Machine Learning with Python

Introduction to ML (Part1)

Dr. Aeshah Alsughayyir

Collage of Computer Science and Engineering

Taibah University

2021-2022

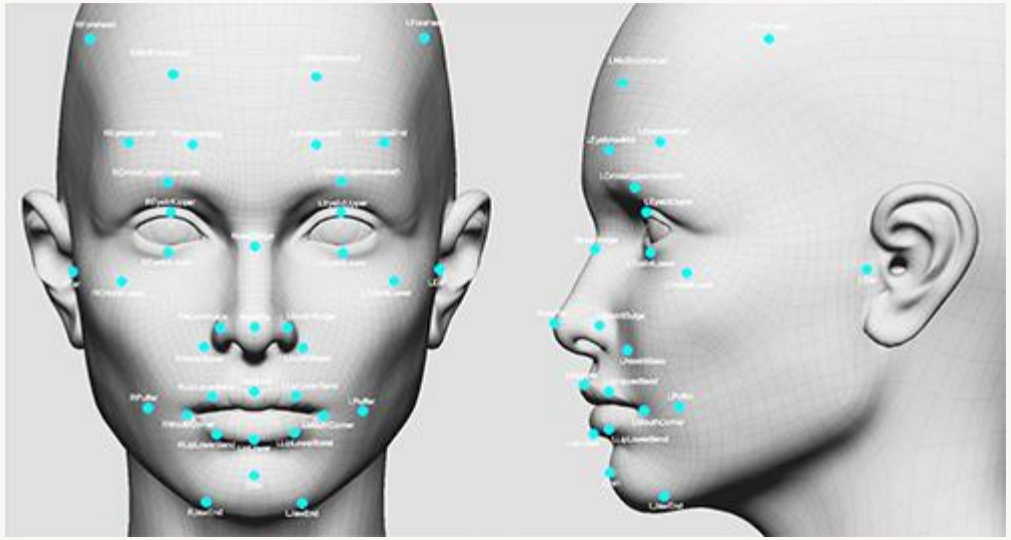
Introduction to Machine Learning

- Motivation
- Machine Learning Definition
- Where is Machine Learning in Computer Science?
- Applications of Machine Learning
- Approaches to Machine Learning
- Learning Process

Motivation

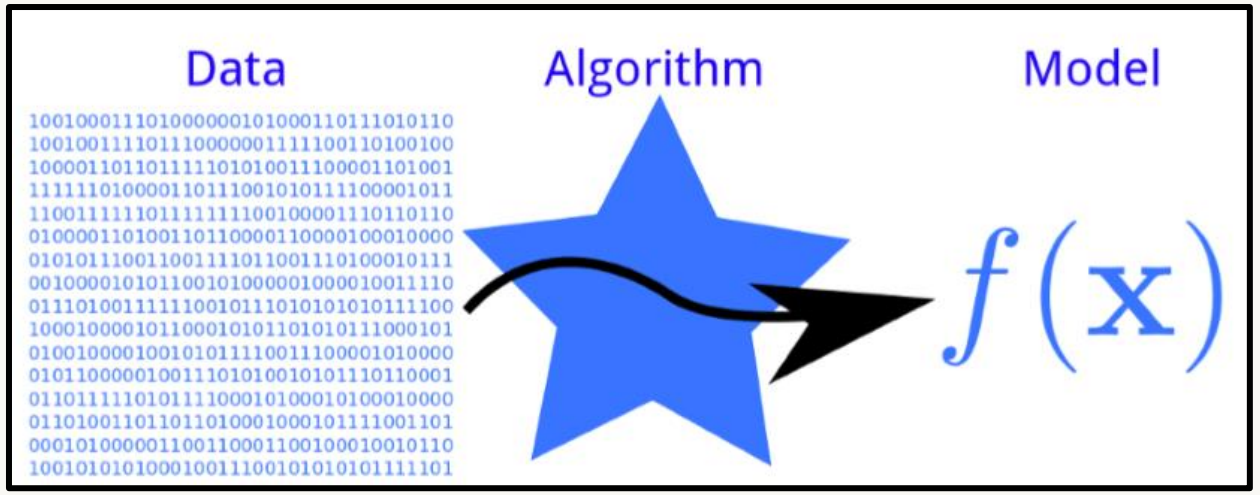
Hard problems:

- Pattern recognition
- Computer vision
- Natural language understanding
- Speech recognition
- Robotics ...



Machine Learning Definition

What is machine learning?



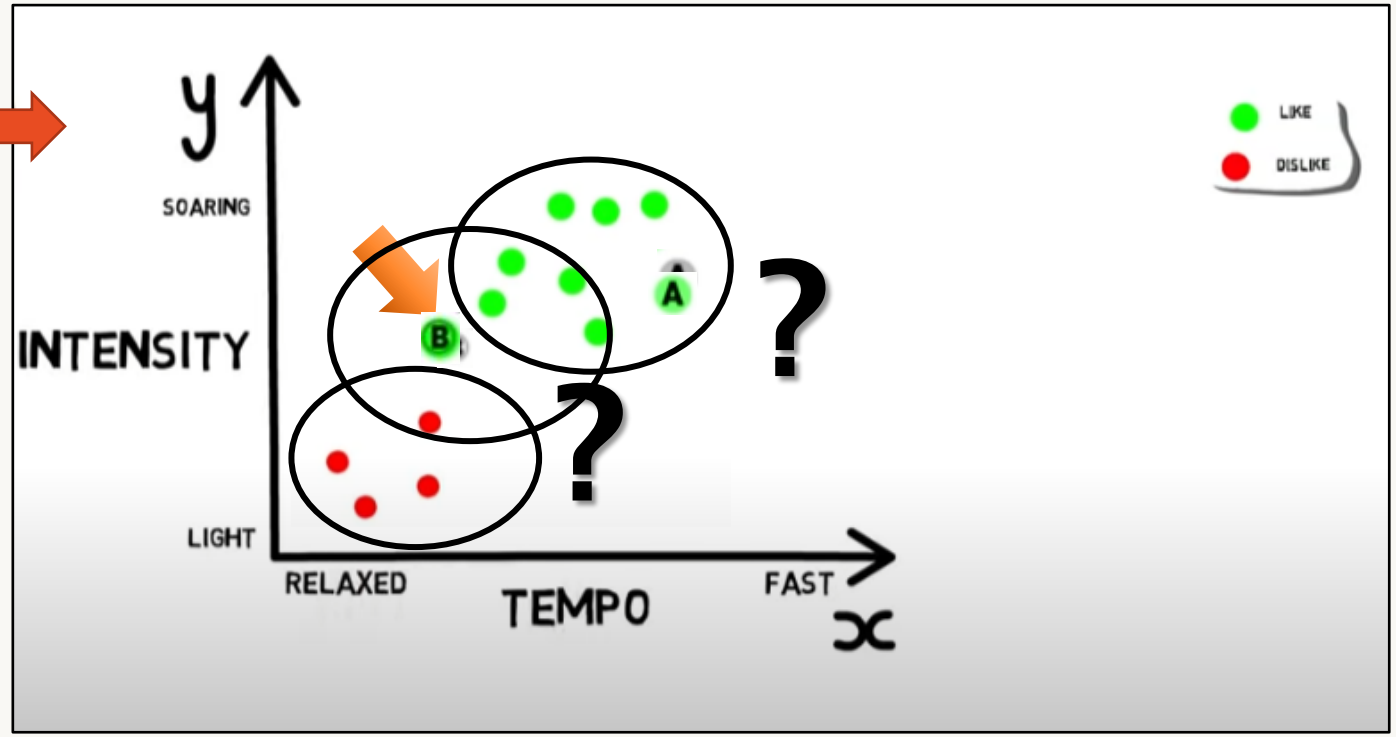
Machine learning (Alpaydin 2009)

Machine learning is programming computers to **optimize a performance criterion** using example **data or past experience**. We have a **model** defined up to some parameter, and **learning** is the execution of a computer algorithm to optimize the parameters of the model using the training data or past experience.

Machine Learning Definition

Prediction

- Tempo.
- Genre.
- Intensity.
- Gender of voice.



Now, Lets check his choices:

SONG A - FAST TEMPO
SOARING INTENSITY

SONG B - MEDIUM TEMPO
MEDIUM INTENSITY

i.e., K-Nearest Neighbors Algorithm

Machine Learning Definition

Prediction

- Based on seen data, the model should be able to **predict** properties of new or unseen data

- From a logical perspective, what the model does is **inference**:
  *based on a limited sample of data, the model **infers** a general rule how the data behave*

- Aim of machine learning → is to build models that **generalize well**

*The goal of ML is **never to make "perfect" guesses**, because ML deals in domains where there is no such thing. The goal is **to make guesses that are good enough** to be useful.*

Machine Learning Definition

Machine learning *is about extracting knowledge from data*.

Knowledge from data

- From data to information to knowledge to action
- Data exists in abundance (plenty) (web, text, video, audio, experimental data, data warehouses, deep web …)
- On the other hand, knowledge is rare and expensive
- Goal: build models that explain the data and allow us to make inferences/predictions

Machine Learning Definition

Data Mining

Data mining is the process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems.

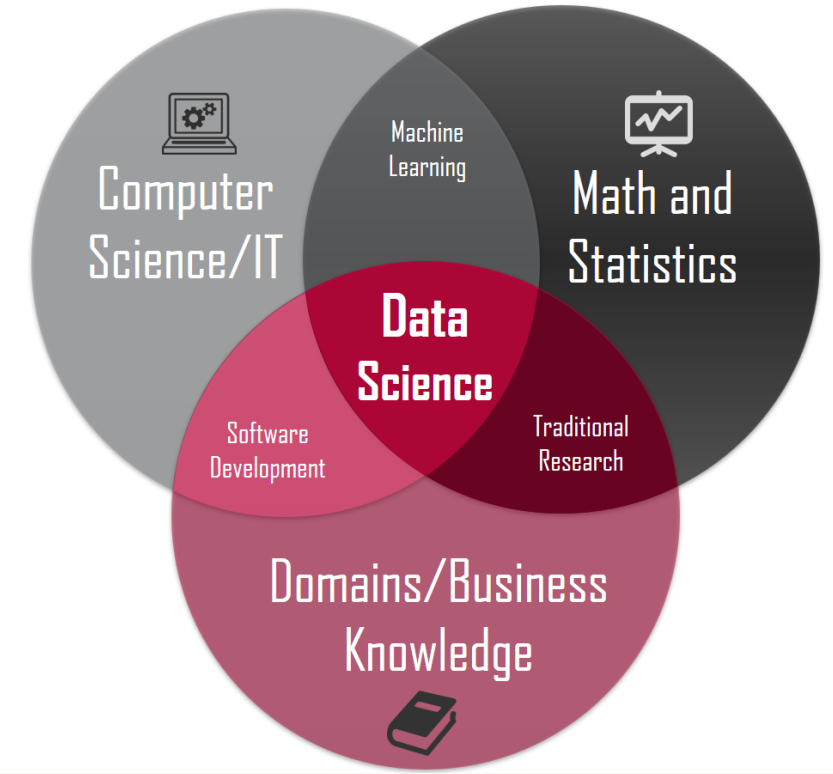
Data mining or knowledge discovery in data applies machine learning algorithms to structured and unstructured databases.

- Commerce: market basket analysis, CRM (Customer Relationship Management)
- Finances: credit risk assessment, credit card fraud
- Manufacturing: optimization, troubleshooting
- Medicine: diagnosis
- Telecommunications: service optimization
- Bioinformatics: gene expression analysis, sequence alignment
- Text mining: document classification, information extraction
- ...

Machine Learning Definition

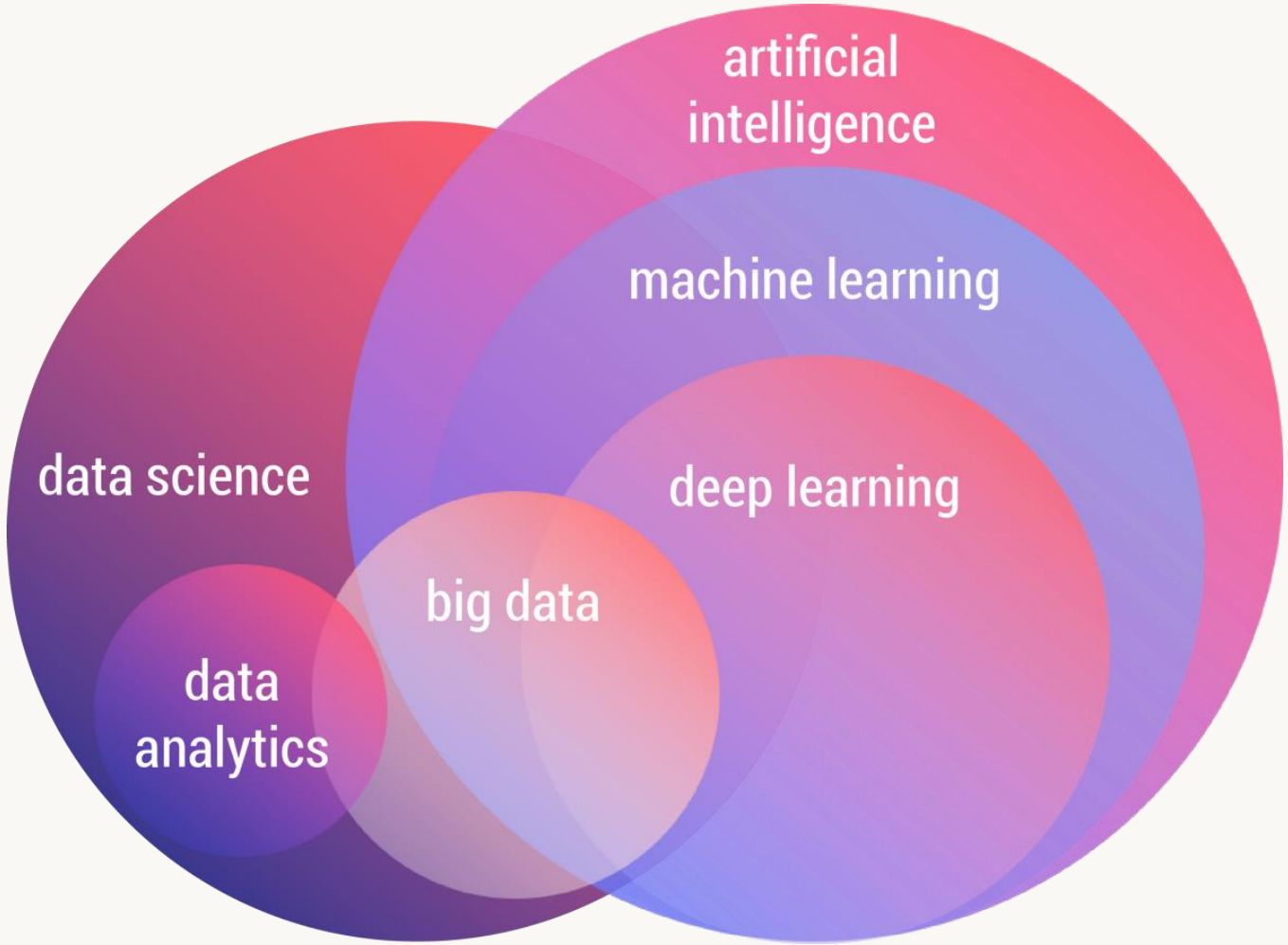
Data Science

- Data science is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from data in various forms, both structured and unstructured, similar to data mining.



- It is a "*concept to unify statistics, data analysis, machine learning and their related methods*" in order to "*understand and analyze actual phenomena*" with data.

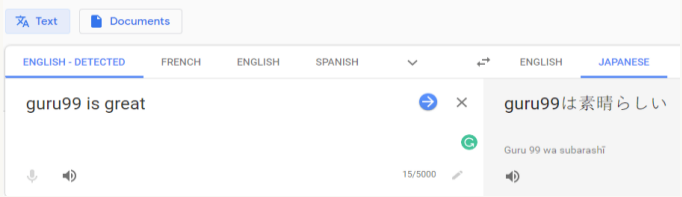
Where is Machine Learning in Computer Science?



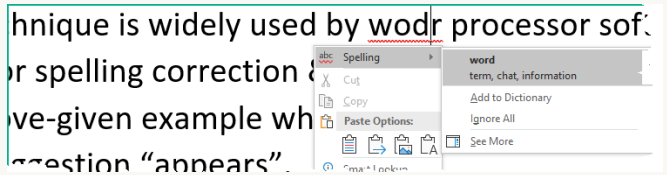
Applications of Machine Learning

➢ Natural Language Processing (NLP)- Applications

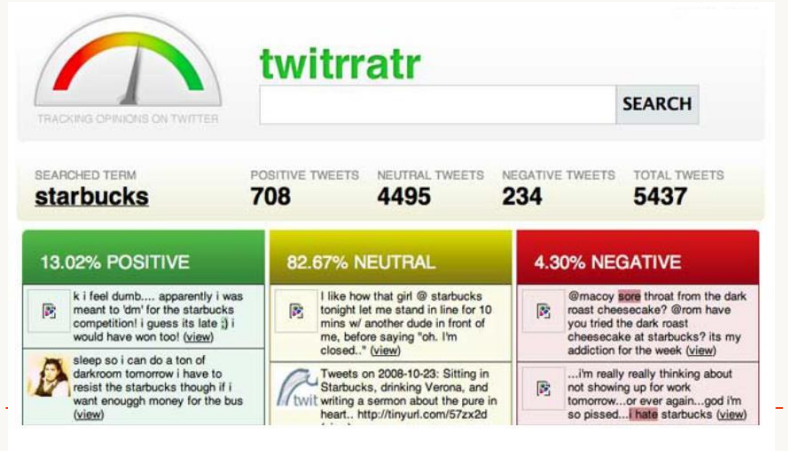
- **Machine Translation**



- **Grammar Correction**



- **Sentiment/Opinion Analysis**



- **Text Summarization**

- **Text Classification**

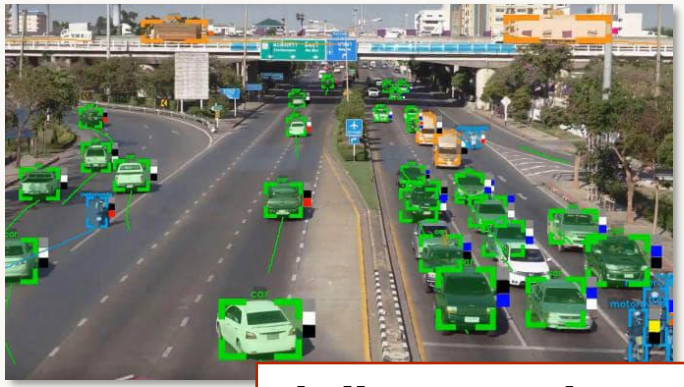
- **Speech recognition:**
  - **Speech to text**
  - **Text to speech**

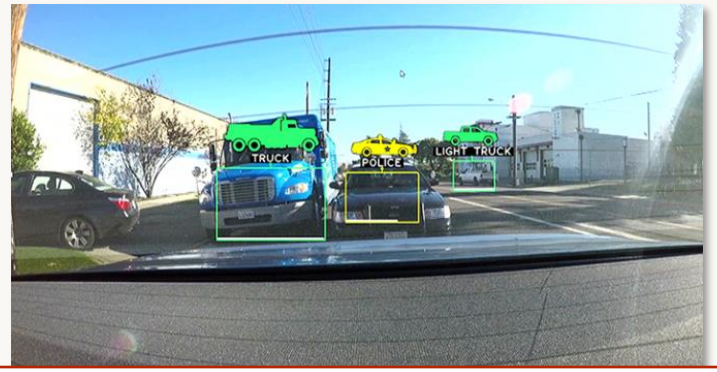
- **Question Answering** (Dialog Systems)
  - **Chatbot**

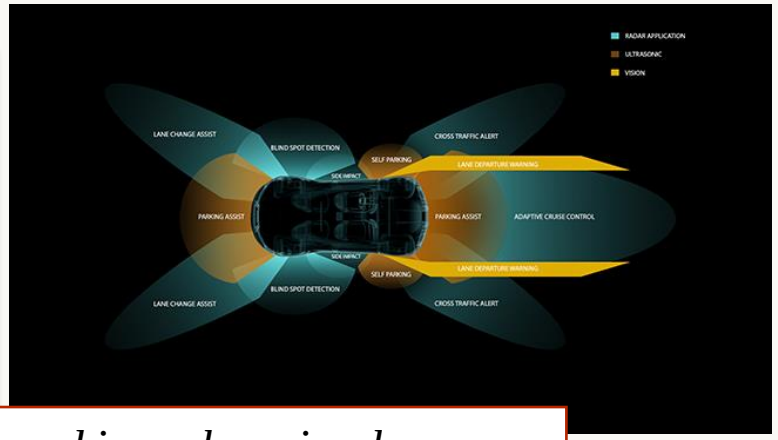
Applications of Machine Learning

- Computer vision and image recognition

  - A classifier recognizes various types of vehicles and traffic signs, even in cases that would be difficult for humans (bad weather conditions etc.)
  - Deep learning: autonomous vehicles (NVIDIA)







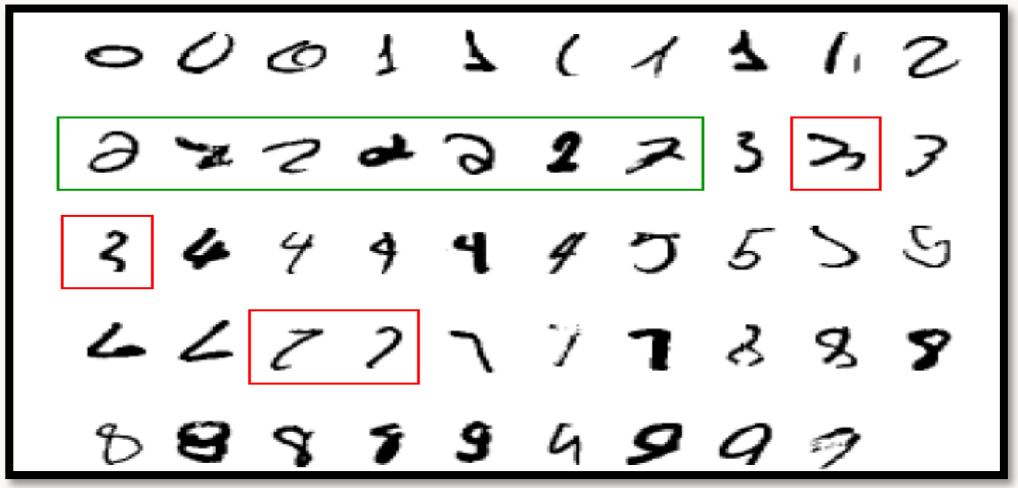
challenging tasks such as *detecting pedestrians, automatic parking, changing lanes, ...*

Applications of Machine Learning

➢ Computer vision and image recognition

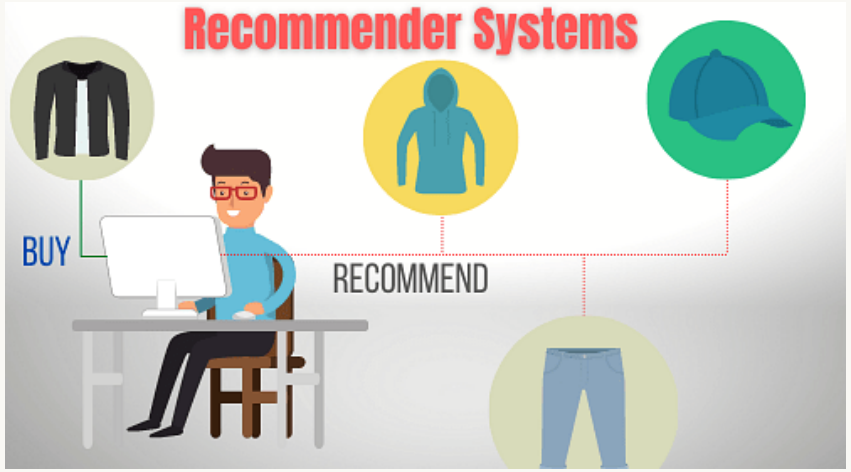
- Deep (dish) learning (Google): Based on a photo of a dish, the system estimates how many calories it has

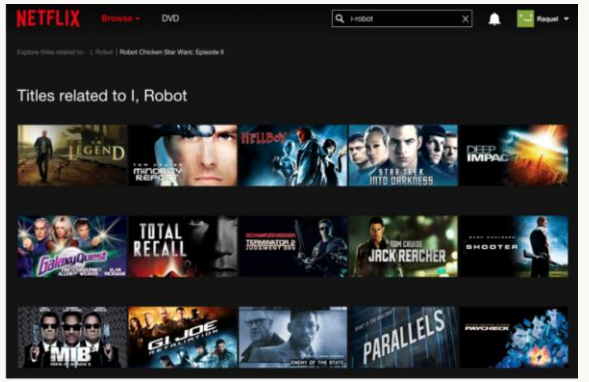
- Handwriting recognition



Applications of Machine Learning

- Recommendation engines



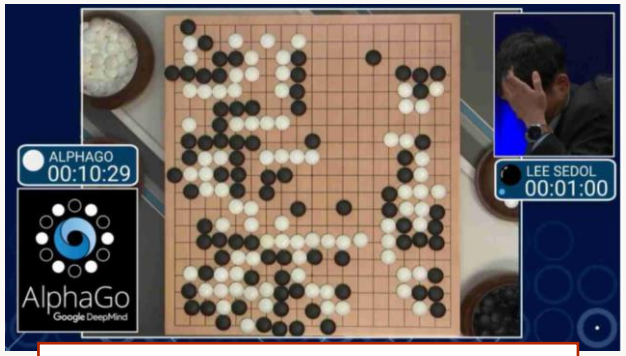


- Robotics

For example:

Tesla humanoid robot

Flying robot



Playing Game: Alpha Go

Summary:

Machine Learning is used when:

- Human expertise does not exist e.g. navigating on Mars
- Problem that is too hard to be solved algorithmically e.g. speech recognition
- Models must be customized e.g. personalized medicine
- Dynamically adaptable systems e.g., robots, adaptable user interfaces
- Models are based on huge amounts of data e.g., genomics
    - data science, big data, data mining

Contents for the next lectures

- Approaches to Machine Learning
- Learning Process

Any questions?