Introduction to Artificial Intelligence

AI+X
INSTITUTE FOR ARTIFICIAL INTELLIGENCE

Goals of AI

Humans are the most intelligent species on Earth.

AI seeks to build intelligent entities

Machines that act on their own in novel situations

What is Artificial Intelligence?

The science of making machines that:

Think rationally

Act rationally

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The science of making machines that:

~~Think rationally~~
Think like people

~~Act rationally~~
Act like people

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The science of making machines that:

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Think like people want them to think

~~Act rationally~~
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Act like people want them to act

What is Artificial Intelligence?

The science of making machines that:

~~Think rationally~~
~~Think like people~~
Think like people want them to think
(most of the time)

~~Act rationally~~
~~Act like people~~
Act like people want them to act
(most of the time)

What is Artificial Intelligence?

- The science of making machines maximally achieve predefined goals.
- Goals are expressed in terms of the utility of the outcomes.

Knowledge Check 1

From which of the following disciplines can AI systems take inspiration from?

- Philosophy
- Psychology
- Mathematics
- Computer engineering
- Economics
- Control theory
- Neuroscience
- Linguistics

Can we take inspiration from our brains?

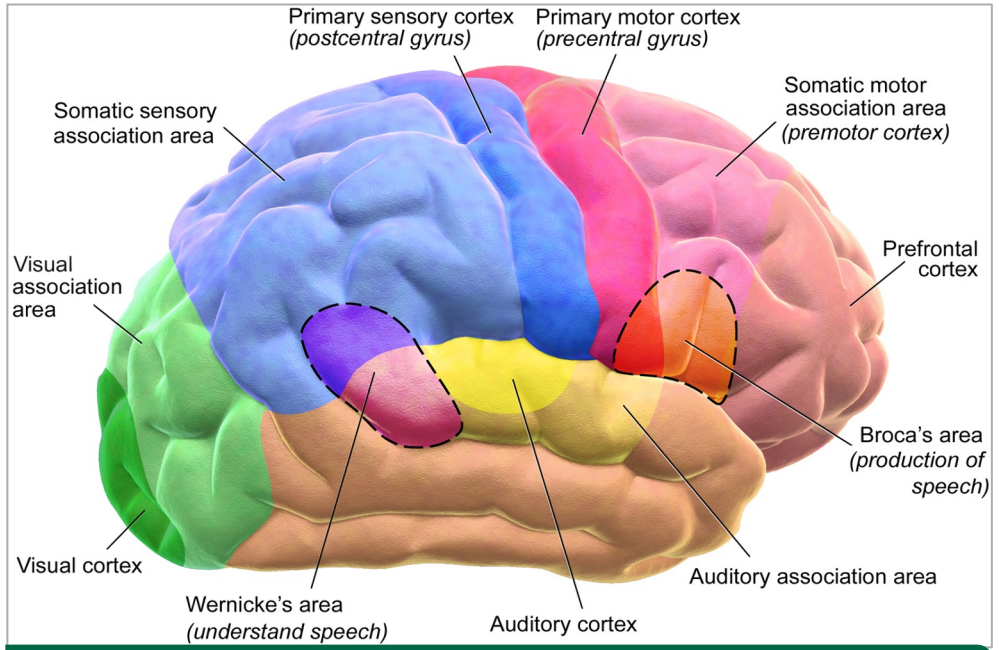


Figure 1. Motor and Sensory Regions of the Cerebral Cortex

> *Great progress notwithstanding, neuroscience still cannot answer the 'big questions' about mind and intelligence.*

Olaf Sporns, Networks of the Brain, The MIT Press, 2010

Brains VS. Computer Analogy

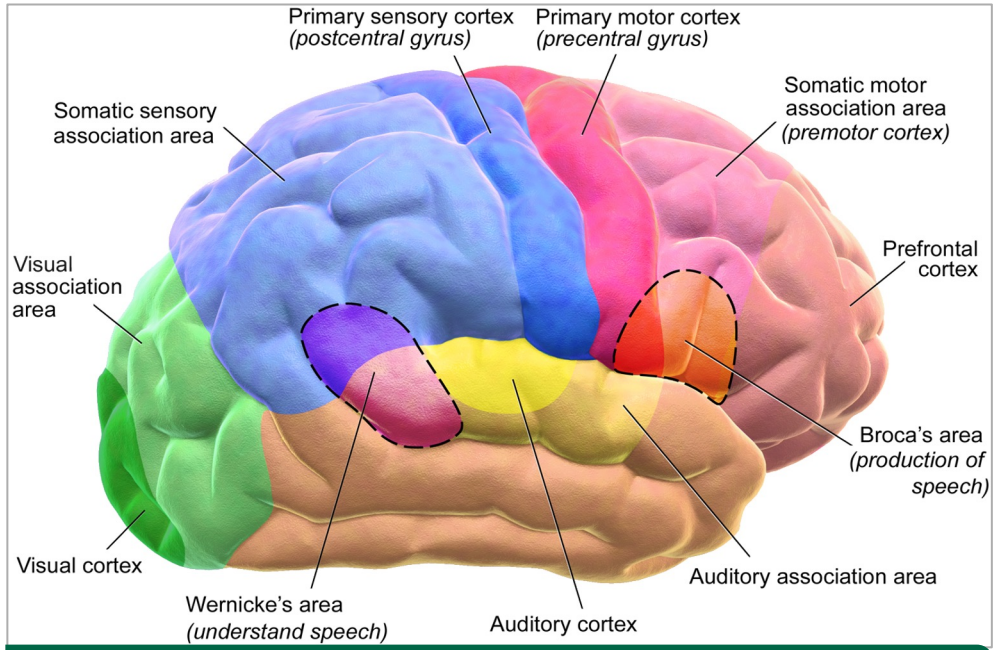
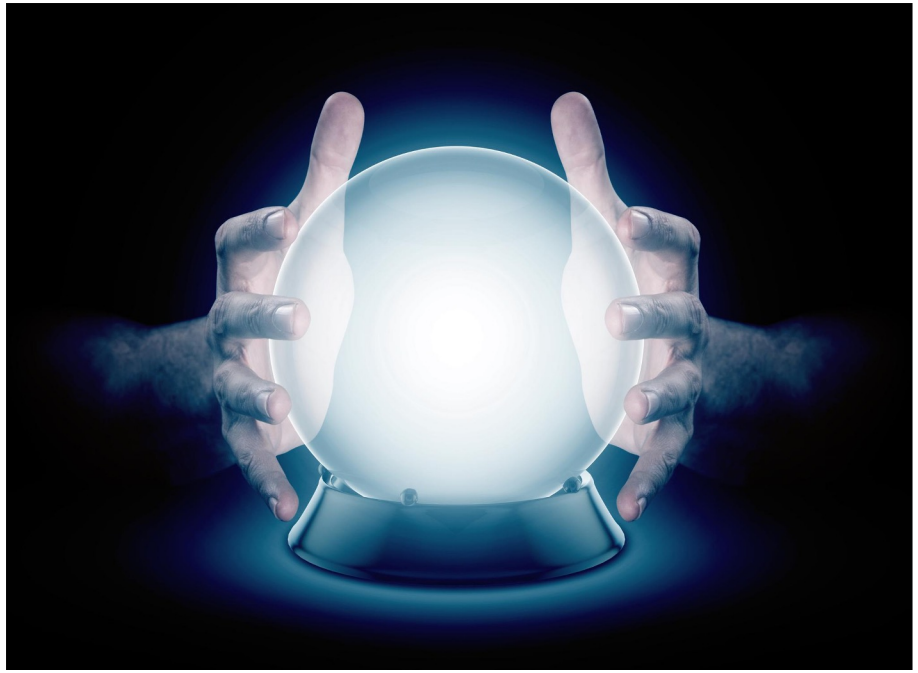


Figure 1. Motor and Sensory Regions of the Cerebral Cortex

Computer Analogy

What our brains are good at?

Computation, Storage



Forecasting

History of AI (1940 – 1950)

- McCulloch & Pitts
  - First computational model of a neuron

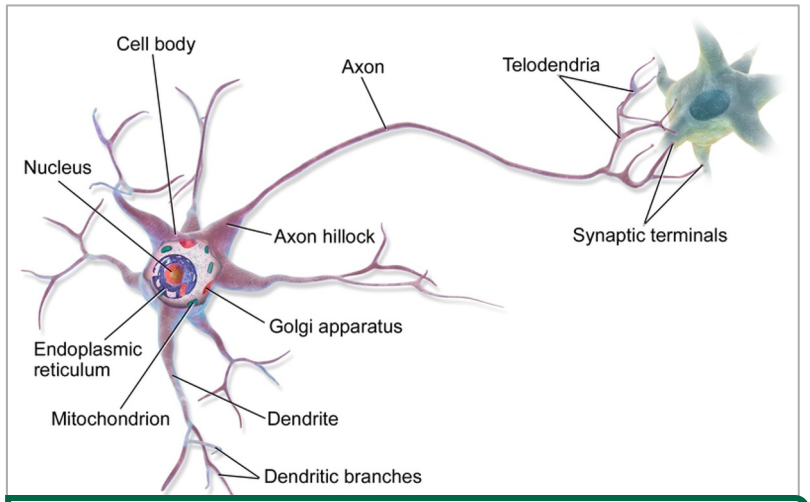


Figure 2. Multipolar Neuron

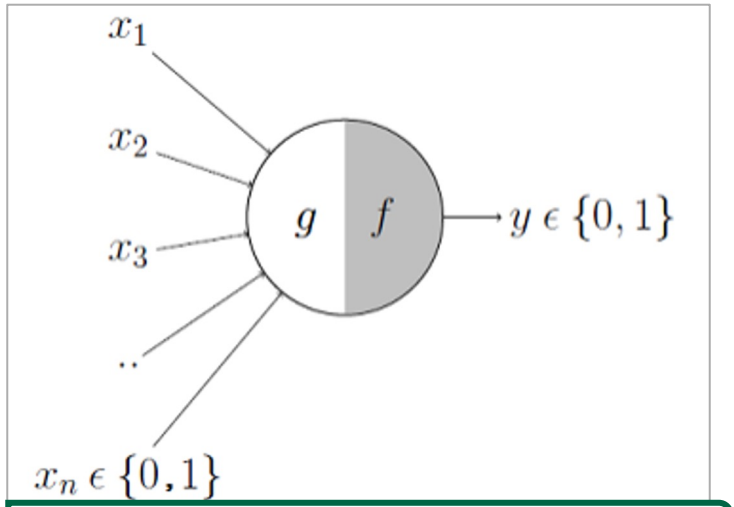


Figure 3. First Computational Model of Neuron

1943

History of AI (1940 – 1950)

- Minsky & Edmonds
  - First hardware implementation of a neural network

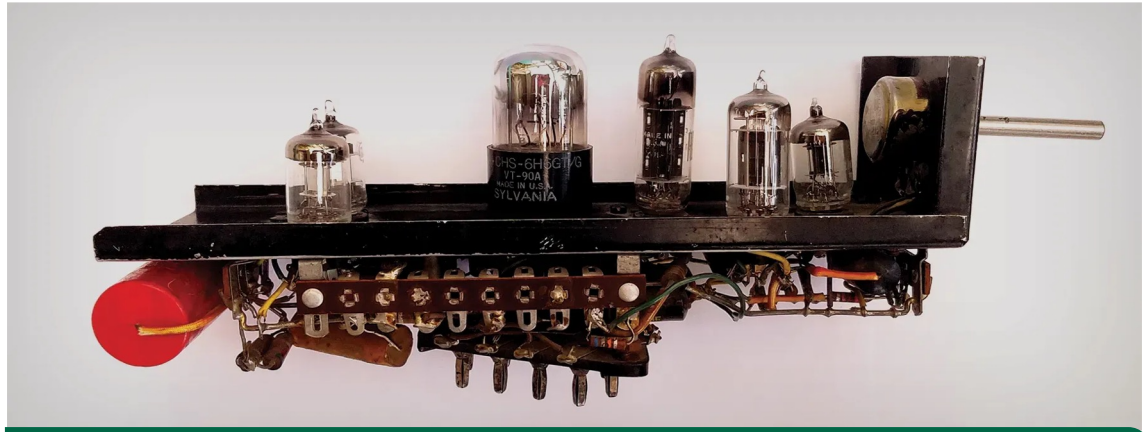


Figure 4. Marvin Minsky engineered the first known artificial neural network, in which “rats” represented as lights learned to solve a maze.

1943 1950

History of AI (1940 – 1950)

- Turning Test

Are there imaginable digital computers which would do well in the imitation game?

- Alan Turing, Computing Machinery and Intelligence, Mind, 1950

1943 1950

History of AI (1950 – 1970)

- Arthur Samuel's checkers playing room

Figure 5. Playing checkers on the 701

1952

1943 1950

History of AI (1950 – 1970)

- Dartmouth summer workshop
  - First use of the term “Artificial intelligence”

> *We propose that a two-month, ten men study of **artificial intelligence** be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.*

- Dartmouth summer camp

History of AI (1950 – 1970)

- McCarthy defined Lisp
  - AI systems based on representation and reasoning in formal logic

History of AI (1950 – 1970)

- Perceptron

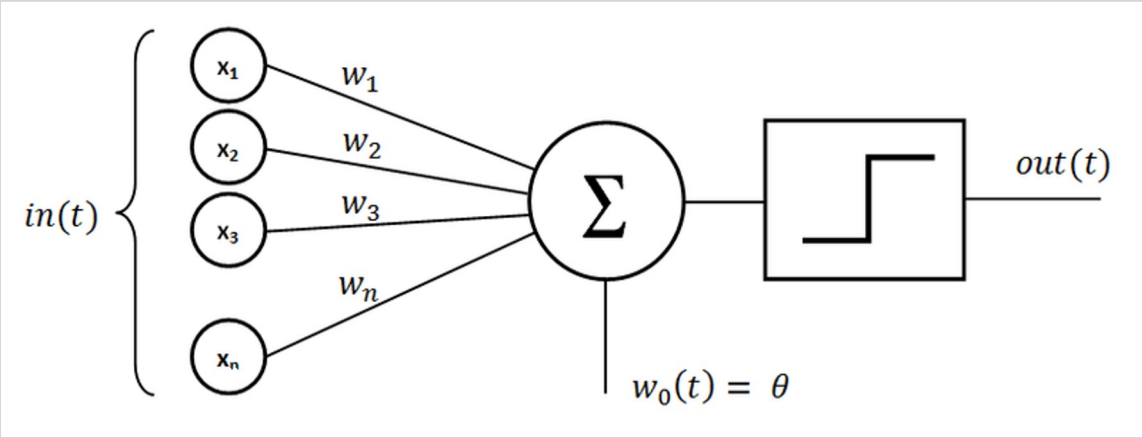


Figure 6. Perceptron

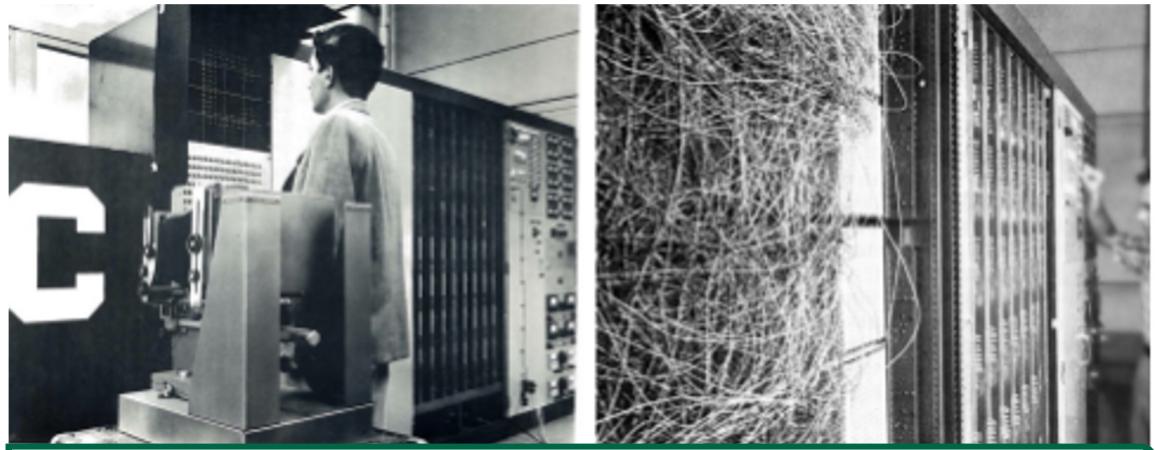


Figure 7. The Mark 1 Perceptron

1943 1950 1952 1956 1962

Knowledge Check 2

How much the perceptron contributes to AI nowadays?

A It was important to develop the foundations of AI, but it is no longer used.

B It was heavily modified since it was proposed, and still has some use in specific applications.

C It is massively used without any major changes.

History of AI (1970 – 1990)

- Overpromise and underdeliver
  - AI Winter (research funds dwindled)
- Era of expert systems

History of AI (1970 – 1990)

- Backpropagation
  - The return of neural networks

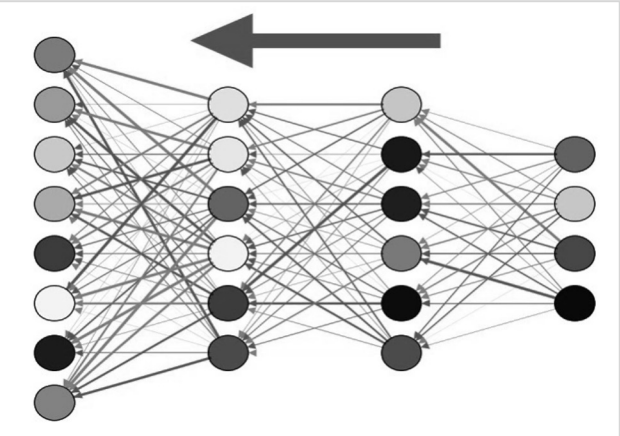


Figure 8. Multilayer Perceptron

1943 1950 1952 1956 1962 1970 1986 1990

History of AI (1990 – 2012)

- AI Spring
  - Statistical approaches
  - Machine Learning
- Subfield reunification
  - Computer vision
  - Robotics
  - Speech recognition
  - Multiagent systems
  - Natural language processing

History of AI (2012 – Present)

- Big data + deep learning
  - Robotics, Healthcare, Self-driving cars, Finance, Travel/transportation, Social media, E-commerce, Marketing, Smart assistants, Customer service, etc.

What People Say About AI

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, former president and CEO of IBM

What People Say About AI

Nobody phrases it this way, but I think that artificial intelligence is almost a humanities discipline. It's really an attempt to understand human intelligence and human cognition."

- Sebastian Thrun, CEO of Kitty Hawk Corporation

What People Say About AI

The pace of progress in artificial intelligence (I'm not referring to narrow AI) is incredibly fast. Unless you have direct exposure to groups like Deepmind, you have no idea how fast - it is growing at a pace close to exponential. The risk of something seriously dangerous happening is in the five-year time frame. 10 years at most.

- Elon Musk in 2014, CEO of Tesla and SpaceX

What People Say About AI

The development of full artificial intelligence could spell the end of the human race….It would take off on its own, and re-design itself at an ever-increasing rate. Humans, who are limited by slow biological evolution, couldn't compete, and would be superseded.

- Stephen Hawking

Films and TV Series

AI films and TV series. Source: Wikipedia

Risks and Benefits

- Benefits
  - Humanity thrived on intelligence

- Risks
  - Misuse
    - Autonomous weapons and surveillance, biased decision making, employment, physical and digital safety
  - The super intelligent AI dilemma

Taxonomy

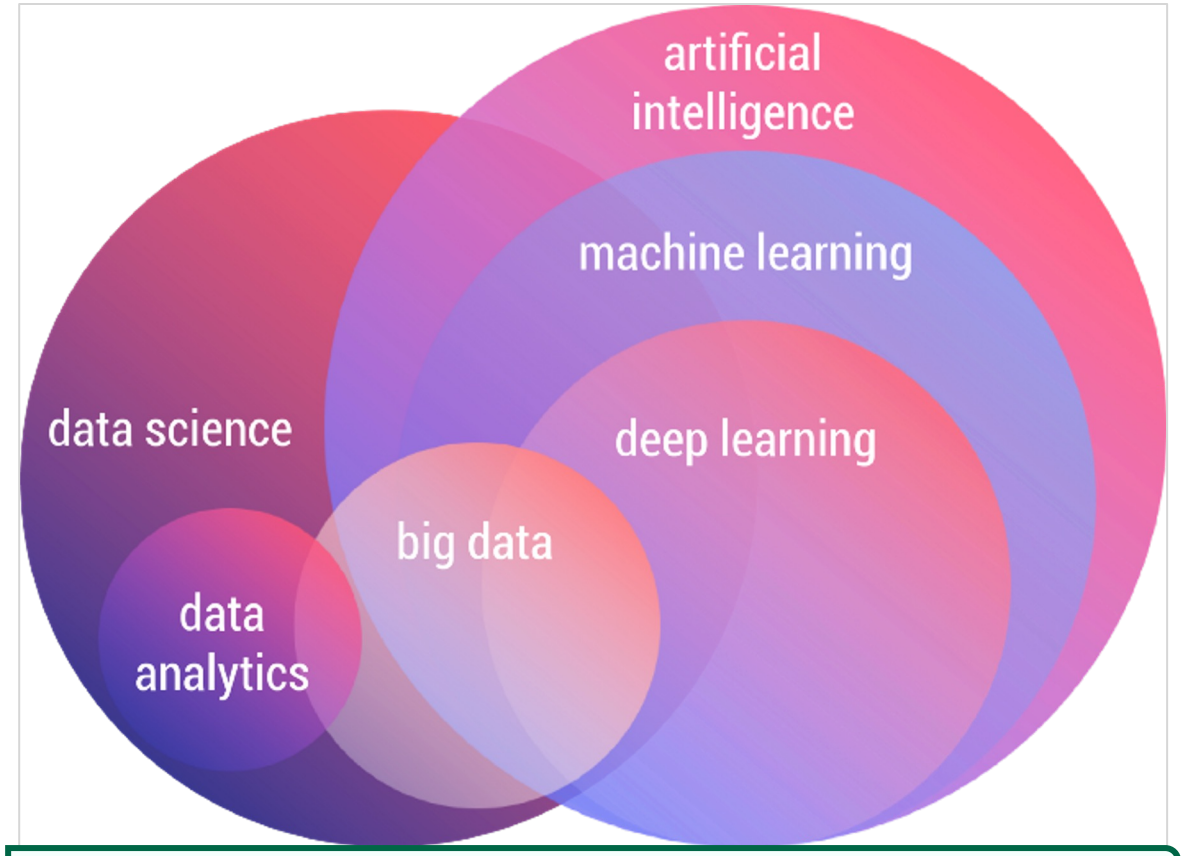
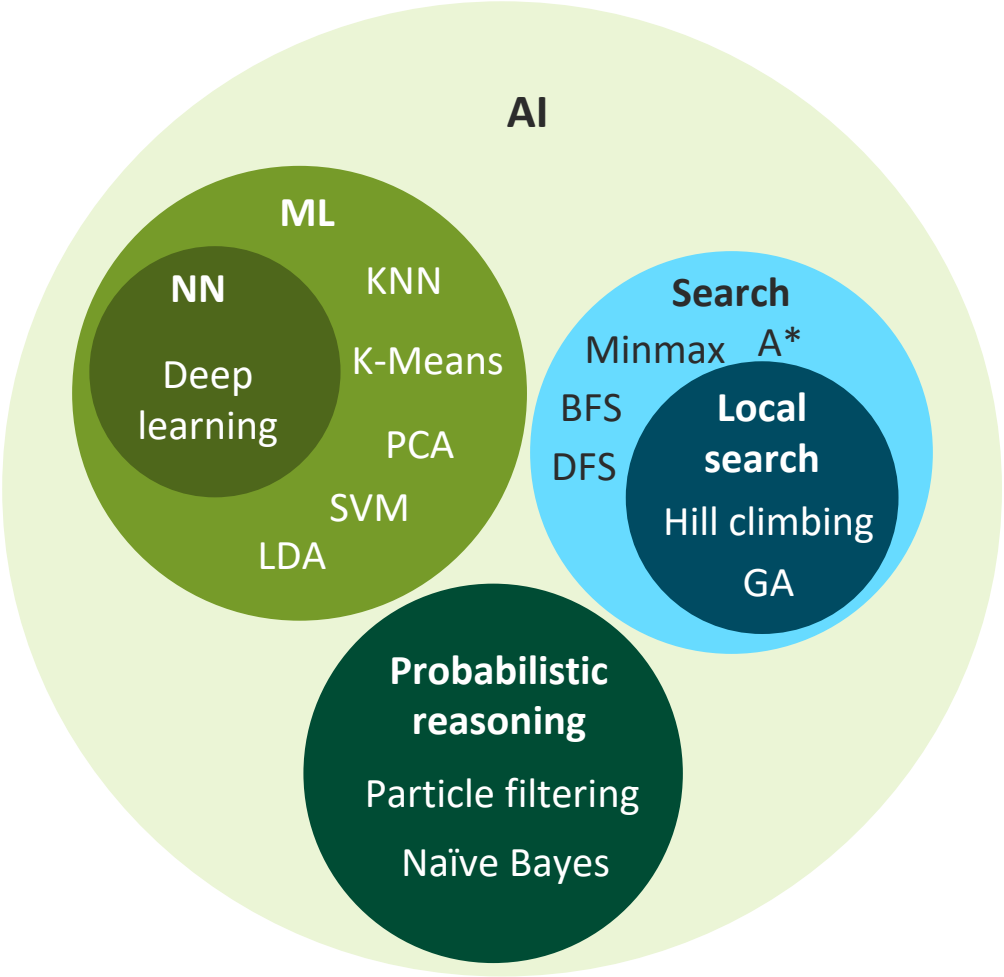


Figure 8. The Taxonomy of Artificial Intelligence and Data Science

Taxonomy


AI
ML
NN
Deep learning
KNN
K-Means
PCA
SVM
LDA
Search
Minmax
A*
BFS
DFS
Local search
Hill climbing
GA
Probabilistic reasoning
Particle filtering
Naïve Bayes

Knowledge Check 3

Which of the following are examples of AI applications?

A List customer trends

B Automated product recommendations

C Word by word translation

D Social media tracking

You have reached the end of the lecture.

Image/Figure Reference

Figure 1. Motor and Sensory Regions of the Cerebral Cortex. Retrieved from: https://en.wikiversity.org/wiki/WikiJournal_of_Medicine/Medical_gallery_of_Blausen_Medical_2014
Figure 2. Multipolar Neuron. https://en.wikipedia.org/wiki/File:Blausen_0657_MultipolarNeuron.png
Figure 3. First Computational Model of Neuron. https://towardsdatascience.com/mcculloch-pitts-model-5fdf65ac5dd1
Figure 4. Marvin Minsky engineered the first known artificial neural network, in which “rats” represented as lights learned to solve a maze. https://www.the-scientist.com/foundations/machine--learning--1951-65792
Figure 5. Playing checkers on the 701. Retrieved from: https://www.ibm.com/ibm/history/ibm100/us/en/icons/ibm700series/impacts/
Figure 6. Perceptron. Retrieved from: https://commons.wikimedia.org/wiki/File:Perceptron_moj.png
Figure 7. The Mark 1 Perceptron. Schuchmann, Sebastian. (2019). Analyzing the Prospect of an Approaching AI Winter. 10.13140/RG.2.2.10932.91524.
Figure 8. The Taxonomy of Artificial Intelligence and Data Science. Retrieved from: https://towardsdatascience.com/4-intersecting-domains-that-you-can-easily-confuse-with-artificial-intelligence-2233cb6ad7d1
Other images were purchased from Gettyimage.