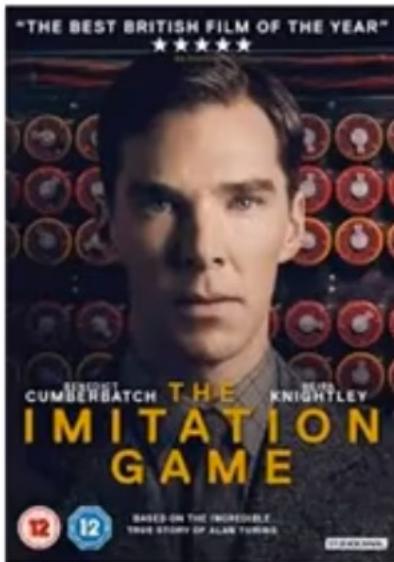
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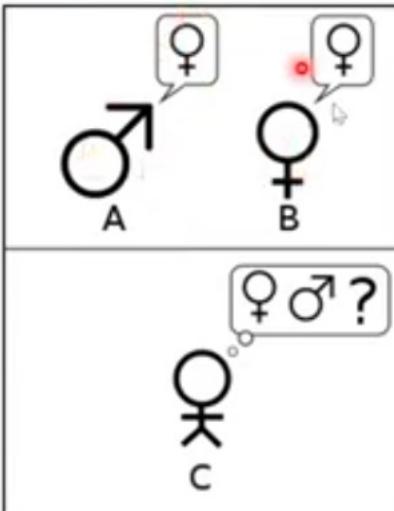


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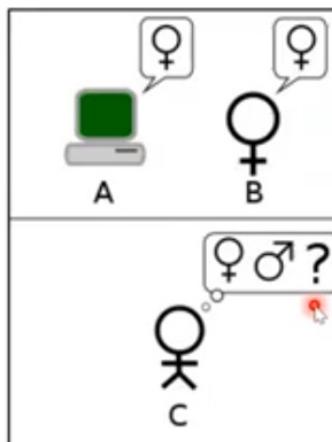
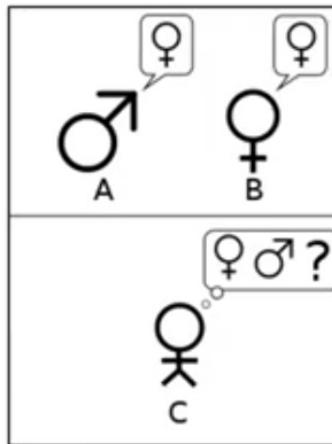
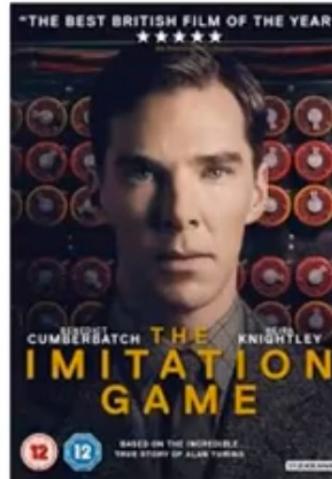
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- Party game – inspiration for Turing Test
- **Player C** tries to determine which of the two is the man and which is the woman



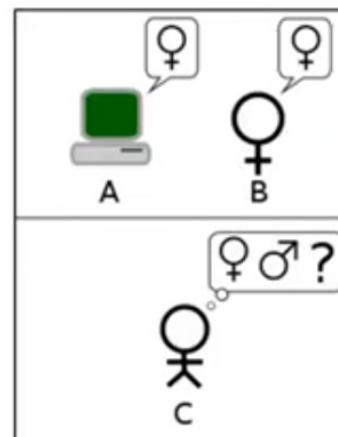
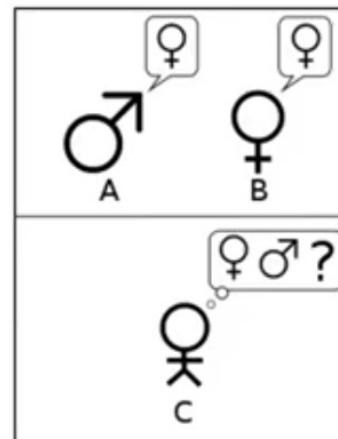
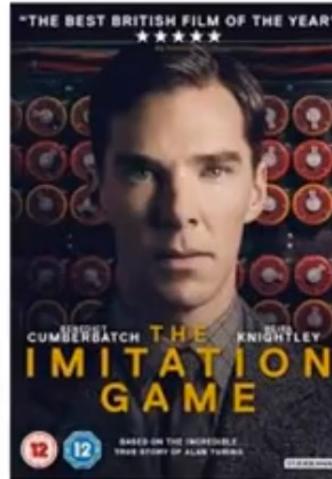
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 - **Player A** = machine – Role of man pretending to be a woman
 - Will the interrogator decide wrongly **as often** when the game is played like this as he does when the game is played between a man and a woman?
 - **Player C** assumes A and B are human



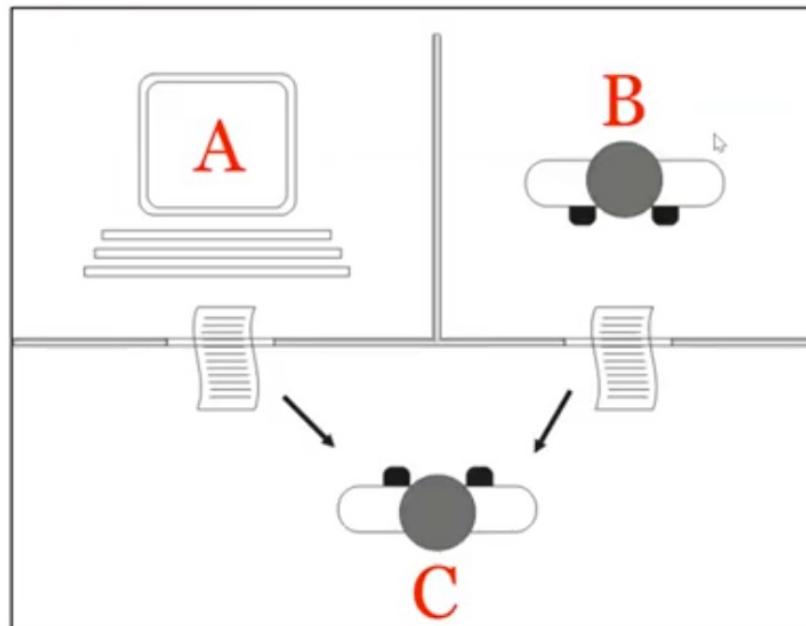
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 - Player C assumes A and B are human
 - Not specifically to determine whether a computer is able to fool an interrogator into believing that it is a human, but rather whether a computer could *imitate* a human



Turing Test: Standard Interpretation

- Player A is a computer and player B a person of either sex
- Not interested in sex determination
- Player C must decide which player is a machine
- Controversy: are the two versions equivalent?
 - A man (Player A) can fail the original test (due to a "lack of resourcefulness")
 - The original test requires the resourcefulness associated with intelligence
 - Not just "simulation of human conversational behavior"



'Birth' of Machine Learning

- **Arthur Samuel – IBM (1955):**
 - Builds a program that learned to play checkers
 - At a strong amateur level
 - Disproved the idea that a computer can only do what they are told
 - 1956 – this program was demonstrated on TV
 - 1959 - coined the term "**machine learning**"



AI History:
Birth (1956)

First AI Workshop

- **John McCarthy** – Dartmouth College (1956)
 - Organized a two-month workshop at Dartmouth
 - 10 attendees:
 - Marvin Minsky, Claude Shannon, Nathaniel Rochester, Arthur Samuel, Trenchard More, Ray Solomonoff, Oliver Selfridge, Allen Newell, Herbert Simon
 - No breakthroughs, but introduced major figures to each other
 - 20 years later – field dominated by their academic ancestry ↗
 - MIT, CMU, Stanford, and IBM



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 - MIT, CMU, Stanford, and IBM
 - Coined the term '**Artificial Intelligence**'
 - The science and engineering of making machines intelligent



Logic Theorist (LT)

- **Herbert Simon & Allen Newell (1956):**
 - First program engineered to mimic the problem-solving techniques of a human being (logic gates)
 - “The first artificial intelligence program”



Logic Theorist (LT)

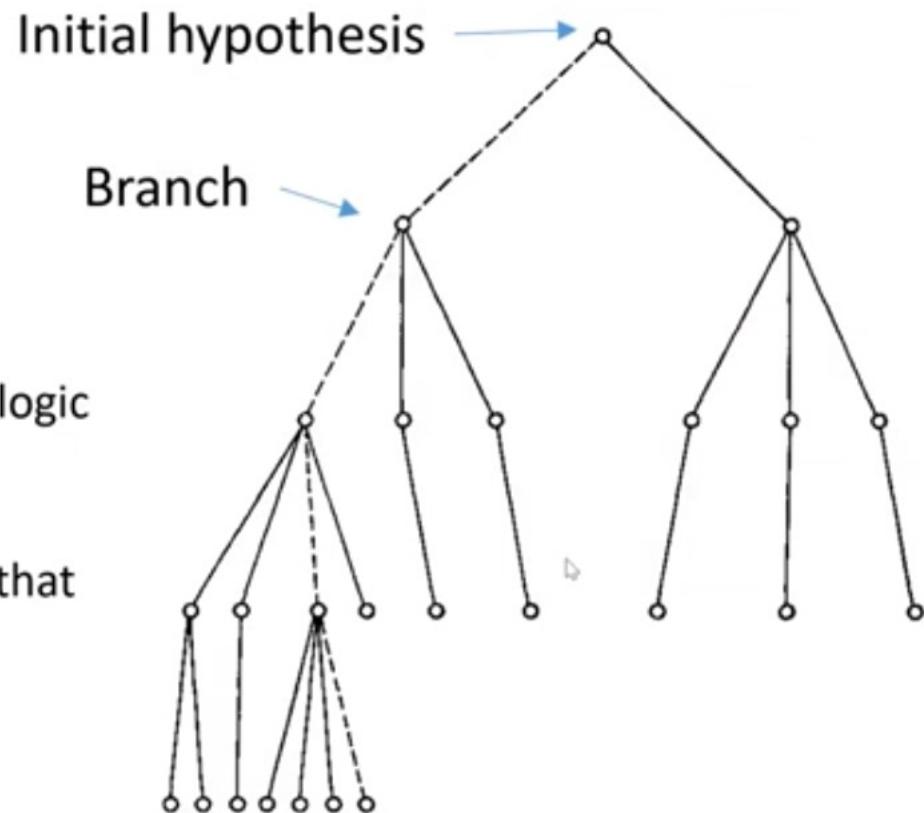
- **Herbert Simon & Allen Newell (1956):**
 - First program engineered to mimic the problem-solving techniques of a human being (logic gates)
 - “The first artificial intelligence program”
 - Eventually proved 38 of the first 52 theorems in *Principia Mathematica*
 - Found new and more elegant proofs for some
 - Submitted to *Journal of Symbolic Logic* with LT included as an author
 - **REJECTED** → a new proof of an elementary mathematical theorem was not notable





Herbert Simon & Allen Newell

- **Reasoning as search**
 - LT explored a **search tree**:
 - each branch was a deduction based on the rules of logic
 - Some node = goal: the proposition to be proved
 - Pathway leading to goal = a proof
 - Proof = a series of statements, each deduced using logic, that led from the hypothesis to the proposition to be proved.





Herbert Simon & Allen Newell

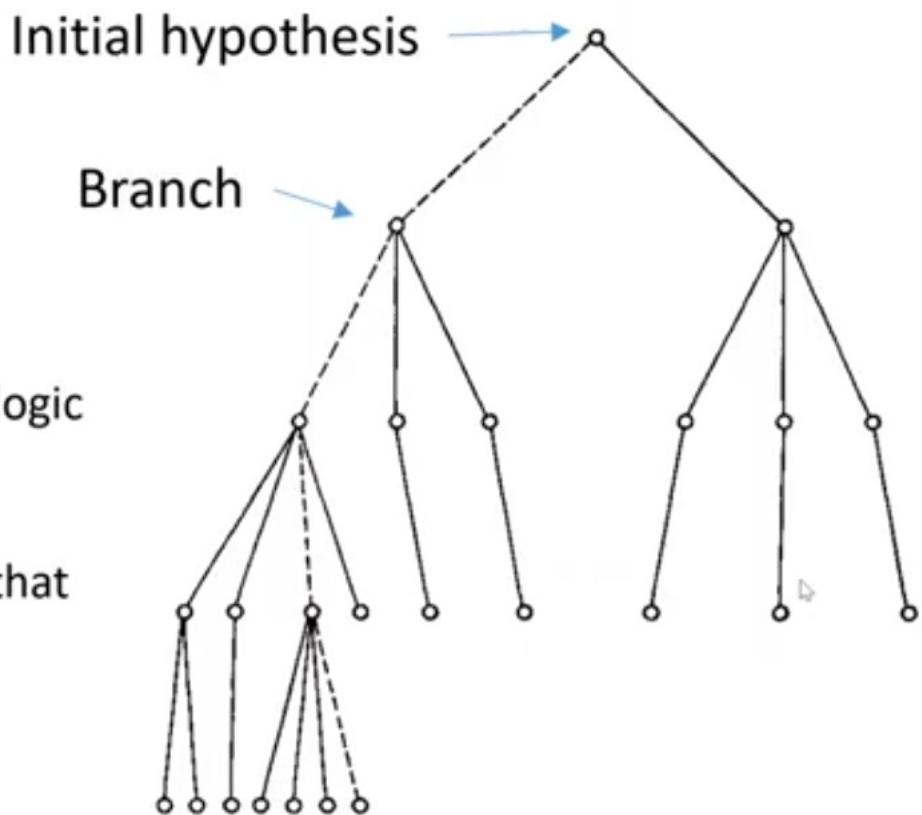
Contributions of LT

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- **Heuristics**

- Realized search tree could grow exponentially
- Needed to "trim" branches unlikely to lead to a solution.
- Coined term "**heuristics**" – i.e. ad hoc rules
- Important → overcome intractable combinatorial explosions in search



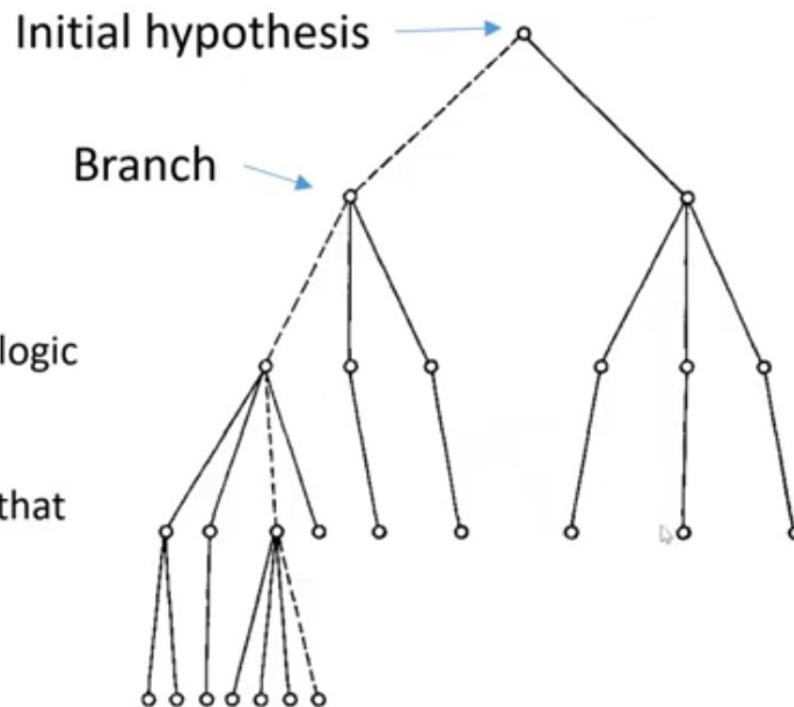


Herbert Simon & Allen Newell

Contributions of LT

- **Reasoning as search**

- LT explored a **search tree**:
 - each branch was a deduction based on the rules of logic
 - Some node = goal: the proposition to be proved
 - Pathway leading to goal = a proof
 - Proof = a series of statements, each deduced using logic, that led from the hypothesis to the proposition to be proved.



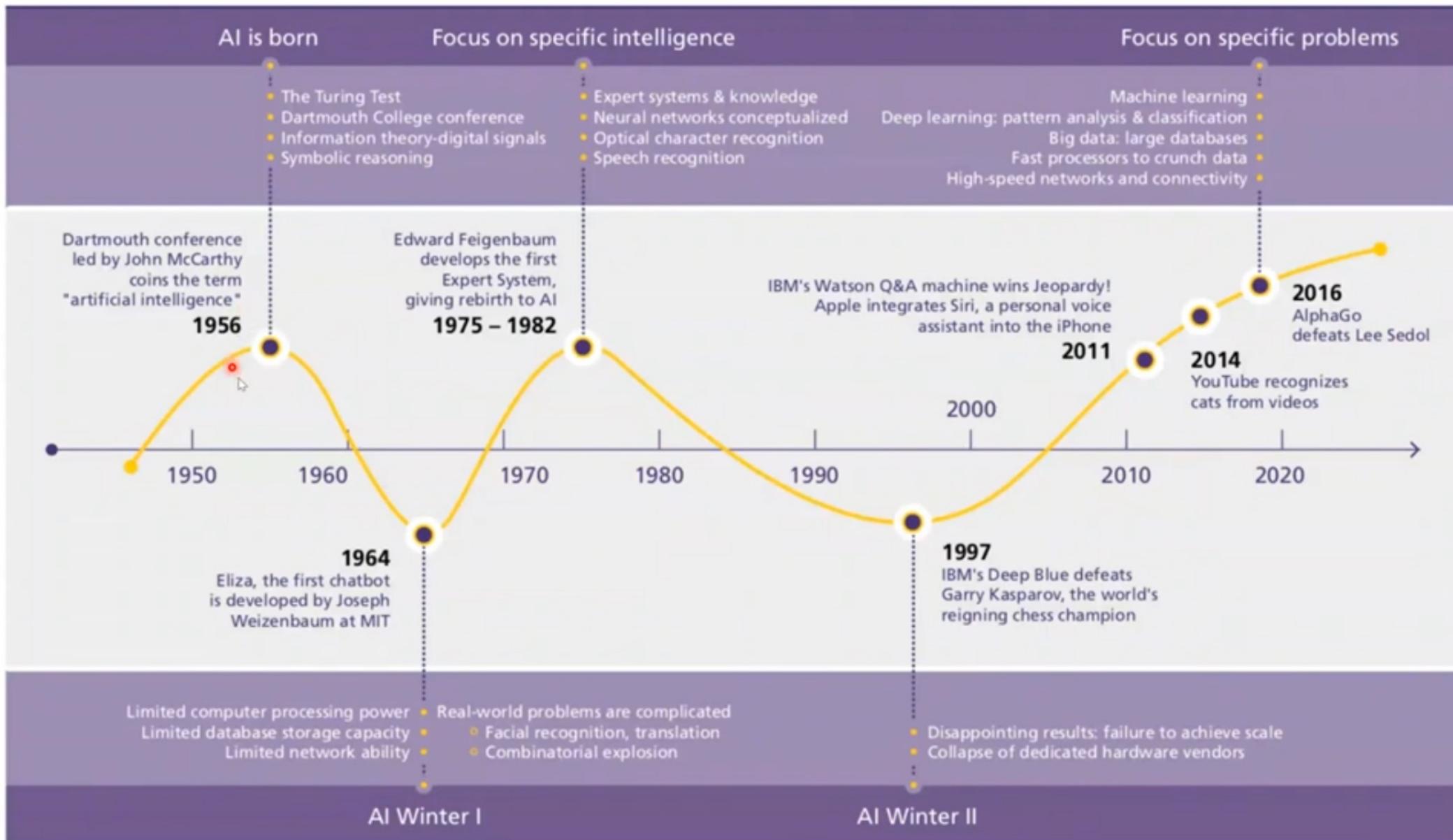
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- **List processing**

- Developed programming language (IPL) → used same form of symbolic list processing later forming the basis of **LISP** programming language

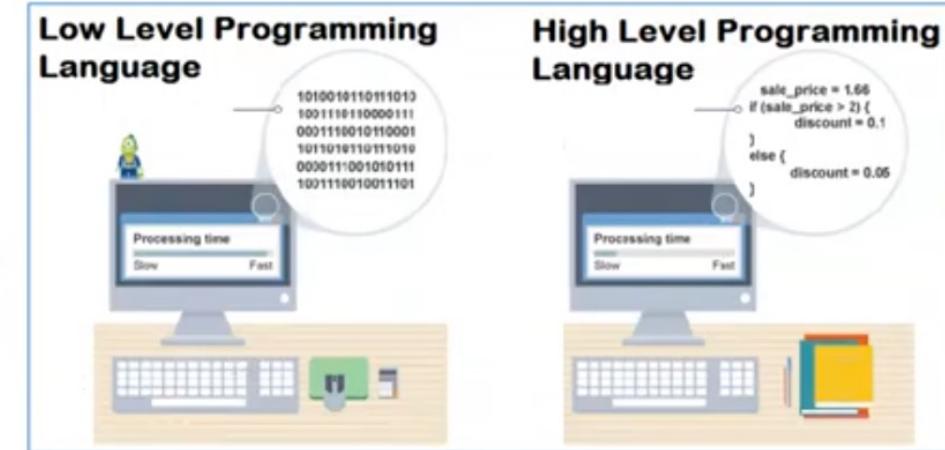
Waves of AI Interest



AI History: Early Enthusiasm (1956-1969)

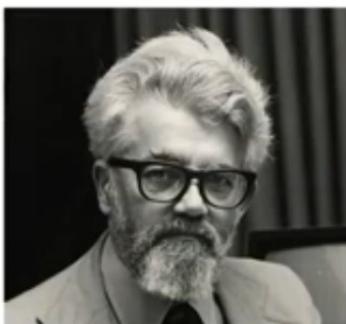
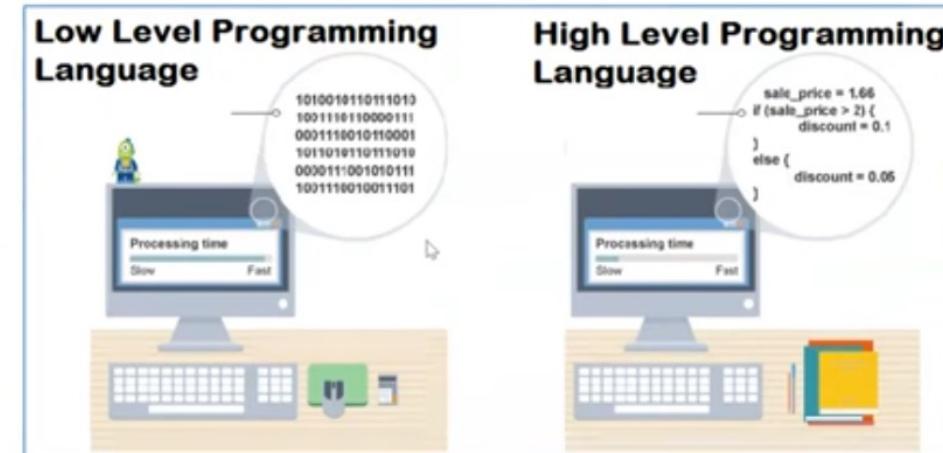
Early Years of 'AI'

- Marked by:
 - Great enthusiasm and expectations
 - Primitive computers and programming tools
- **John McCarthy – MIT - (1958):**
 - Invents **LISP** – high level programming language



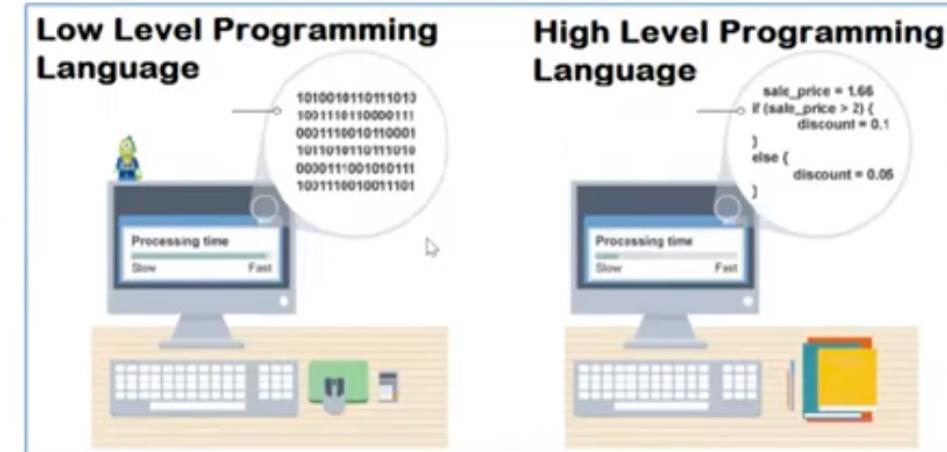
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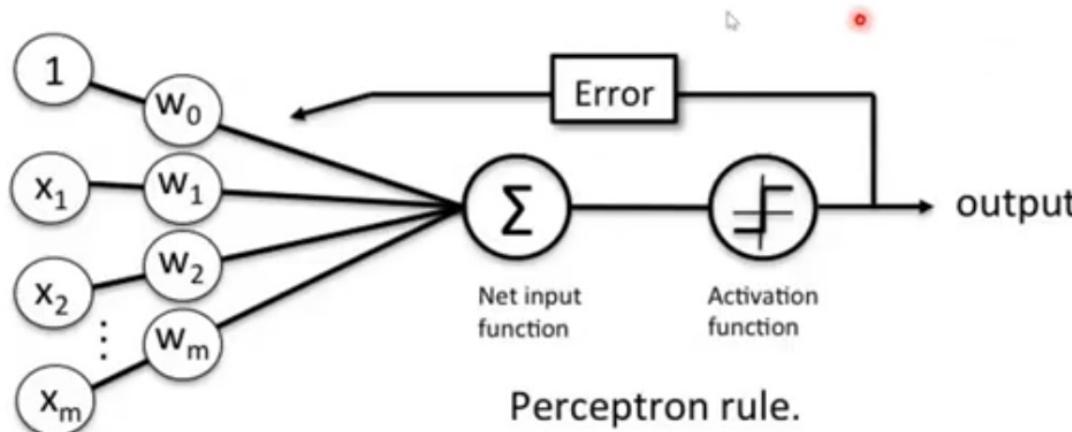
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- **Herbert Gelernter – IBM - (1959):**
 - Builds the **Geometry Theorem prover**
- **Herbert Simon & Allen Newell (1961):**
 - Developed the **General Problem Solver (GPS)**
 - Imitate human problem-solving (first to embody “**thinking humanly**”)
 - (1976) – **Physical symbol system hypothesis:**
 - A physical symbol system has the necessary and sufficient means for general artificial intelligence

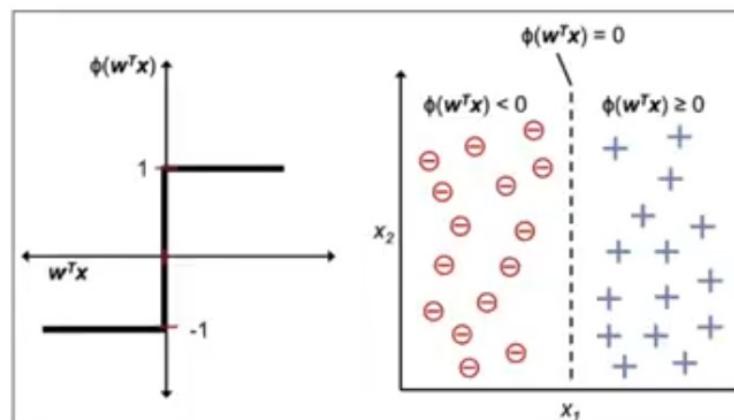


Perceptron

- **Frank Rosenblatt** – Cornell Aeronautical Laboratory - (1958):
 - Mark I Perceptron (1960)
 - First computer → learn new skills by trial and error

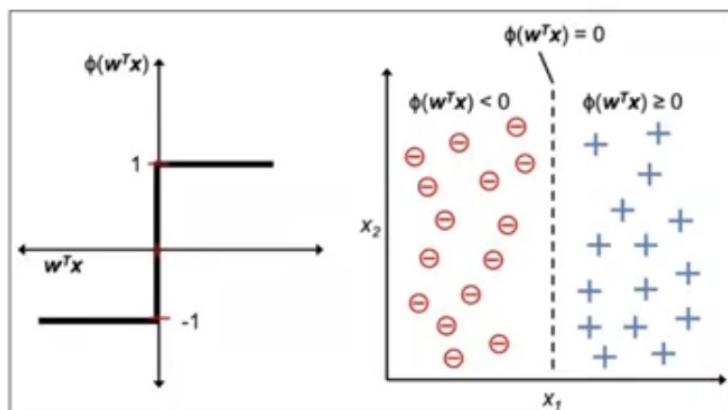
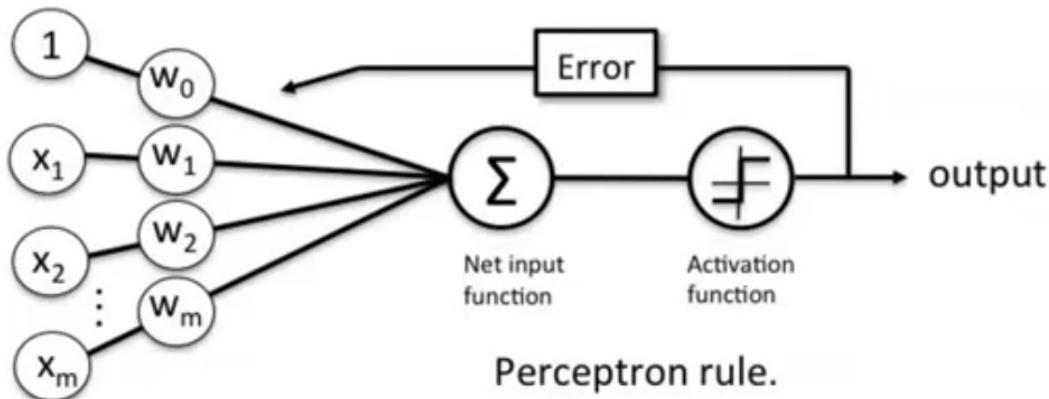


Perceptron rule.



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Other Early Successes

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 - Found first 'AI' Lab
 - Emphasized general purpose methods for logical reasoning



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- **Charles Rosen** – Stanford Research Institute - (1966-1969):

- Developed 'SHAKY' – First 'electronic person'
 - General-purpose mobile robot to be able to reason about its own actions
 - Programmed in LISP



<https://www.youtube.com/watch?v=7bsEN8mwUB8>

Other Early Successes

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 - General-purpose mobile robot to be able to reason about its own actions
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- **Joseph Weizenbaum** – MIT - (1966):
 - ELIZA: Pioneering chat-bot
 - Early **natural language processing** computer program
 - First program capable of attempting the Turing Test



```
Welcome to      EEEEEE LL      IIII  222222  AAAAA
                  EE   LL      II    ZZ  AA  AA
                  EEEE  LL      II    ZZ  AAAAAAA
                  EE   LL      II    ZZ  AA  AA
                  EEEEEE  LLLL  IIII  222222  AA  AA

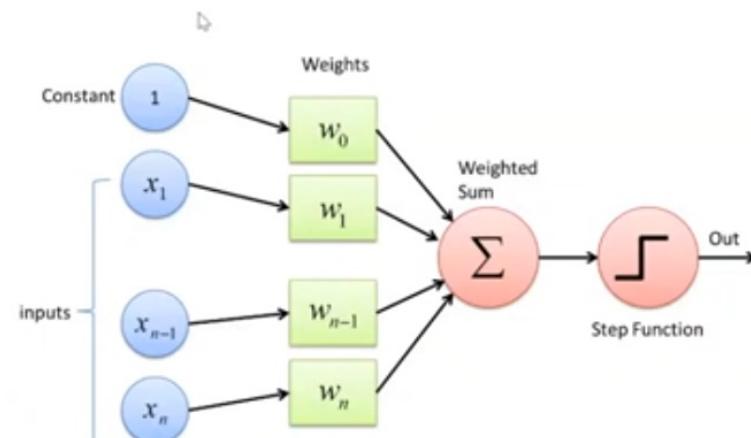
Eliza is a mock Rogerian psychotherapist.
The original program was described by Joseph Weizenbaum in 1966.
This implementation by Norbert Landsteiner 2005.

ELIZA: Is something troubling you ?
YOU: Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU: They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU: Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU: He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU: It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU: 
```

AI History: A Dose of Reality (1966-1973)

Hype vs. Realities

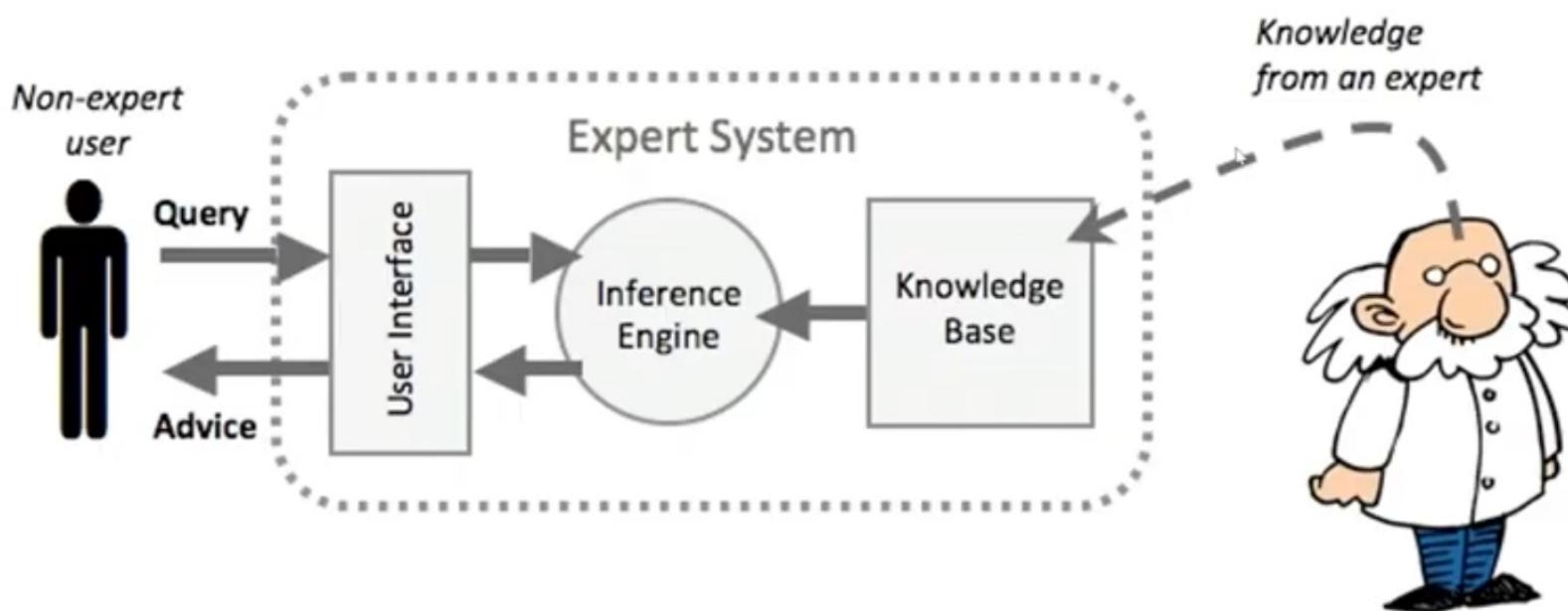
- “From the beginning, AI researchers were not shy about making predictions of their coming successes” – Stuart Russell
- Hard Realities of the time:**
 - No knowledge of subject matter:**
 - (1966) Early translation systems (Sputnik era)
 - Accurate translation requires background knowledge (i.e. knowledge base)
 - Intractability of problems:**
 - Believed that ‘scaling up’ to larger problems was simply a hardware limitation
 - Representable [solution] does not mean it’s learnable
 - (1973) Failure to address → British defunding of AI research
 - Limitations on structures used to generate intelligent behavior:**
 - Marvin Minsky & Papert (1969):
 - Perceptrons: can only represent linear functions
 - Finding limited by their focus on a single neuron (layer)
 - Led drying up of neural network research finding



AI History: Knowledge-Based Systems (1972-1979)

Expert System

- Knowledge-based systems (i.e. expert systems)
- A computer system that emulates the decision-making ability of a human expert
- Solve complex problems by reasoning through bodies of knowledge, represented mainly as **if-then rules** rather than through conventional procedural code
- Expert systems were among the first truly successful forms of artificial intelligence (AI) software



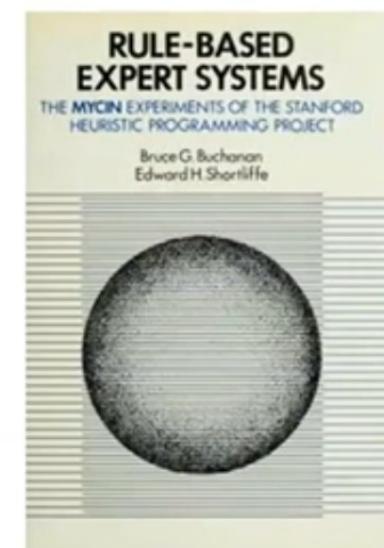
Dawn of Expert Systems

- Focus on ‘general-purpose’ reasoning systems now seen as ‘weak methods’
 - Don’t scale to large or difficult problems
- **Alternative** – powerful, domain-specific knowledge allowing larger reasoning steps for narrow areas of expertise
- **Edward Feigenbaum & Bruce Buchanan** – Stanford - (1969):
 - DENDRAL: identifying unknown organic molecules, by analyzing their mass spectra and using knowledge of chemistry
 - Feigenbaum seen as “father of expert systems”



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- **De Dombal** – (1972):
 - Develops expert system for diagnosis of acute abdominal pain
- **Edward Shortliffe, Feigenbaum & Buchanan** (1976):
 - **MYCIN**: expert system for diagnosis
 - Blood borne infectious diseases
 - 450 expert rules
 - Capable of dealing with uncertainty
 - Performed as well as some experts
 - Considerably better than Jr. doctors



Other Expert Systems of the Time

- University of Pittsburgh (1979-1985):
 - INTERNIST-I: General medical diagnosis program
 - Designed to capture the expertise of just one man, Jack D. Myers, MD
 - CADUCEUS:
 - Improve on MYCIN (blood borne infections)
 - Instead embracing all internal medicine. CADUCEUS eventually could diagnose up to 1000 different diseases

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- The Air Operations Division (AOD):
 - Uses rule based expert systems AI for:
 - Combat and training simulators
 - Mission management aids
 - Support systems for tactical decision making



AI History: AI Becomes an Industry (1980-1986)

Artificial Intelligence = \$

- **Japanese - Fifth Generation Project (1981):**
 - 10-year plan to build intelligent computers running PROLOG
 - **PROLOG:** logic programming invented by Alain Colmerauer (1972)
- U.S. formed **Microelectronics and Computer Technology Corporation** in response
 - Both focus on chip design and human interface research
 - British AI funding reinstated (Alvey Report)
 - In all three countries – ambitious goals ultimately never reached

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 - R1: expert system for configuring computers
 - By 1986 – saving the company ~ \$40 million/year
 - By 1988 – 40 expert systems deployed



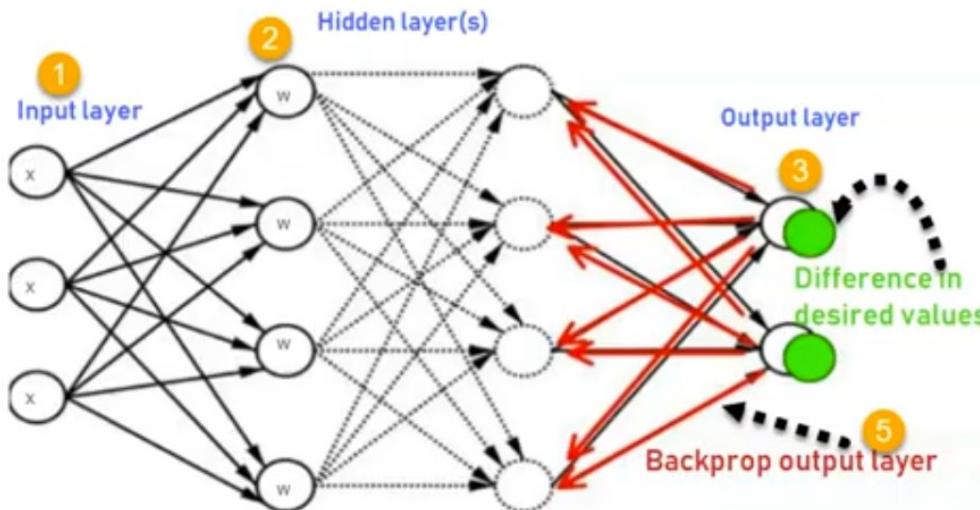
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- **DuPont (1988):**
 - 100 **expert systems** in use and 500 in development
 - Saving estimated \$10 million/year
 - Nearly every major U.S. corporation was using or investigating expert systems
- Billions invested in expert systems, vision systems, robots, software, and hardware



Resurgence of Neural Networks

- Mid-80's:
 - At least 4 groups 'reinvent' **back-propagation** learning algorithm
 - Used in the training of feedforward neural networks for supervised learning
 - Originally described by **Bryson & Ho (1969)**

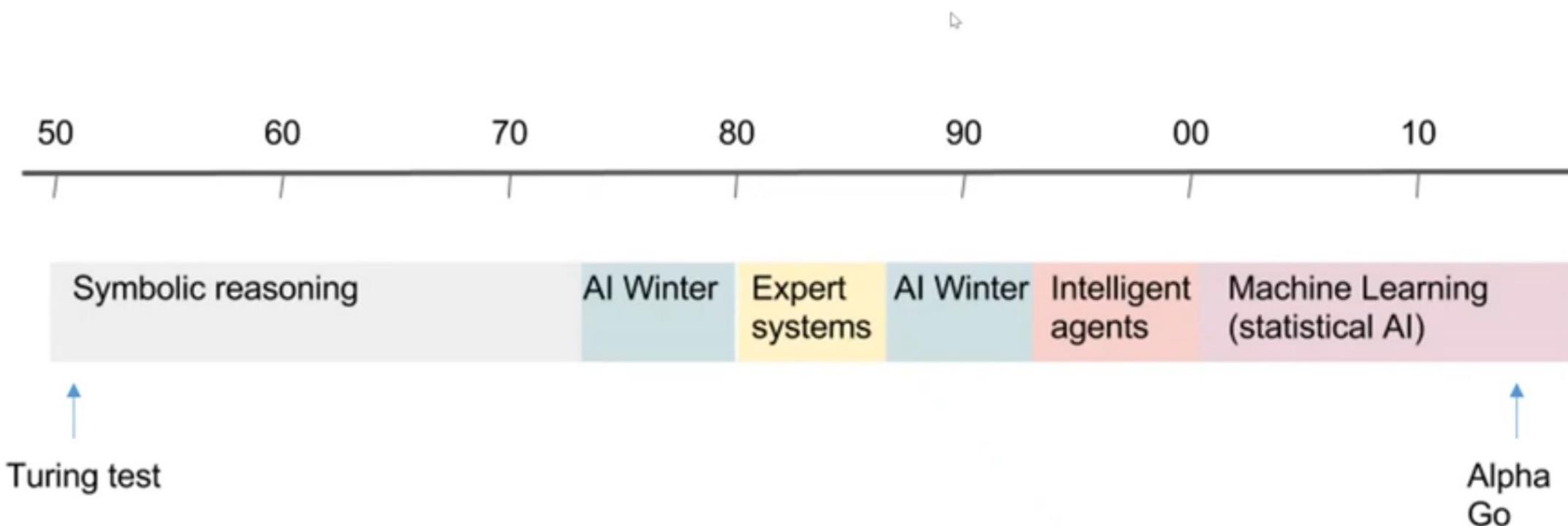


- **Terrence Sejnowski (1986):**
 - Nettalk – learns to read text aloud
 - **Connectionism** – sub-discipline of AI born
 - Contrasts with symbolic reasoning perspective of AI



Second “AI Winter”

- Companies fell by the wayside → failing to deliver on extravagant promises
- Reduced funding and interest in AI research



AI History: AI Adopts the Scientific Method (1987-1995)

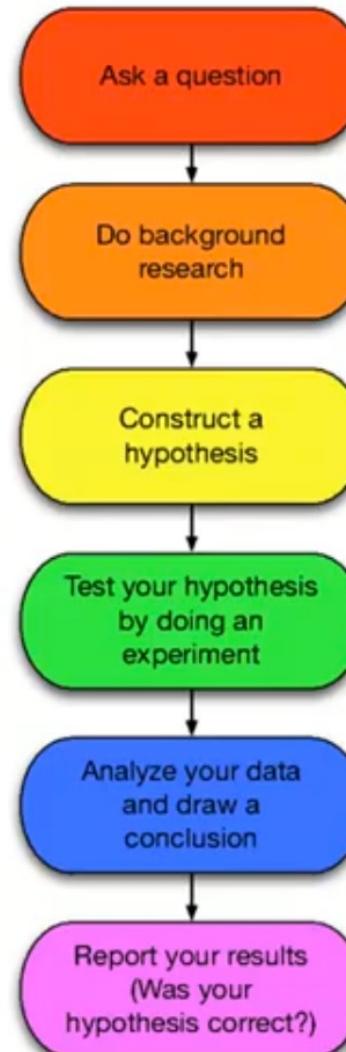
Shifting Perspectives

- “AI was founded in part as a rebellion against the limitations of existing fields like control theory and statistics, but now it is embracing those fields” – Stuart Russell

- New emphasis in AI:

- Hypotheses must be subjected to rigorous empirical experiments
- Reproducibility
- Results analyzed statistically

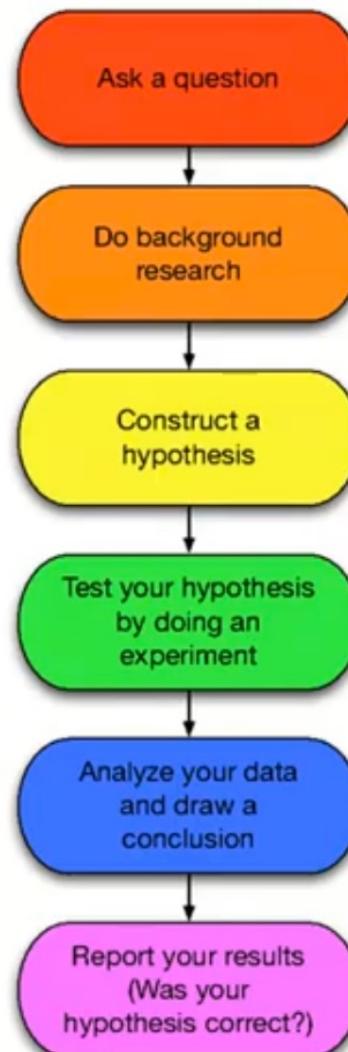
Scientific Method



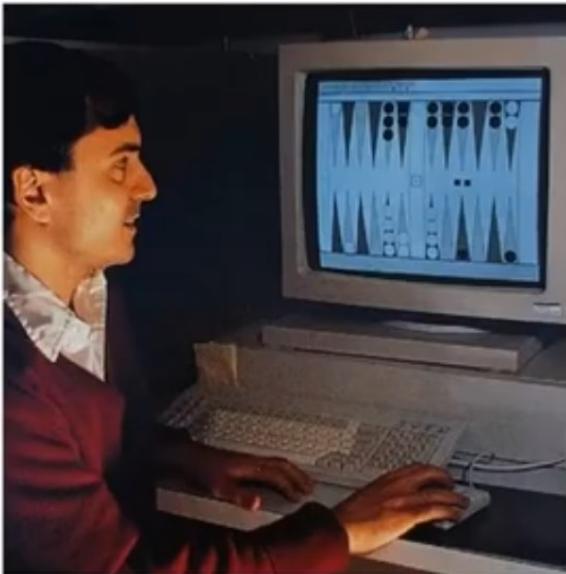
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- New emphasis in AI:
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 - Reproducibility
 - Results analyzed statistically
- Judea Pearl & Peter Cheeseman (1990):
 - Bring probability theory into AI with **Bayesian networks**
 - Allows learning from experience
 - Combines best of classical AI and neural networks
- Pearl, Eric Horvitz & David Heckerman (1980's):
 - **Normative expert systems**: act rationally according to laws of **decision theory** instead of trying to imitate them through steps of human experts
 - Windows operating system (1990's) includes several of these for diagnostic problem correction

Scientific Method



Landmarks of the 90's



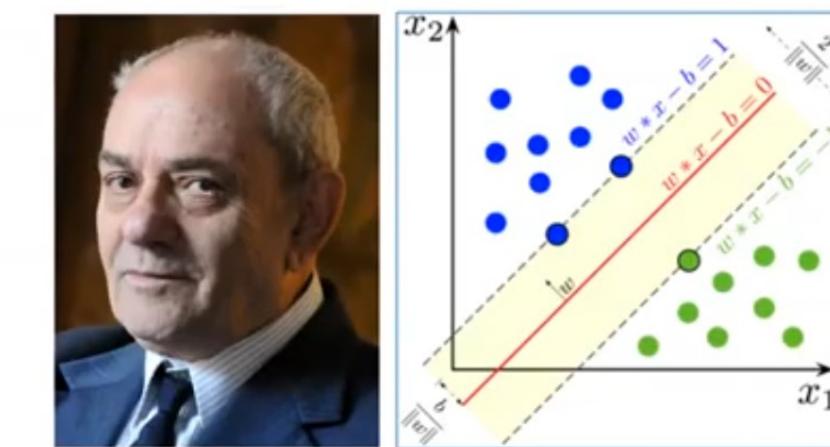
Gerald Tesauro – IBM (1992): TD-gammon program
Neural networks showing advantage of reinforcement learning



World-wide RoboCup Initiative (1993-1997):
Build soccer-playing autonomous robots



IBM (1997): Deep Blue - Chess computer
Defeats world champion Gary Kasparov

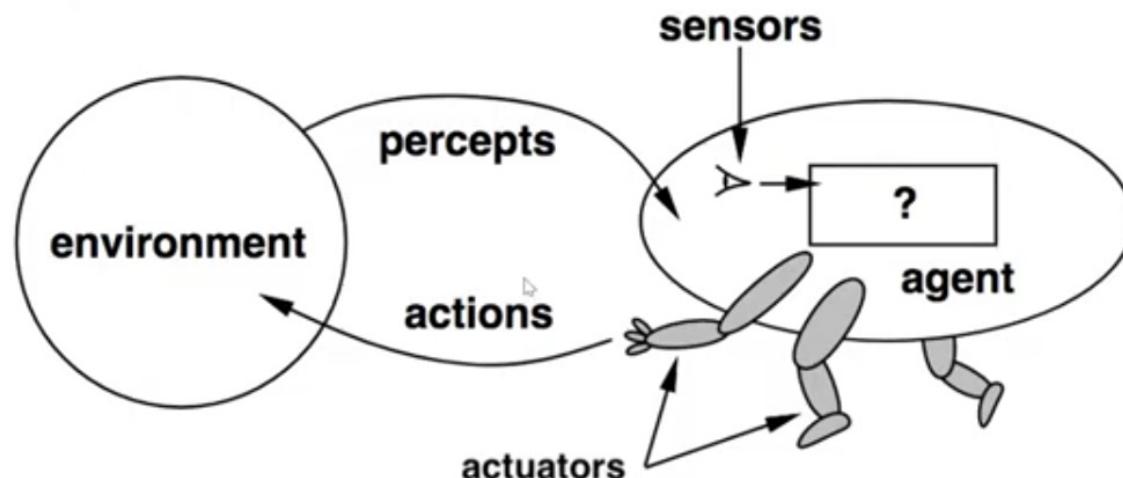


Vladimir N. Vapnik (1995):
Support Vector Machine developed (current standard)

AI History: Emergence of Intelligent Agents *(1995-present)*

Intelligent Agents

- An **autonomous entity** that acts towards **achieving goals** upon an environment
- Observes environment with sensors/perceptors
- Acts on environment with effectors/actuators
- Intelligent agents may learn or use preprogrammed knowledge to achieve their goals
- May be simple or complex
 - Simple = reflex machine, such as a thermostat
 - Complex = self driving car



Developed Agents

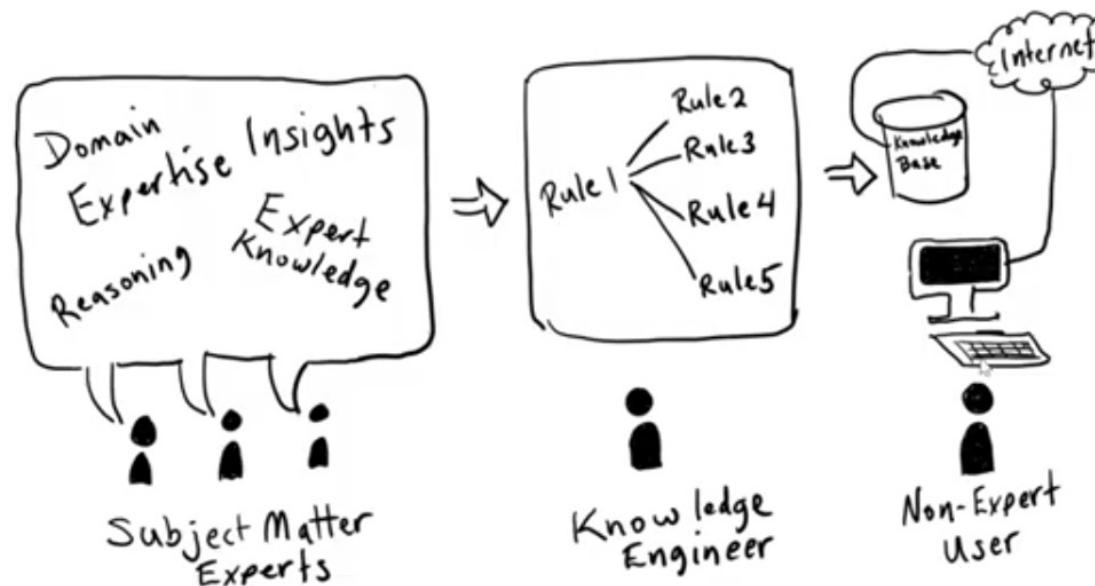
- **Allen Newell, John Laird, & Paul Rosenbloom (1987-1990):**
 - SOAR: a virtual agent
 - SOAR Project: Develop the fixed computational building blocks necessary for general intelligent agents
- **iRobot (2002):**
 - Roomba: autonomous vacuum cleaner that avoids obstacles
- **DARPA (2004):**
 - Introduces first challenge for autonomous vehicles
 - NASA explores surface of Mars with Spirit Rover
- **Google (2009):**
 - First self-driving car to handle urban environments
 - Drives on California freeway
 - Project Waymo



AI History:
Availability of
Very Large Datasets
(2001-present)

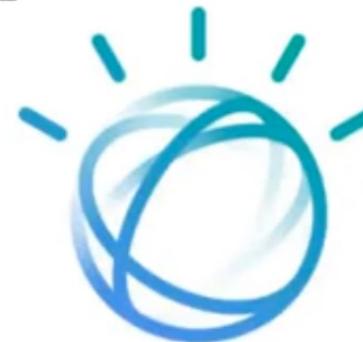
Algorithm vs. Data

- Emphasis has been on the algorithm as the subject of study
- Often in the era of ‘big data’ makes more sense to worry about the data instead of the algorithm
- Halevy et. al (2009):
 - Knowledge bottleneck – problem of how to express all the knowledge a system needs
 - May be solved by learning methods rather than hand-coded knowledge engineering



Recent AI Landmarks [1]

- **IBM Watson Supercomputer (2011):**
 - Initially developed to answer questions on the quiz show Jeopardy!
 - (2013) Adapted for utilization management decisions in lung cancer treatment at Memorial Sloan Kettering Cancer Center
- **Siri, Google Now, Cortana, & Alexa (2011-2014):**
 - Use speech recognition to answer questions and perform simple tasks
- **Google Brain (2012):**
 - Computer cluster trains itself to recognize a 'cat' from millions of images on YouTube
- **Chatbot Eugene Goostman (2014):**
 - Passes Turing Test – inciting controversy
 - Researchers call for a new Turing test

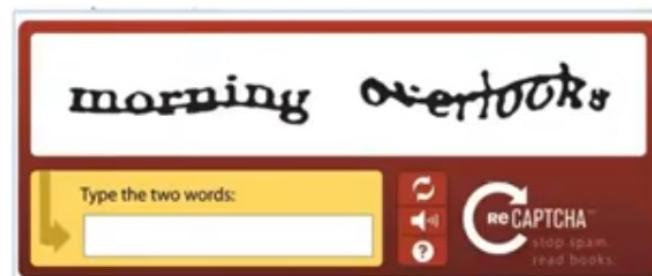


Recent AI Landmarks [2]

- **Alpha Go** (2016):
 - Beats professional Go player Lee Sedol 4-1



- **Vicarious** (2017):
 - AI start up company beats CAPTCHA and reCAPTCHA 'Turing Test'



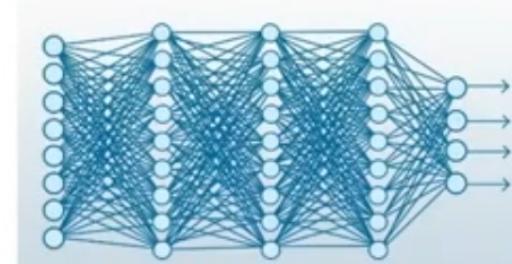
- **Alibaba** (2018):
 - Language processing program outscores Stanford students on reading comprehension test
- **2018:**



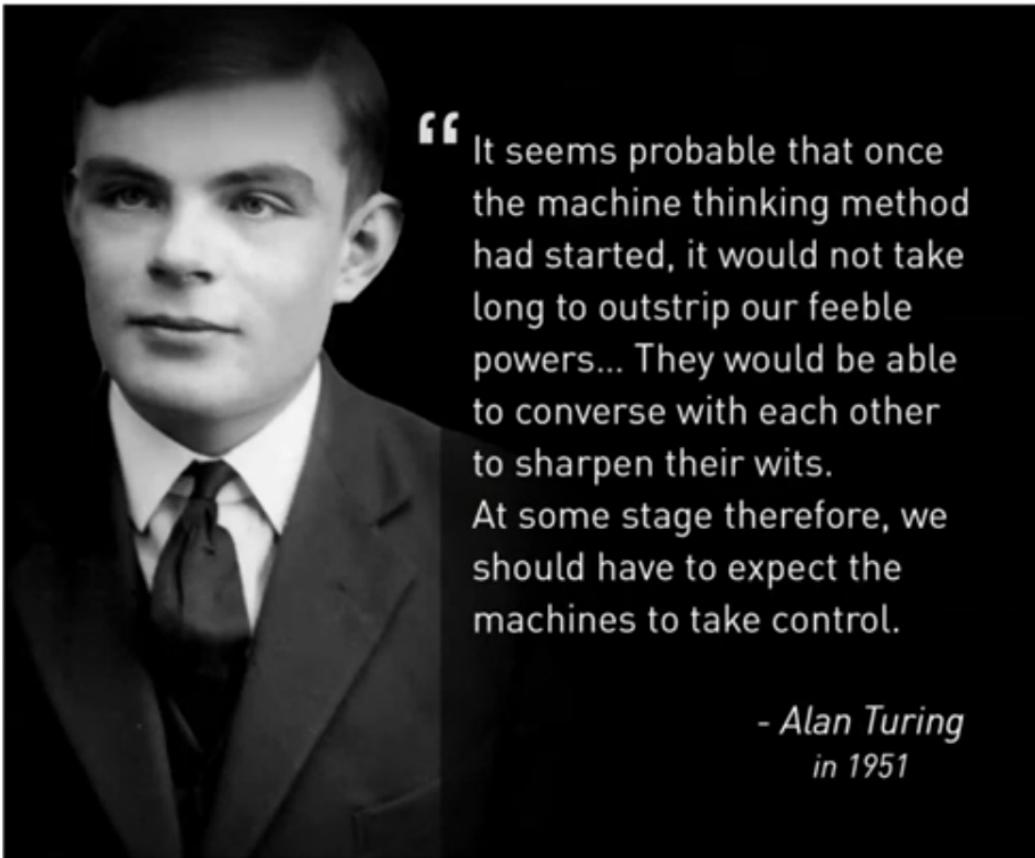
- Most universities have courses on artificial intelligence
- European Union establishes guidelines for dealing with ethics in AI

Other AI Related Histories of Importance

- Computer Hardware
 - Microchips/CPU
 - RAM/ROM
- Computer Software
 - Computing Languages
 - Operating Systems
 - Graphical User Interfaces
 - Video Games
- Artificial Life
- Robotics
- Machine Learning
- Natural Language Processing

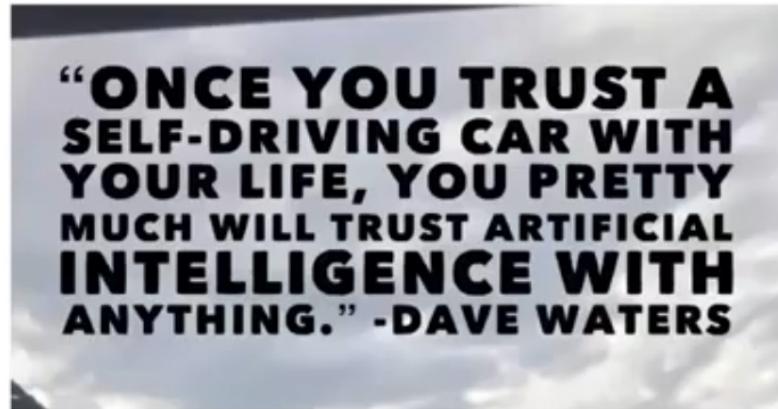


AI Words of Warning



“It seems probable that once the machine thinking method had started, it would not take long to outstrip our feeble powers... They would be able to converse with each other to sharpen their wits.
At some stage therefore, we should have to expect the machines to take control.

*- Alan Turing
in 1951*



“In the long term, artificial intelligence and automation are going to be taking over so much of what gives humans a feeling of purpose.” -Matt Bellamy



The development of full artificial intelligence could spell the end of the human race.

— Stephen Hawking —



With artificial intelligence we are summoning the demon.

— Elon Musk —

AI Words of Optimism

"Whenever I hear people saying AI is going to hurt people in the future I think, yeah, technology can generally always be used for good and bad and you need to be careful about how you build it ... if you're arguing against AI then you're arguing against safer cars that aren't going to have accidents, and you're arguing against being able to better diagnose people when they're sick."

MARK ZUCKERBERG
(CEO, Facebook)

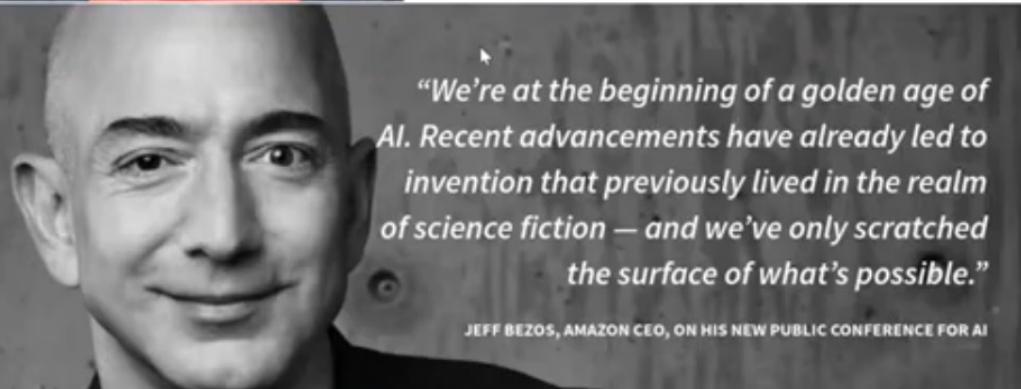
Anything that could give rise to smarter-than-human intelligence - in the form of Artificial Intelligence, brain-computer interfaces, or neuroscience-based human intelligence enhancement - wins hands down beyond contest as doing the most to change the world. Nothing else is even in the same league.

Eliezer Yudkowsky



A year spent in artificial intelligence is enough to make one believe in God.

— Alan Perlis —



“ Some people call this artificial intelligence, but the reality is this technology will enhance us. So instead of artificial intelligence, I think we'll augment our intelligence. ”

—Ginni Rometty
CEO of IBM

"Artificial intelligence would be the ultimate version of Google. The ultimate search engine that would understand everything on the web. It would understand exactly what you wanted, and it would give you the right thing. We're nowhere near doing that now. However, we can get incrementally closer to that, and that is basically what we work on."

LARRY PAGE
CEO of Alphabet

"We're at the beginning of a golden age of AI. Recent advancements have already led to invention that previously lived in the realm of science fiction — and we've only scratched the surface of what's possible."

JEFF BEZOS, AMAZON CEO, ON HIS NEW PUBLIC CONFERENCE FOR AI

“ ... AI will not replace doctors,
but instead will augment them,
enabling physicians to practice
better medicine with greater
accuracy and increased
efficiency

”

-Benjamin Bell