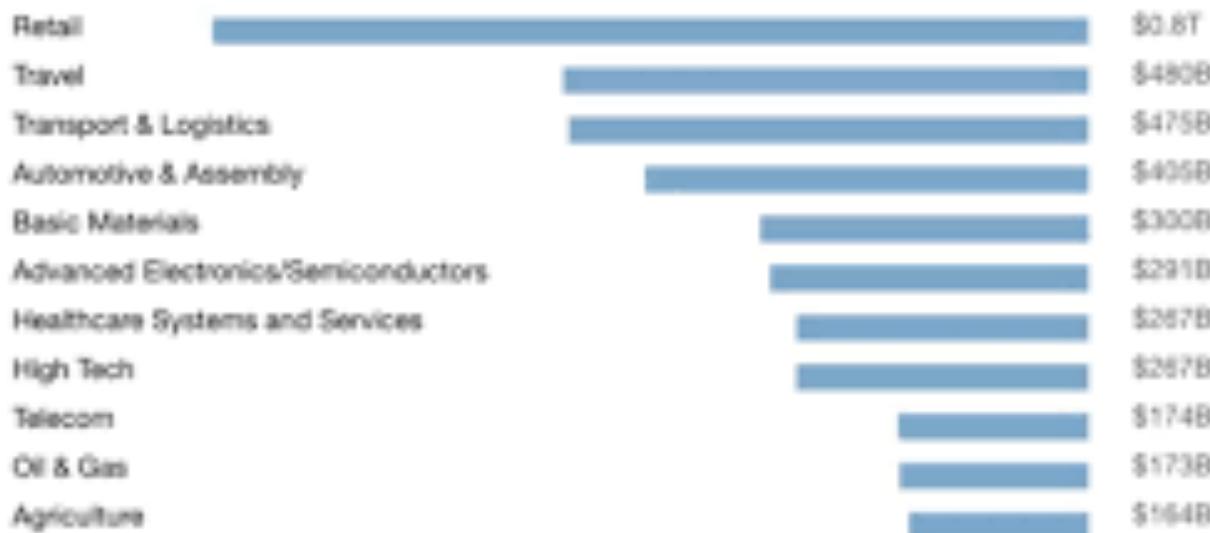


Introduction to Artificial Intelligence

- **Outline:**
 1. AI approaches
 2. Foundations of AI
 3. Building an AI system

AI value creation
by 2030

\$13
trillion



Introduction to Artificial Intelligence

- **Outline:**

1. AI approaches
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Four types of AI approaches

Systems that think like humans	Systems that think rationally
<p>"The exciting new effort to make computers think . . . <i>machines with minds</i>, in the full and literal sense" (Haugeland, 1985)</p> <p>"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)</p>	<p>"The study of mental faculties through the use of computational models" (Charniak and McDermott, 1985)</p> <p>"The study of the computations that make it possible to perceive, reason, and act" (Winston, 1992)</p>
<p>"The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990)</p> <p>"The study of how to make computers do things at which, at the moment, people are better" (Rich and Knight, 1991)</p>	<p>"A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkoff, 1990)</p> <p>"The branch of computer science that is concerned with the automation of intelligent behavior" (Luger and Stubblefield, 1993)</p>
Systems that act like humans	Systems that act rationally

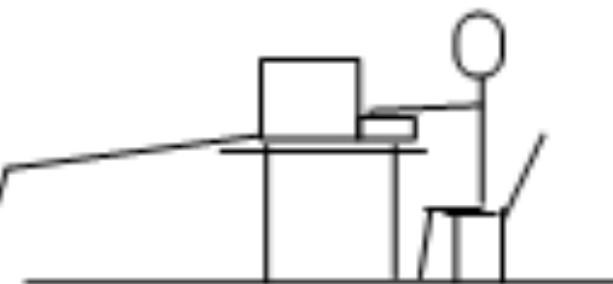
Thinking humanly: The cognitive modelling approach

- Need to define how humans think, i.e., need to get inside the actual workings of human minds:
 - Through introspection: trying to catch our own thoughts
 - Through psychological experiments: if the program's input/output and timing behavior matches human behavior → some of the program's mechanisms may also be operating in humans.

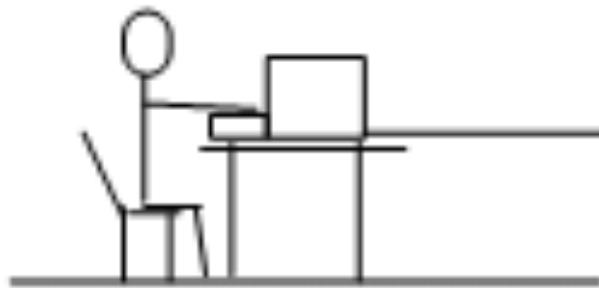
Acting humanly: The Turing Test approach

- Be proposed by Alan Turing (1950)
- The computer should be interrogated by a human via a teletype, and passes the test if the interrogator cannot tell if there is a computer or a human at the other end.
- The computer must possess the following capabilities:
 - Natural language processing
 - Knowledge representation
 - Automated reasoning
 - Machine learning,...

No. My name is Mary.



Hi! Are you a computer?



?



Are you kidding, I'm Hal and I
can't even multiply two-digit
numbers!

Some Turing Test questions

- What is the meaning of life?
- Why is the sky blue?
- How are you? How are you feeling today?
- Which came first, the chicken or the egg?
- What is love? How does love feel?
- Who is your best friend?
- Do you think that I should undergo an operation to remove my brain and install a computer in my head?
- When were you born? Tell me about your childhood.

<https://www.playbuzz.com/mikaylal13/the-turing-test-are-you-a-computer-or-human>

Thinking rationally: The laws of thought approach

- Aristotle was one of the first to attempt to codify "right thinking".

Correct premises + argument structures → correct conclusions

Acting rationally: The rational agent approach

- Based on agent
- Agent is just something that perceives and acts.
- AI is viewed as the study and construction of rational agents.

Introduction to Artificial Intelligence

- **Outline:**

- 1. AI approaches

- 2. Foundations of AI**

- 3. Building an AI system

Foundations of AI

- Philosophy
- Mathematics
- Computer engineering
- Linguistics



Introduction to Artificial Intelligence

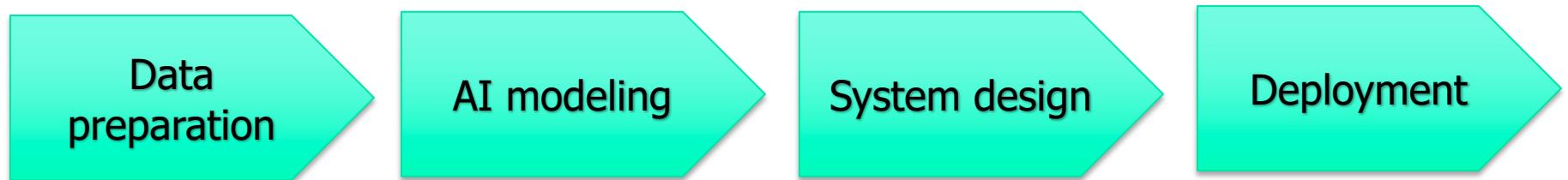
- **Outline:**
 1. AI approaches
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Building an AI system

<https://www.youtube.com/watch?v=NCmzWdbdS28&t=54s>



Bulding an AI system



Data preparation

- Most important, time consuming
- Good data:
 - Lot of data → enough
 - Consistent (data need to be pre-processing)
- Tasks:
 - Collect data
 - Clean data
 - Label data
 - Augmenting data sets with synthetic data

AI modeling

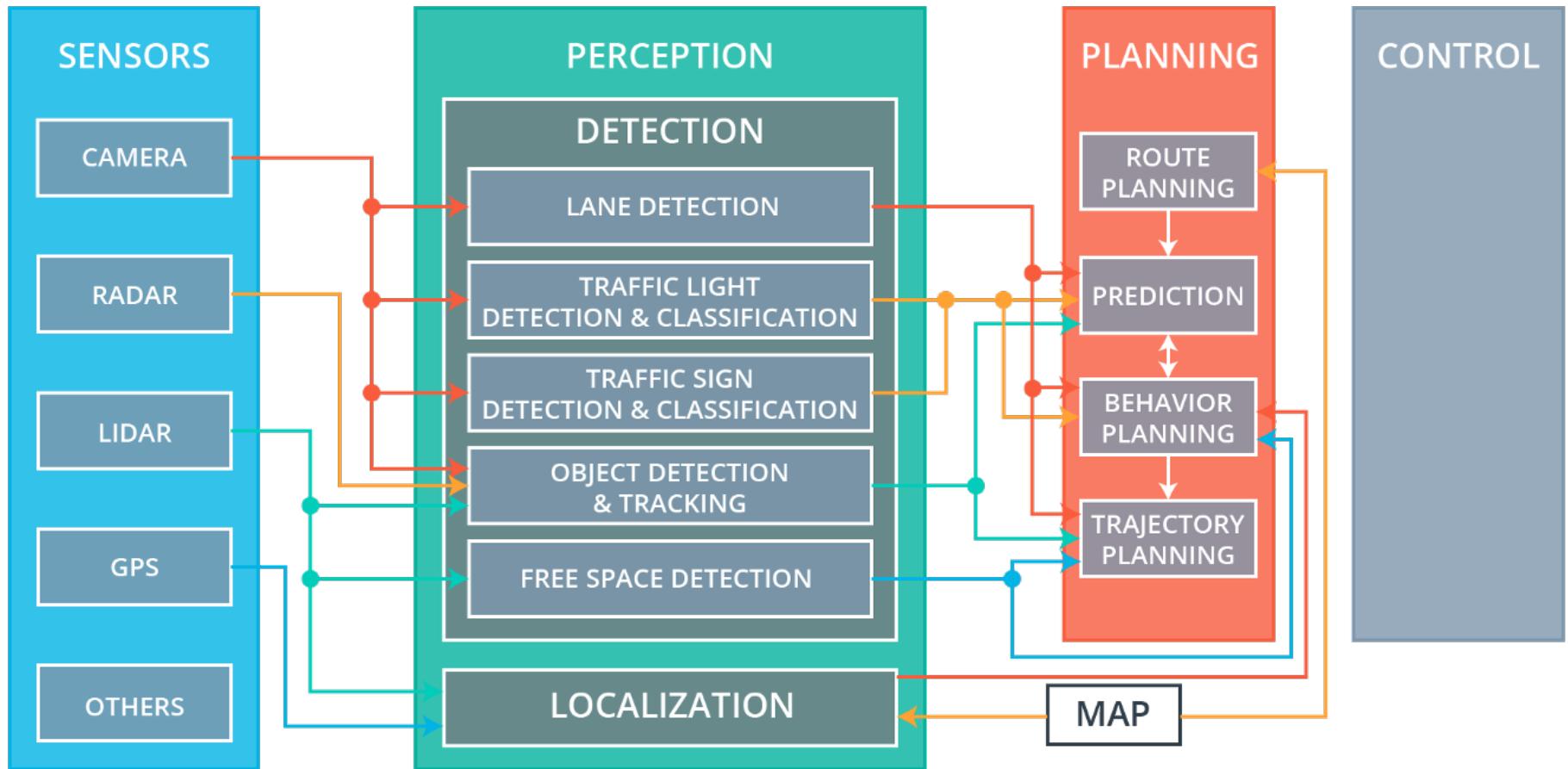
- AI models (AI algorithms)
 - Machine learning: regression, SVM, tree, Naïve Bayes,...
 - Deep learning: GAN, CNN, LSTM,...
- AI modeling: Create a model to interpret data and to make decisions based on that data
- Tasks:
 - Select a model
 - Tune model: identify the optimal parameters (through iterative test loops, checking the results → modify and improve the model)

System design

- AI model is a part of a complete working system
- Tasks:
 - Adding AI to the system: AI must coexist with all other pieces fluidly
 - Simulation: to verify that the pieces work together correctly in all scenarios

System design

- Example: self-driving taxi



Deployment

- To integrate AI into a part of a real-world system

Đọc thêm

Intelligent agents

- Reading chapter 2 from page 31 to 49

Ref. [1]: Stuart Russell & Peter Norvig, “[Artificial intelligence: A modern approach](#),” Prentice-Hall, Third Edition, 2009.

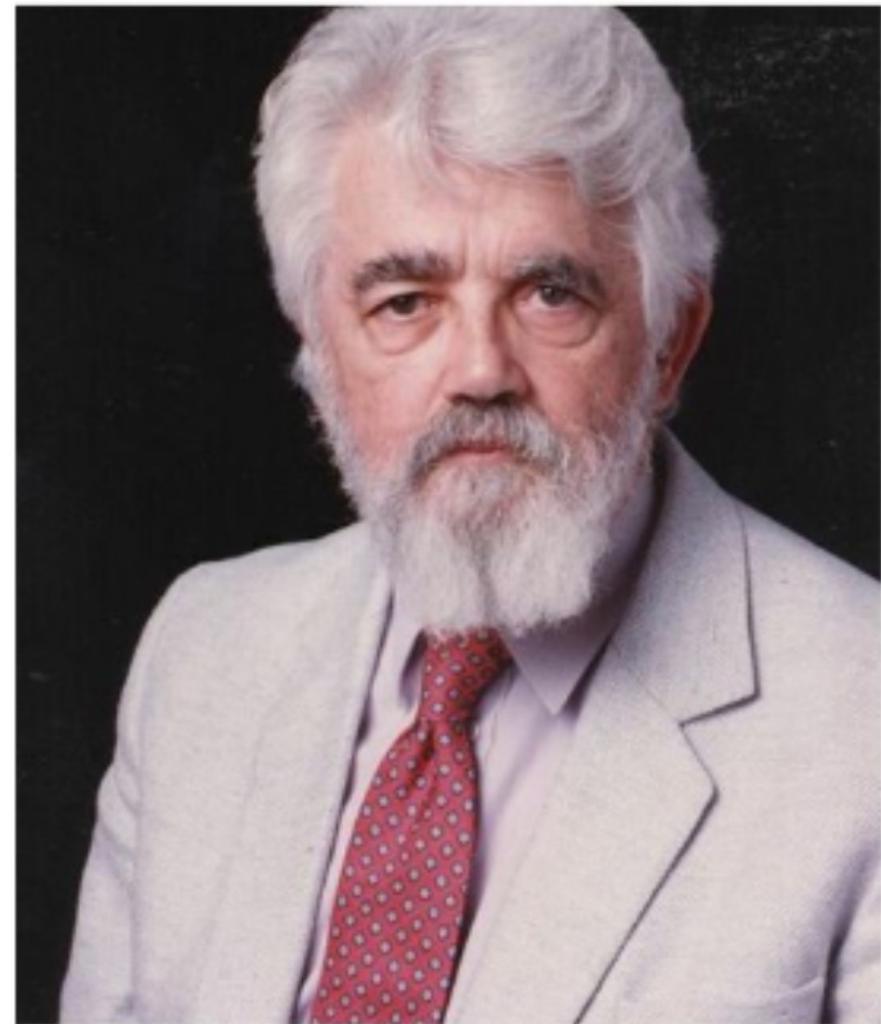
What is AI?



John McCarthy

John McCarthy first coined the term Artificial Intelligence in the year 1956

Father of AI



In 1956 John McCarthy regarded as the father of AI, organized a conference to draw the talent and expertise of others interested in machine intelligence for a month of brainstorming. He invited them to Vermont for "The Dartmouth summer research project on artificial intelligence." From that point on, because of McCarthy, the field would be known as Artificial intelligence. Although not a huge success, the Dartmouth conference did bring together the founders in AI, and served to lay the groundwork for the future of AI research.

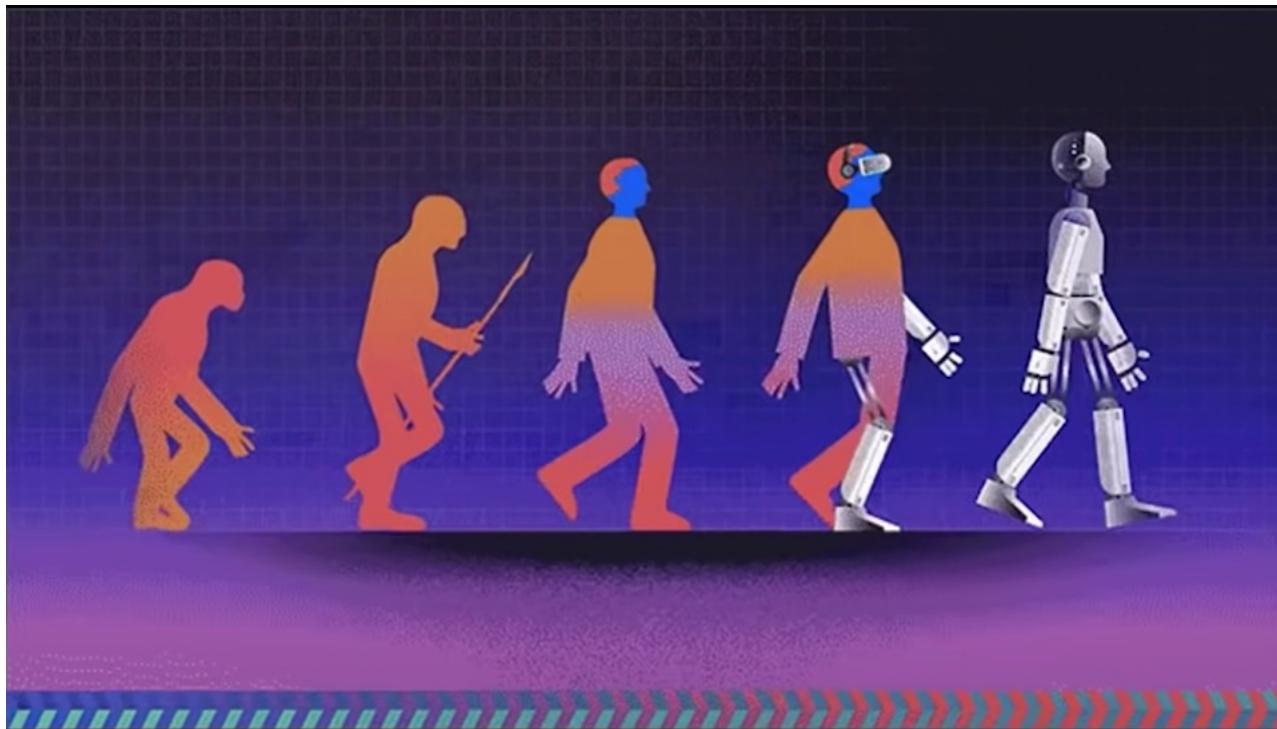
What is AI?

- Science and engineering of making intelligent machines
 - Theory and development of computer systems able to perform tasks normally requiring human intelligence
- AI is a technique of getting machine to work and behave like human

What is artificial intelligence (AI)?

- A field of computer science
- Simulation of human intelligence
- Machines are programmed to think like humans and mimic their actions
- Two main types:
 - **Narrow AI:** theory and development of computer systems that perform tasks such as perceiving, classifying, recognition, etc.
 - **General AI/strong AI:** full autonomy

History of AI



History of AI

- Greek mythology:
 - Thinking of concept of machines and mechanical men
 - Ex: Talos



History of AI

- 1940s:
- (1943) Warren McCullough and Walter Pitts publish the paper "A Logical Calculus of Ideas Immanent in Nervous Activity," which proposes the first mathematical model for building a neural network.
- (1949) In his book "The Organization of Behavior: A Neuropsychological Theory", Donald Hebb proposes the theory that neural pathways are created from experiences and that connections between neurons become stronger the more frequently they're used. Hebbian learning continues to be an important model in AI.

History of AI

- 1950s:
 - (1950) Alan Turing publishes the paper “Computing Machinery and Intelligence,” proposing what is now known as the Turing Test, a method for determining if a machine is intelligent.
 - (1950) Harvard undergraduates Marvin Minsky and Dean Edmonds build SNARC, the first neural network computer.
 - (1950) Claude Shannon publishes the paper “Programming a Computer for Playing Chess.”

History of AI

- 1950s:
 - (1956) The phrase “artificial intelligence” is coined at the Dartmouth Summer Research Project on Artificial Intelligence. Led by John McCarthy, the conference is widely considered to be the birthplace of AI.
 - (1956) Allen Newell and Herbert Simon demonstrate Logic Theorist (LT), the first reasoning program.

History of AI

- 1950s:
 - (1958) John McCarthy develops the AI programming language Lisp and publishes “Programs with Common Sense,” a paper proposing the hypothetical Advice Taker, a complete AI system with the ability to learn from experience as effectively as humans.
 - (1959) Allen Newell, Herbert Simon and J.C. Shaw develop the General Problem Solver (GPS), a program designed to imitate human problem-solving.

History of AI

- 1950s:
 - (1959) Herbert Gelernter develops the Geometry Theorem Prover program.
 - (1959) Arthur Samuel coins the term “machine learning” while at IBM.
 - (1959) John McCarthy and Marvin Minsky found the MIT Artificial Intelligence Project.

History of AI

- 1960s:
 - (1963) John McCarthy starts the AI Lab at Stanford.
 - (1966) The Automatic Language Processing Advisory Committee (ALPAC) report by the U.S. government details the lack of progress in machine translations research, a major Cold War initiative with the promise of automatic and instantaneous translation of Russian. The ALPAC report leads to the cancellation of all government-funded MT projects.
 - (1969) The first successful expert systems are developed in DENDRAL, a XX program, and MYCIN, designed to diagnose blood infections, are created at Stanford.

History of AI

- 1970s:
 - (1972) The logic programming language PROLOG is created.
 - (1973) The "Lighthill Report," detailing the disappointments in AI research, is released by the British government and leads to severe cuts in funding for artificial intelligence projects.
 - (1974-1980) Frustration with the progress of AI development leads to major DARPA cutbacks in academic grants. Combined with the earlier ALPAC report and the previous year's "Lighthill Report," artificial intelligence funding dries up and research stalls. This period is known as the "[First AI Winter](#)."

History of AI

- 1980s:
 - (1980) Digital Equipment Corporations develops R1 (also known as XCON), the first successful commercial expert system. Designed to configure orders for new computer systems, R1 kicks off an investment boom in expert systems that will last for much of the decade, effectively ending the first "AI Winter."
 - (1982) Japan's Ministry of International Trade and Industry launches the ambitious Fifth Generation Computer Systems project. The goal of FGCS is to develop supercomputer-like performance and a platform for AI development.

History of AI

- 1980s:
 - (1983) In response to Japan's FGCS, the U.S. government launches the Strategic Computing Initiative to provide DARPA funded research in advanced computing and artificial intelligence.
 - (1985) Companies are spending more than a billion dollars a year on expert systems and an entire industry known as the Lisp machine market springs up to support them. Companies like Symbolics and Lisp Machines Inc. build specialized computers to run on the AI programming language Lisp.

History of AI

- 1980s:
 - (1987-1993) As computing technology improved, cheaper alternatives emerged and the Lisp machine market collapsed in 1987, ushering in the "Second AI Winter." During this period, expert systems proved too expensive to maintain and update, eventually falling out of favor.

History of AI

- 1990s:
 - (1991) U.S. forces deploy DART, an automated logistics planning and scheduling tool, during the Gulf War.
 - (1992) Japan terminates the FGCS project in 1992, citing failure in meeting the ambitious goals outlined a decade earlier.
 - (1993) DARPA ends the Strategic Computing Initiative in 1993 after spending nearly \$1 billion and falling far short of expectations.
 - (1997) IBM's Deep Blue beats world chess champion Gary Kasparov

History of AI

- 2000s:
 - (2005) STANLEY, a self-driving car, wins the DARPA Grand Challenge.
 - (2005) The U.S. military begins investing in autonomous robots like Boston Dynamics' "Big Dog" and iRobot's "PackBot."
 - (2008) Google makes breakthroughs in speech recognition and introduces the feature in its iPhone app.
 - (2011) IBM's Watson trounces the competition on Jeopardy!.
 - (2011) Apple releases Siri, an AI-powered virtual assistant through its iOS operating system.

History of AI

- 2000s:
 - (2012) Andrew Ng, founder of the Google Brain Deep Learning project, feeds a neural network using deep learning algorithms 10 million YouTube videos as a training set. The neural network learned to recognize a cat without being told what a cat is, ushering in the breakthrough era for neural networks and deep learning funding.
 - (2014) Google makes the first self-driving car to pass a state driving test.
 - (2014) Amazon's Alexa, a virtual home is released

History of AI

- 2000s:
 - (2016) Google DeepMind's AlphaGo defeats world champion Go player Lee Sedol. The complexity of the ancient Chinese game was seen as a major hurdle to clear in AI.
 - (2016) The first "robot citizen", a humanoid robot named Sophia, is created by Hanson Robotics and is capable of facial recognition, verbal communication and facial expression.
 - (2018) Google releases natural language processing engine BERT, reducing barriers in translation and understanding by machine learning applications.

History of AI

- 2000s:
- (2018) Waymo launches its Waymo One service, allowing users throughout the Phoenix metropolitan area to request a pick-up from one of the company's self-driving vehicles.
- (2020) Baidu releases its LinearFold AI algorithm to scientific and medical teams working to develop a vaccine during the early stages of the SARS-CoV-2 pandemic. The algorithm is able to predict the RNA sequence of the virus in just 27 seconds, 120 times faster than other methods.

AI applications

- Agriculture
- Banking
- Business
- Chip manufacturing
- Education
- Finance
- Healthcare
- Telecommunication
- Transportation
-

Four types of AI

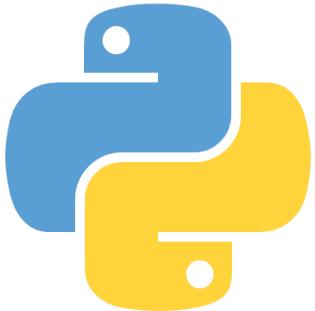
- Reactive Machines: able to perceive and react to the world in front of it as it performs limited tasks
- Limited Memory: able to store past data and predictions to inform predictions of what may come next
- Theory of Mind: able to make decisions based on its perceptions of how others feel and make decisions
- Self-Awareness: able to operate with human-level consciousness and understand its own existence

AI programming

- Python
- R
- Java
- Matlab
- ...

Python

- Famous language: be used by a lot of developers
- Simple syntaxes
- Easy to learn
- Easy to implement (Python has possible predefined functions to support most AI/ML algorithms)
- Be created by Guido Rossum in 1989



R

- Statistical programming language
- Easy to learn
- Syntax is similar to English language
- Effective language for analyzing and manipulating the data for statistical purpose
- Available libraries to support AI, ML



Java

- Effective language for search algorithms, ANN, genetic programming
- Easy to use, easy to debug
- Good graphical representation of data



Matlab

- Widely used programming language for statistical computing
- Easy to learn and perform data preprocessing, image labeling, network design and transfer learning.
- Available domain-specific toolboxes and apps
- Easy to combine statistics and machine learning to apply to some specific techniques (e.g., signal processing, image processing, text analytics, optimization and controls).

