Artificial Intelligence III:
Artificial Intelligence and Deep Learning

Lecture 1

Introduction

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Artificial Intelligence (AI)

- AI was usually found in the Hollywood Movie's world

Artificial Intelligence

Avengers: Age of Ultrons

The Terminator

Alita: Battle Angel

iRobot

Artificial Intelligence Era

- AI is everywhere now!

Recommender System

LLM

SORA

Live Filter

Apple Intelligence

Robot Dog

Humanoid Robot

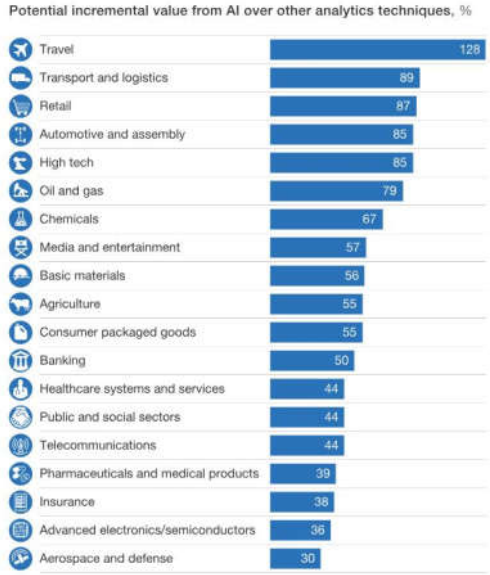
Delivery Robot

Healthcare Robot

Autonomous Driving

AI Impact

- Companies invested **USD 26 - 39B** in AI in 2016
- AI created **USD 3.5-5.8T** in value annually in 2018



ARTIFICIAL INTELLIGENCE THE NEXT DIGITAL FRONTIER?
https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning

Artificial Intelligence Era

- Sophia, made by Hanson Robotics (2017)
- World's 1st robot citizen in Saudi Arabia

AI Impact

AlphaGo


Ke Jie
(3 – 0)


Sedol Lee
(4 – 1)

2017

AlphaGo Zero
without using data from human games,
and stronger than any previous version

DeepMind

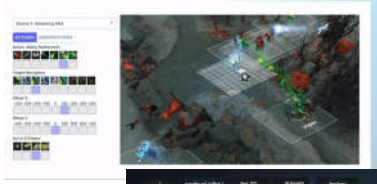
https://en.wikipedia.org/wiki/AlphaGo
https://deepmind.com/

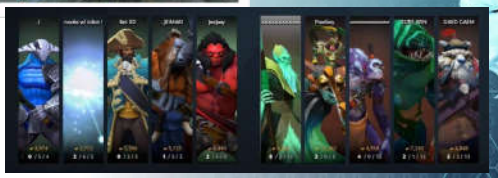
AI Impact

OpenAI Five (2018)
Dota 2 Bot

OpenAI

Defeat the professional team twice
99.4% win in 42,729 matches with public players





AI Impact

IBM: Project Debater (2019)

"We should subsidize preschool."
- Project Debater (Agree)
- Harish Natarajan (Disagree)

15 mins	Preparation
4 mins	Opening statement
4 mins	Rebuttal
2 mins	Summary

Poll	Agree	Disagree	Undecided
Before	79%	13%	8%
After	62% **(-17%)**	30% **(+17%)**	8%

58%: Project Debater better enriched their knowledge about the topic compared to Harish's 20%

AI Impact

OpenAI: ChatGPT (2022)

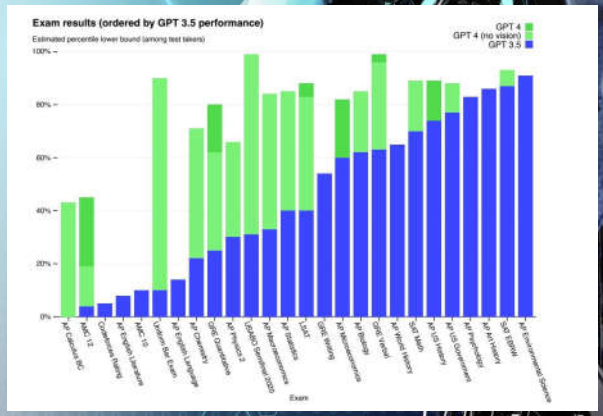
- Chat with images, voice and create images
- Understanding: Summary, extraction, expansion
- Translation
- Programming

Large Language Model

Replace the equivalent of 300 million full-time jobs

"ChatGPT is scary good, we are not far from dangerously strong AI.“ by Elon Musk

OpenAI



https://openai.com/chatgpt

AI Impact

OpenAI: Sora (2024)

OpenAI

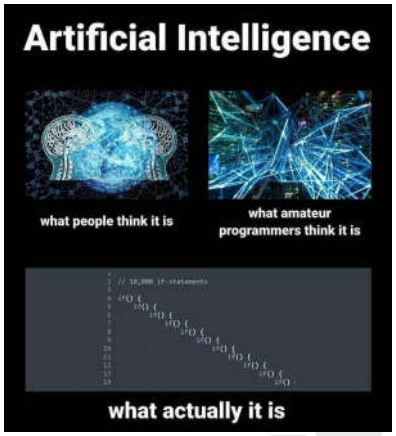
Historical footage of California during the gold rush

A close up view of a glass sphere that has a zen garden within it. There is a small dwarf in the sphere who is raking the zen garden and creating patterns in the sand.

https://openai.com/sora

About this course

- In this course, you are expected to
  - Grasp Core AI Concepts
  - Apply Basic AI Tools
  - Appreciate AI
- NOT Aim
  - Mathematics Proof
  - Understand all the detail and rationales



What is Intelligence?

- Intelligence
  - Different meaning to different people
  - Culture and situation specific
- “Intelligence”, your **first impression?**

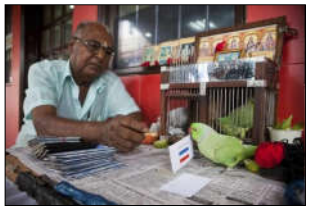
When does human intelligence begin?

- Human is intelligent, but begins at **when**?
  - After graduation?
  - 5 years old?
  - 6 months old?
  - Before birth?



Do Animals have Intelligence?







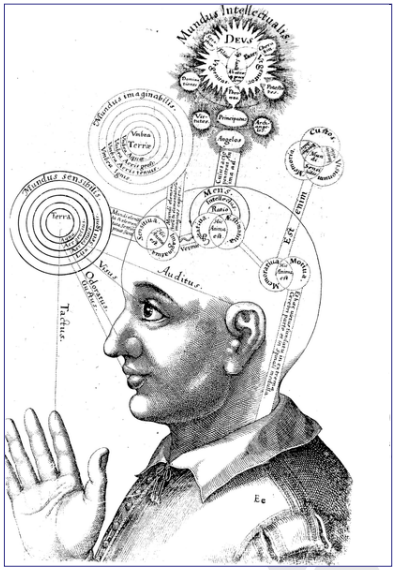


General Discussion

- **Different in degrees**
  - More / Less intelligent
- **Intelligence is relative**
  - Intelligence test score 100 is the average of all people currently
- **Different aspects**
  - Memory
  - Learning
  - Thinking
  - Language
  - Creativity
  - Emotion
  - Perceptual Abilities
  - Motor Abilities

Views from Psychology Experts

- In 1921, the Journal of Educational Psychology asked 14 leading experts in the field to **define intelligence**

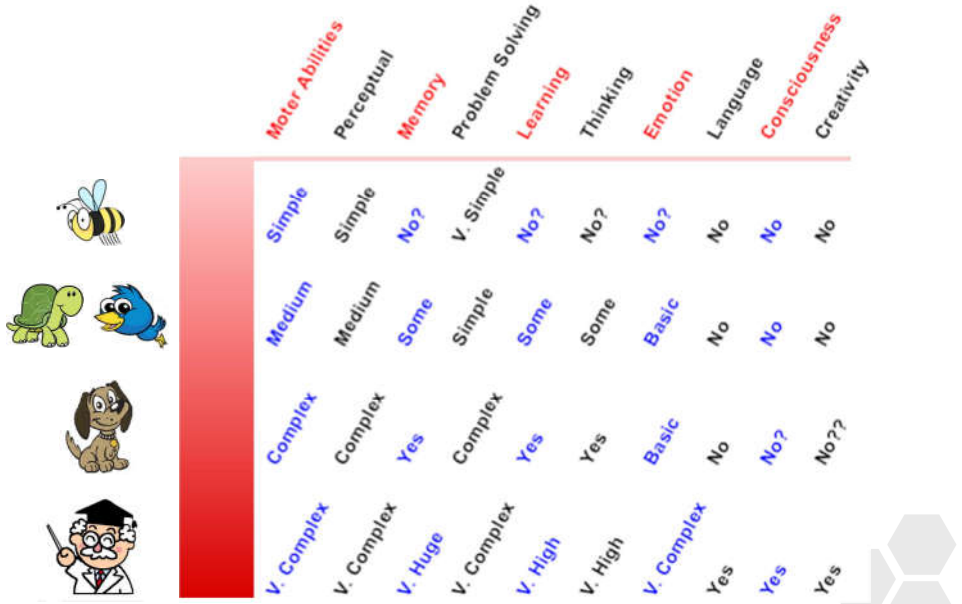


What is Intelligence?
Views from Psychology Experts

- Here are some of them
  - The ability to carry on **abstract thinking** (L. M. Terman)
  - Having learned or **ability to learn** to adjust oneself to the environment (S. S. Colvin)
  - The **ability to adapt** oneself adequately to relatively new situation in life (R. Pintner)
  - The **capacity to acquire capacity** (H. Woodrow)
  - The **capacity to learn to profit** by experience (W. F. Dearborn)
- Most of them hold that intelligence is the ability to solve a problem

Rolf Pfeifer, Christian Scheier, "Understanding Intelligence", MIT Press, 1999

What is Intelligence?
Summary



Artificial Intelligence (AI)

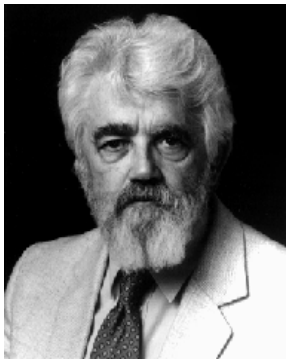
- A computer has human intelligence
  - Solve the problem by themselves

Artificial Intelligence (AI)

- **Automation**
  - Completely relieve human beings of repetitive or dangerous tasks
  - Undertake intelligent analysis of huge amount of information
- **Enrich entertainment**
  - animation, digital camera & TV
- **User-Friendly**
  - Aware of users' needs

AI Development

- AI started from **1956**, coined by American computer scientist John McCarthy
- "Long" history of development



Can AI become HI?

- How to evaluate an intelligent computer (machine intelligence)?
  - The most famous method is called ***Turing Test***
  - This test was invented by Alan M. Turing
    - English mathematician, logician and cryptographer
    - 1912-1954

Can AI become HI?

Turing Test

- Two contestants: Machine and Human
- A human judge will talk with the two contestants and decide which is human, and which is machine
- To keep it fair, the conversation is usually text-based, (like instant messaging service)
- If the judge is less than 50% accurate, the computer passes the test

Can AI become HI?

Turing Test

- Many algorithms achieves satisfying results in chatting with human
  - Old generation: Cortana, Siri, Google Now, Blackberry Assistant
  - Now: LLM based assistants
- Do they really understand you?
- Are they really intelligent?

Turing Test: Digger wasp

- When the female wasp brings food to her burrow, she deposits it on the threshold, goes inside the burrow to check for intruders, and then if the burrow is clear, the wasp brings in the food
- Is this behavior **intelligent**?

Turing Test: Digger wasp

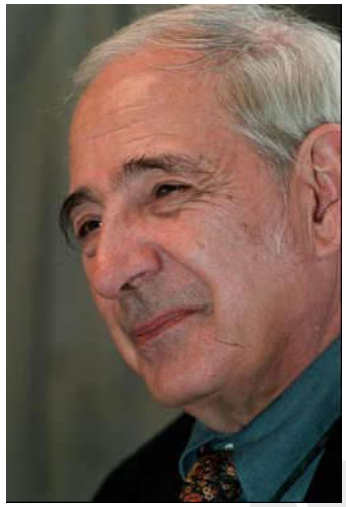
- If the experimenter moves the food away from burrow while the wasp is inside the burrow checking, what will happen?
- The wasp repeats the entire procedure again and she can be made to repeat this cycle of behavior forty times
- Obviously, it is a meaningless rule-based action
- Is the wasp as **intelligent** as you think?

Turing Test

- "Look intelligent" means real intelligence?
- **Maillardet's Automaton** (Henri Malliardet, 1805)
  - Draw several complex images

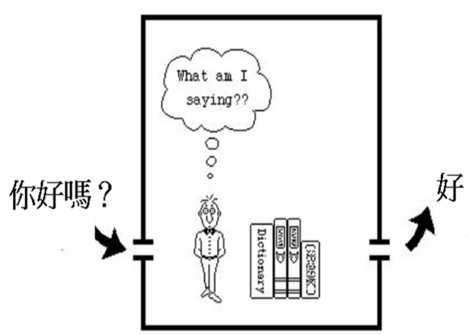
The Chinese Room

- In 1980, American philosopher **John Searle** argued convincingly that a computer can never be truly intelligent even it passes the Turing test because it is never able to understand anything
- He illustrated the argument using "**the Chinese Room**"



The Chinese Room

- Searle placed himself in an imaginary locked room
- Through a slot in the door of the room, he was fed a Chinese question
- He passed out the correct answer in response to the question, by following a complex set of instructions
- It appeared to people outside the room that he understood Chinese but he didn't!



The Chinese Room

- Searle claims that two kinds of AI
  - **Weak AI**
    - Perform tasks similar to what human will do
    - No understanding behind the task
      - e.g., emotion, rationale, motivation, background
  - **Strong AI**
    - Able to think and possess understanding (a mind)
    - Searle claims that strong AI is impossible

Specific Problems

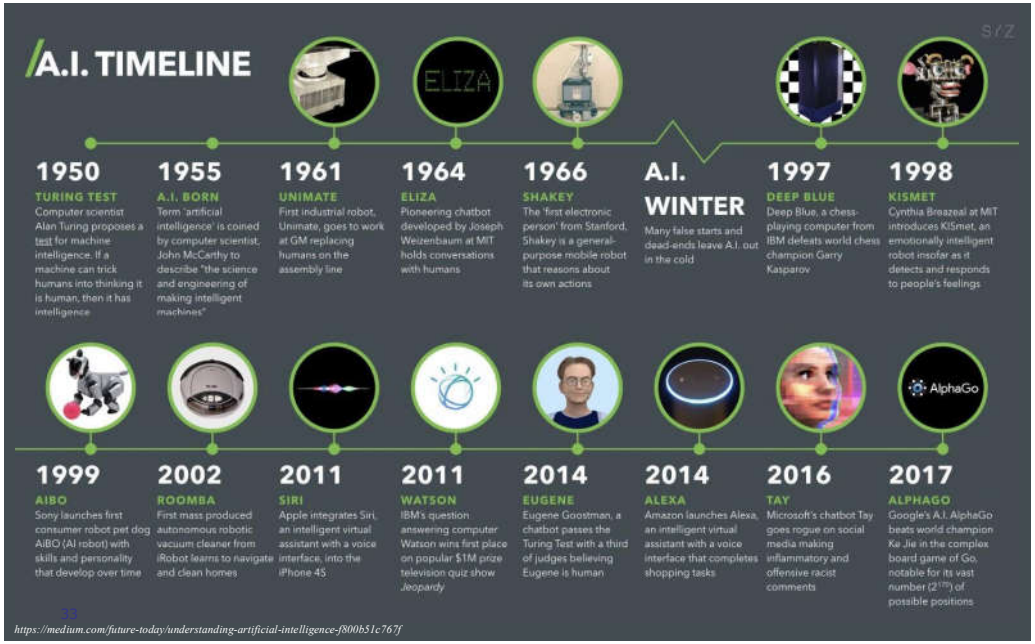
- Handling general tasks not easy for AI
- Smaller problems are more achievable
  - E.g. hand-writing recognition and game-playing
- Outcomes:
  - Optimal: Not possible to perform any better
  - Strong super-human: Performs better than all humans
  - Super-human: Performs better than most humans
  - Par-human: Performs similarly to most humans
  - Sub-human: Performs worse than most humans

http://en.wikipedia.org/wiki/Progress_in_artificial_intelligence

Can AI become HI?

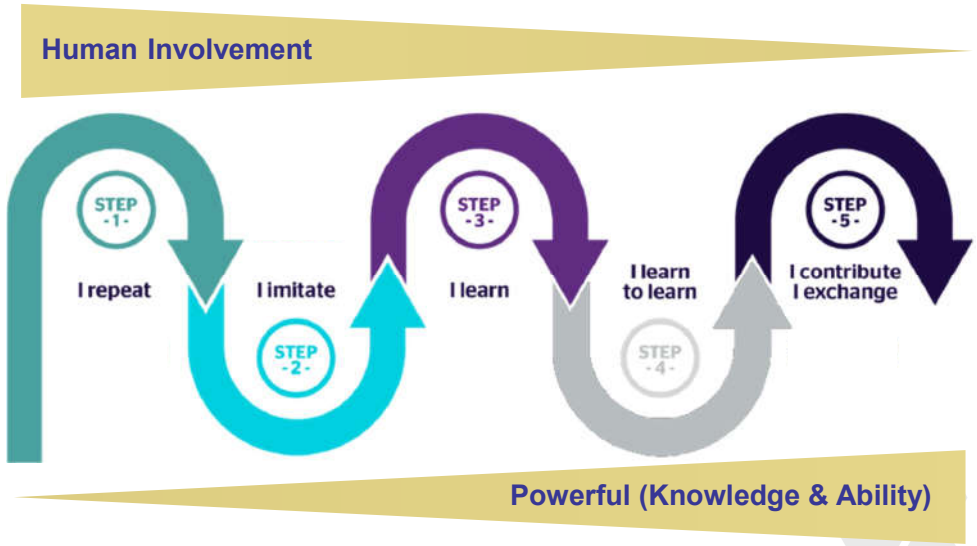
- In **Weak AI** sense, **Yes**
  - Act like human
  - Useful computer systems to solve specific task
  - Some successful results have been achieved
- In **Strong AI** sense, **maybe…**
  - Think like human
  - Artificial minds
  - The debate is still raging on

AI Development



https://medium.com/future-today/understanding-artificial-intelligence-f800b51c767f

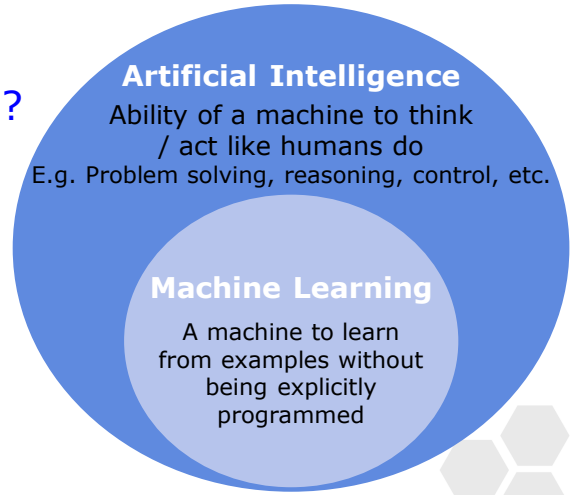
AI Development



https://atos.net/en/artificial-intelligence

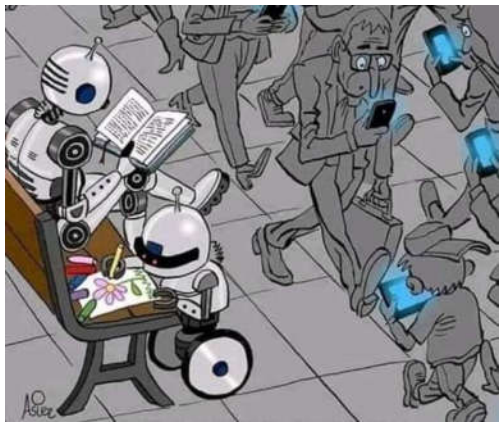
AI vs Machine Learning (ML)

- ML is powerful but not suitable for all applications
- Everything can learn from data??

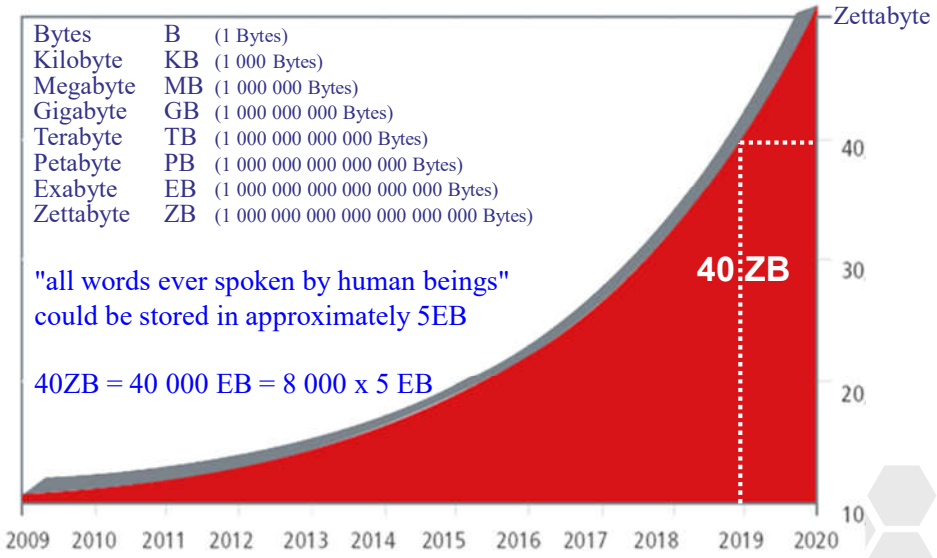


Machine Learning

- What if a machine can learn…



Plenty of Data



Source: International Data Corporation

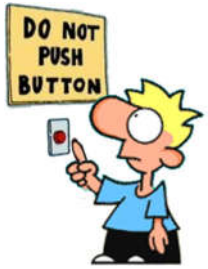
Plenty of Data

- The Internet provides **a platform for Big Data**
  - Collection
  - Storage
  - Sharing
  - Processing

Machine Learning

Supervised Learning
Correct / Wrong

Unsupervised Learning
No ground truth



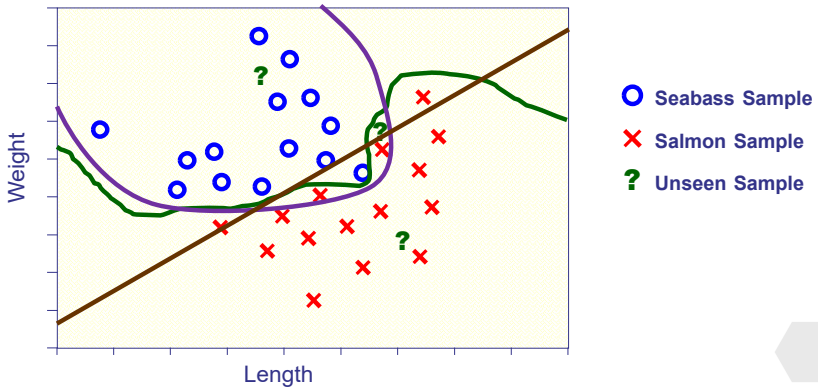
Reinforcement Learning
Learn from reward

Supervised Learning

- Ground truth (desired output) is provided
- A sample (x, y)
  - x: a feature vector
  - y: a desired output (e.g. label, value, …)
- Learn the mapping between x and y
- Predict y for an unseen x
- Error can be measured explicitly

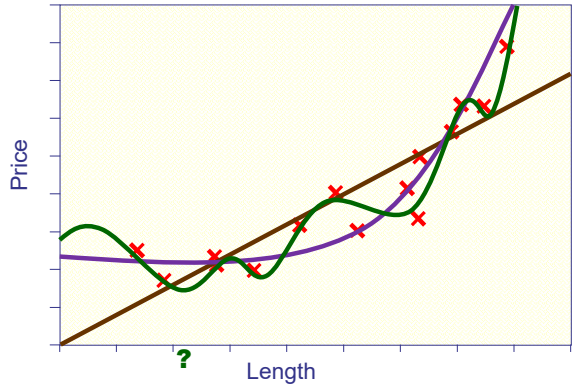
Supervised Learning

- **Classification**
  - y is a label of the sample
  - E.g. x = (Length, Weight)
    y = Seabass or Salmon



Supervised Learning

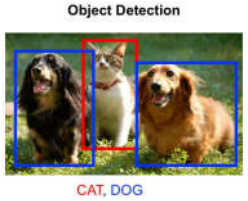
- **Regression**
  - y is a real number
  - E.g. x = (Length)
    y = Price of a fish



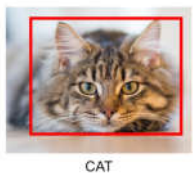
Supervised Learning

- Example

Class
(Classification)



For each bounding box
- Size and Coordination
(Regression)
- Class
(Classification)



A bounding box
- Size and Coordination
(Regression)
- Class
(Classification)

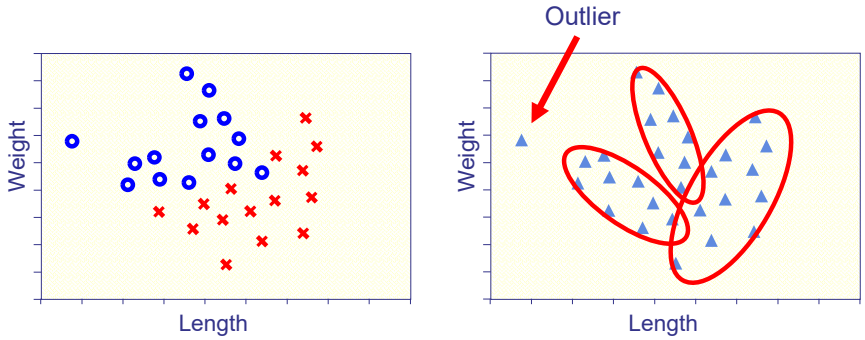
For each bounding box
- Size and Coordination
(Regression)
- Class
(Classification)
- Which pixel is background?
(Classification)

Unsupervised Learning

- Only x is available
- No desired output (y) is given
- Find relation/structure/speciality of data
- Never know how good your results are
  - Evaluation base on an assumption

Unsupervised Learning

- Clustering
- Outlier Detection

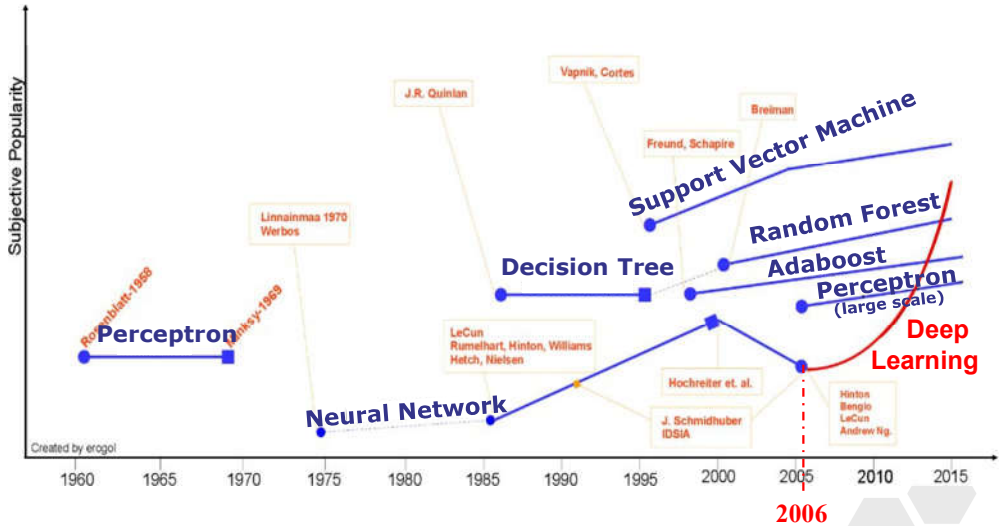


With labelled information **Without labelled information**

Unsupervised Learning

- Example: Customer Segmentation

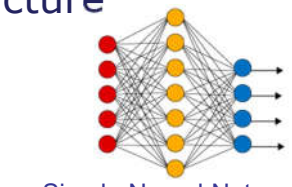
Deep Learning



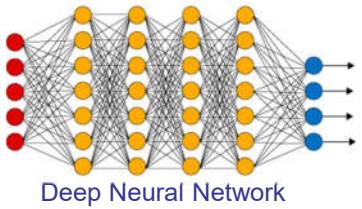
http://www.erogol.com/brief-history-machine-learning/

Deep Learning

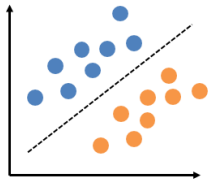
- Deep Learning, means Artificial Neural Network with a deep structure

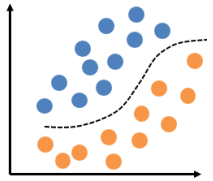


Simple Neural Network



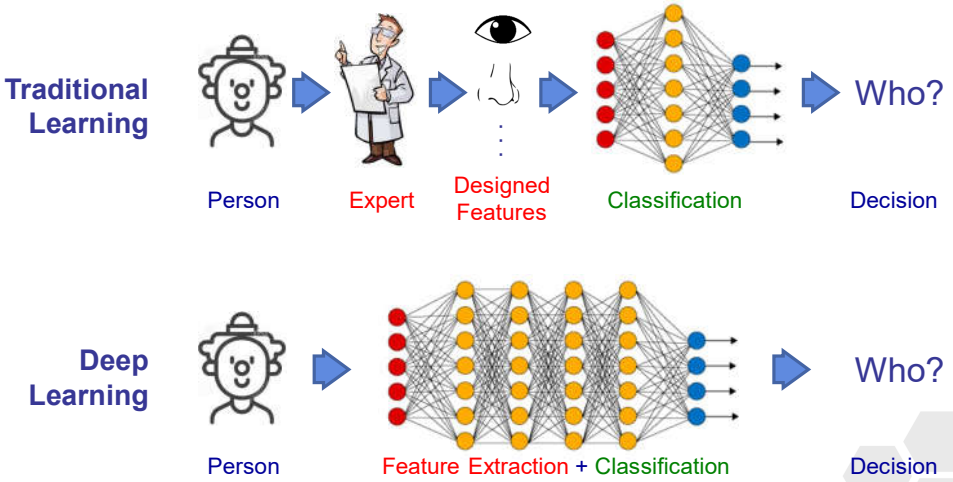
Deep Neural Network





Deep Learning

- Features does not rely on experts anymore



Future AI

Strong AI?

Future AI

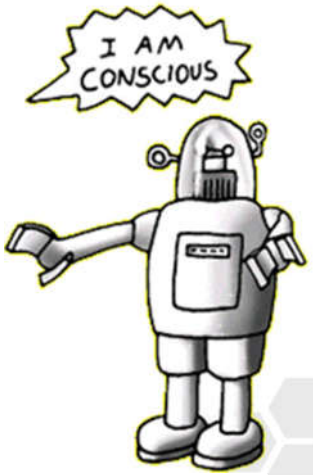
Strong AI?

- Is LLM beneficial for students and humanity?

Future AI

Strong AI?

- Success of LLM alerts us that the strong AI is coming soon



- Who is responsible for the decisions made by AI?
- Is ethics part of our consideration when dealing with AI?
- Will it be controllable?
- Is it good for human?

Is AI Irreversible Trend?

- When and where is this education?

Her parents too poor?

No TV game?

No multi-media?

Only pencil and paper?

Boys doing sewing?

How can they earn a living?

Is AI Irreversible Trend?

- Waldorf School of the Peninsula in California Silicon Valley
  - 75% of the school parents are managers or executives from Silicon Valley Hi Tech companies

Is AI Irreversible Trend?

- Bill Gates didn't let his children get a cell phone until they reached 14
- Steve Jobs won't let his kids use iPad
- How about us?