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Chap. 1. Introduction

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AI Breakthroughs

Image classification

"Dog" *"Cat"*

As of *2015*, computers can be trained to perform better on this task than humans.

Machine translation

"I am a student" →  → *"Je suis étudiant"*

As of *2016*, we have achieved near-human performance using the latest AI techniques.

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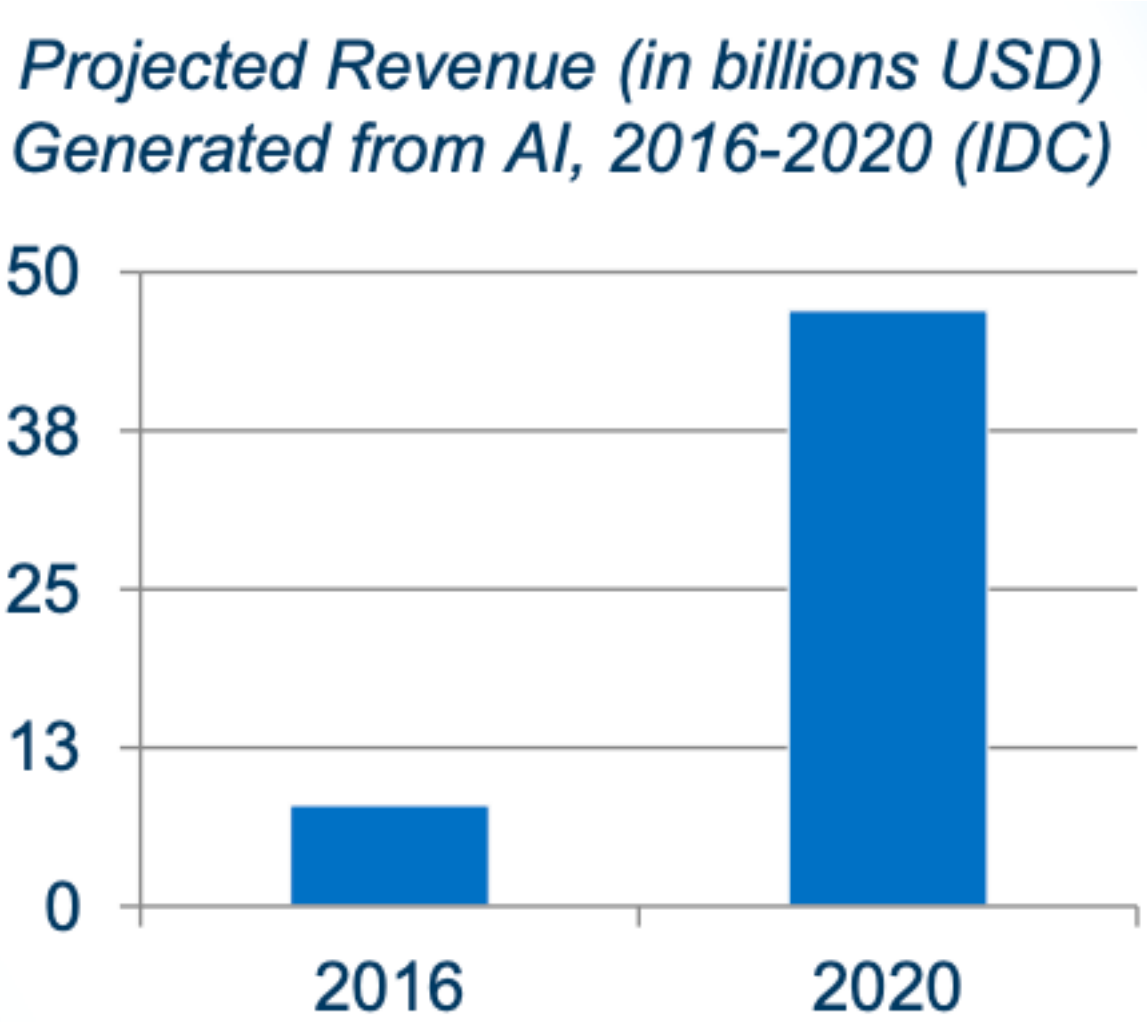
AI Is The New Electricity

"About 100 years ago, electricity transformed every major industry. AI has advanced to the point where it has the power to transform...every major sector in coming years."

-Andrew Ng, Stanford University



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Outline

- What is AI?
- A Brief History of AI

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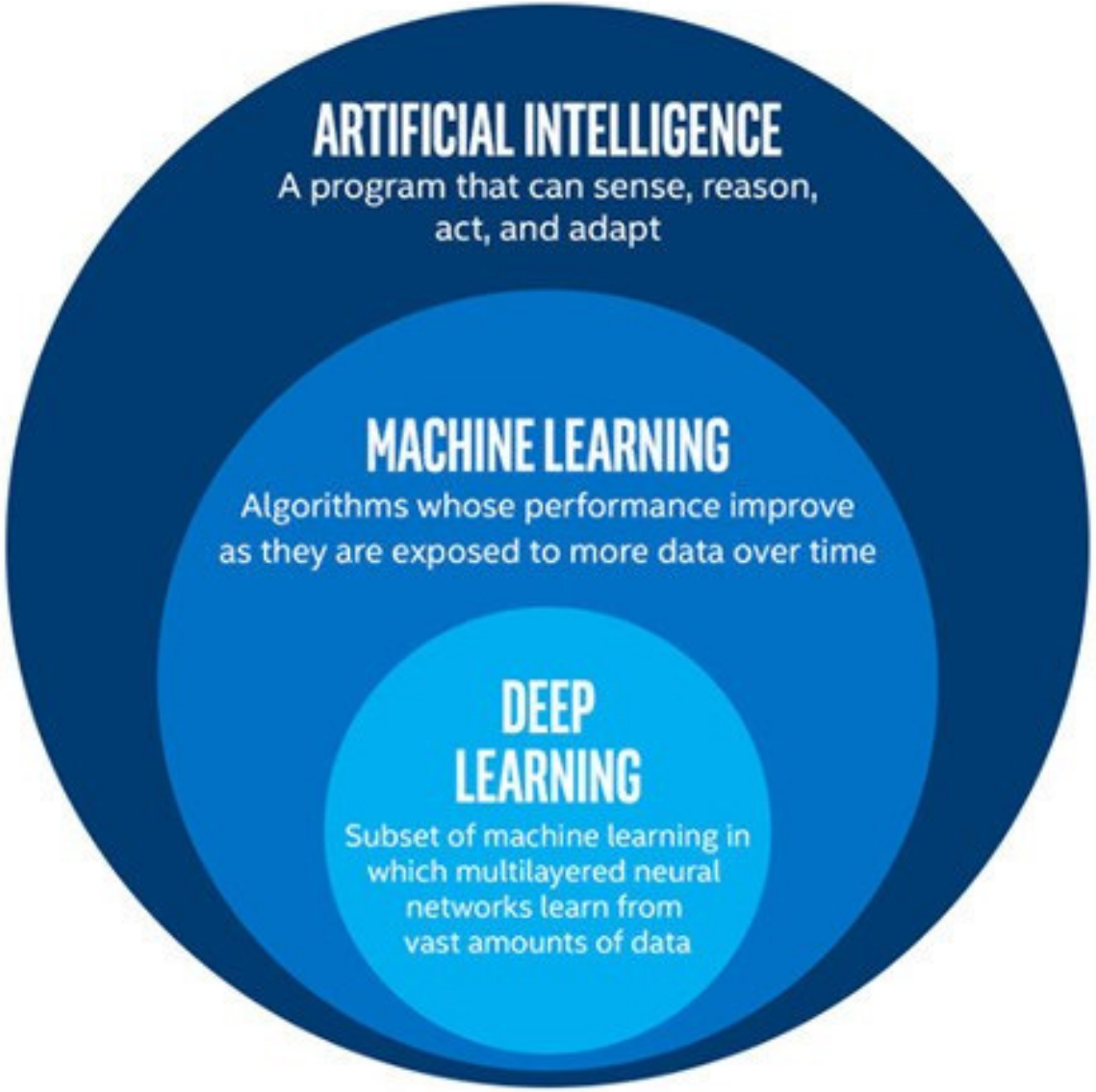
What is AI?

- Artificial Intelligence
- Machine Learning
- Deep Learning



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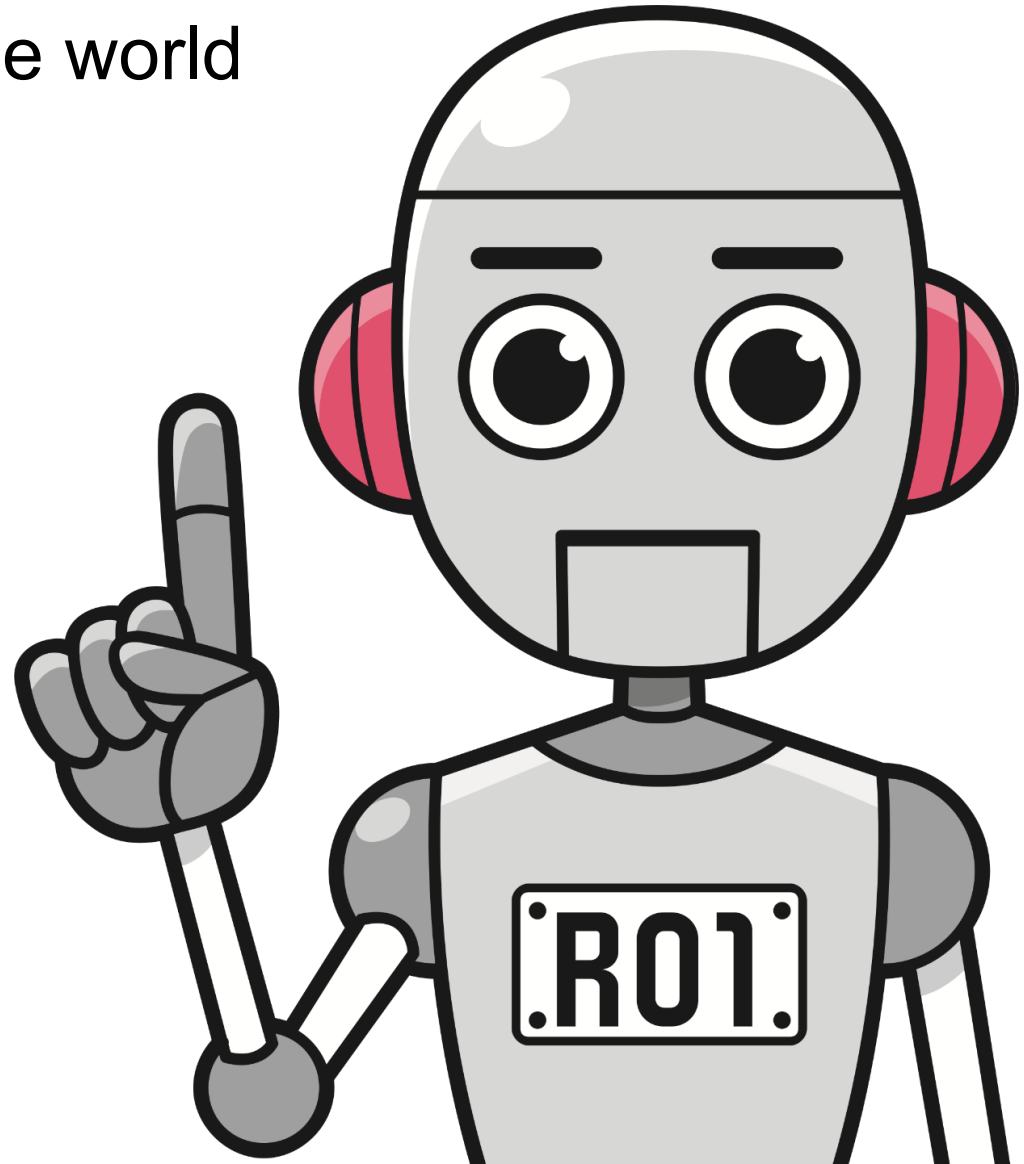
What is AI?

- AI is not about robots that take over the world



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What is AI?

- The ability of a computer program (or a machine) to think and learn.
- An active field of study that aims to make computers “smart”

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What is AI?

- "Artificial intelligence is a computerised system that exhibits behaviour that is commonly thought of as requiring intelligence." [1]
- "Artificial Intelligence is the science of making machines do things that would require intelligence if done by man." [2]
- The father of AI, Alan Turing, defines this discipline as:

"AI is the science and engineering of making intelligent machines, especially intelligent computer programs." [3]

[1] Preparing for the Future of Artificial Intelligence, NSTC, 2016
[2] Raphael, B. 1976. The thinking computer. San Francisco, CA: W.H. Freeman
[3] http://www-formal.stanford.edu/jmc/whatisai/node1.html

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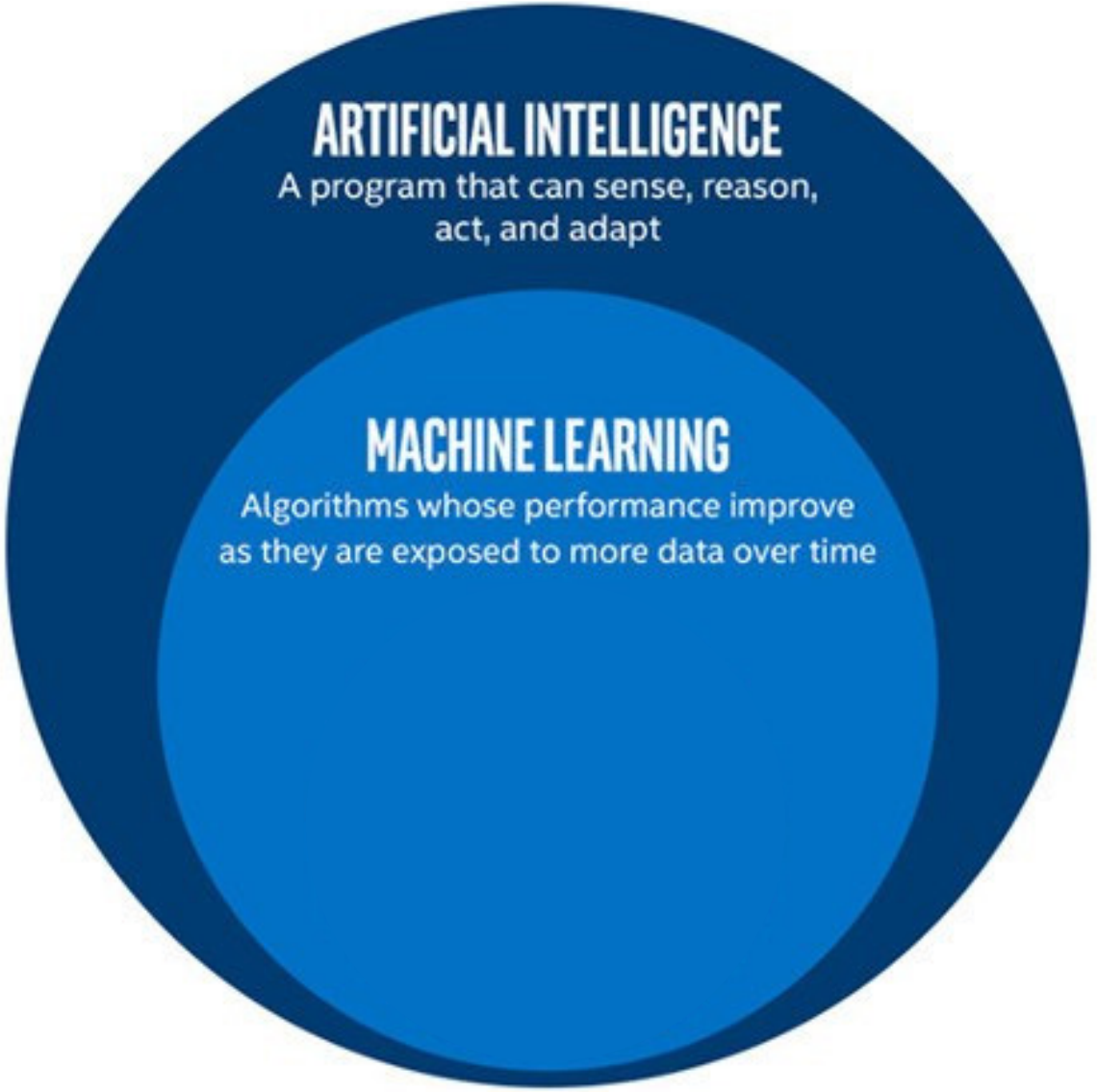
Machine Learning

- "The study and construction of programs that are not explicitly programmed, but learn patterns as they are exposed to more data over time." (Intel)



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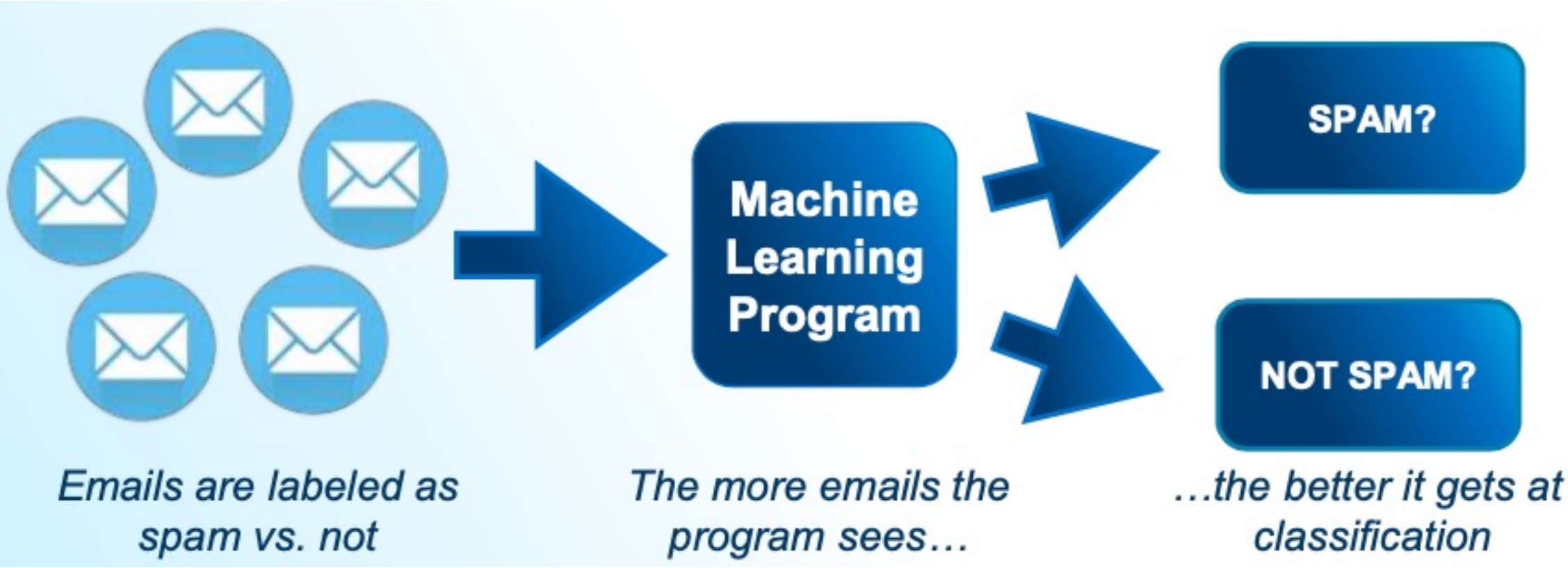
Machine Learning

- These programs learn from repeatedly seeing data, rather than being explicitly programmed by humans.



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Machine Learning

	Dataset	Goal	Example
Supervised Learning	Has a target column	Make predictions	Fraud detection
Unsupervised Learning	Does not have a target column	Find structure in the data	Customer segmentation

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Machine Learning

- Suppose you wanted to identify fraudulent credit card transactions.
- You could define features to be:
  - Transaction time
  - Transaction amount
  - Transaction location
  - Category of purchase
- The algorithm could learn what feature combinations suggest unusual activity.

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Machine Learning Limitations

- Suppose you wanted to determine if an image is of a cat or a dog.
- What features would you use?
- This is where **Deep Learning** can come in.

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Deep Learning

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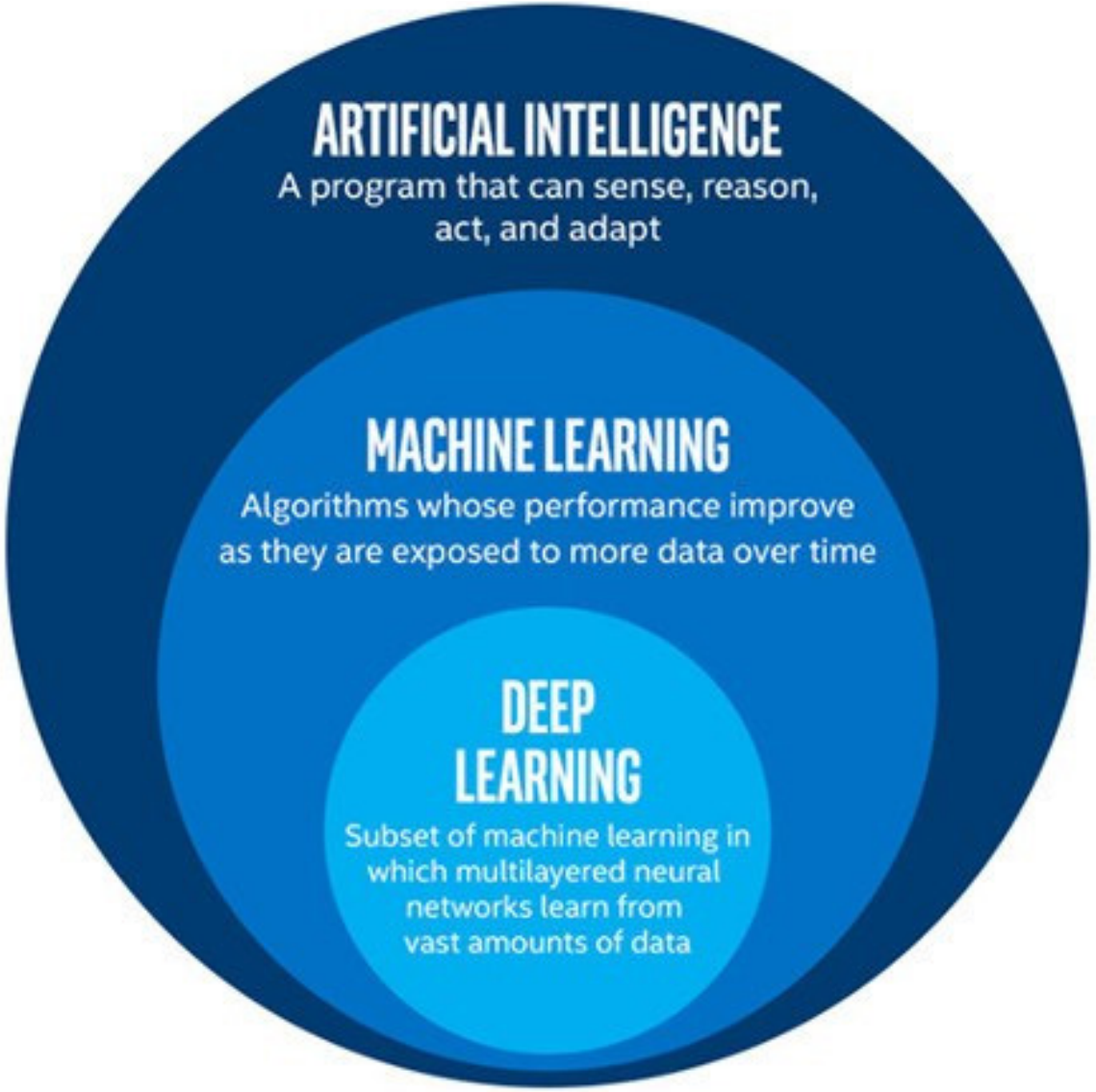

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Deep Learning

Classic Machine Learning

Step 1: Determine features.
Step 2: Feed them through model.

Feature Detection

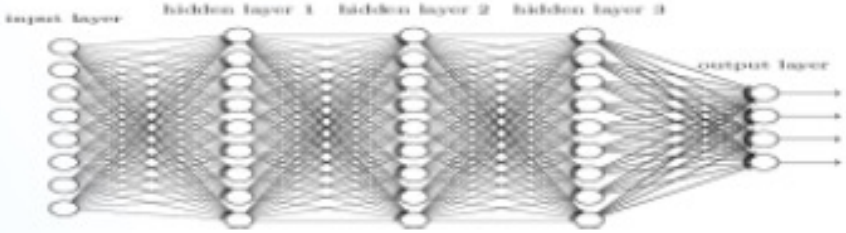
Machine Learning Classifier Algorithm

"Arjun"

Deep Learning

Steps 1 and 2 are combined into 1 step.

Neural Network



"Arjun"

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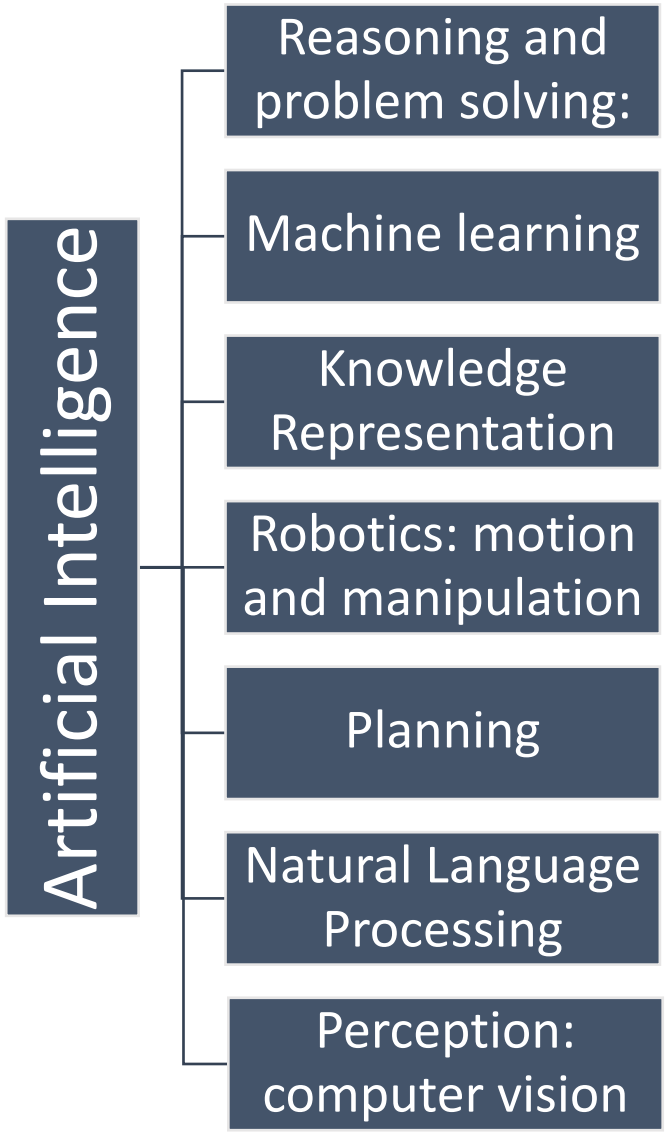
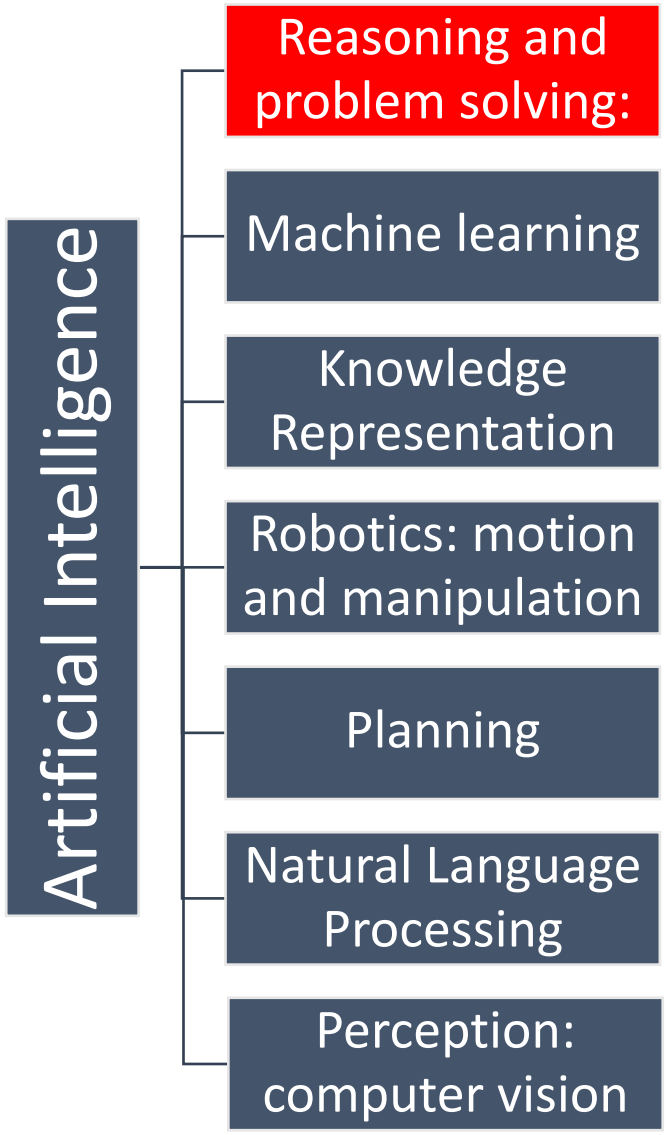
Main Branches of AI



Main Branches of AI



- Reasoning and problem solving: generates conclusions from available knowledge using logical techniques. Then use that knowledge to solve problems.

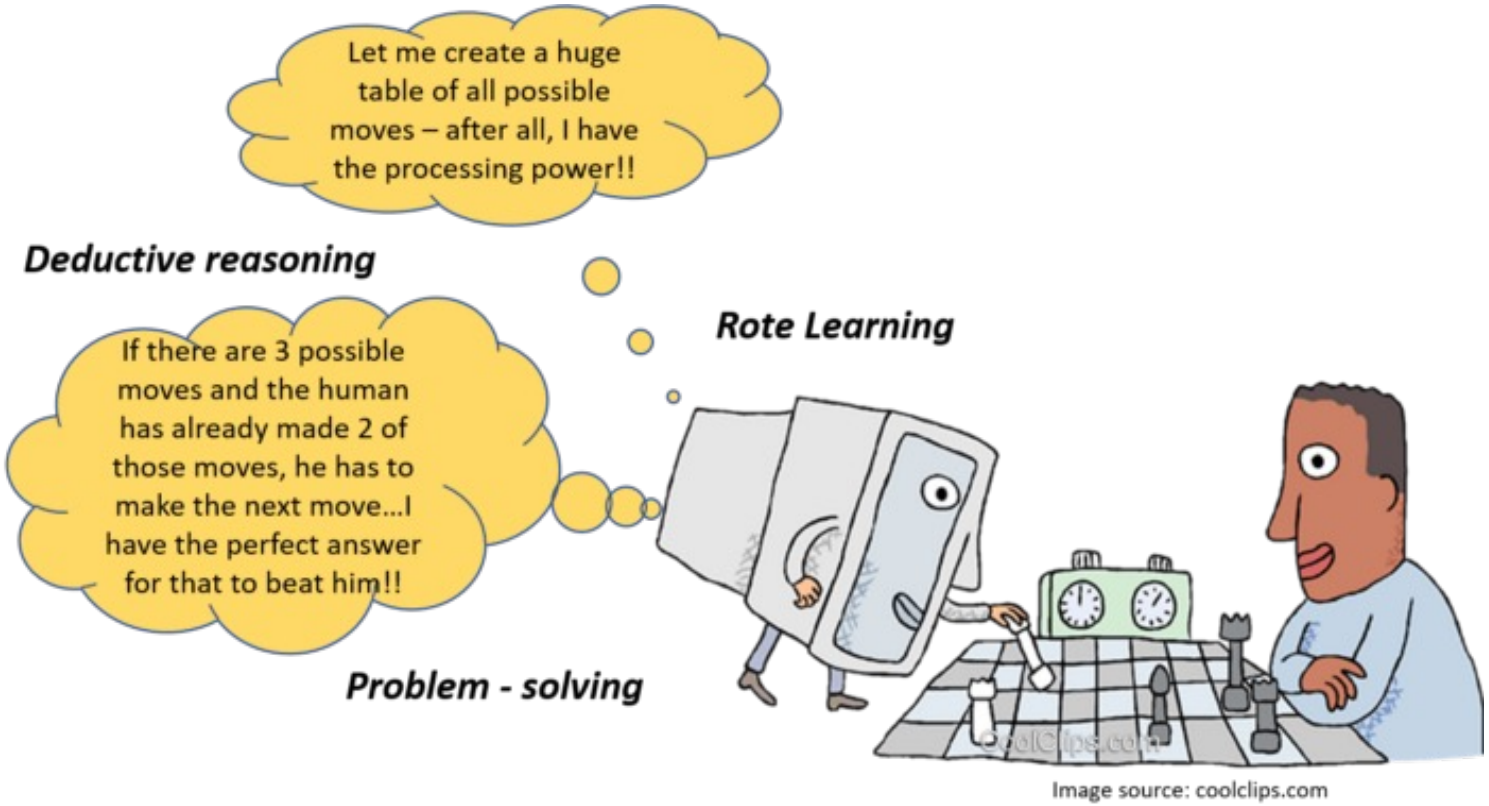
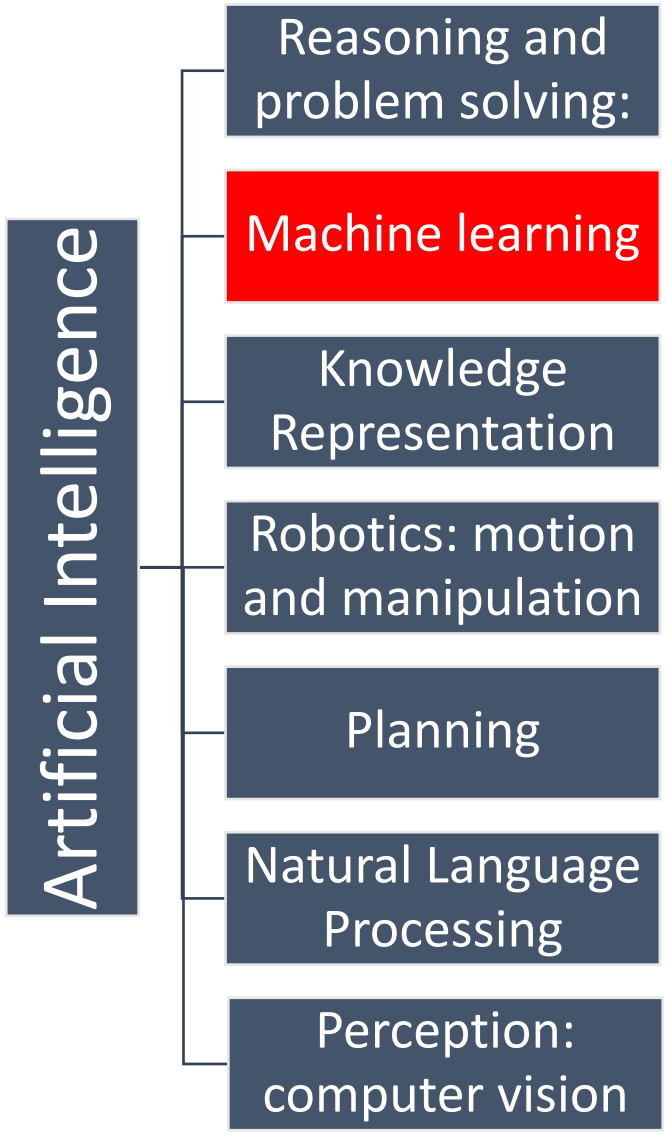


Image source: coolclips.com

Main Branches of AI



- Machine learning: the techniques to give computer systems the ability to "learn".

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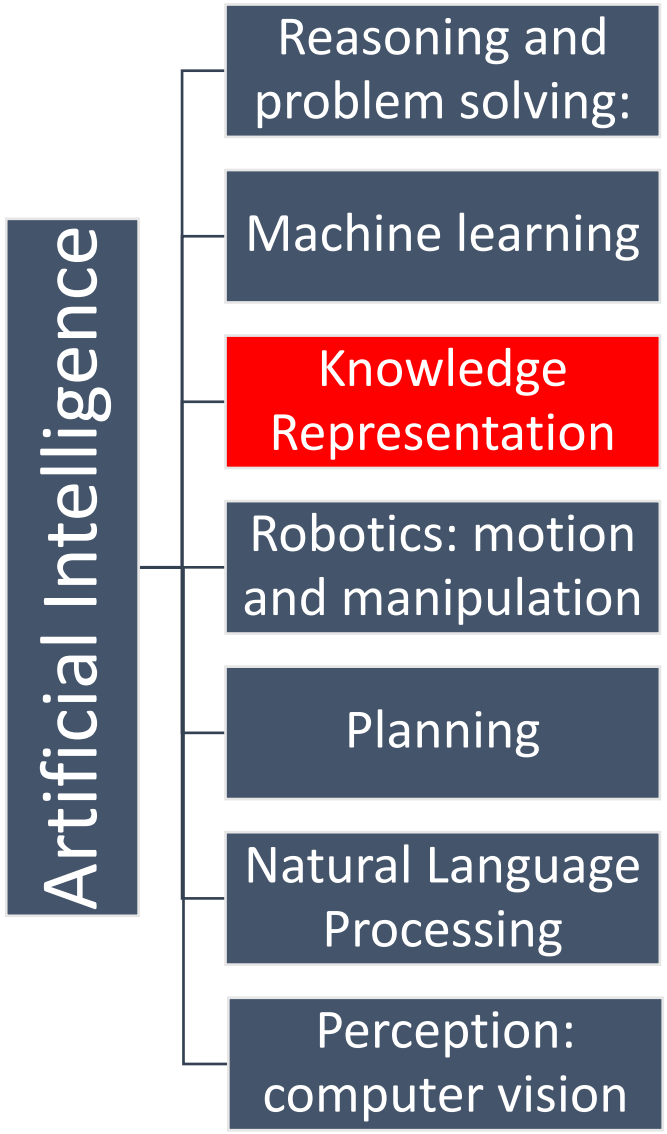
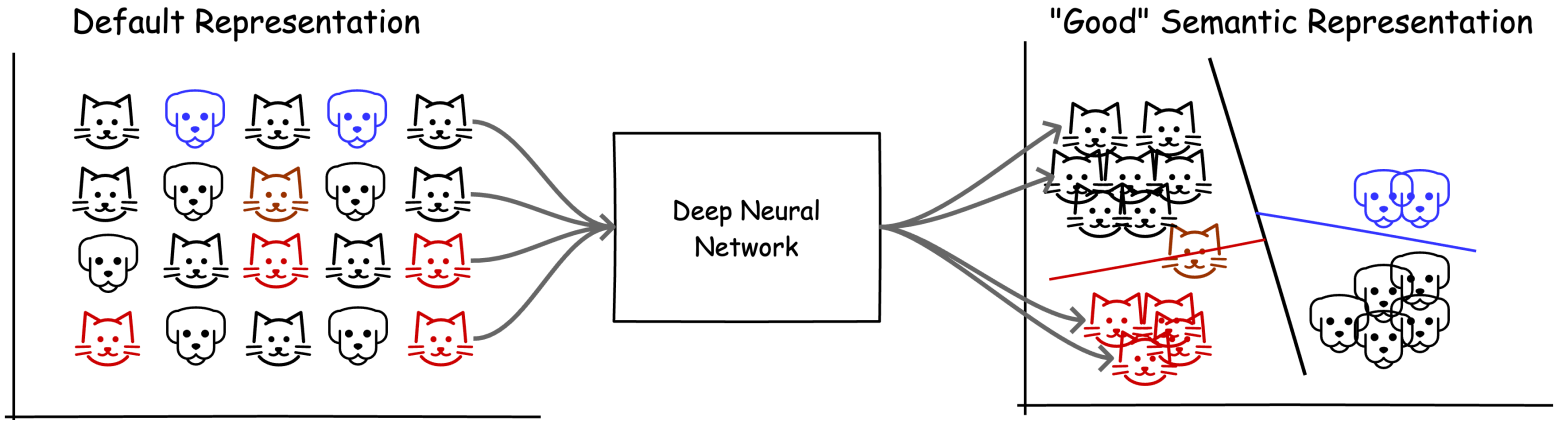
Main Branches of AI



- Knowledge Representation: representing information about the world in a form that a computer system can utilize to solve complex tasks



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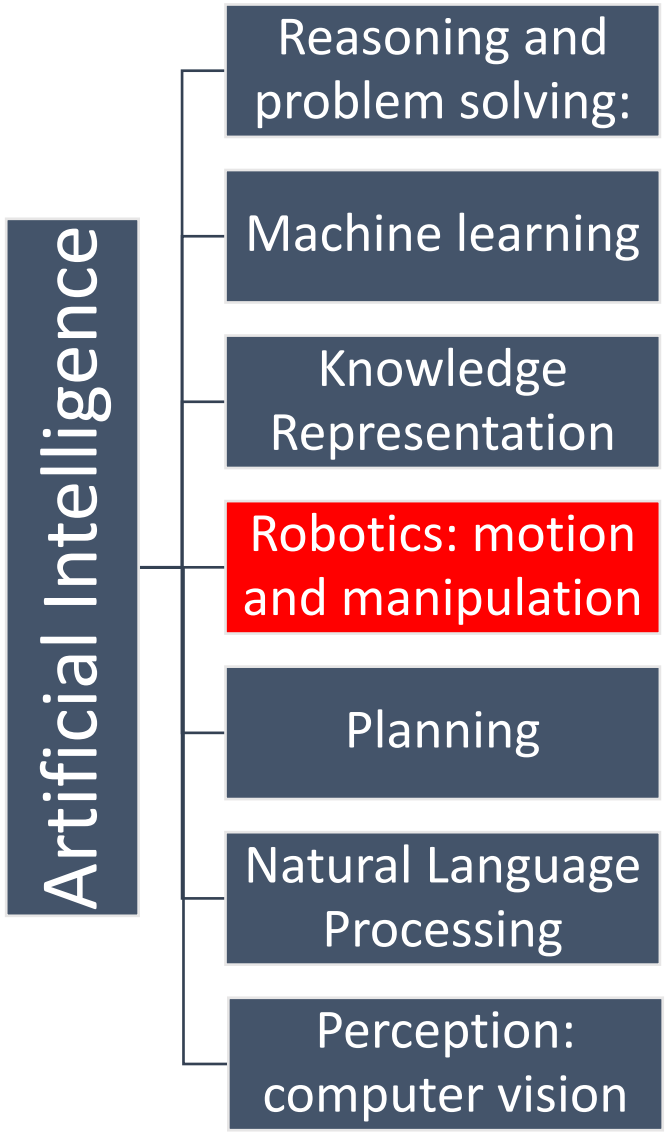
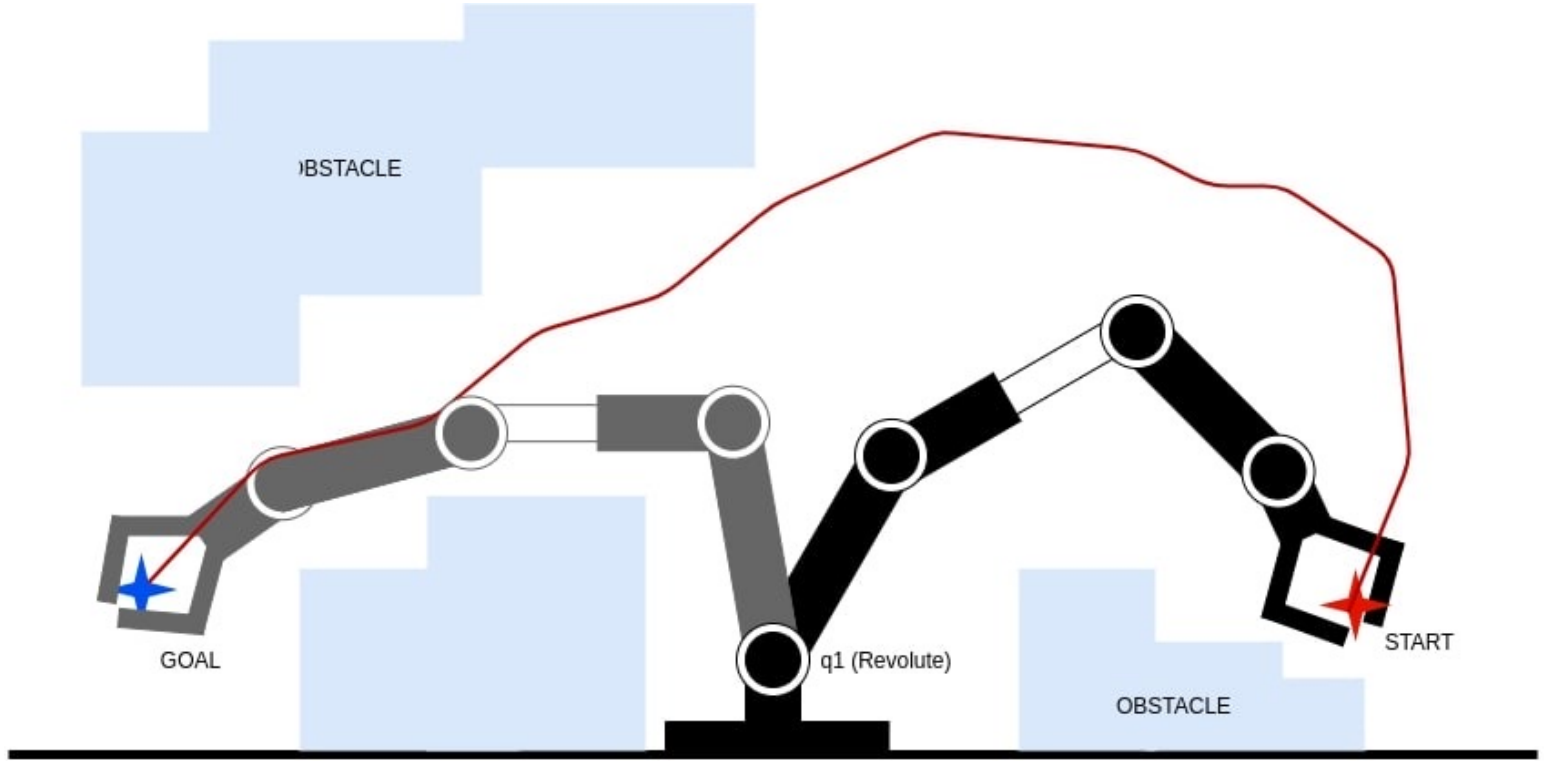


- Robotics: motion and manipulation. Making the robots capable of navigating different environment and manipulate



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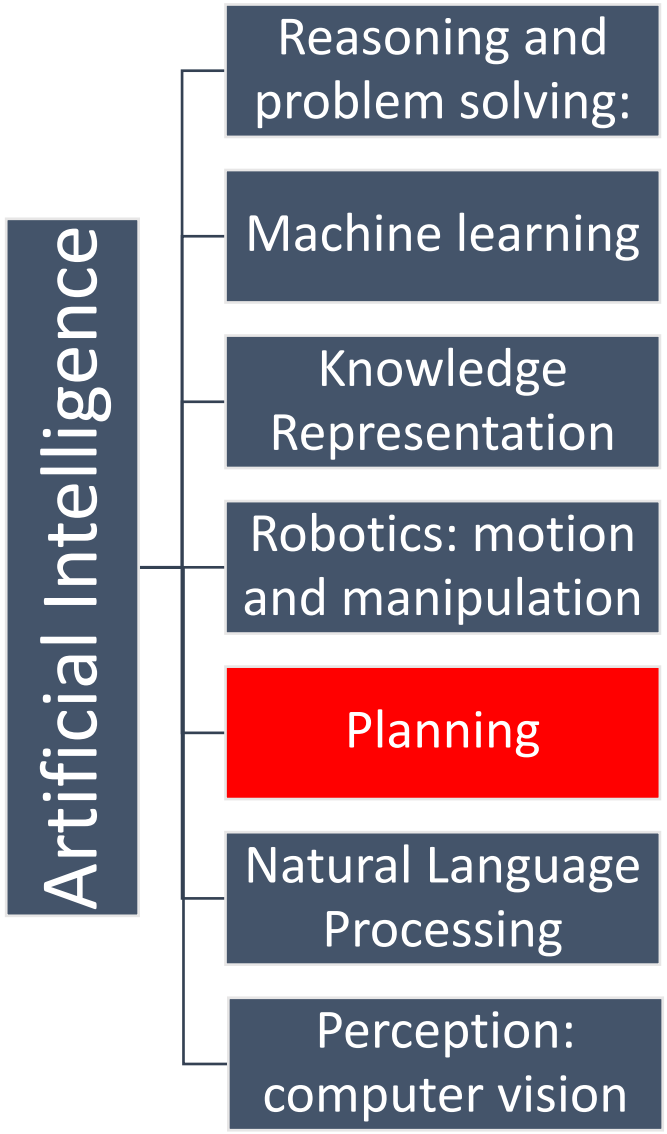
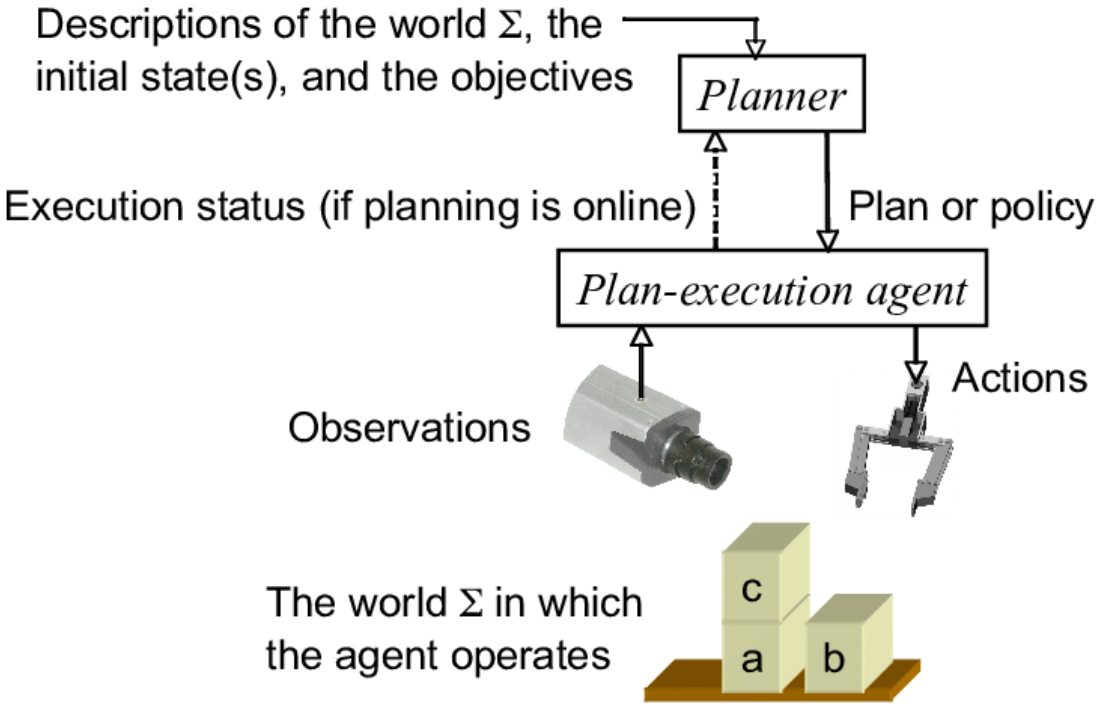


- Planning: decision making tasks performed by the robots or computer programs to achieve a specific goal



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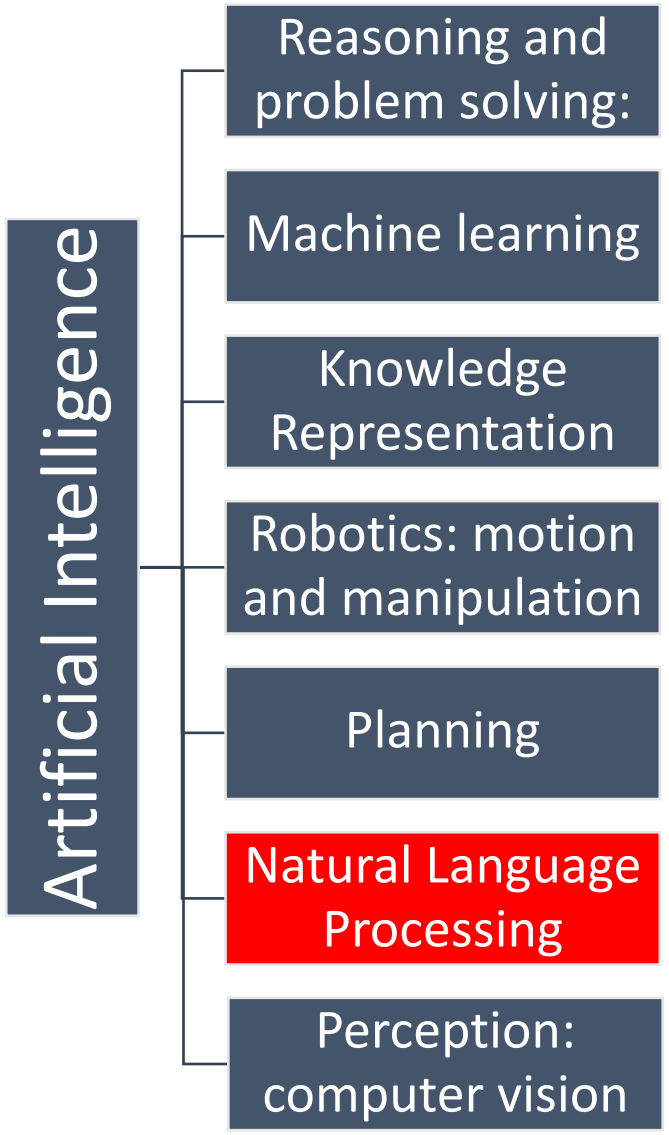
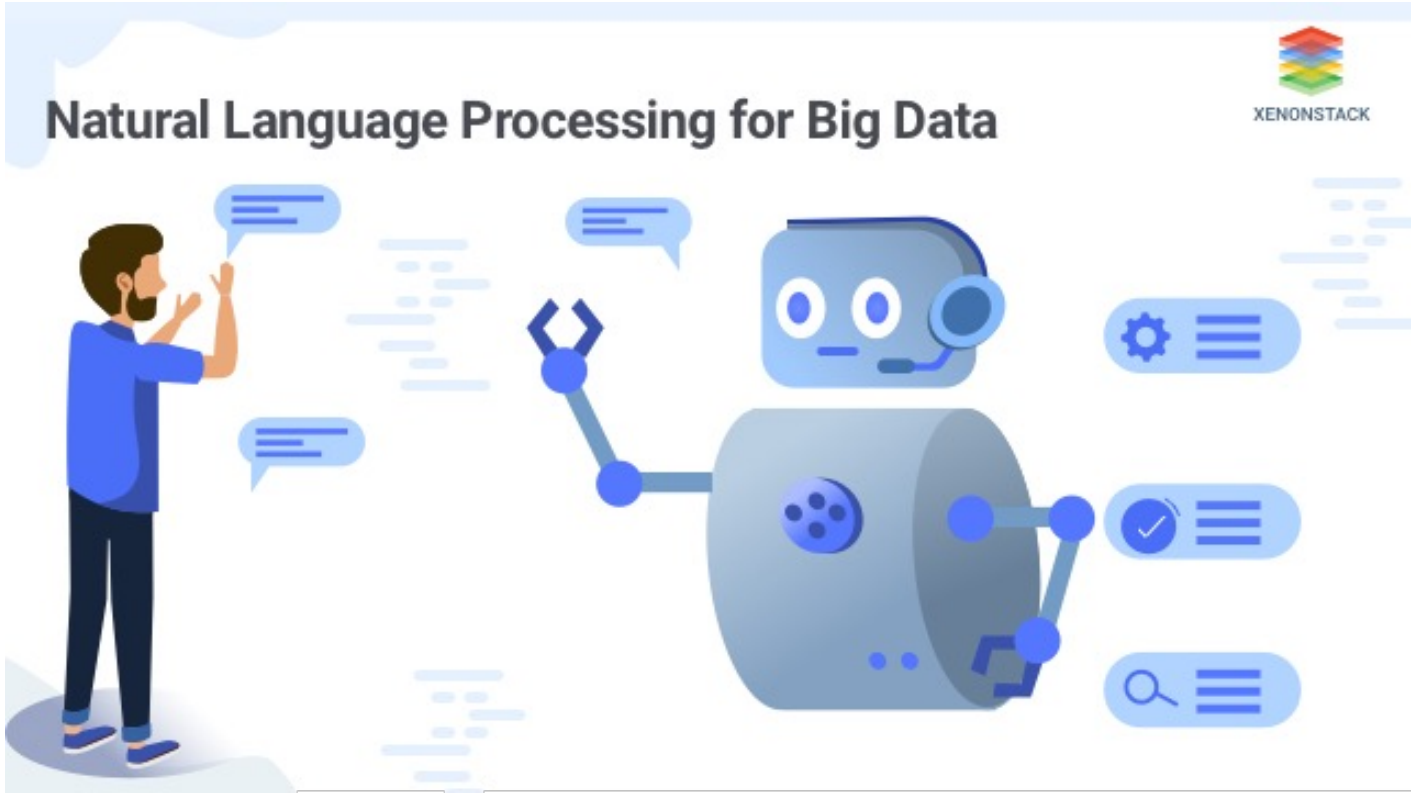


- Natural Language Processing: helps computers understand, interpret and manipulate human language



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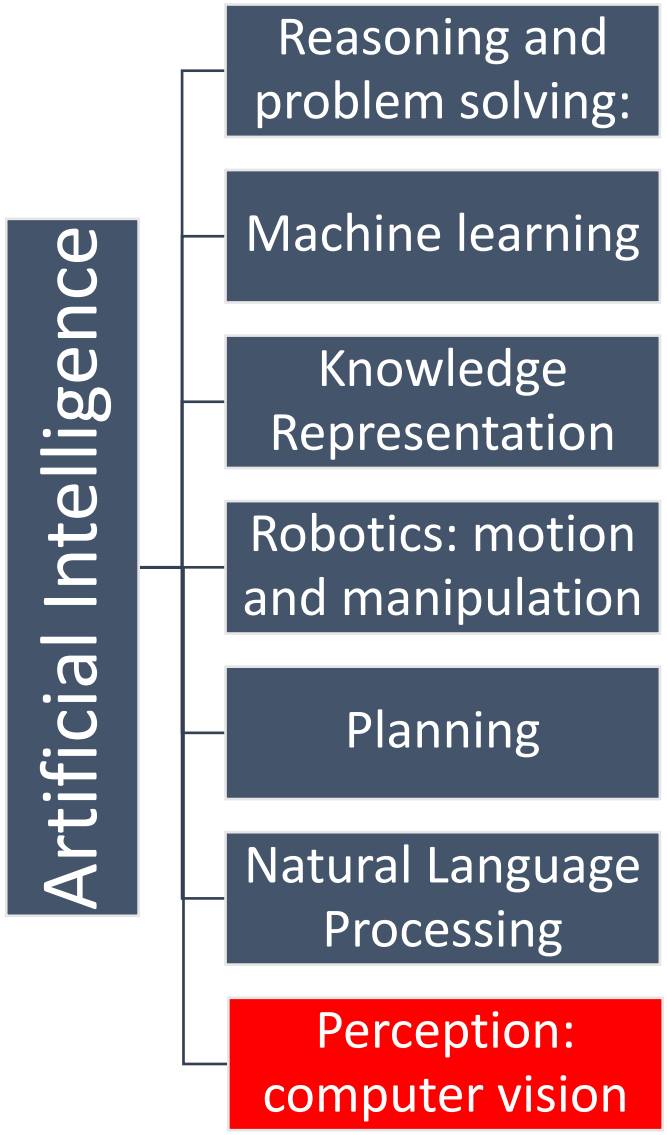

- Perception: computer vision methods for acquiring, processing, analyzing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolic information

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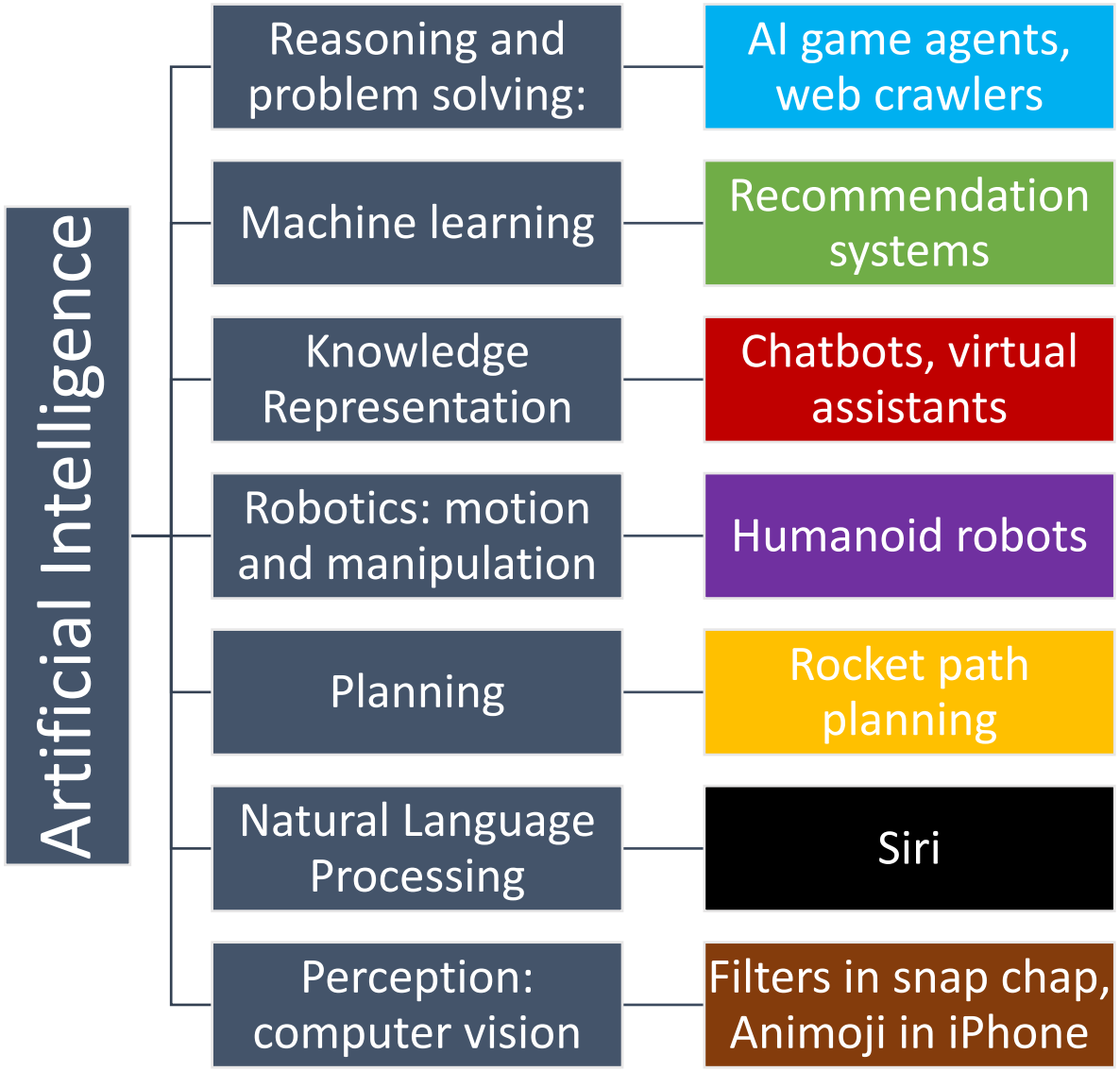
Some Examples



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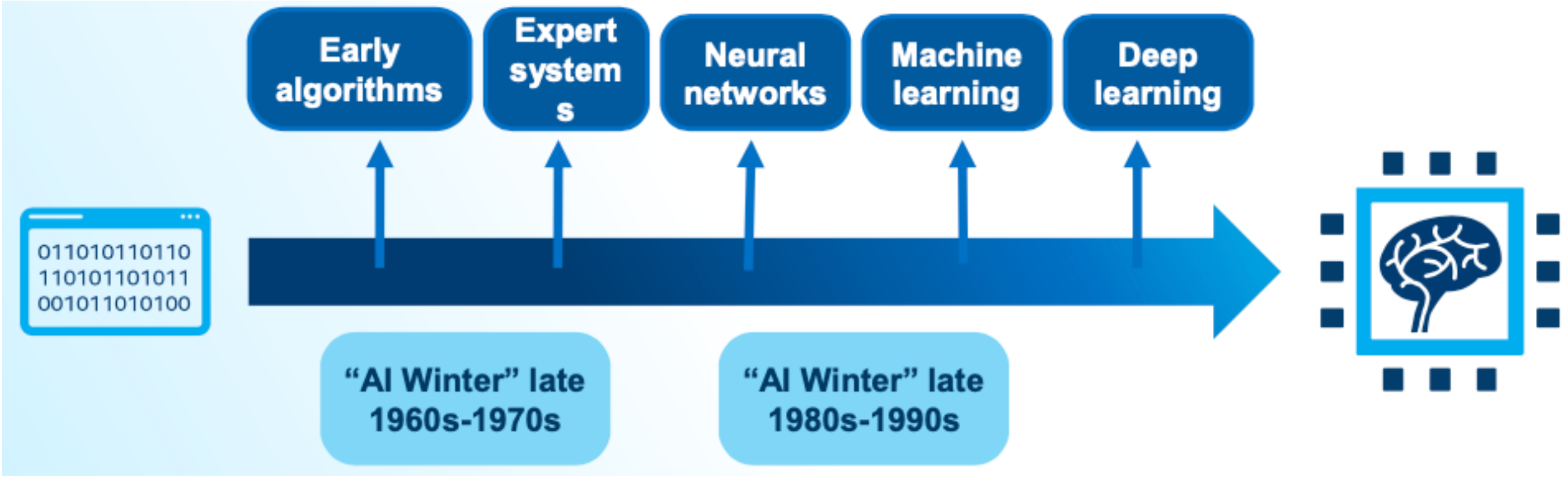
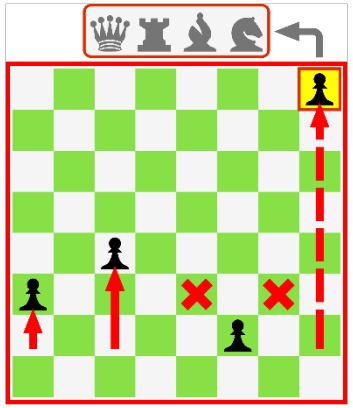
A Brief History of AI

- AI has experienced several hype cycles, where it has oscillated between periods of excitement and disappointment.



A Brief History of AI

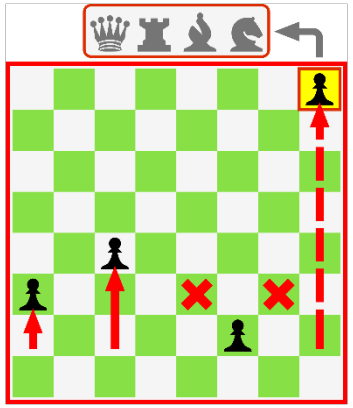
- 1950s – 1970s
- Search methods
- Simple Neural Networks



First Era

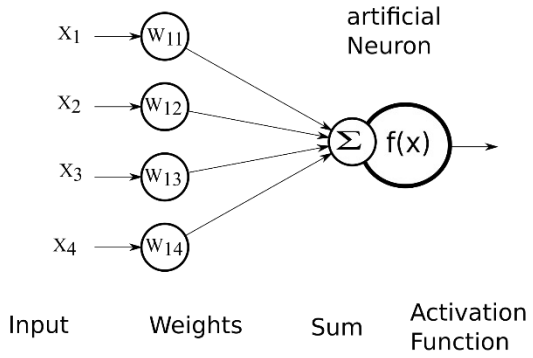
A Brief History of AI

- 1950s – 1970s
- Search methods
- Simple Neural Networks



First Era

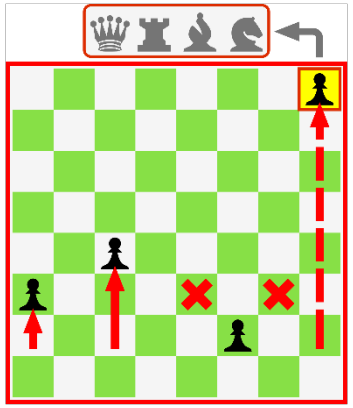
- 1980s – 2010s
- Advances Neural Networks
- Machine learning
- Data mining



Second Era

A Brief History of AI

- 1950s – 1970s
- Search methods
- Simple Neural Networks



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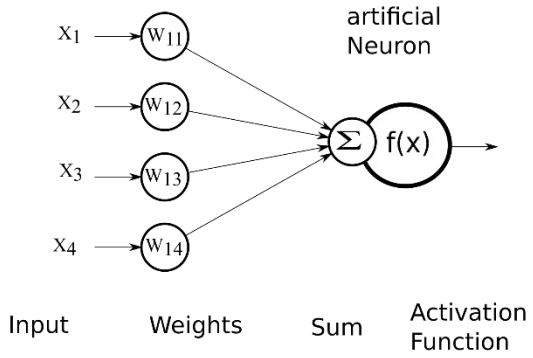
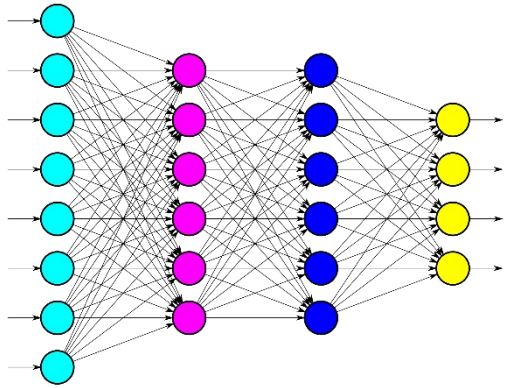


Second Era

- Present
- Deep Learning
- Big data



Third Era

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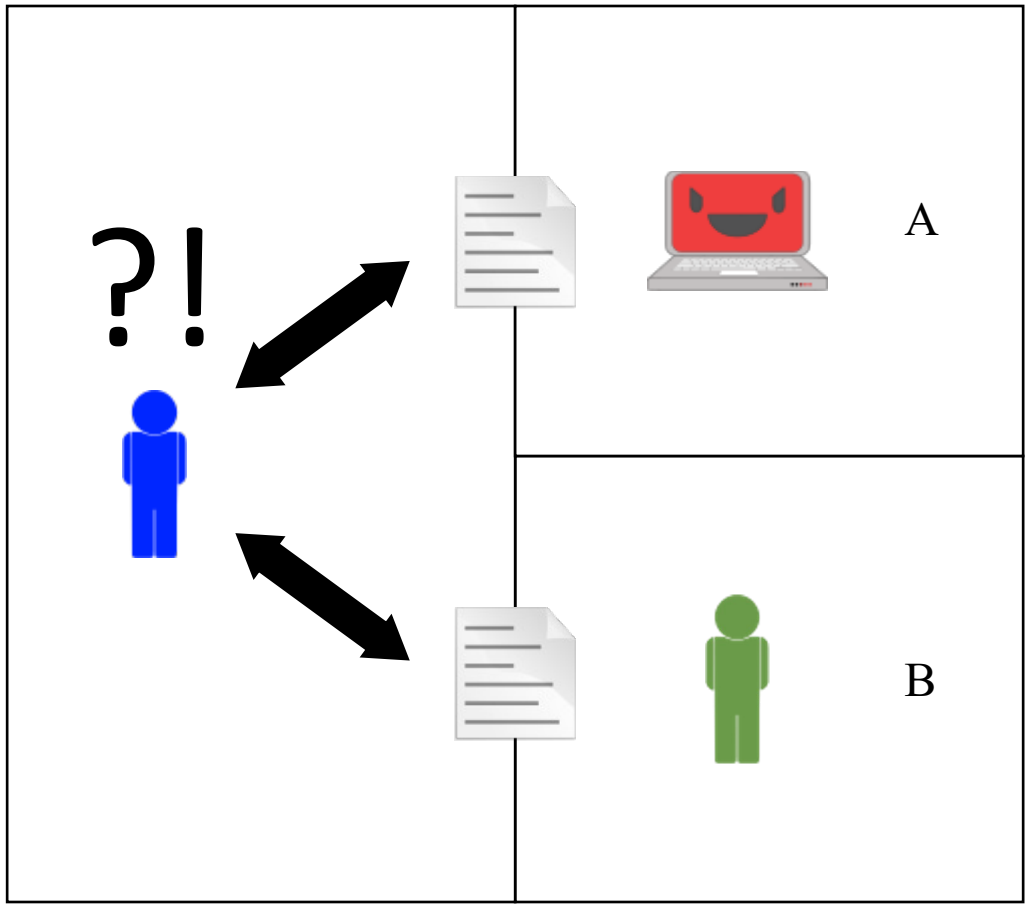
First Era

- 1950: Alan Turing, the father of AI, proposed a Turing test to test a machines ability to exhibit intelligent behavior.
- 1955, The first self-learning game program
- 1961, The first robotic arm was added to the production line of General Motors in USA.
- 1964: Simple programs to process natural language
- 1965: Simple chatbots
- 1974: First autonomous vehicle

Turing Test



Objective: a test of a machine's ability to show intelligent behaviour equivalent to, or indistinguishable from a human

Method: Three rooms, two humans, one computer (machine). Communications is done via text

Theory: If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test.

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The First "AI Winter"

- 1966: ALPAC committee evaluated AI techniques for machine translation and determined there was little yield from the investment.
- 1969: Marvin Minsky published a book on the limitations of the Perceptron algorithm which slowed research in neural networks.
- 1973: The Lighthill report highlights AI's failure to live up to promises.
- The two reports led to cuts in government funding for AI research leading to the first "AI Winter."

John R. Pierce, head of ALPAC

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1980's AI Boom

- Expert Systems - systems with programmed rules designed to mimic human experts.
- Ran on mainframe computers with specialized programming languages (e.g. LISP).
- Were the first widely-used AI technology, with two-thirds of "Fortune 500" companies using them at their peak.
- 1986: The "Backpropogation" algorithm is able to train multi-layer perceptrons leading to new successes and interest in neural network research.

Early expert systems machine

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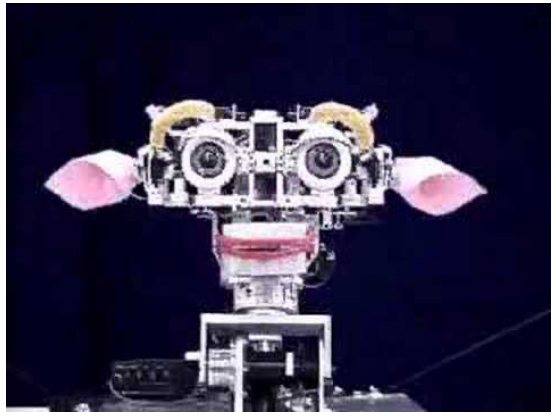
Another AI Winter (late 1980's – early 1990s)

- Expert systems' progress on solving business problems slowed.
- Expert systems began to be melded into software suites of general business applications (e.g. SAP, Oracle) that could run on PCs instead of mainframes.
- Neural networks didn't scale to large problems.
- Interest in AI in business declined.

Second Era

- 1989: first Autonomous vehicle using NNs
- 1997: Garry Kasparov was beaten in chess by a program (deep blue)
  - Calculate 200 million moves/s
- 1999: AIBO designed by Sony
- 1999: First emotional robot in MIT lab
- 2009: Google start to build self-driving cars



Third Era

- 2011: Siri and Cortana
- 2014: A chatbot is said to beat the Turing test
- 2014: Researchers called for a new Turing test
- 2015: Elon Musk and other elites donated $1B for Open AI project
- 2015-2018: Data science, AlphaGo, Tesla,
- 2023: ChatGPT, Stable Diffusion, Deepfake

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How Is This Era of AI Different?