NANYANG POLYTECHNIC

Introduction to AI

The concept of artificial intelligence and why it is important

In May 1997, Deep Blue defeated Kasparov in chess

In 2011, IBM Watson won against two of the best human players in Jeopardy

In March 2016, AlphaGo beat Lee Sedol in Go in a five-game match

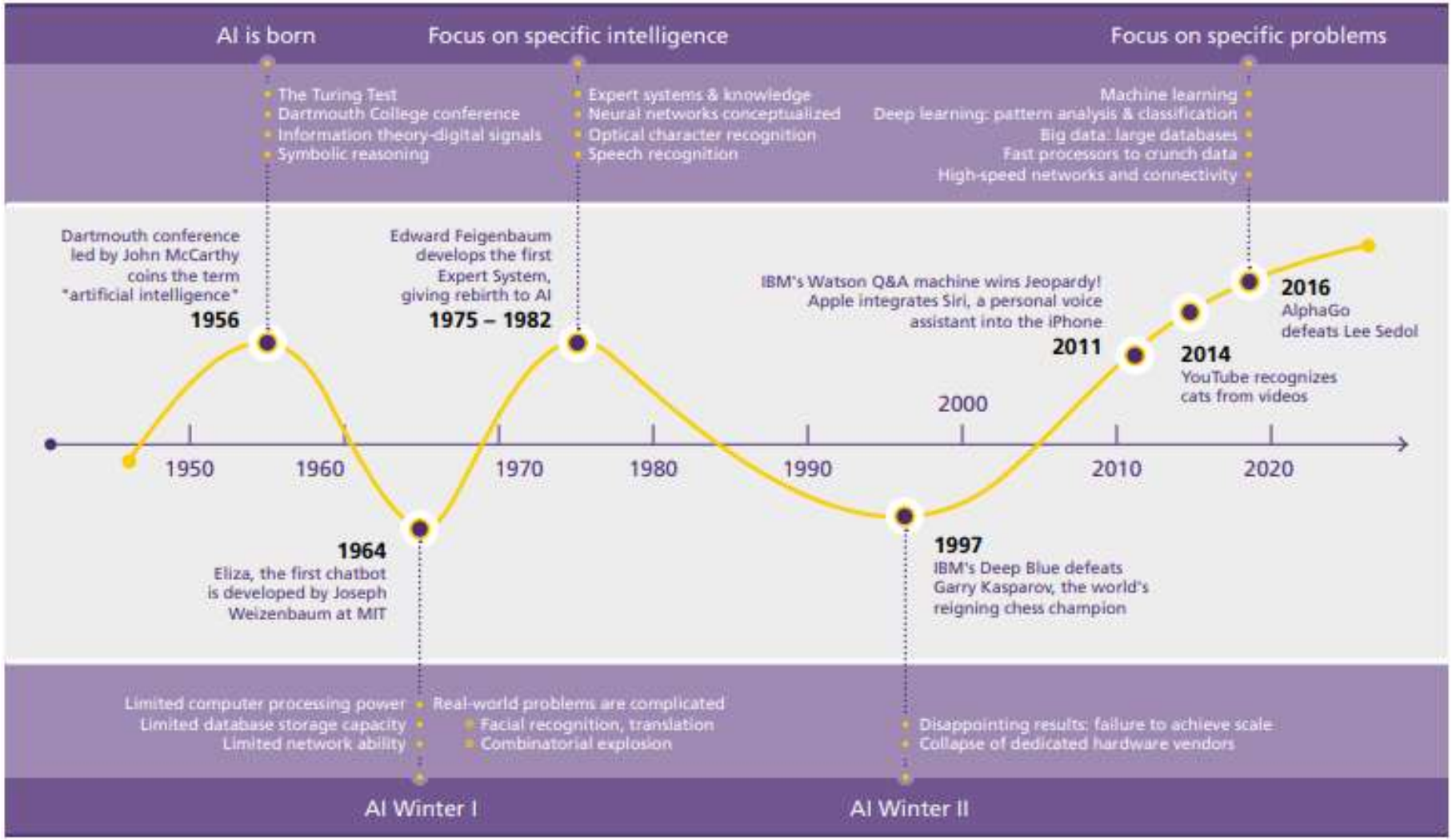


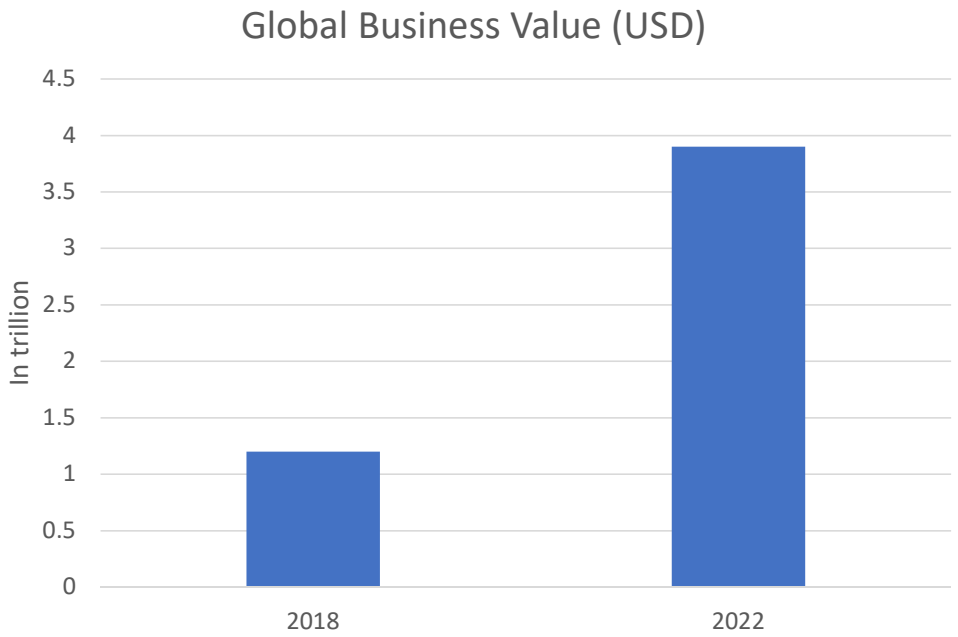
Figure 1: An AI timeline; **Source:** Lavenda, D./Marsden, P.

AI is the new electricity

"Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years"

- Andrew Ng

Projected AI-derived business value



"Global business value derived from artificial intelligence is projected to reach $3.9 trillion in 2022"

Course Overview

- **Introduction to Artificial Intelligence**
- Data Science Foundation
- Essentials of Machine Learning
- Machine Learning Algorithms
- Machine Learning Project

About yourself

- Any programming background?
- Any experience with Python?
- Any mathematics background?

AI – **What does it mean?**

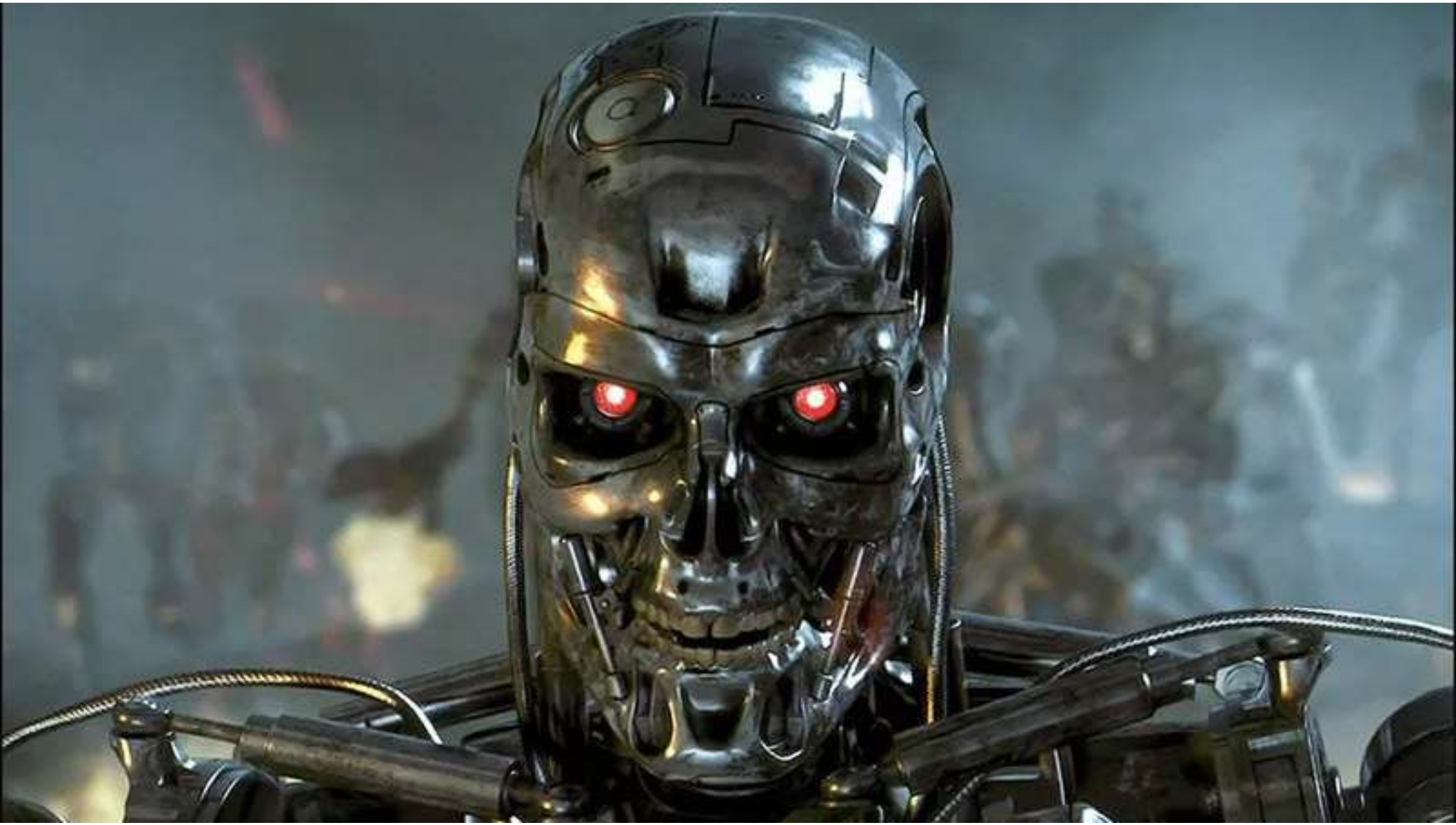
- The science and engineering of making intelligent machines
  - John McCarthy, pioneer in field of AI
- Ability of a computer program or machine to think and learn
- Mimic learning and problem solving associated with the human mind
- Understanding the structure and behaviour of intelligent agents

AI – **What does it mean?**

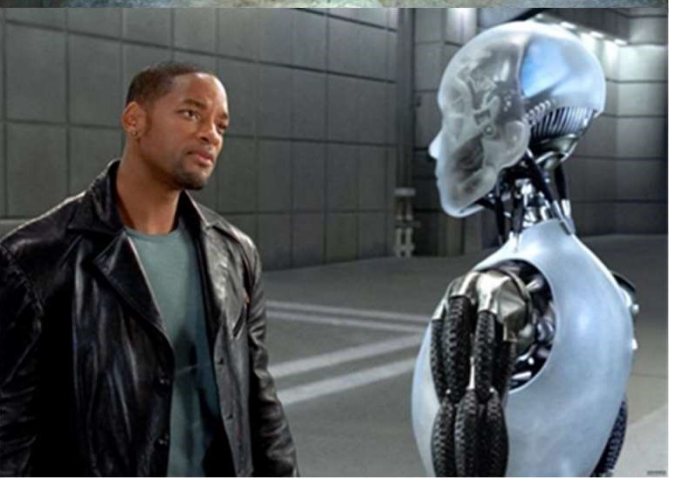
- The science and engineering of making intelligent machines
  - John McCarthy, pioneer in field of AI
- Ability of a computer program or machine to think and learn
  - Wikipedia
- The study of agents that receive percepts from the environment and perform actions
  - Artifical Intelligence: A Modern Approach
- Mimic learning and problem solving associated with the human mind

Intelligence – **Types and Descriptions**

Type of Intelligence	Description
Linguistic	The ability to speak and write
Musical	The ability to create, use and understand sounds
Logical-mathematical	The ability to think conceptually, logically and mathematically
Visual Aesthetic	The ability to think in terms of physical space and perceive spatial information
Bodily-Kinesthetic	The ability to be keenly aware of body movement and control over motor skills
Intra-personal	The ability to be aware of one's own feeling, intention and motivations
Interpersonal	The ability to recognize other people's feelings, belief and intentions



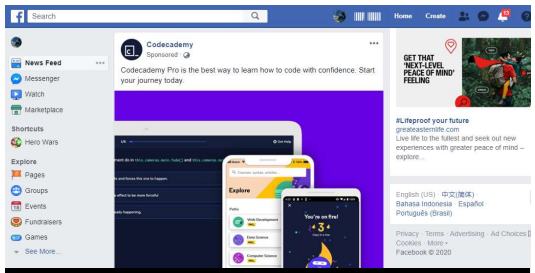
The State of AI



- Long way from achieving **artificial general intelligence**
- Probably not going to see a sentient and conscious robot in the near future
- Current implementations are generally good at a single function with no capability in anything else

Everyday AI

Apple

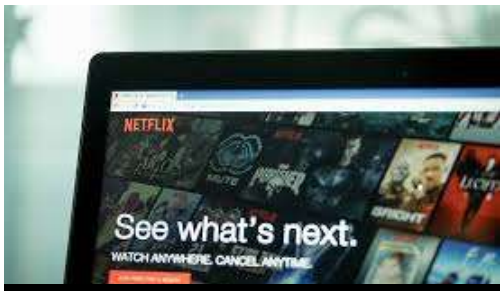


Facebook

Tesla

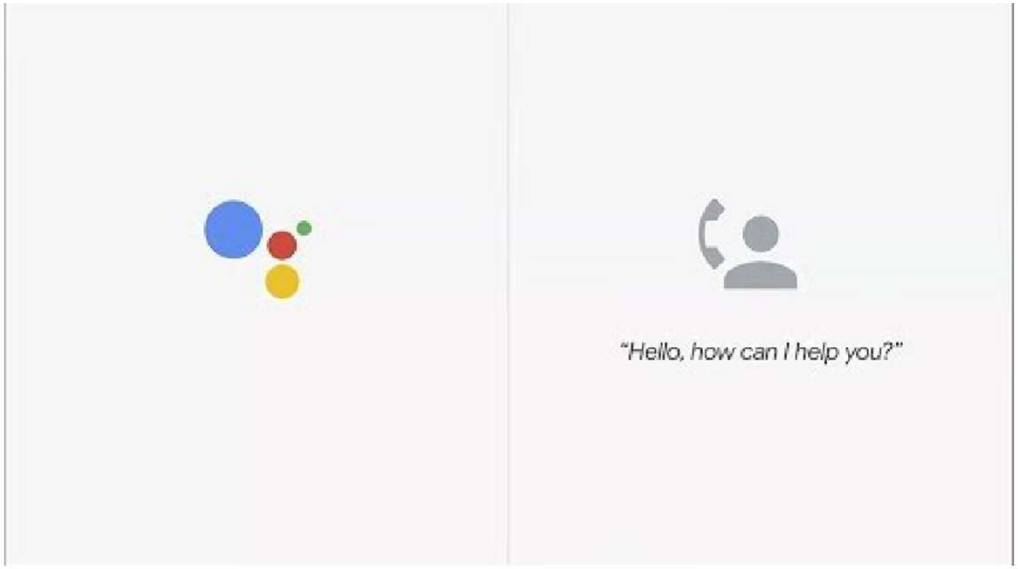
Amazon

Google



Netflix

Google Duplex demo



AI-powered smart glasses

https://www.scmp.com/tech/gear/article/3077122/hangzhou-park-security-uses-ai-powered-smart-glasses-detect-people-fever

Levels of AI

Artificial Narrow Intelligence (ANI)

- designed and trained for a particular task
- natural language processing, speech and image recognition, and self-driving
- Examples: Virtual personal assistants, such as Apple's Siri

Artificial General Intelligence (AGI)

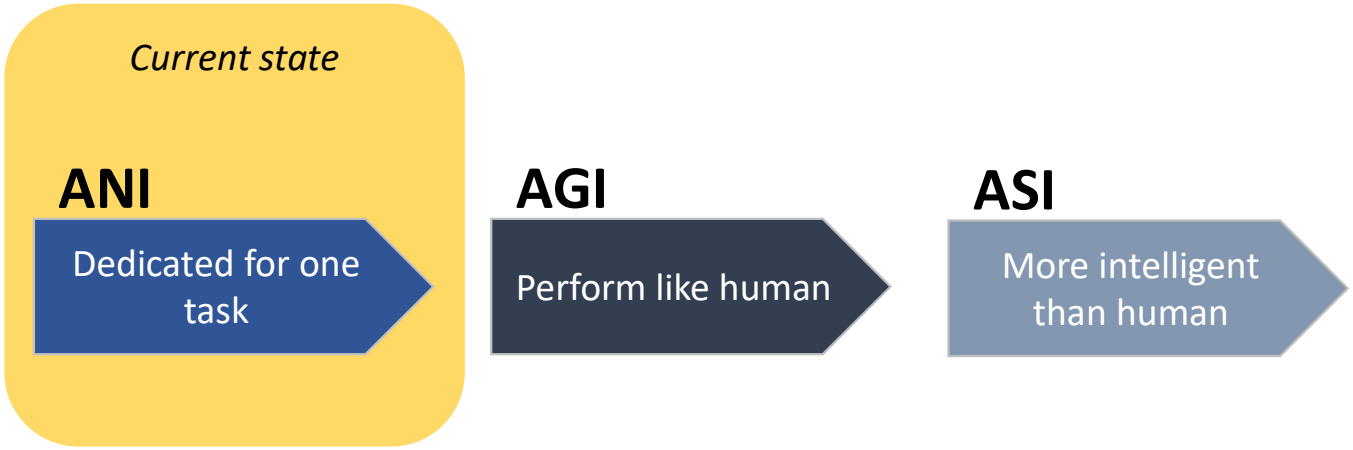
- generalized human cognitive abilities
- when presented with an unfamiliar task, it has enough intelligence to find a solution.
  - earning university degrees
  - convincing humans that it is human.

Explore the Turing Test (determine if a computer can think like a human) and how proposals over the years are made on determining the intelligence of a computer

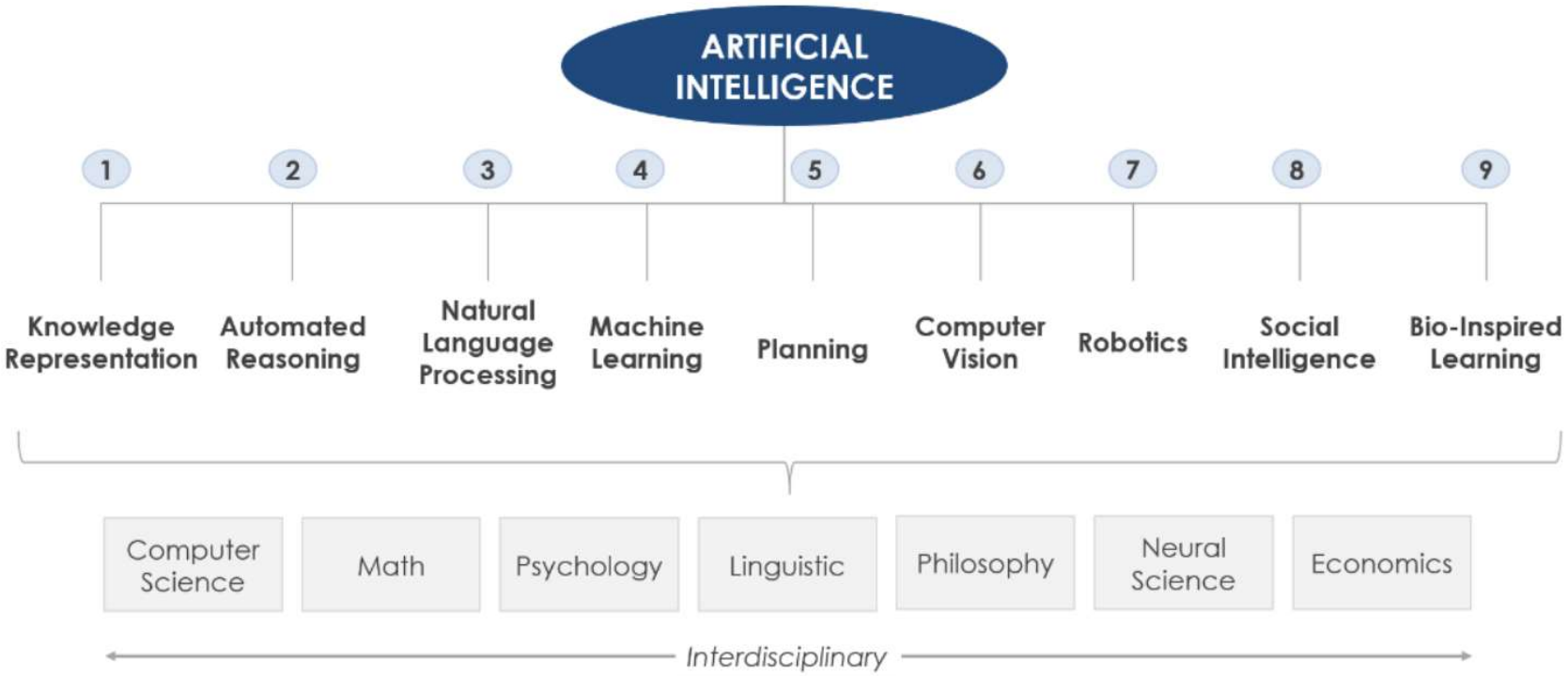
Levels of AI

Artificial Super Intelligence (ASI)

- Demonstrates intelligence beyond human capabilities
- May outperform humans, help to achieve societal objectives or threaten human race



Branches of AI

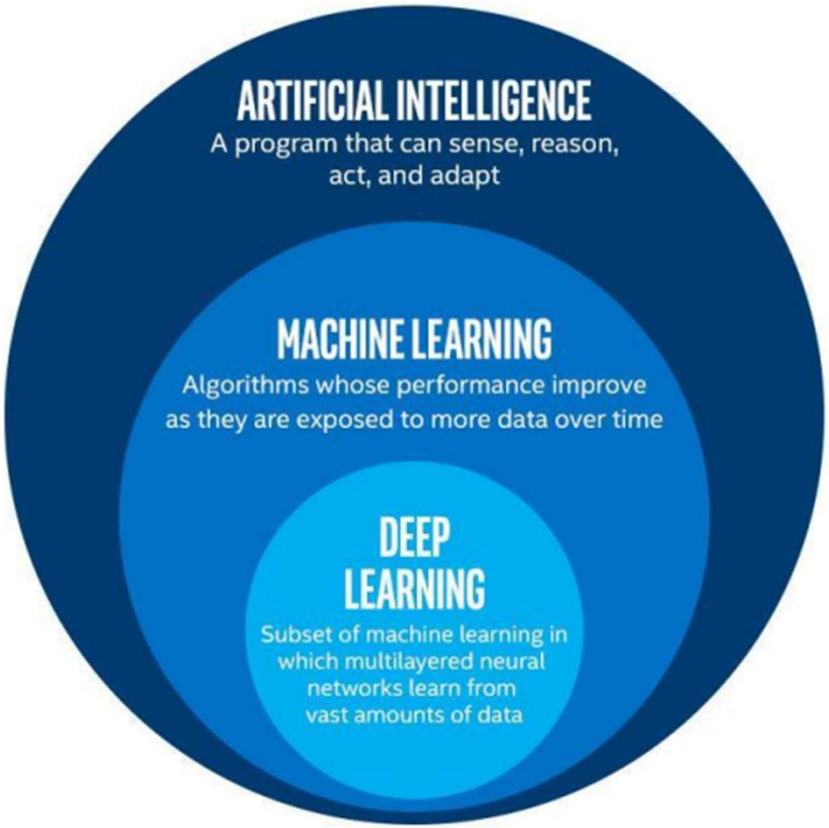


Source: Adaptation of Taiger Presentation Slide at IMDA AI workshop, May 2018

Machine Learning and Deep Learning

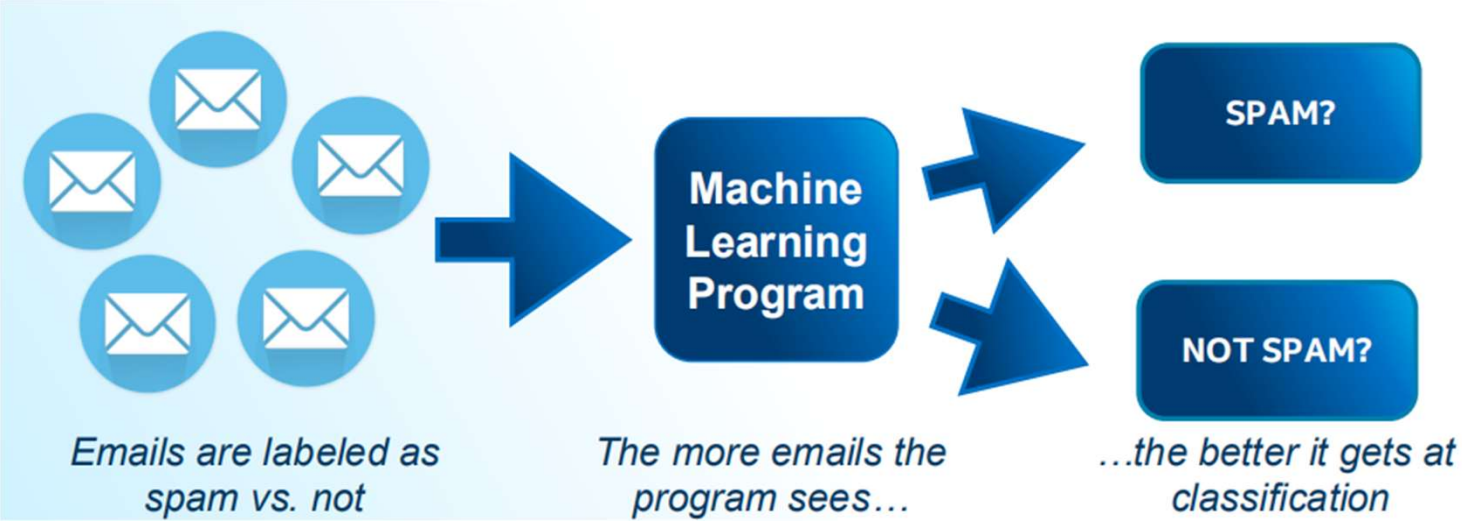
- Machine Learning
  - Consists of techniques that enable computers to figure out patterns from the data to make decisions or predictions
  - No explicit programming to perform task
- Deep Learning
  - Solve complex problem using complicated models called “deep neural networks”

Models determine best representation of original data; in classic machine learning, humans must do this.



Machine learning

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



Machine learning

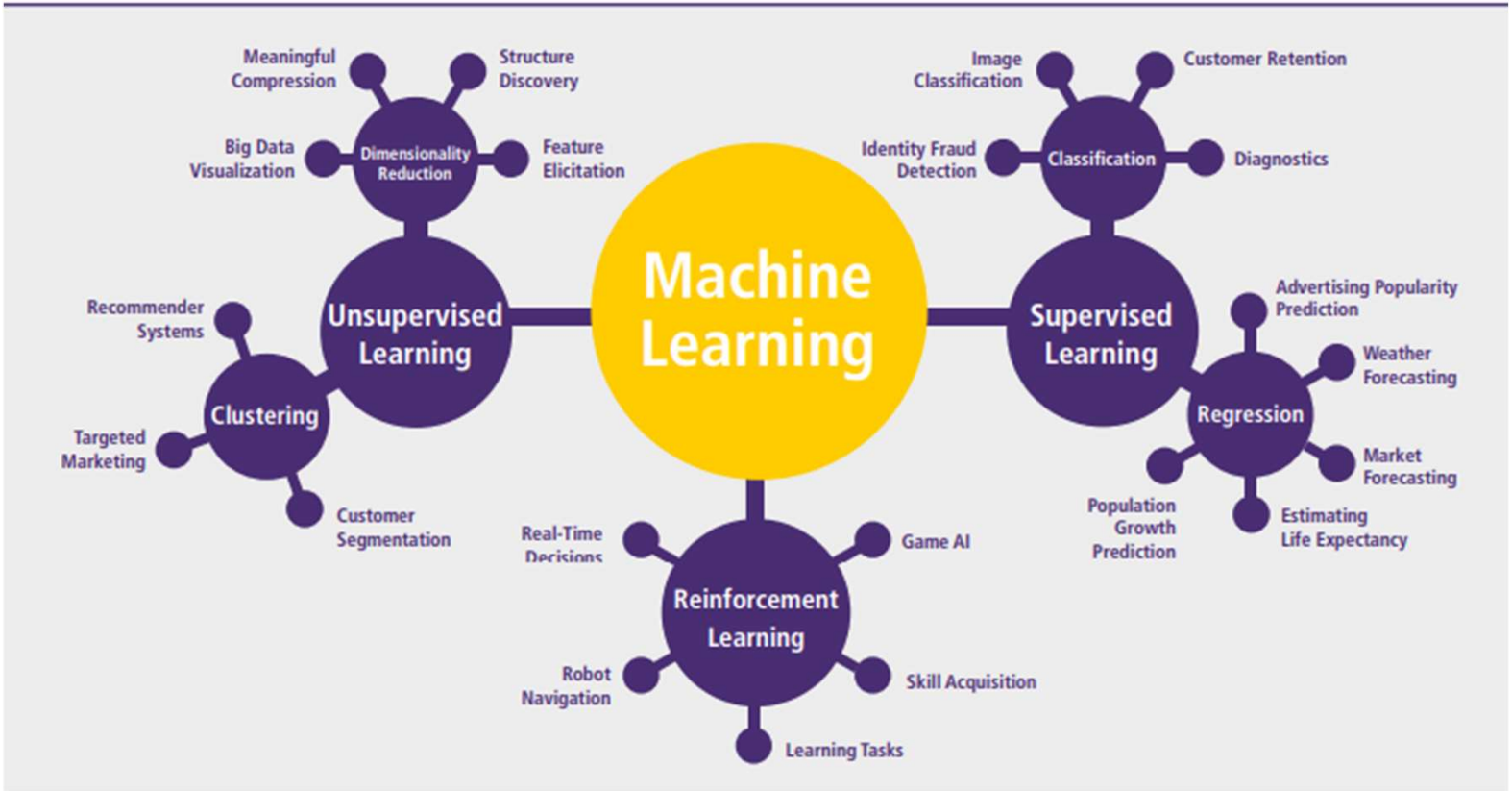
This example is learning to classify a species from a set of measurement features.

Features:
Attributes of the data.

Target:
Column to be predicted.

sepal length	sepal width	petal length	petal width	species
6.7	3.0	[illegible]	2.3	virginica
6.4	2.8	5.6	2.1	virginica
4.6	3.4	1.4	0.3	setosa
6.9	3.1	4.9	1.5	versicolor
4.4	2.9	1.4	0.2	setosa
4.8	3.0	1.4	0.1	setosa
5.9	3.0	5.1	1.8	virginica
5.4	3.9	1.3	0.4	setosa
4.9	3.0	1.4	0.2	setosa
5.4	3.4	1.7	0.2	setosa

Machine learning



Machine learning

Suppose you wanted to identify fraudulent credit card transaction.

You could define the features to be:

- Transaction time
- Transaction amount
- Transaction location
- Category of purchase

The algorithm could learn what feature combinations suggest unusual activity.

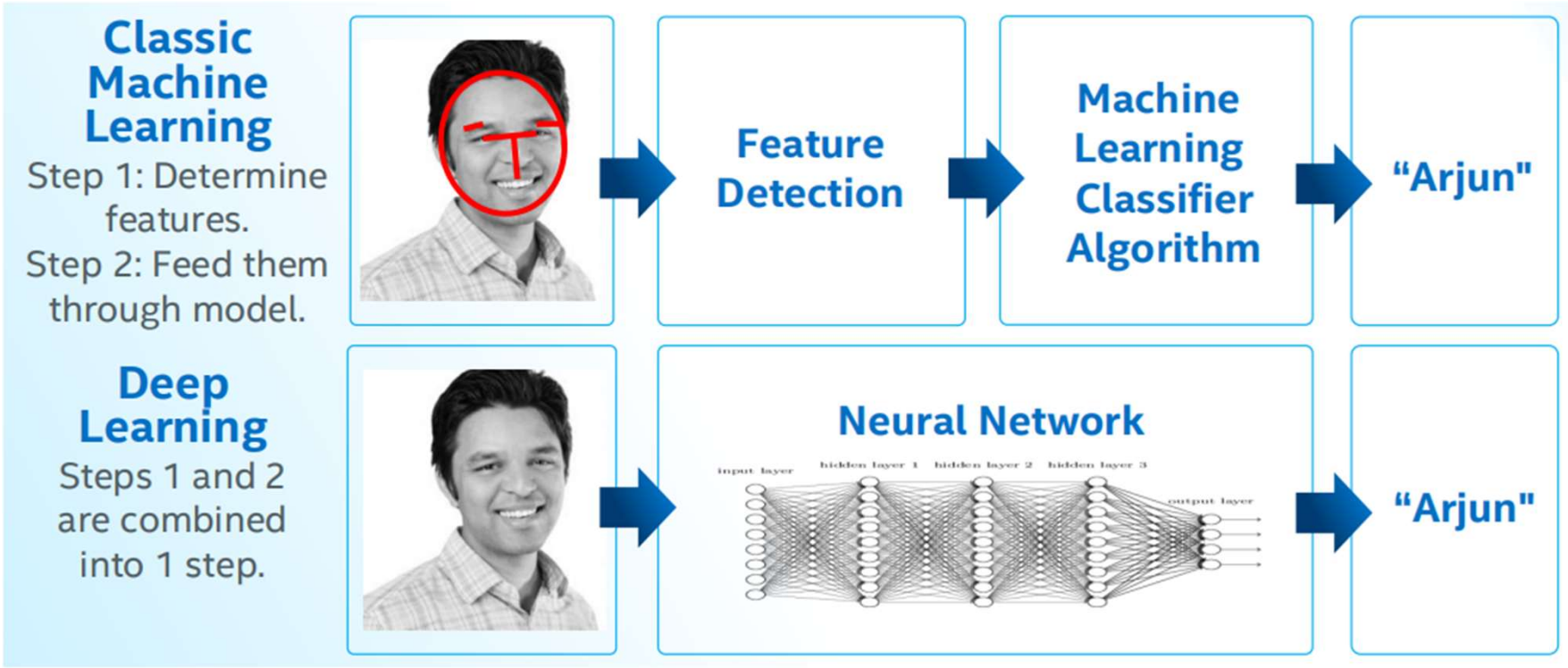
Machine learning limitations

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.

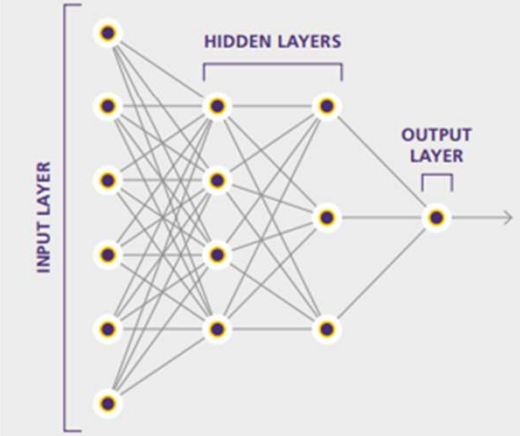
Dog and cat recognition

Deep learning



Deep learning

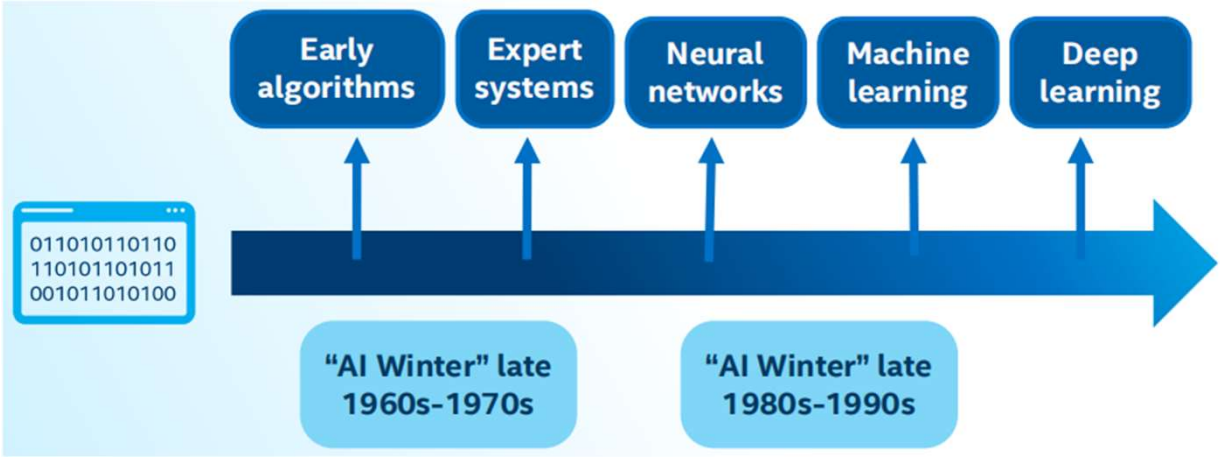
- Deep learning (Neural Network)
  - Modelling human neuron
  - Stacking of small algorithmic components (not models)
  - Modelling of functions of functions instead of a single function
    - It reduces with the complexity of fitting data in super-high-dimensional space
    - It is a best fit for multi-core, multi-processor environment



Problem Type	Inputs	Hidden Layers	Output
Image Recognition	Picture(s)	Person? Face? Gender? Age? Hair & eye color?	Is it you? (%)
Loan Approval	Loan application	Income? Credit history? Employment? Marital status?	Will you repay? (%)
Online Ad Placement	Social media profile, browsing history	Demographics? Browsing history metadata	Will you click? (%)

Evolution of AI (self-reading)

- The field of AI has experienced several hype cycles, where it has fluctuated between periods of excitement and disappointment



Evolution of AI (self-reading)

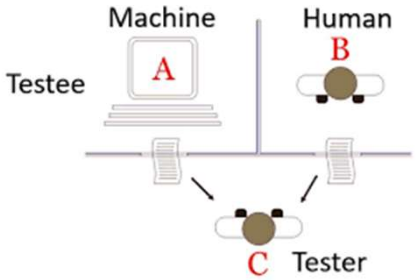
1950s: Early AI

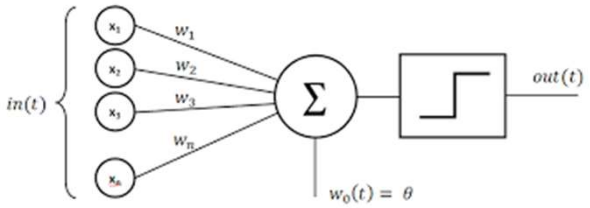
• 1950: Alan Turing developed the Turing test to test a machines ability to exhibit intelligent behavior.

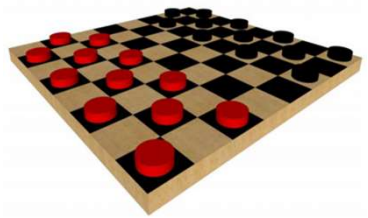
• 1956: Artificial Intelligence was accepted as a field at the Dartmouth Conference.

• 1957: Frank Rosenblatt invented the perceptron algorithm. This was the precursor to modern neural networks.

• 1959: Arthur Samuel published an algorithm for a checkers program using machine learning.







Evolution of AI (self-reading)

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.”

Evolution of AI (self-reading)

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.

Evolution of AI (self-reading)

The Second "AI Winter" (later 1980's – early 1990's)

- 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.

Evolution of AI (self-reading)

Classical Machine Learning (Late 1990's to early 2000's)

- Advancements in the SVM algorithm led to it becoming the machine learning method of choice.
- AI solutions had successes in speech recognition, medical diagnosis, robotics, and many other areas.
- AI algorithms were integrated into larger systems and became useful throughout industry.
- The Deep Blue chess system beat world chess champion Garry Kasparov.
- Google search engine launched using artificial intelligence technology.

Evolution of AI (self-reading)

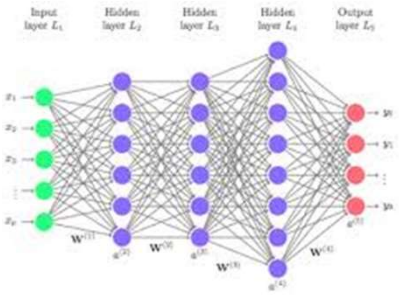
Rise of Deep Learning (2006 – current)

• 2006: Geoffrey Hinton publishes a paper on unsupervised pre-training that allowed deeper neural networks to be trained.

• Neural networks are rebranded to deep learning.

• 2009: The ImageNet database of human-tagged images is presented at the CVPR conference.

• 2010: Algorithms compete on several visual recognition tasks at the first ImageNet competition.



Summary

- Understand the definition of Artificial Intelligence (AI)
- Understand the levels and types of AI
- Understand the evolution of AI