Introduction to Machine Learning: Clustering, Classification, and Regression

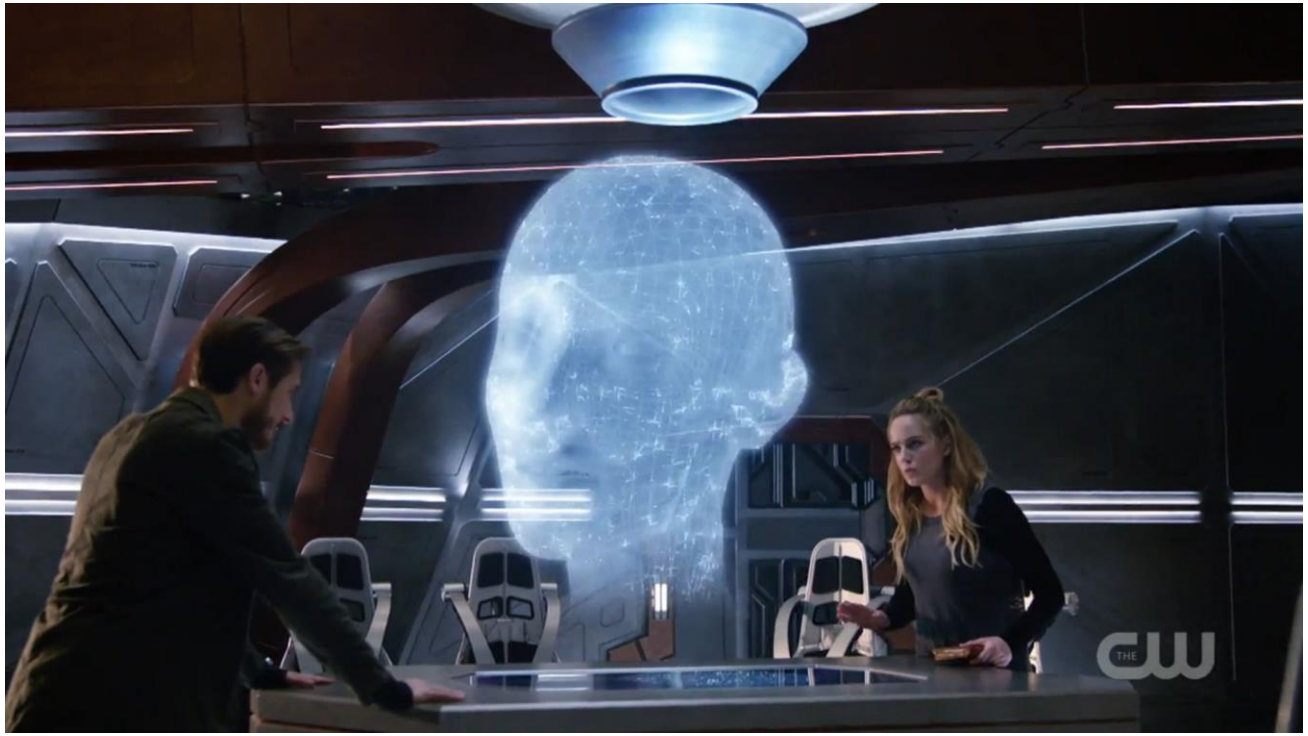
Liang Liang

General Artificial Intelligence

https://www.hbo.com/westworld

https://arrow.fandom.com/fr/wiki/Gideon_(Waverider)

Legends of Tomorrow

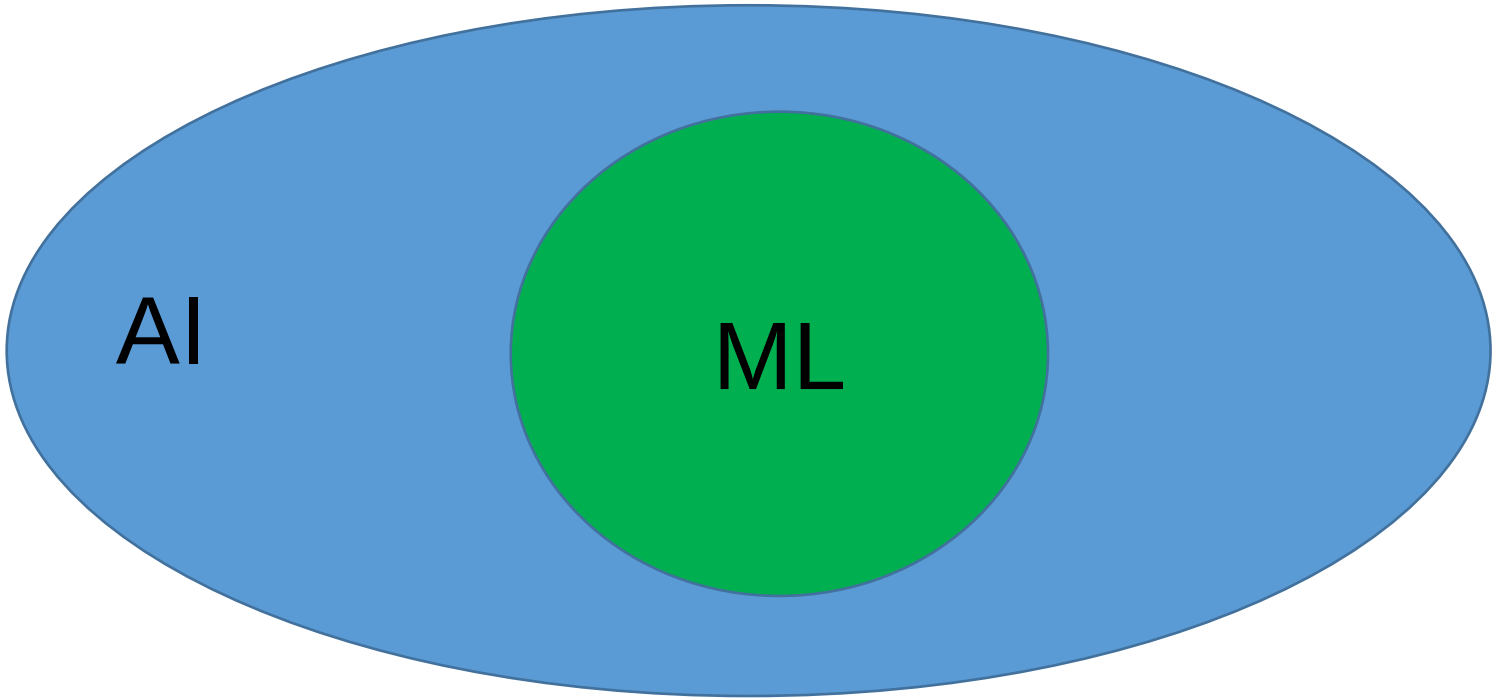


Machine Learning

- It is a sub-field of AI

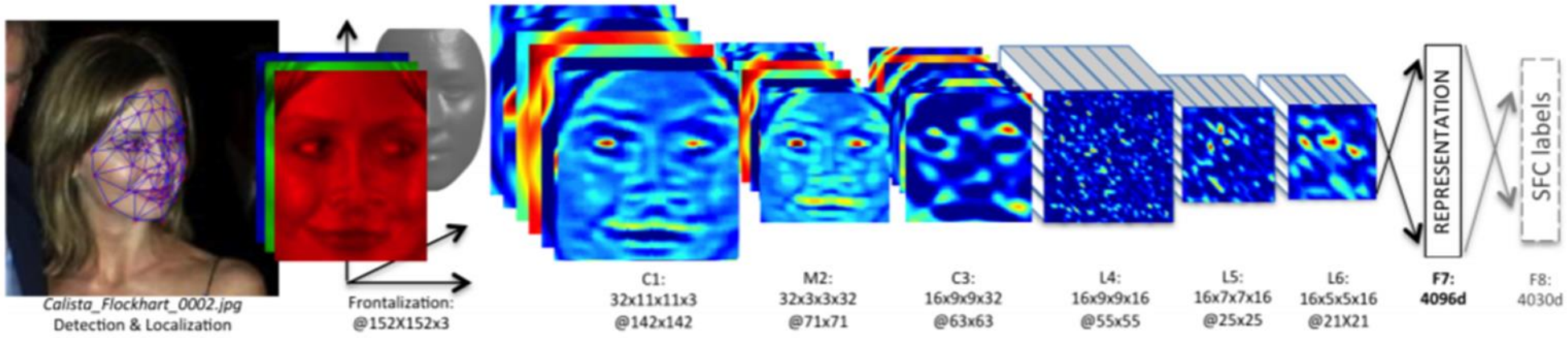
- "Machine learning is the science of getting computers to act without being explicitly programmed." - Andrew Ng

- "to investigate how computer agents can improve their perception, cognition, and action with experience. Machine Learning is about machines improving from data, knowledge, experience, and interaction. " – https://www.ml.cmu.edu/


AI
ML

Machine Learning (Specialized AI)

- Vision (image recognition, semantic segmentation, etc)
  - as good as or better than humans in some applications



Facebook:
DeepFace: Closing the Gap to Human-Level Performance in Face Verification

Machine Learning (Specialized AI)

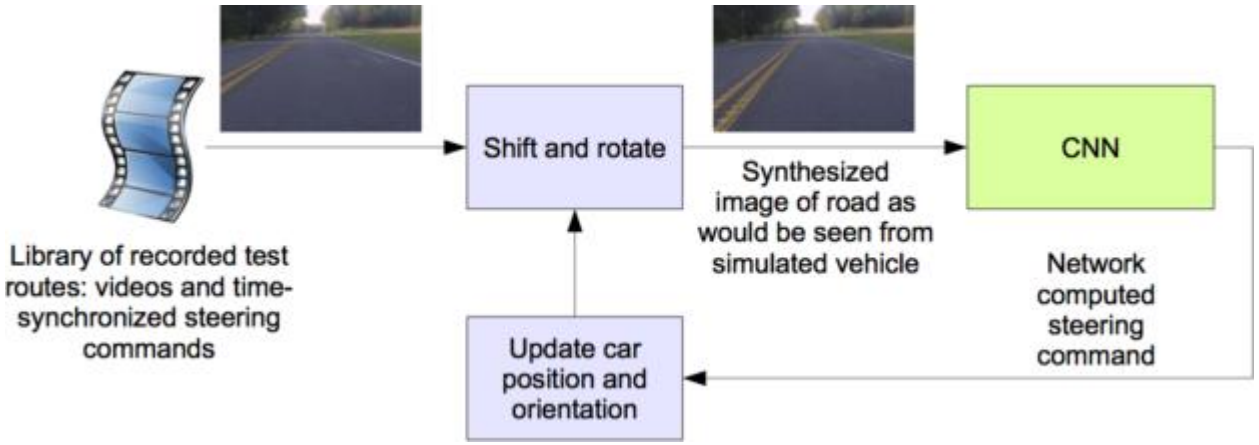
- Vision (image recognition, semantic segmentation, etc)
  - as good as or better than humans in some applications

computer vision system for self-driving cars

https://www.nvidia.com/en-au/self-driving-cars/drive-px/

Auto-driving in 2016 by Nvidia

- https://developer.nvidia.com/blog/deep-learning-self-driving-cars/



https://www.youtube.com/watch?v=NJU9ULQUwng

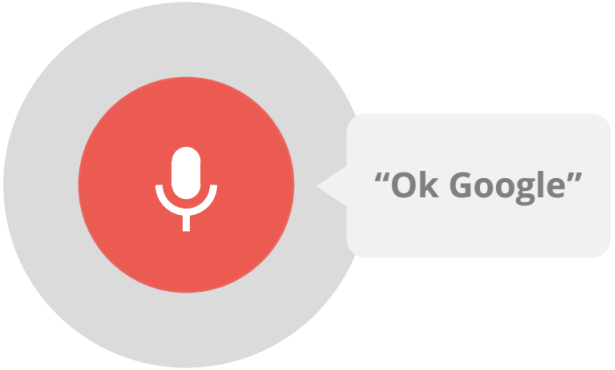
Tesla Self-Driving Test (Beta 10.12.1, May 2022)

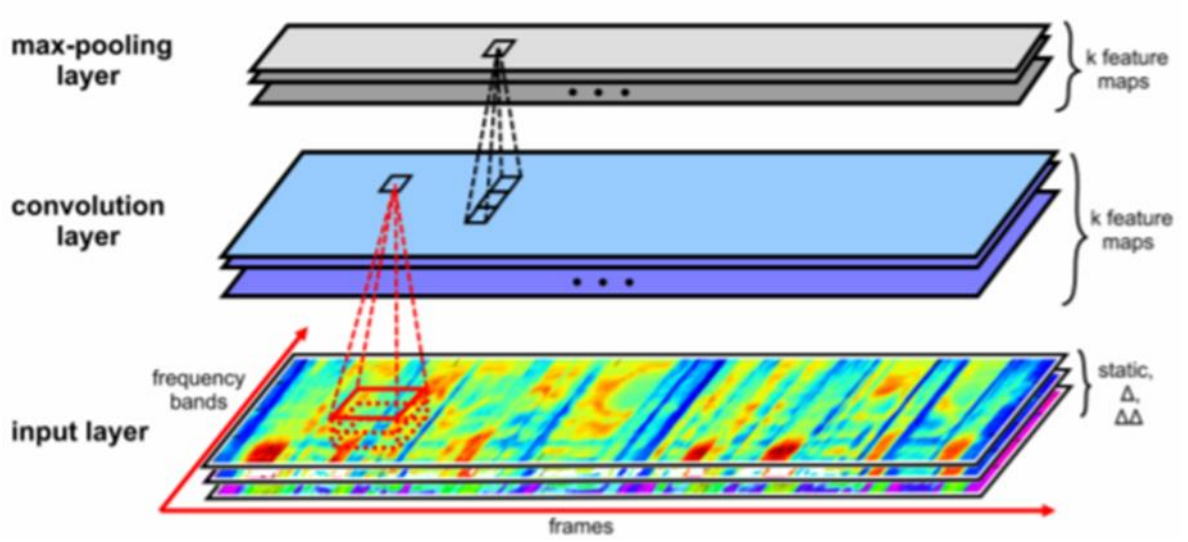
- https://www.youtube.com/watch?v=_ZYEjYnmPlA

Level 0	No automation
Level 1	Semi-automated systems, like cruise control.
Level 2	Semi-automated systems, like steering, speed and braking.
Level 3	Automated driving in some conditions, driver available to take over
Level 4	Automated driving in most conditions
Level 5	Automated driving in all conditions

Machine Learning (Specialized AI)

- Speech (e.g. speech recognition, speaker recognition, etc)



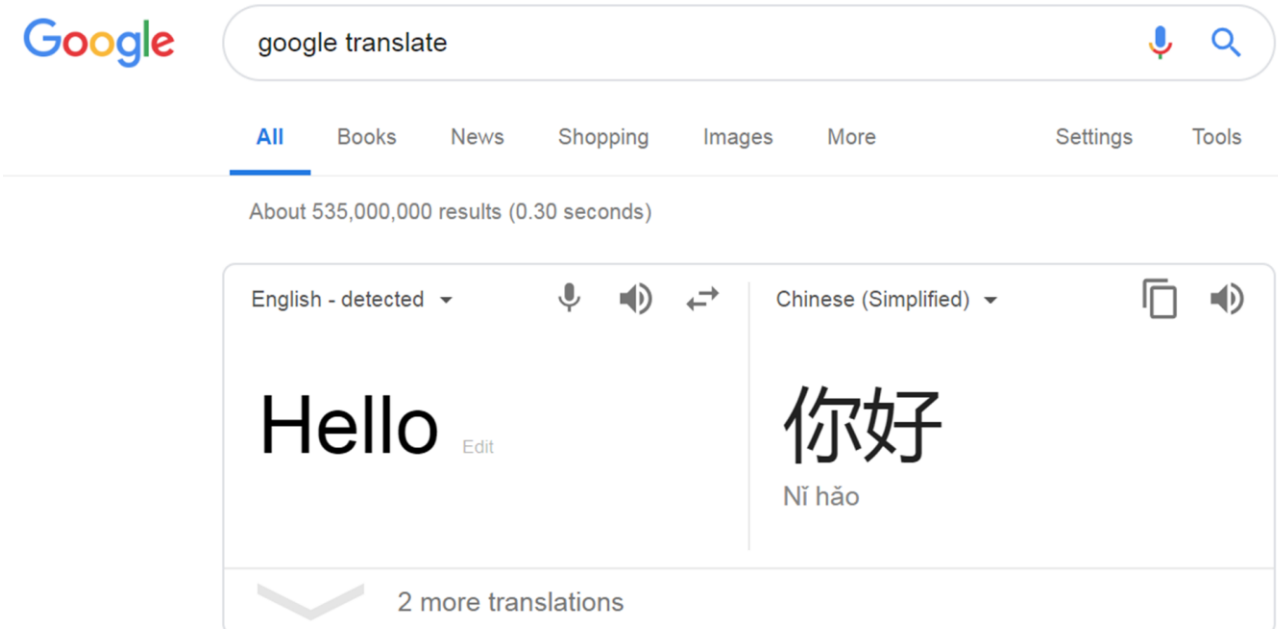


Towards End-to-End Speech Recognition with Deep Convolutional Neural Networks

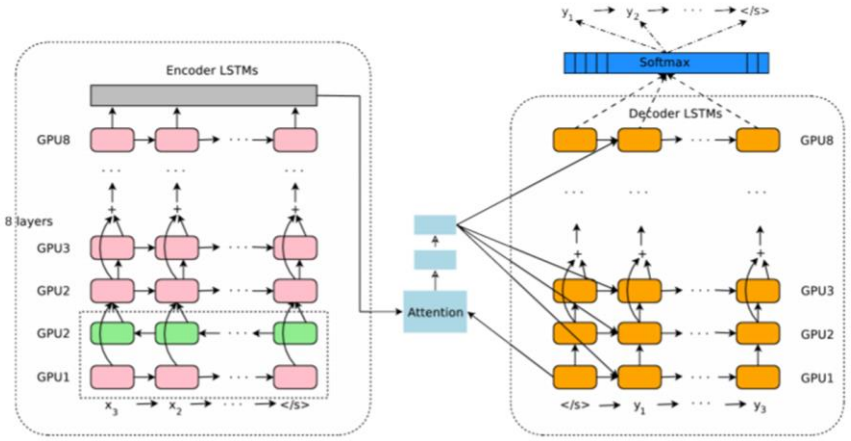
https://arxiv.org/pdf/1701.02720.pdf

Machine Learning (Specialized AI)

- Text (e.g. language translation, chat-bot)



https://arxiv.org/pdf/1609.08144.pdf



https://arxiv.org/pdf/1706.03762.pdf

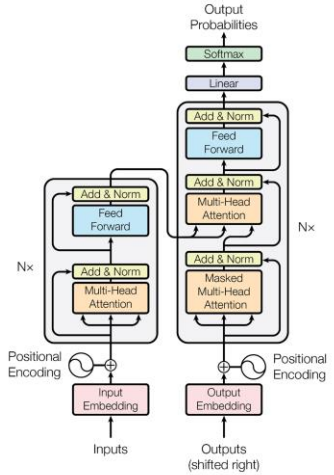


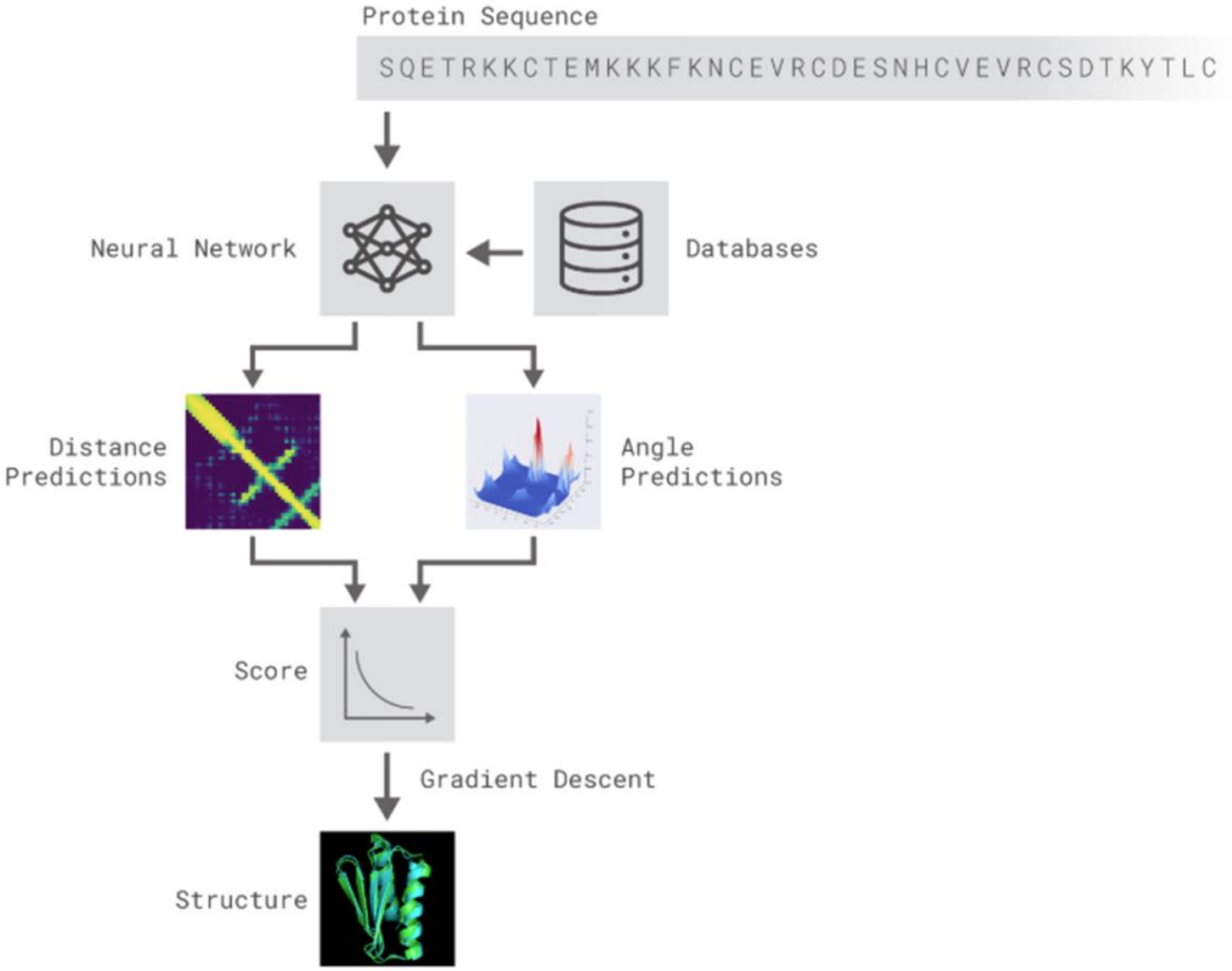
Figure 1: The Transformer - model architecture.

Machine Learning (Specialized AI)

- Bioinformatics

https://deepmind.com/blog/alphafold/

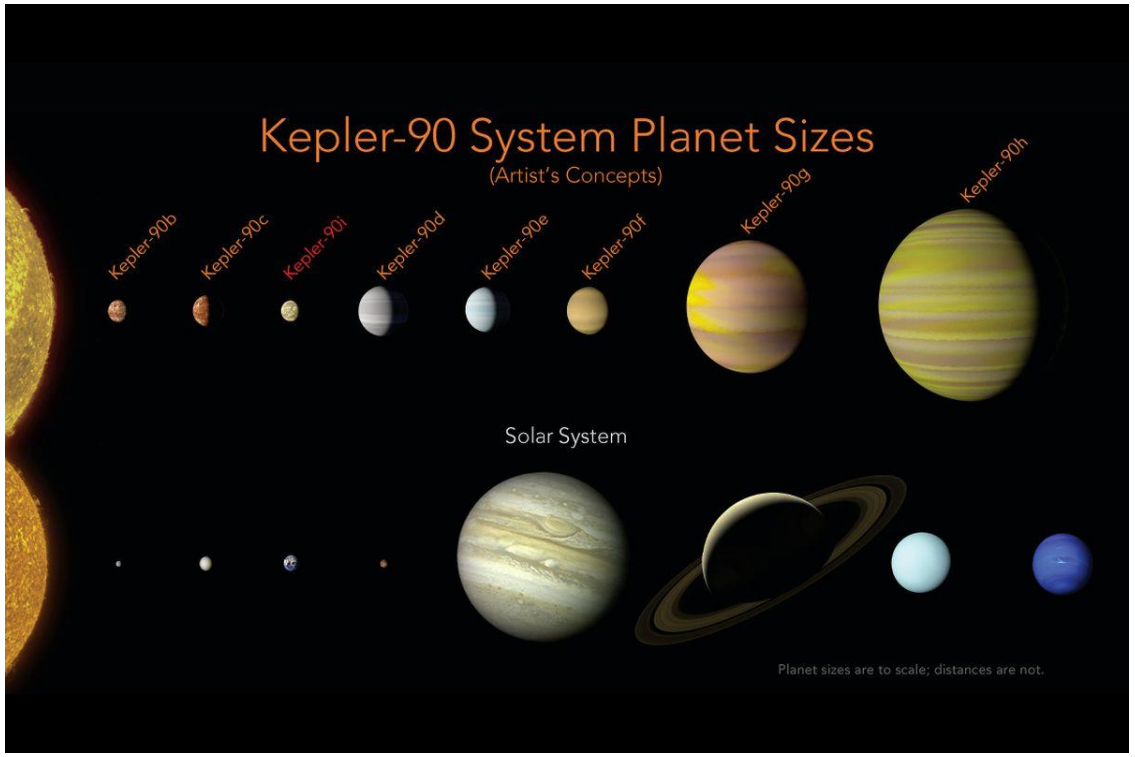
deep neural networks are trained to predict properties of the protein from its genetic sequence.



Machine Learning (Specialized AI)

- Astronomy

https://ai.googleblog.com/2018/03/open-sourcing-hunt-for-exoplanets.html



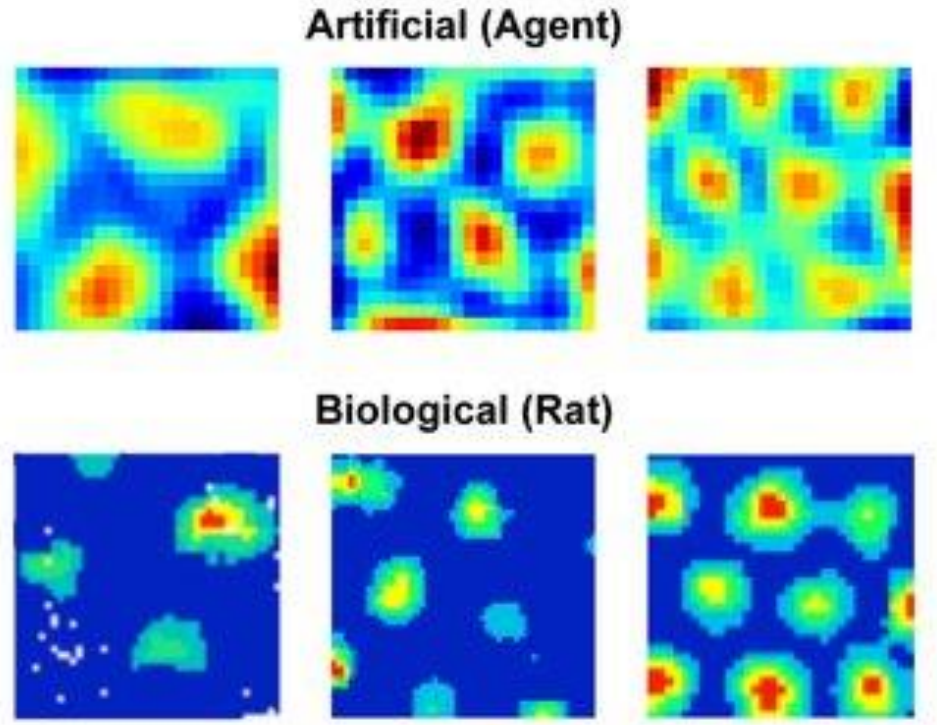
Researchers at Google in 2017 discovered two exoplanets by using ML algorithms to analyze data from NASA's Kepler space telescope and accurately identify the most promising planet signals.

Machine Learning (Specialized AI)

- Neuroscience

Researchers at Google Deepmind in 2018 developed ML algorithms which behave like grid-cells in animal (and human) brain for navigation.

Use artificial neural networks to explain the real neural networks in brains



Our experiments with artificial agents yielded grid-like representations ("grid units") that were strikingly similar to biological grid cells in foraging mammals.

Machine Learning (Specialized AI)

- Finance

A company named simility uses ML algorithms to detect different types of fraud activities.

(1) Account takeover fraud
(2) Wire Fraud: transfer money..
(3) Money Laundering (drug dealer…)
(4) Mobile Check Deposit Fraud
(scan fake check using smartphone)

The algorithms take into account the following information of the user: keyboard patterns, time and location, transaction amount, frequency of transactions, etc…

PayPal acquired simility in July 2018

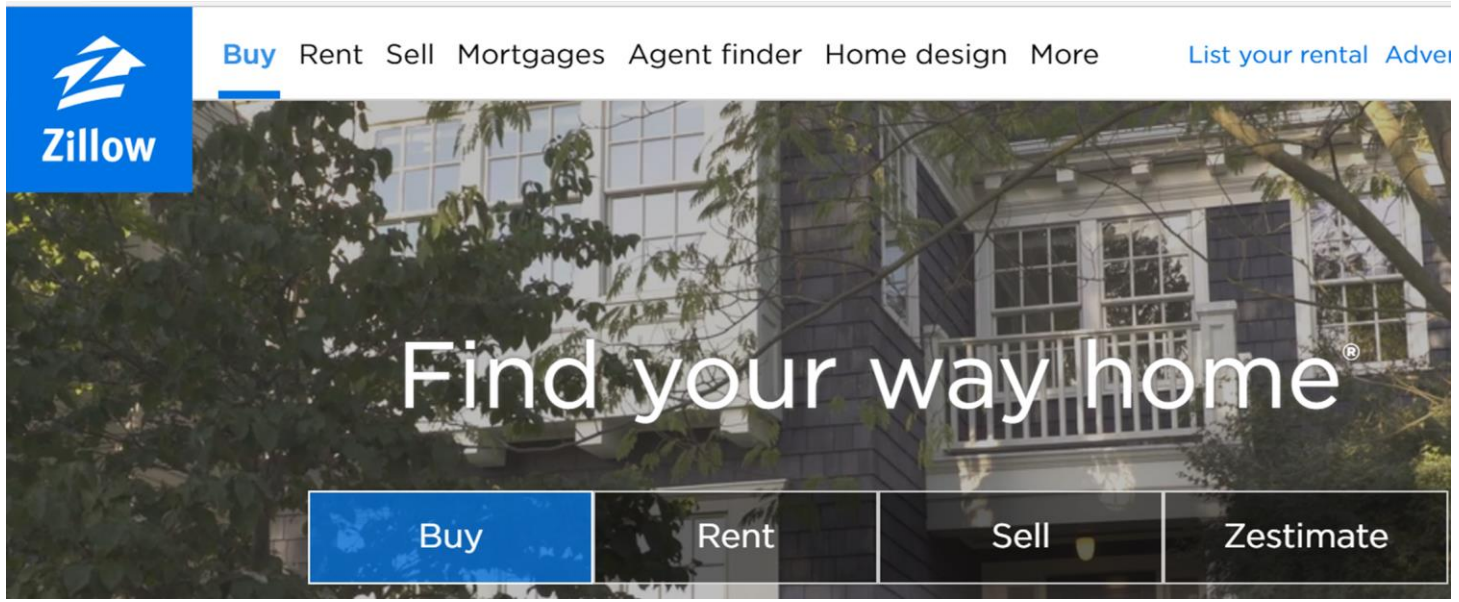
Machine Learning (Specialized AI)

- Realestate

The company Zillow is trying to use ML-algorithms to predict future sale prices of homes.

It offered **$1,000,000 USD** to anyone who can develop ML algorithms for price prediction in 2017

https://www.kaggle.com/c/zillow-prize-1

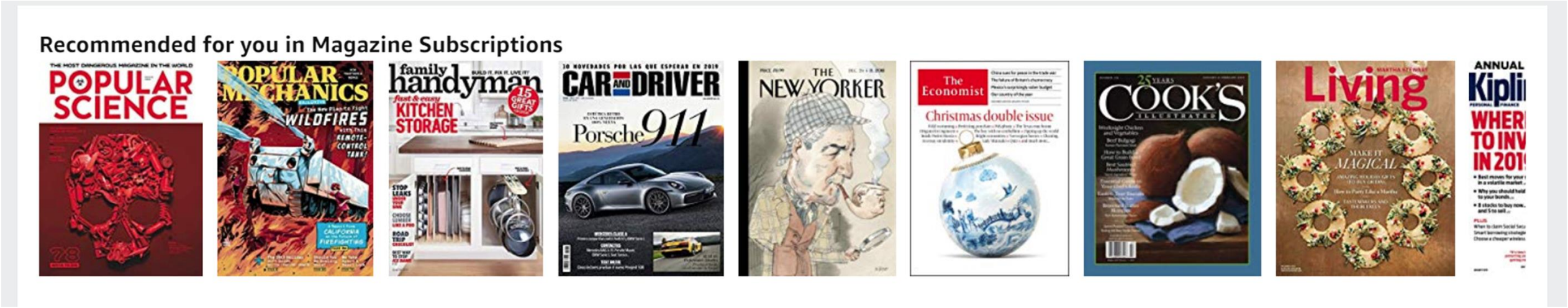


Zillow is the leading real estate and rental marketplace (online platform).
Through Zillow, people can buy, sell, and rent homes.

Machine Learning (Specialized AI)

- Online Recommendation

Amazon makes product recommendation based on your browsing history

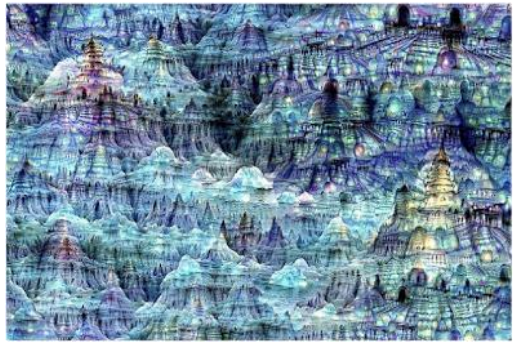
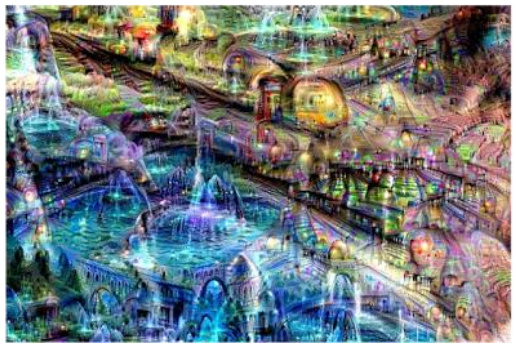


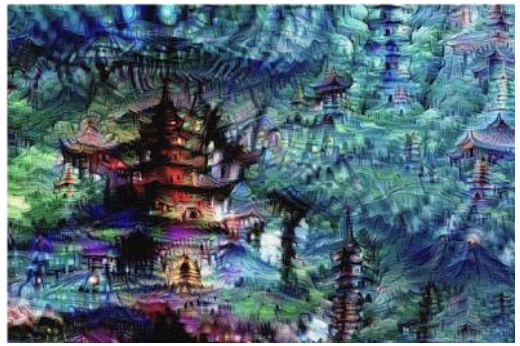
Machine Learning (Specialized AI)

- Just for fun

deep dream (google)





Style transfer

Machine Learning (Specialized AI)

- ML Artist (e.g. Stable Diffusion)

https://replicate.com/stability-ai/stable-diffusion/examples

https://huggingface.co/spaces/stabilityai/stable-diffusion

a flying pig over university of miami

https://stablediffusionlitigation.com/

We've filed a lawsuit challenging Stable Diffusion, a 21st-century collage tool that violates the rights of artists.

Because AI needs to be fair & ethical for everyone.

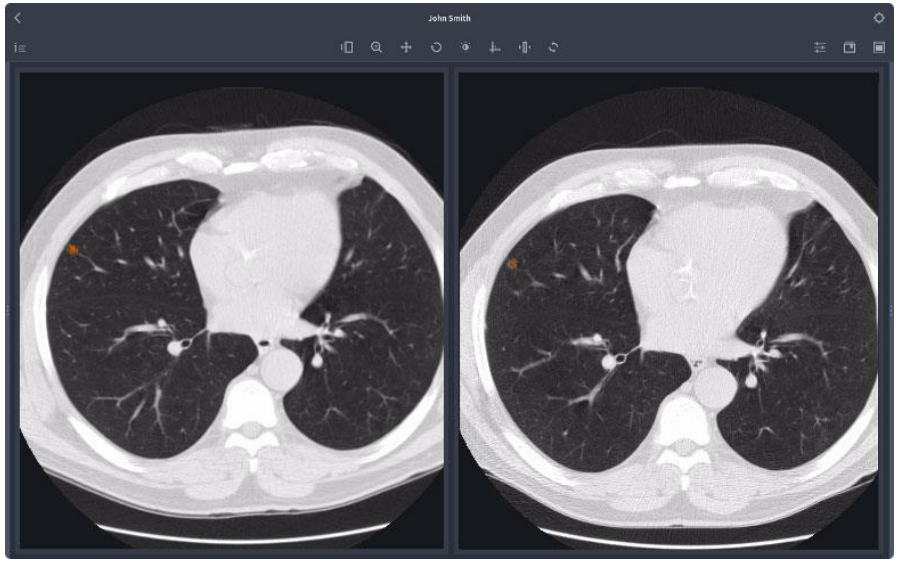
JANUARY 13, 2023

Hello. This is Matthew Butterick. I'm a writer, designer, programmer, and lawyer. In November 2022, I teamed up with the amazingly excellent

Machine Learning (Specialized AI)

- Medical Imaging and Image Analysis

https://www.arterys.com/lung

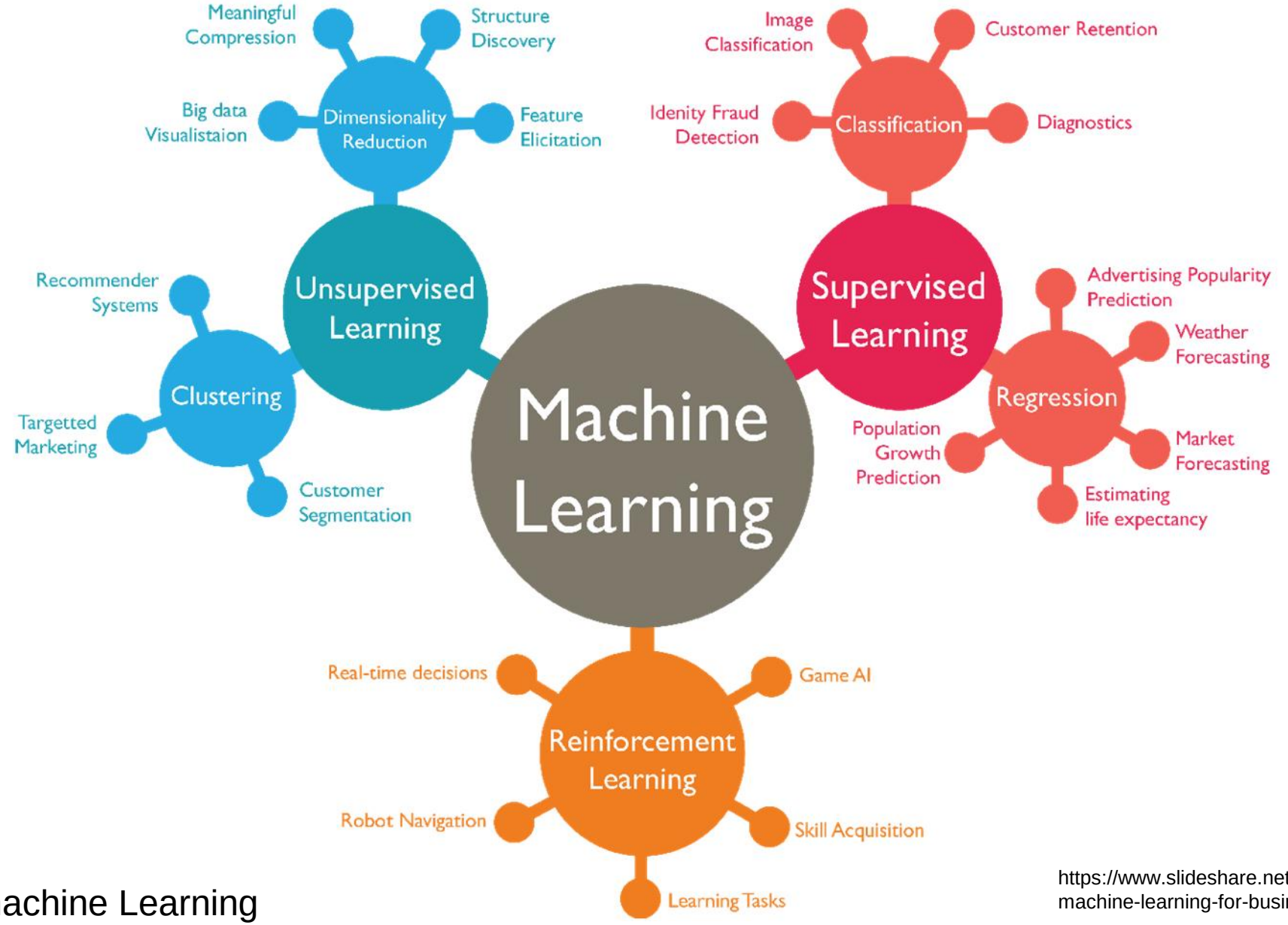


Some patients may have lung nodules.

A lung nodule is a type of lesion which could develop into cancer.

A company Arterys use ML algorithms to automatically detect lung nodules on CT images, and assess the risks. (FDA cleared)

Machine Learning



Three types of machine Learning

https://www.slideshare.net/awahid/big-data-and-machine-learning-for-businesses

What is **Machine Learning (ML)** ?

- Machine Learning is a sub-field of Artificial Intelligence.

  It has many definitions if you google it ….

  - Machine Learning is to extract patterns from data.
  - Machine Learning is to give computers the ability to learn without being explicitly learned.
  - Study of algorithms that improve their performance at some task with experience
  - Machine Learning is the study of (computer) algorithms that can learn something from data and apply the learned knowledge to perform some tasks.

- **ML** algorithms can keep improving their performance by using more data. - More Data, Better Performance.

Machine Leaning (ML) needs mathematics

Basics (if you want to learn ML and make applications)

- Calculus
- Linear Algebra
- Probability and Statistics

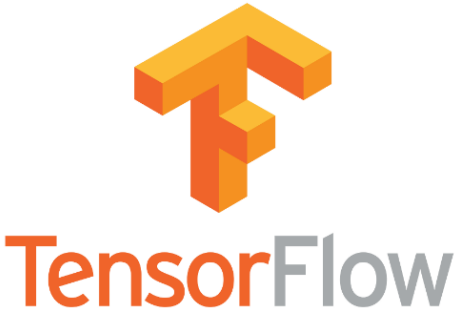
Advanced (if you want to be an ML researcher):

- Information Theory
- Numerical Method and Optimization
- Signal Processing (speech and image recognition)
- Stochastic Process (reinforcement learning)
- Control Theory (reinforcement learning)

Machine Leaning (ML) needs Python

- Python is #1 programming language for ML

Three major open source software packages for machine learning



Each package is written by using a mixture of different programming languages: C/C++ and Python.

Users can use the packages through Python.

It is much easier to use Python than C/C++

Machine Leaning (ML) needs Python

- Basic Python Packages for data manipulation and visualization

Numpy: store data and manipulate data

Pandas to process tabular data

Matplotlib to visualize data