INTRODUCTION to MACHINE LEARNING

Computer Engineering
Srinakharinwirot University Ongkharak Campus

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23. 01. 2023

AGENDA

Machine Learning

What’s Machine Learning
History of Machine Learning
Type of Machine Learning

Real World ML

Applications of ML
Understanding AI, ML & DL
Material for Study

Applied ML

ML Process Flow
Tool & Frameworks

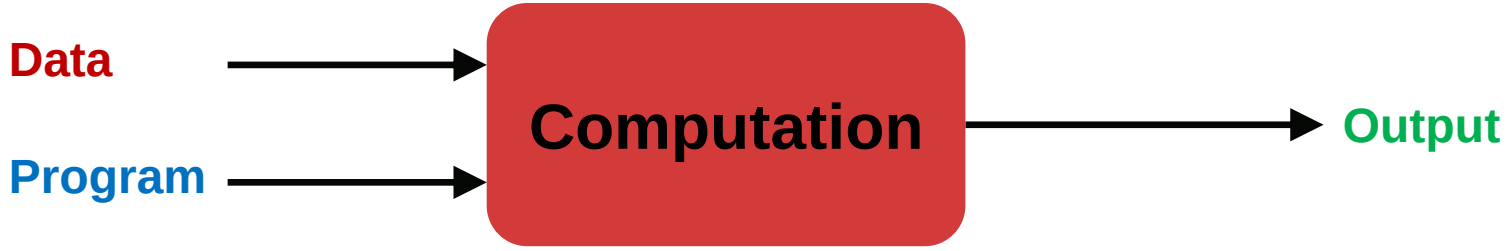
Work Shop

Linear Regression
K-Mean Clustering
Reinforcement Learning

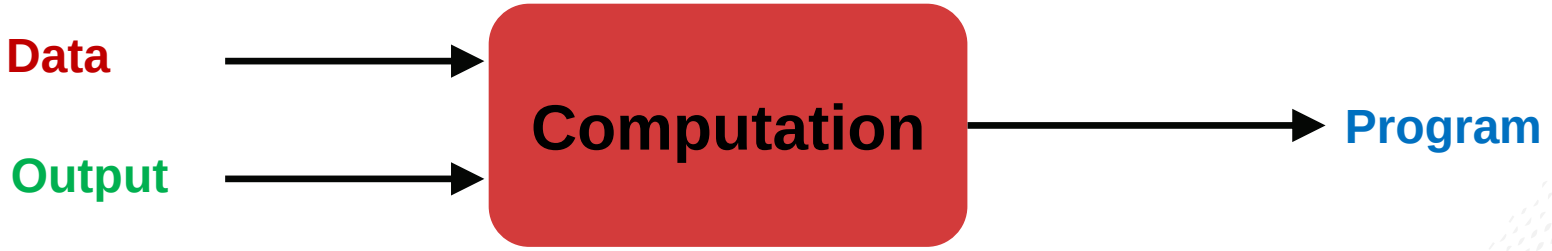
MACHINE LEARNING

What's Machine Learning?

Traditional Programming



Machine Learning



Why Machine Learning?

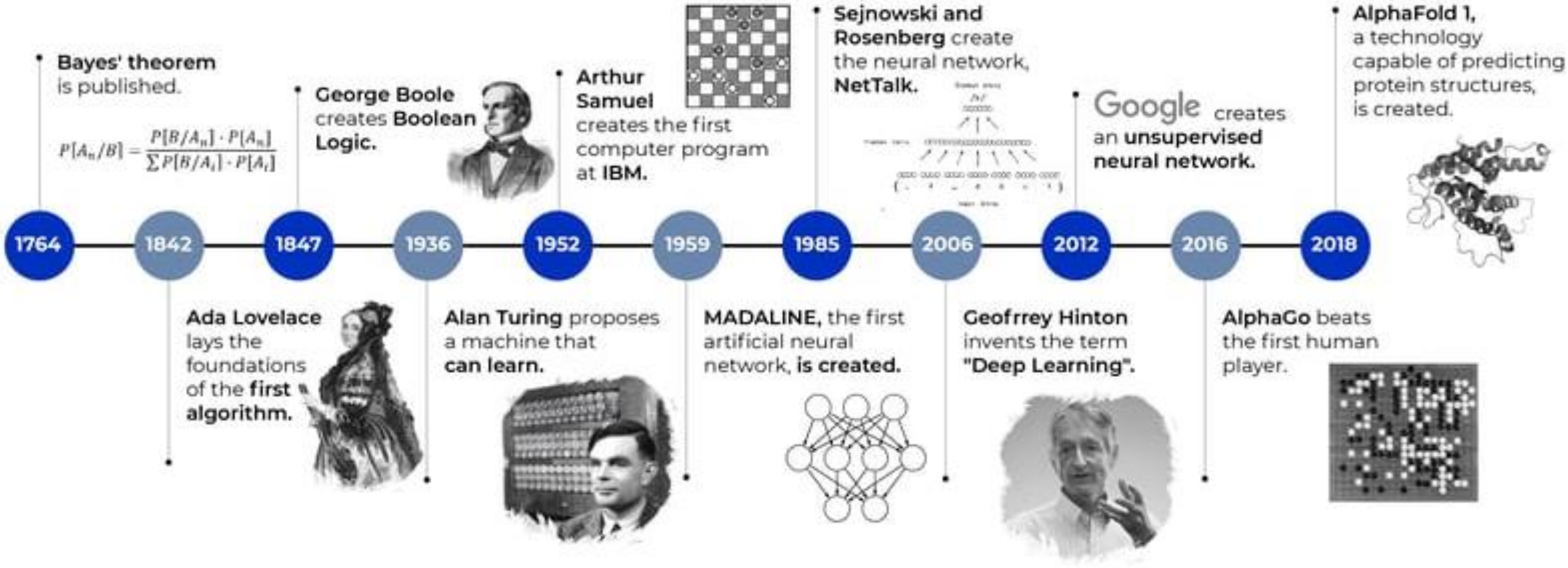
Availability

- **Data**
- **Data Storage**
- **Developer**
- **Processing**

Such as.

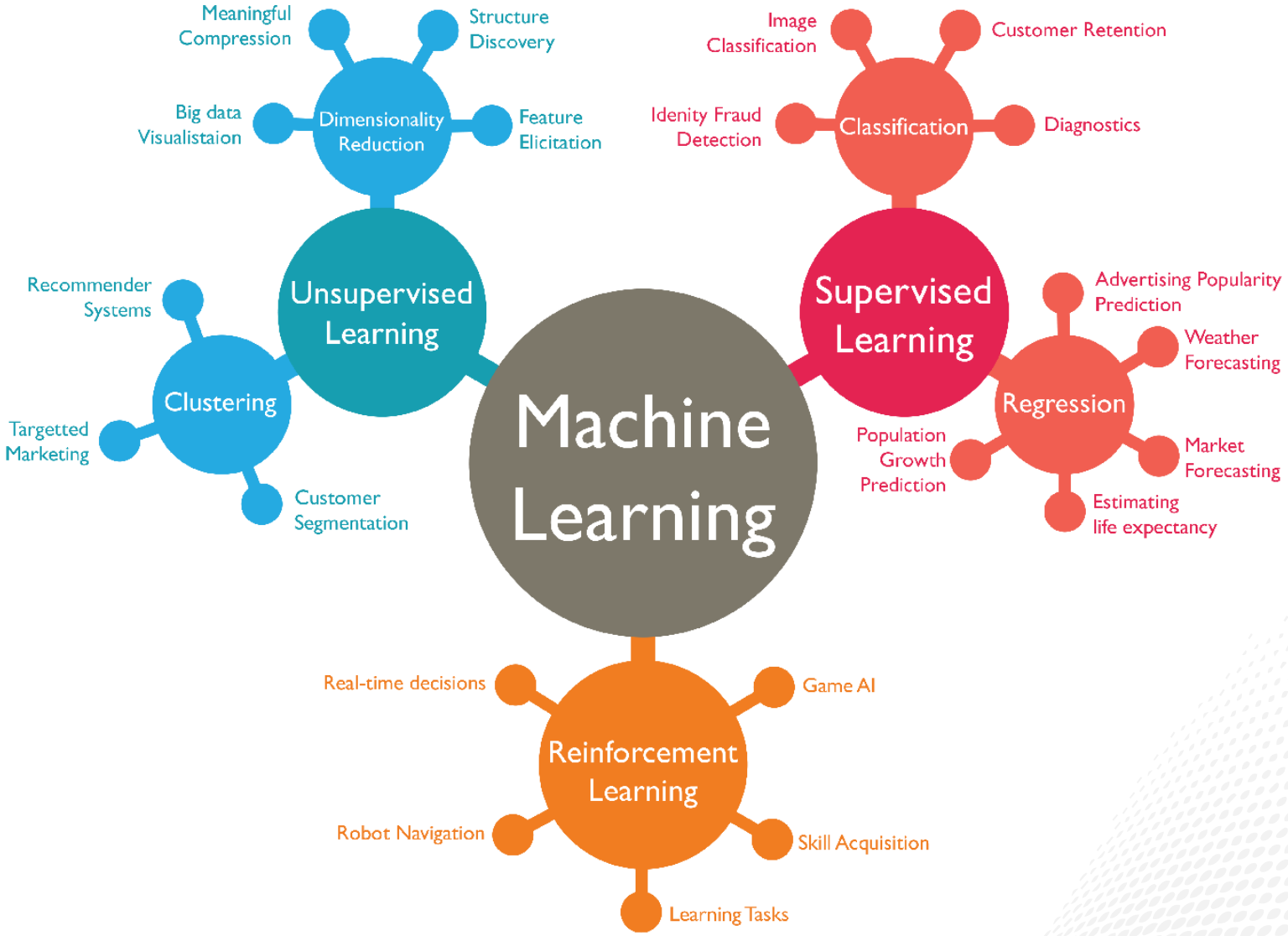
- **Manufacturing.** Predictive maintenance and condition monitoring
- **Retail.** Upselling and cross-channel marketing
- **Healthcare and life sciences.** Disease identification and risk satisfaction
- **Travel and hospitality.** Dynamic pricing
- **Financial services.** Risk analytics and regulation
- **Energy.** Energy demand and supply optimization

History of Machine Learning



https://www.algotive.ai/blog/machine-learning-what-is-ml-and-how-does-it-work

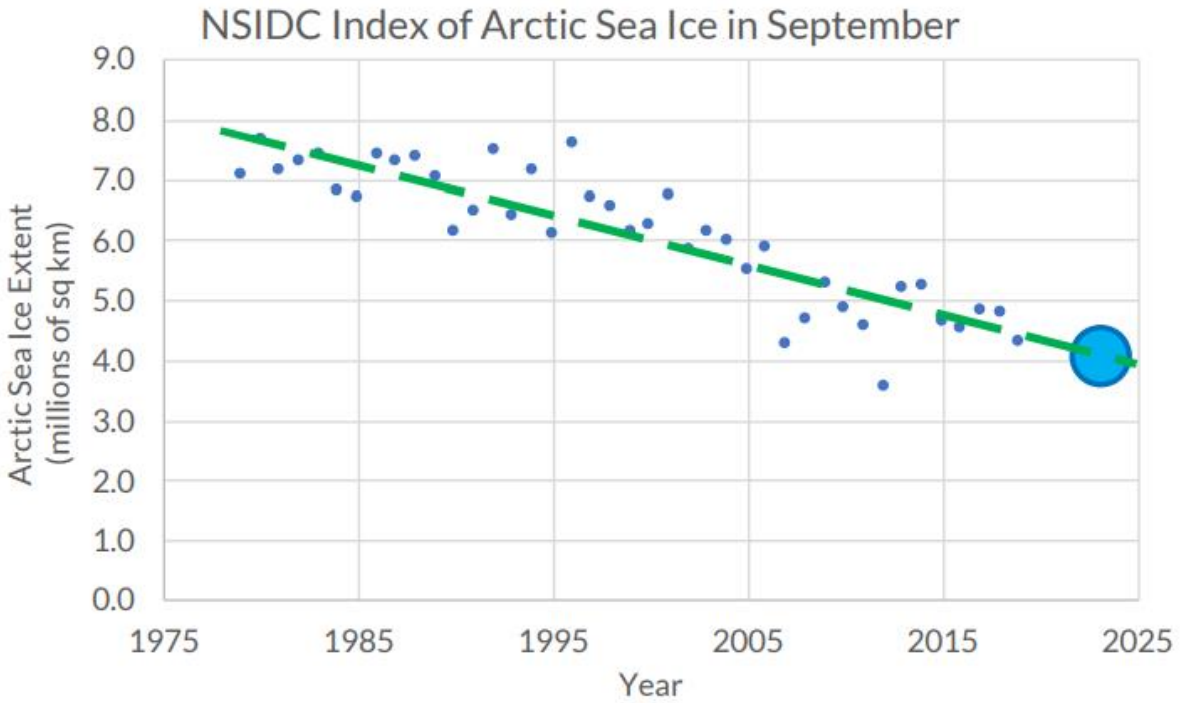
Type of Machine Learning



https://towardsdatascience.com/machine-learning-types-2-c1291d4f04b1

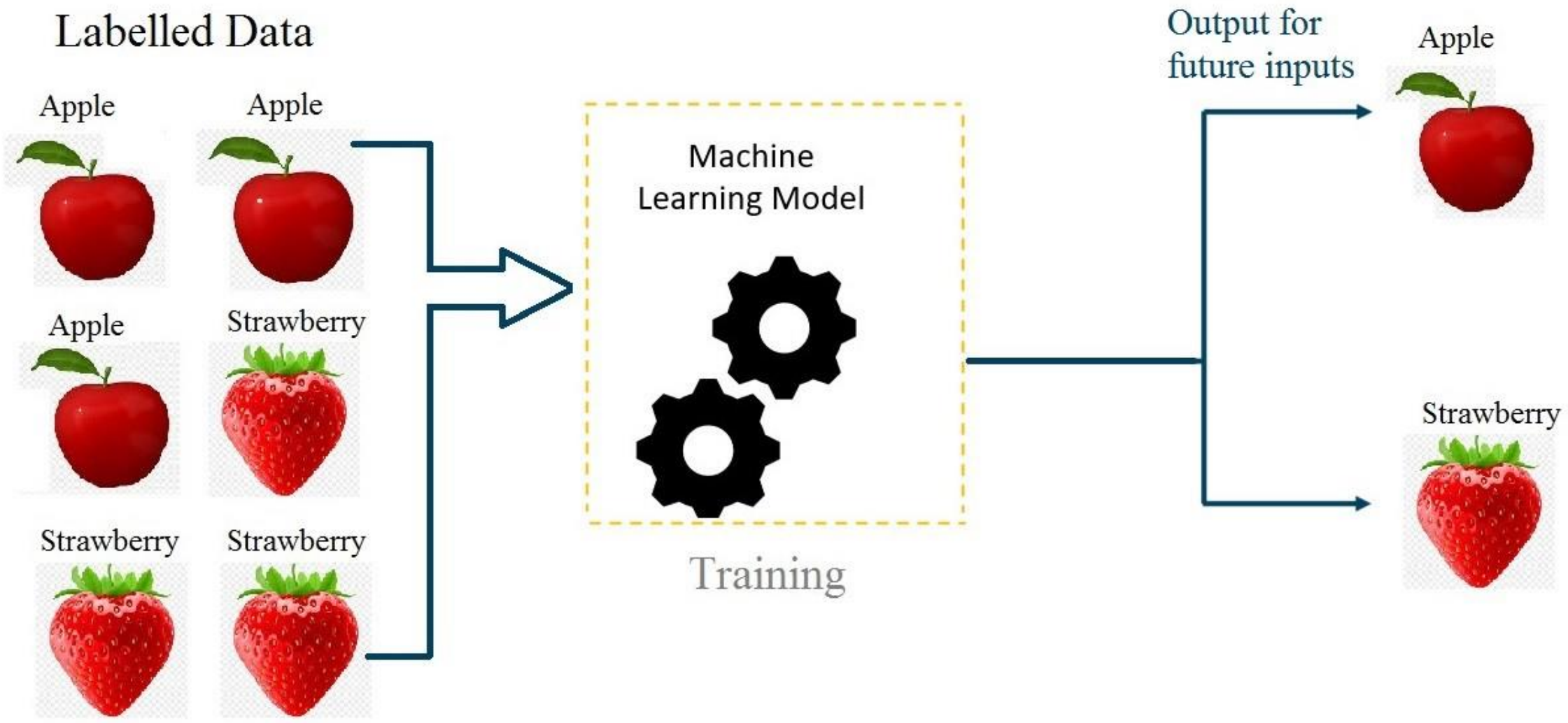
Supervised Learning

- Given $(x_1, y_1), \ldots, (x_n, y_n)$, learn a function that predicts y given x
- **Regression:** Labels y are real-valued



https://www.seas.upenn.edu/~cis5190/fall2022/

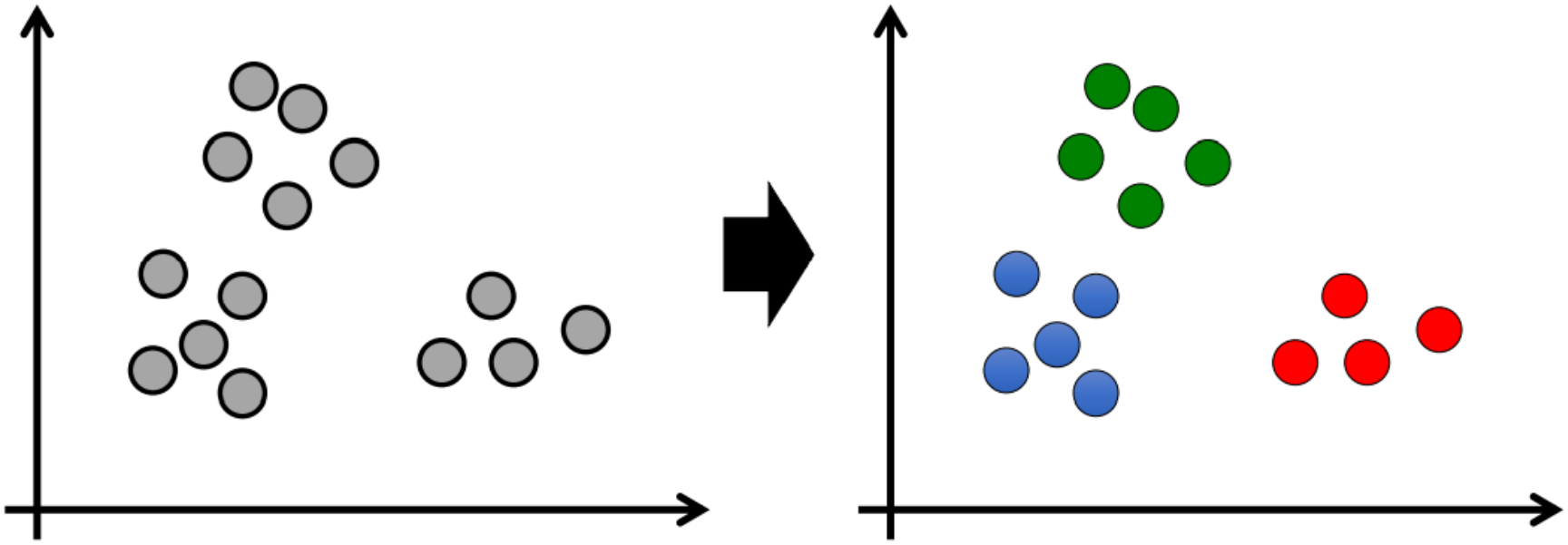
Supervised Learning



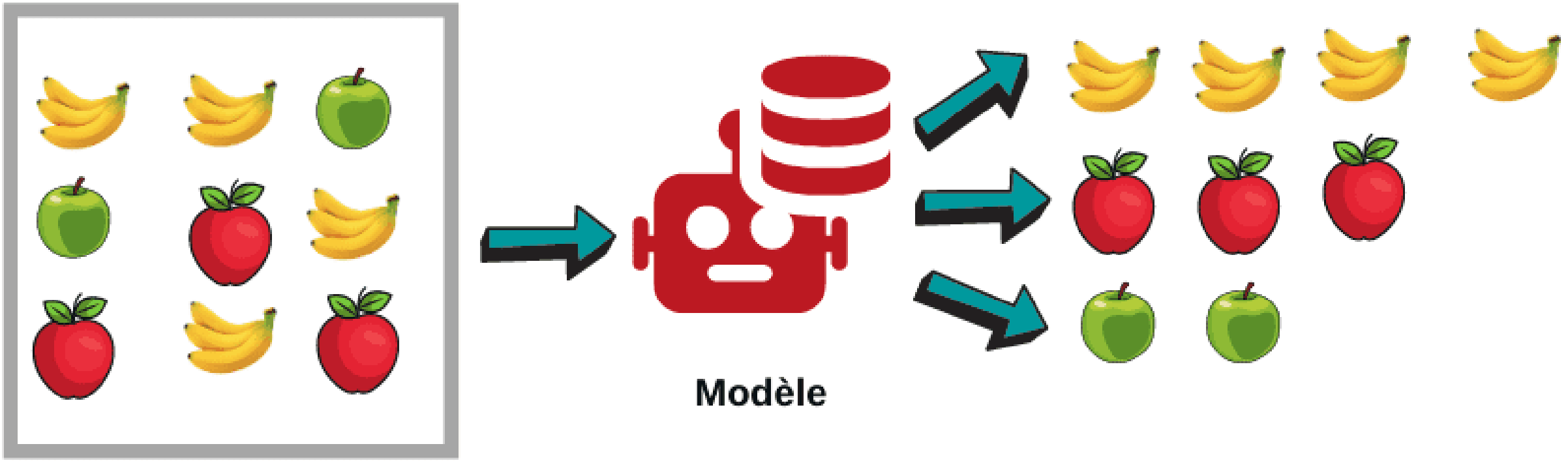
https://www.nerotricots.top/ProductDetail.aspx?iid=151477805&pr=40.88

Unsupervised Learning

- Given $x_1, \ldots, x_n$ (no labels), output hidden structure in x's
  - E.g., clustering

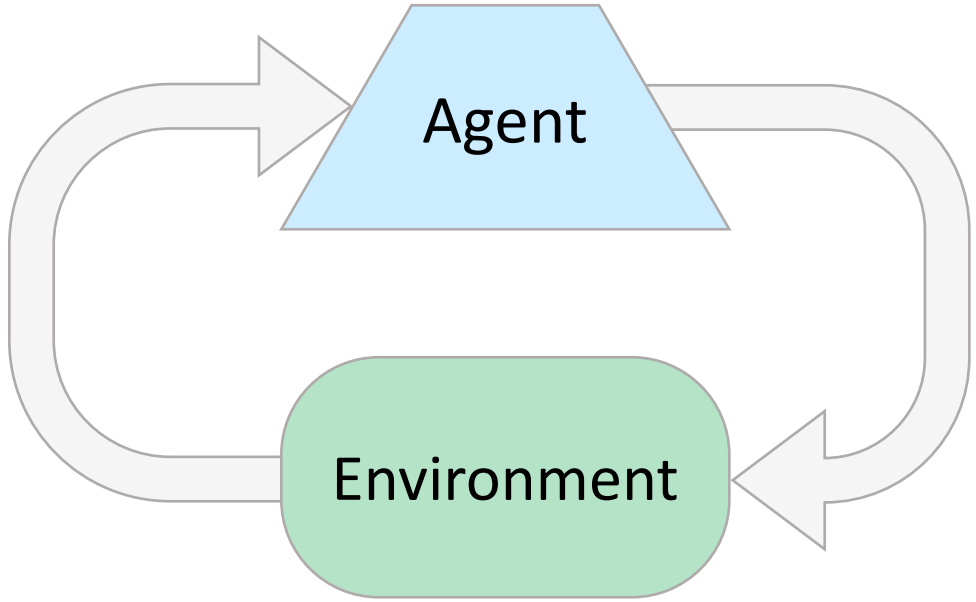


Unsupervised Learning



https://phedone.com/en/blog/artificial-intelligence-what-is-the-unsupervised-learning/

Reinforcement Learning



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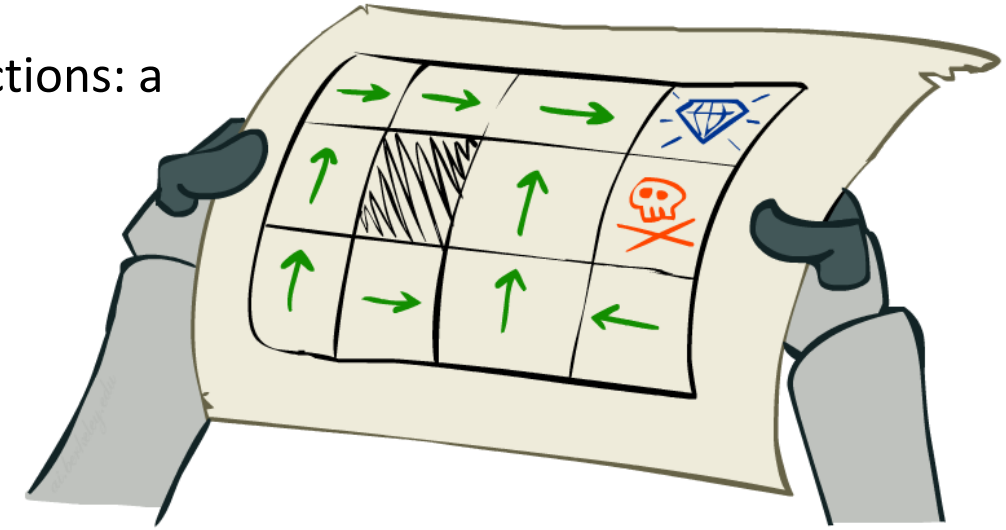
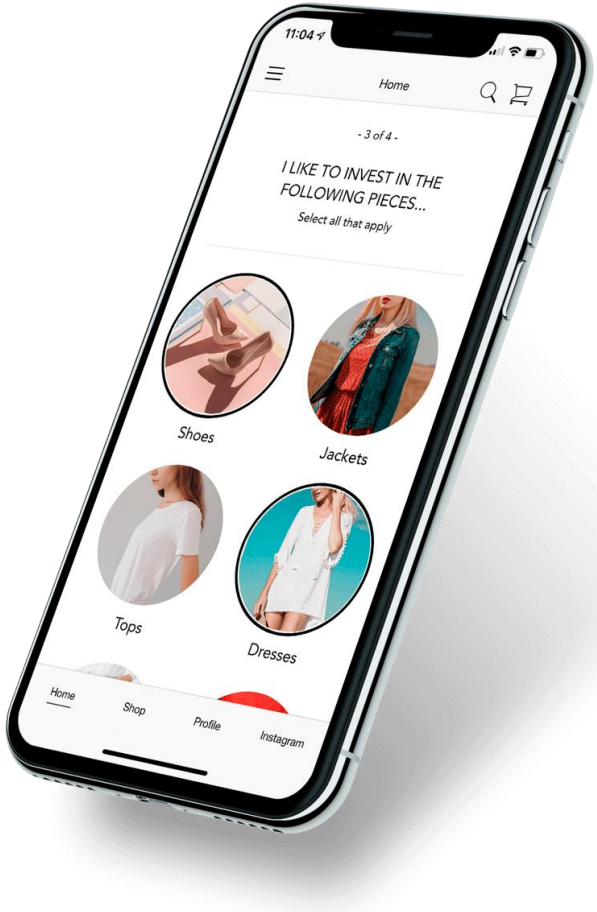


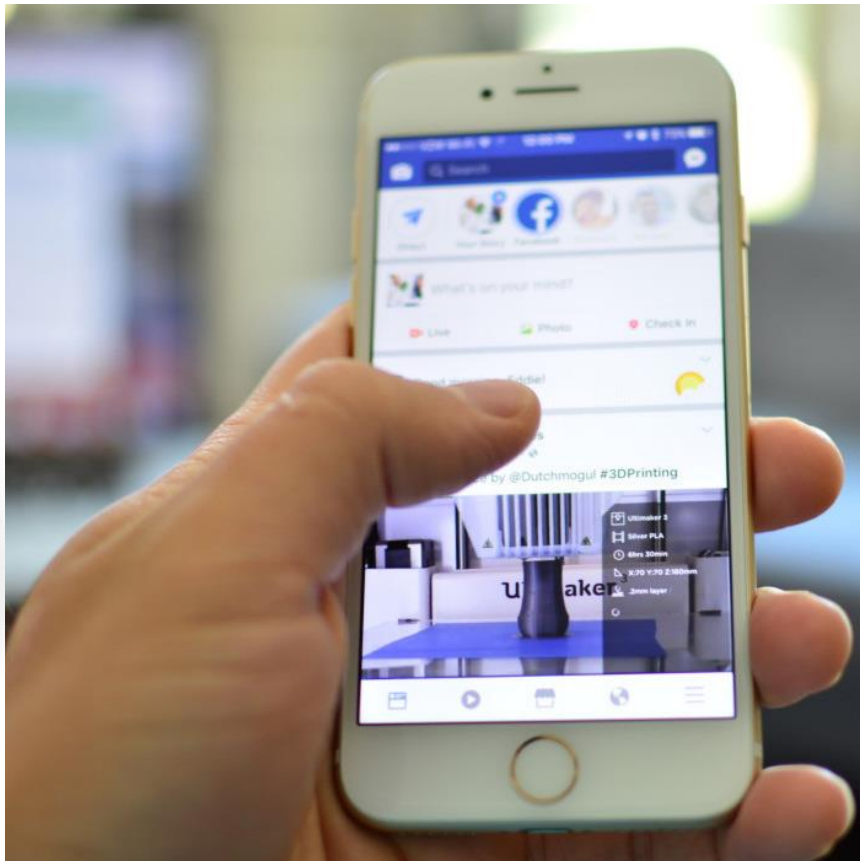
- Idea:
  - Receive feedback in the form of rewards
  - Agent's utility is defined by the reward function
  - Must (learn to) act so as to maximize expected rewards
  - All learning is based on observed samples of outcomes!

REAL WORLD MACHINE LEARNING

Applications of Machine Learning



Personalized Shopping

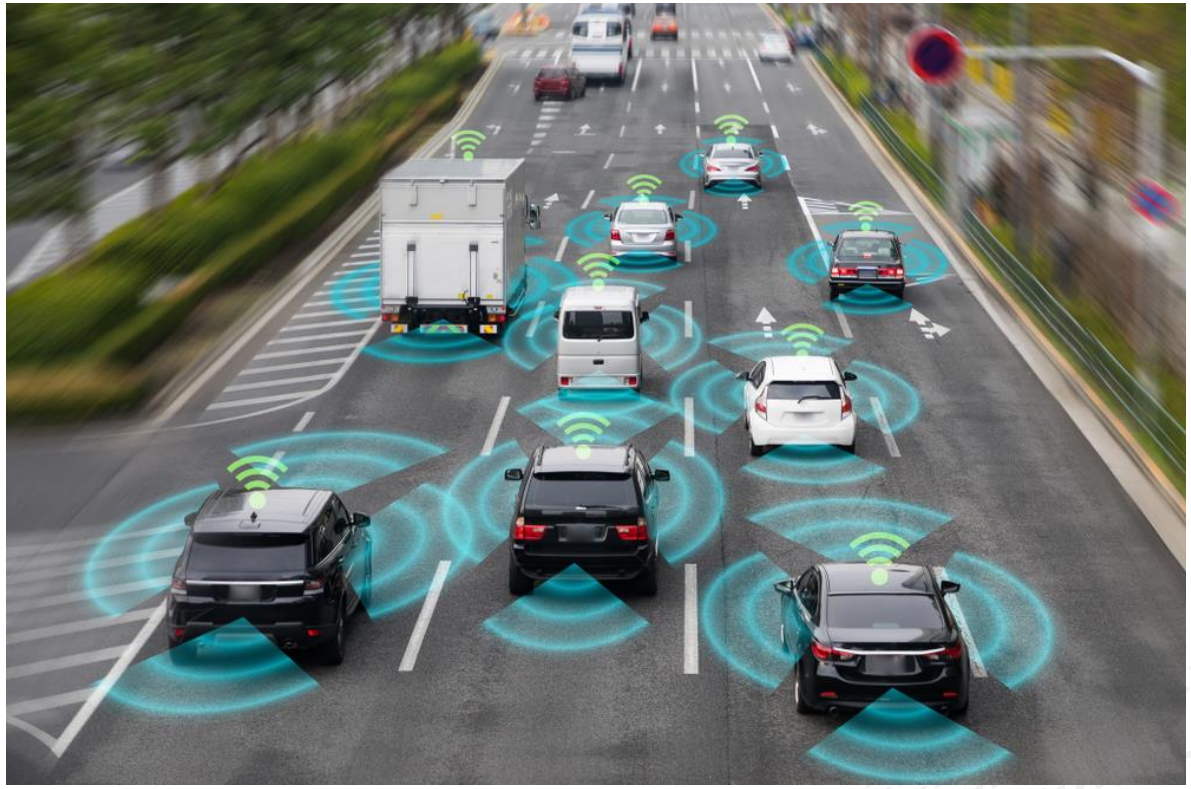


Facebook Ads

Fraud Prevention

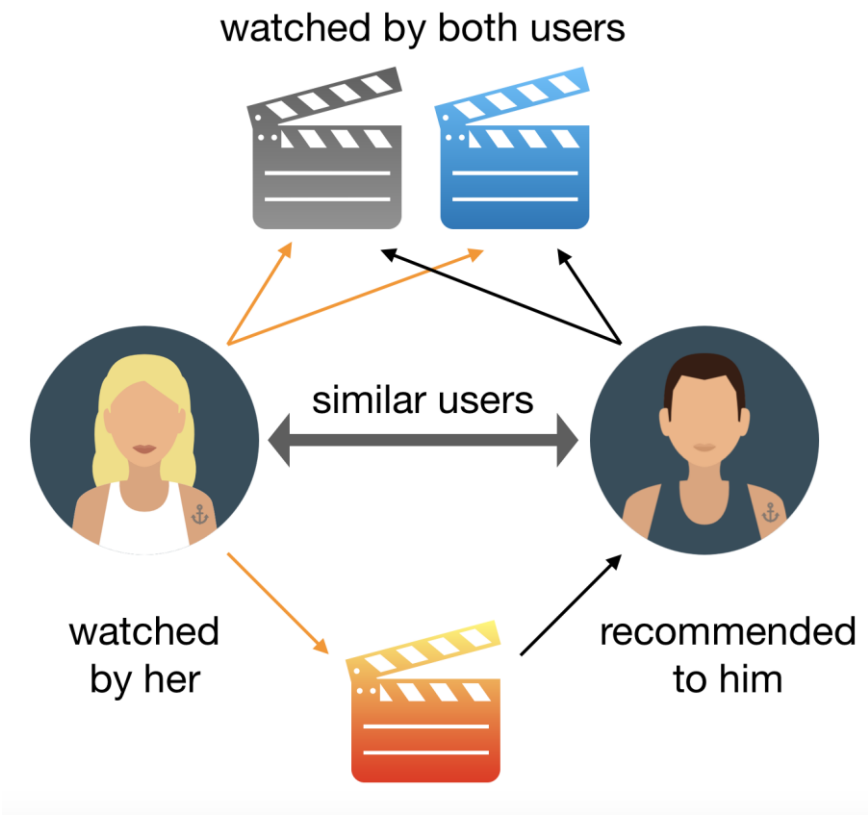
Applications of Machine Learning

Voice Assistants

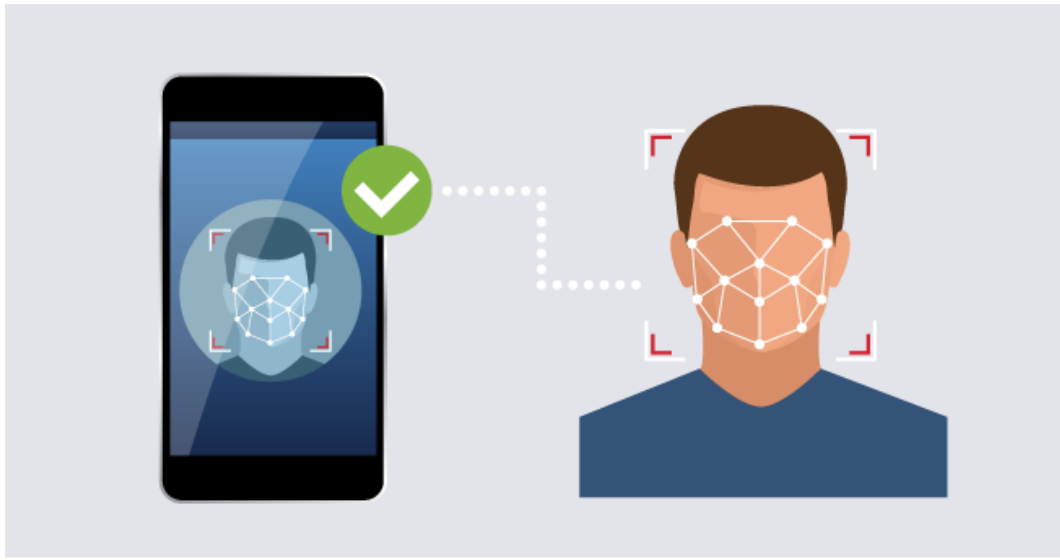


Autonomous Vehicles

Applications of Machine Learning



Recommendation System

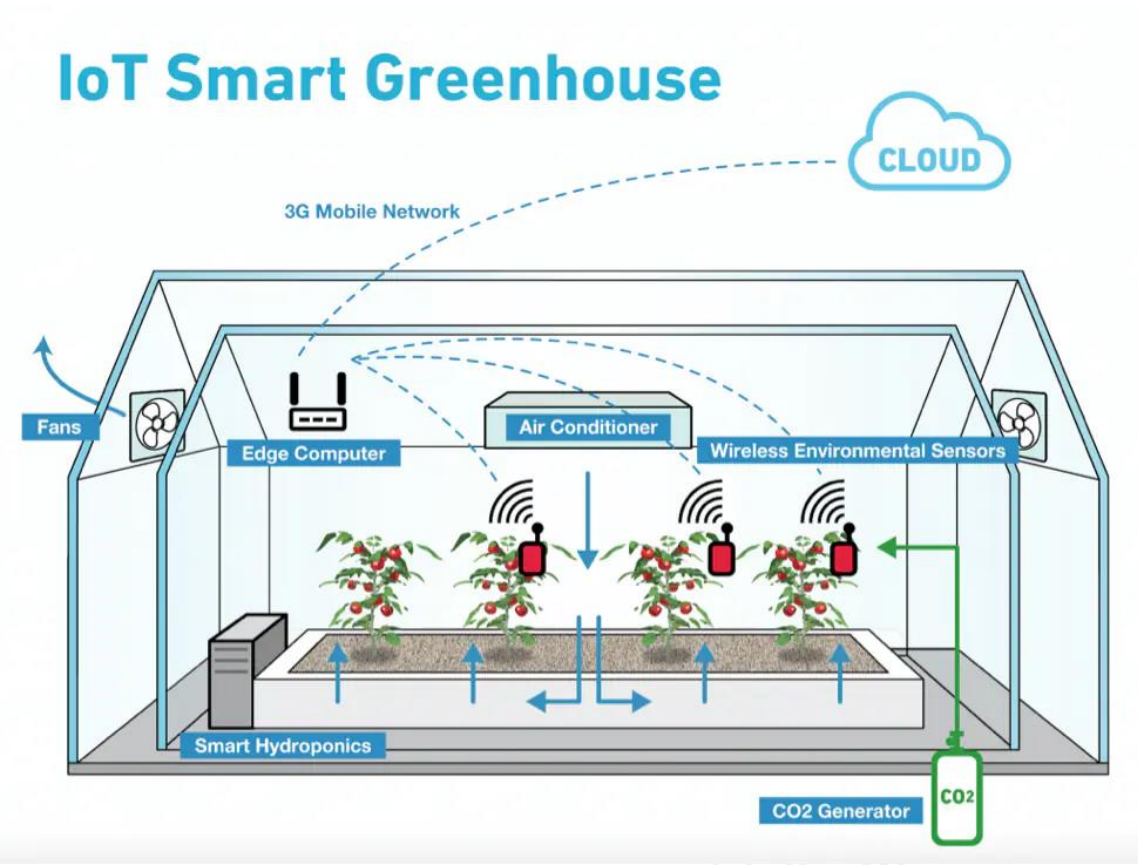


Source: Golden Sikorka/stock.adobe.com. | GAO-21-526

Facial Recognition

Applications of Machine Learning

Google Map



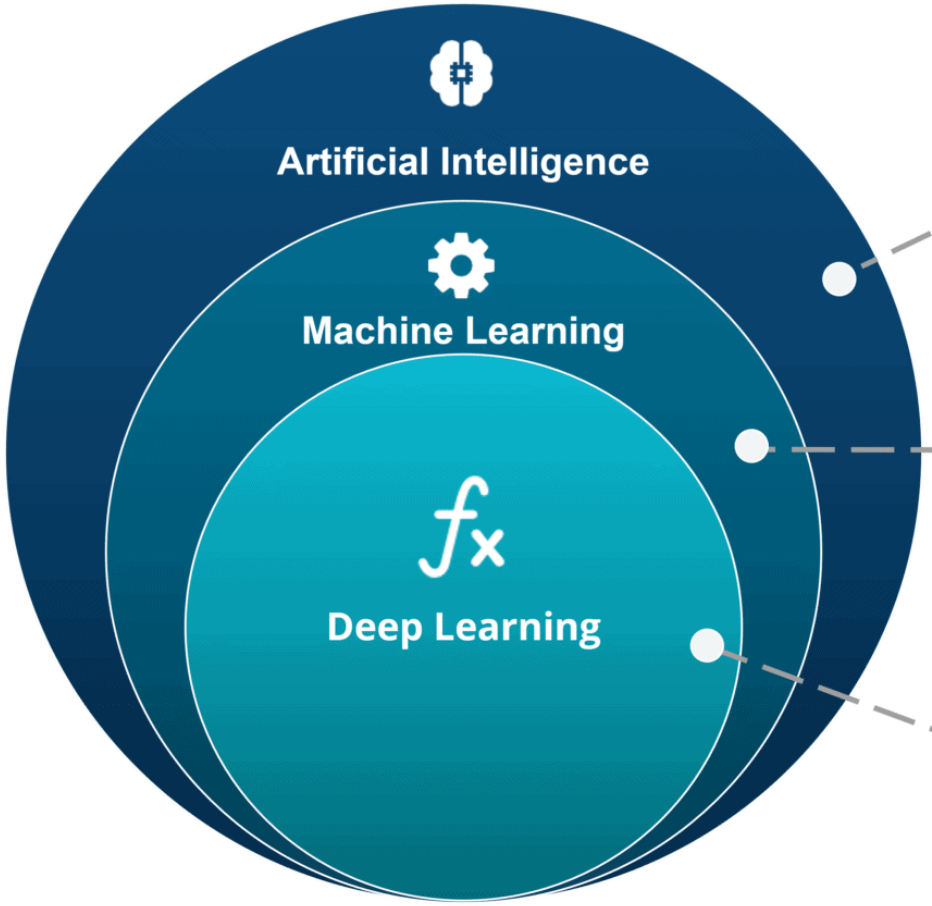
Smart Farm

Applications of Machine Learning

Chat Bot

Letter of Recommendation

Understanding AI, ML & DL



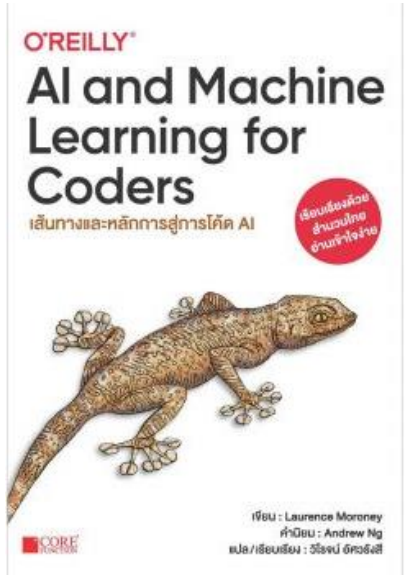
ARTIFICIAL INTELLIGENCE
A technique which enables machines to mimic human behaviour

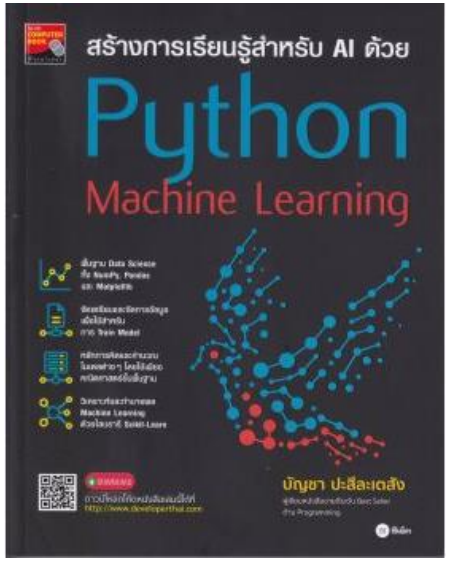
MACHINE LEARNING
Subset of AI technique which use statistical methods to enable machines to improve with experience

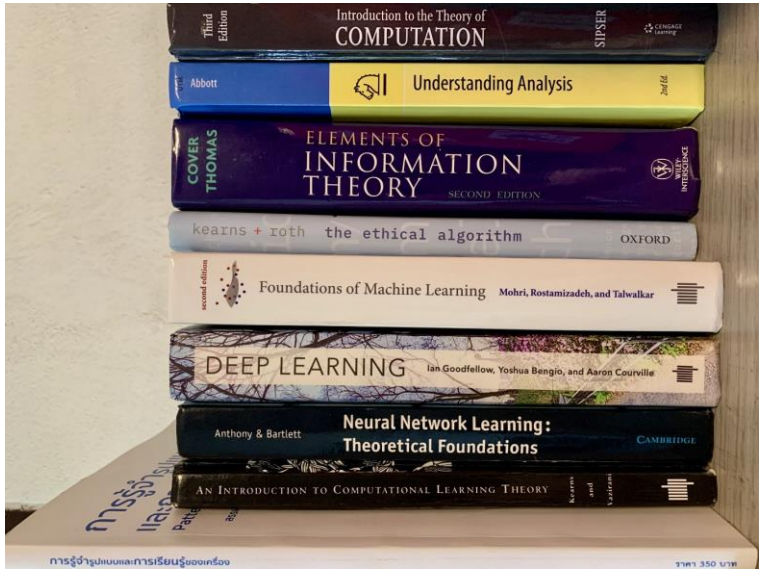
DEEP LEARNING
Subset of ML which make the computation of multi-layer neural network feasible

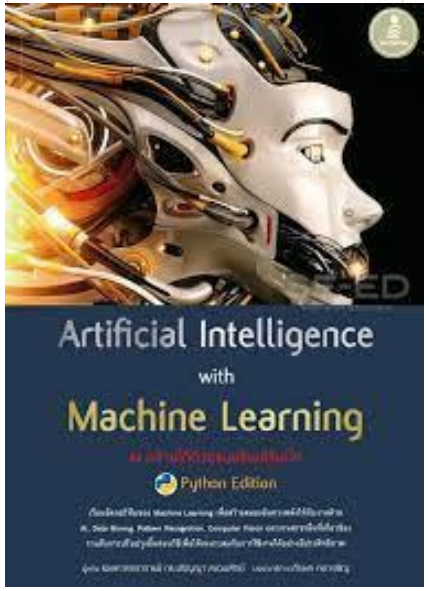
https://k21academy.com/datascience/deep-learning/dl-vs-ml/

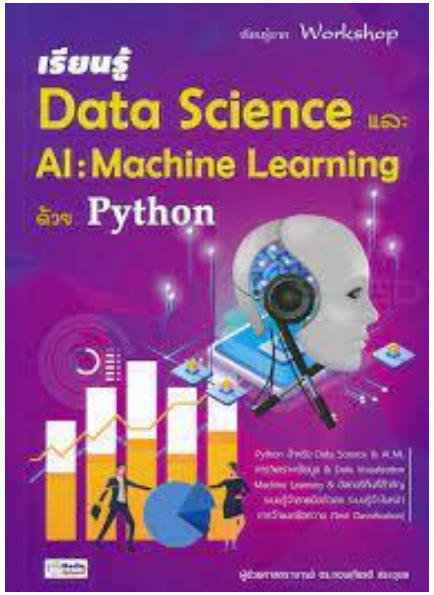
Material for Study



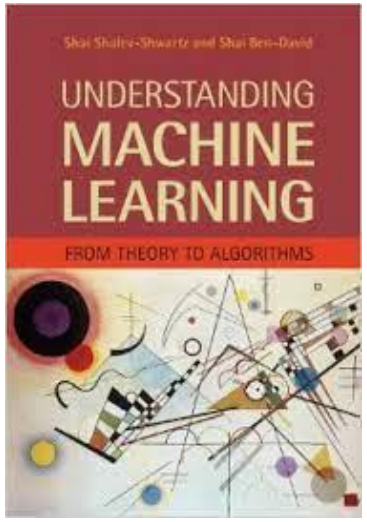








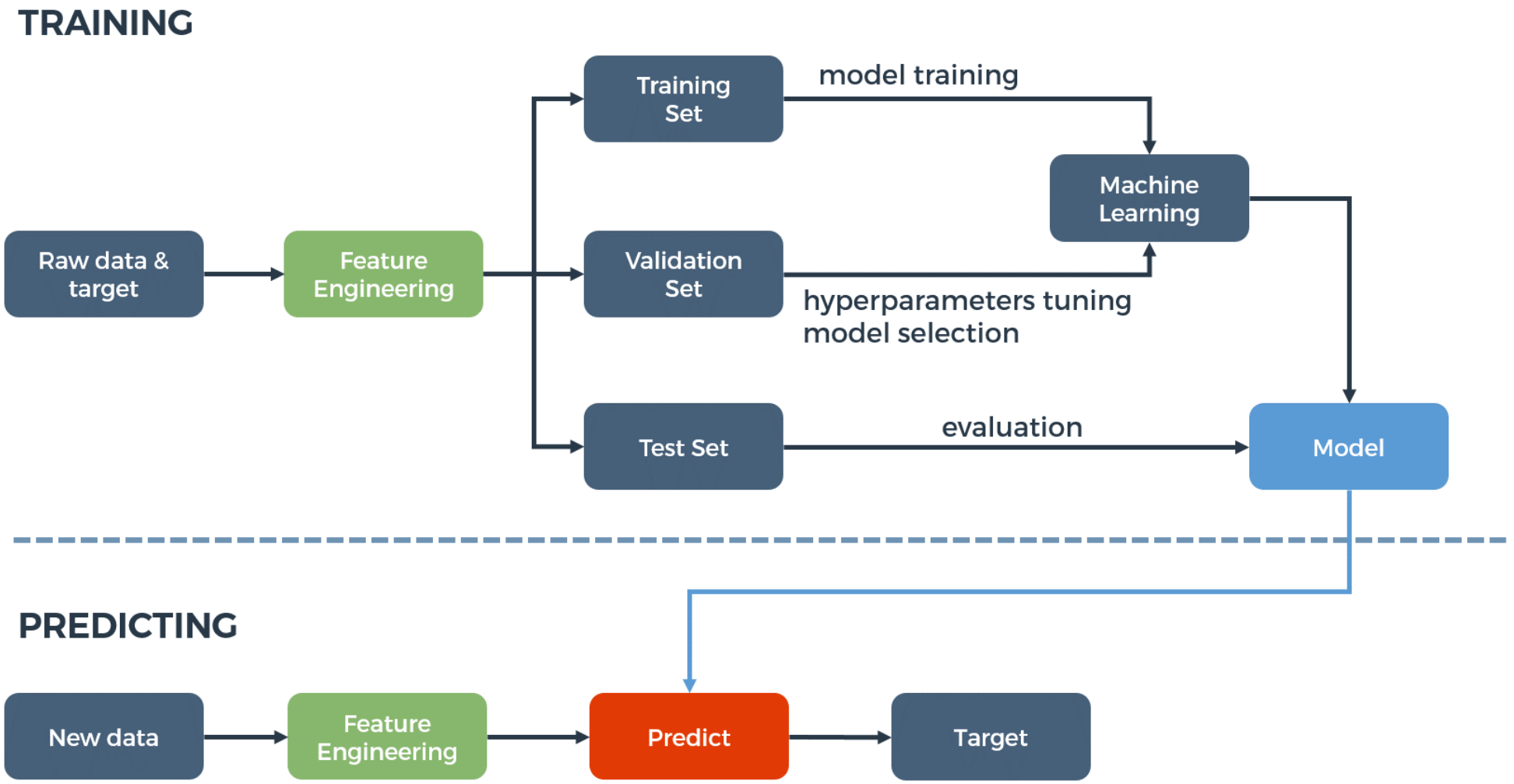
https://guopai.github.io



https://medium.com/@vacharapat/รีวิวหนังสือ-machine-learning-ด้านทฤษฎี-bf856f90283

APPLIED MACHINE LEARNING

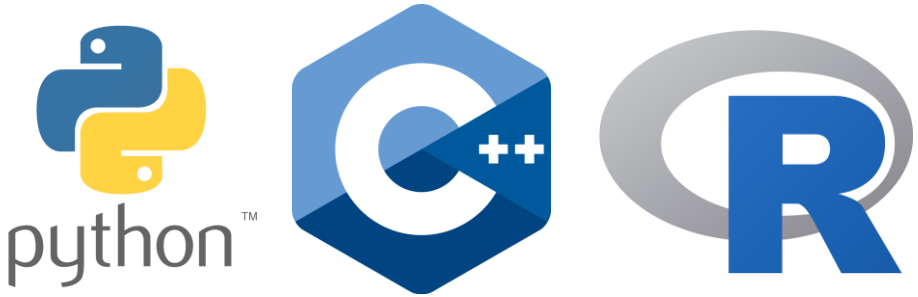
Machine Learning Process



https://hackernoon.com/a-brief-overview-of-automatic-machine-learning-solutions-automl-2826c7807a2a

Tools & Frameworks

ML Languages



Data Analysis and Visualization tools

General ML Frameworks

ML Frameworks for neural network modelling

https://www.pinterest.com/pin/technology--412290540891517265/

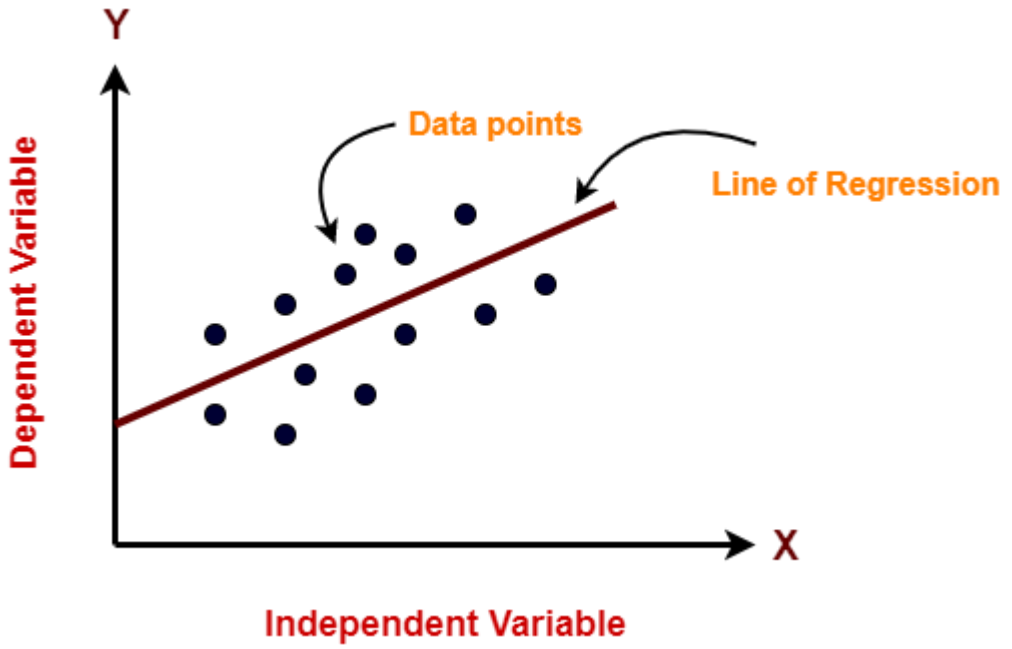

unplug

WORK SHOP
MACHINE LEARNING

Linear Regression

Simple Linear Regression

$$Y = \beta_0 + \beta_1 X$$



- Y is a dependent variable.
- X is an independent variable.
- β_0 and β_1 are the regression coefficients.
- β_0 is the intercept or the bias that fixes the offset to a line.
- β_1 is the slope or weight that specifies the factor by which X has an impact on Y.

https://www.gatevidyalay.com/linear-regression-machine-learning-examples/

Linear Regression

What is the best Model?

1. R Square/Adjusted R Square

$$R^2 = 1 - \frac{SS_{Regression}}{SS_{Total}} = 1 - \frac{\sum_i (y_i - \hat{y}_i)^2}{\sum_i (y_i - \bar{y})^2}$$

2. Mean Square Error(MSE)/Root Mean Square Error(RMSE)

$$MSE = \frac{1}{N} \sum_{i=1}^{N} (y_i - \hat{y}_i)^2$$

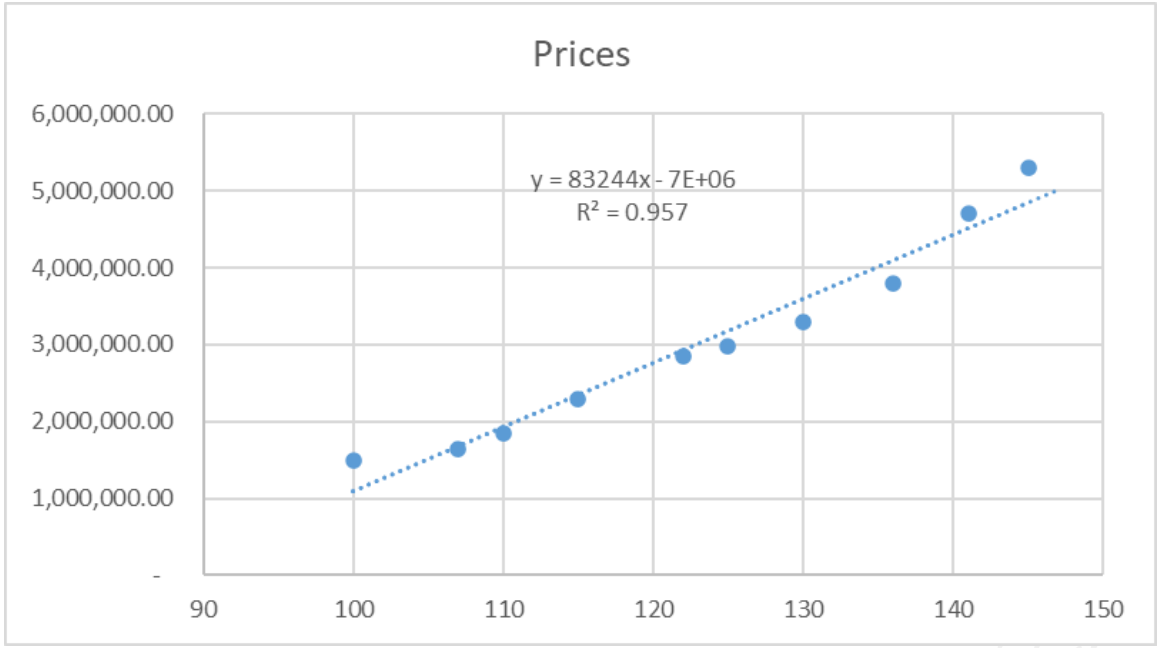
3. Mean Absolute Error(MAE)

$$MAE = \frac{1}{N} \sum_{i=1}^{N} |y_i - \hat{y}_i|$$

Linear Regression

Ex. Simple Linear Regression

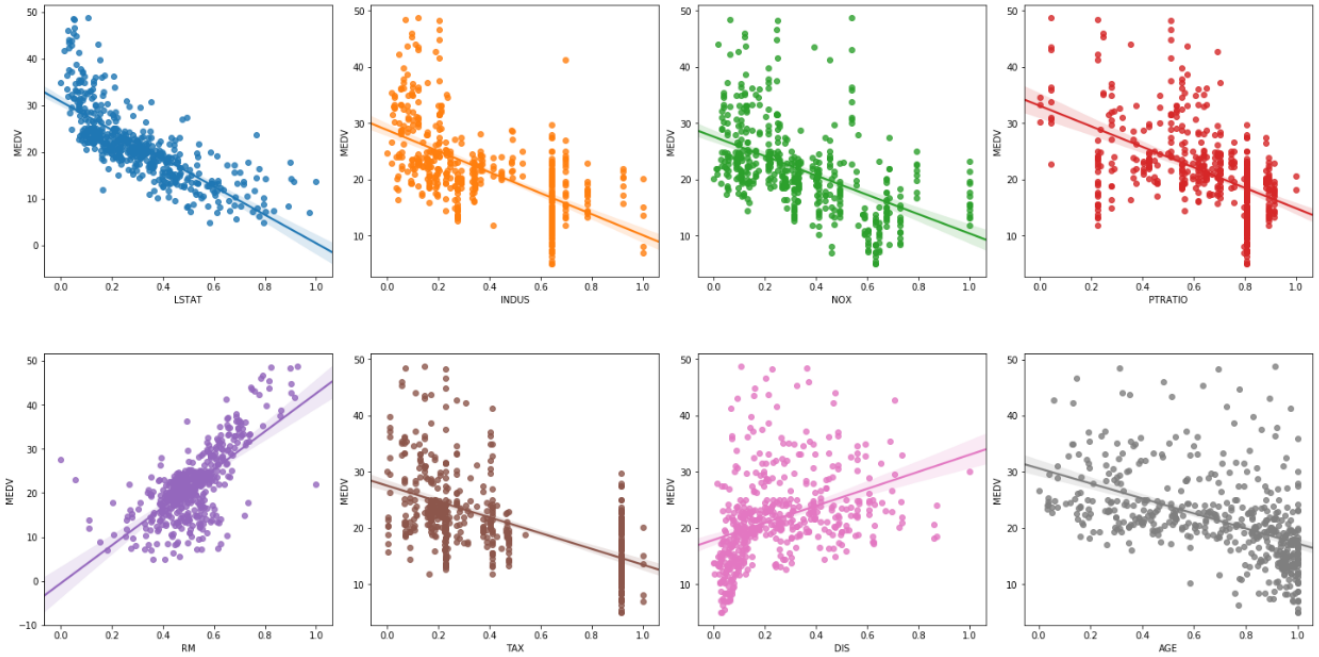
Square Meter	Prices
100	1,500,000.00
107	1,650,000.00
110	1,840,000.00
115	2,300,000.00
122	2,850,000.00
125	2,975,000.00
130	3,300,000.00
136	3,800,000.00
141	4,700,000.00
145	5,300,000.00



Prediction = ??

Linear Regression

Multiple Linear Regression



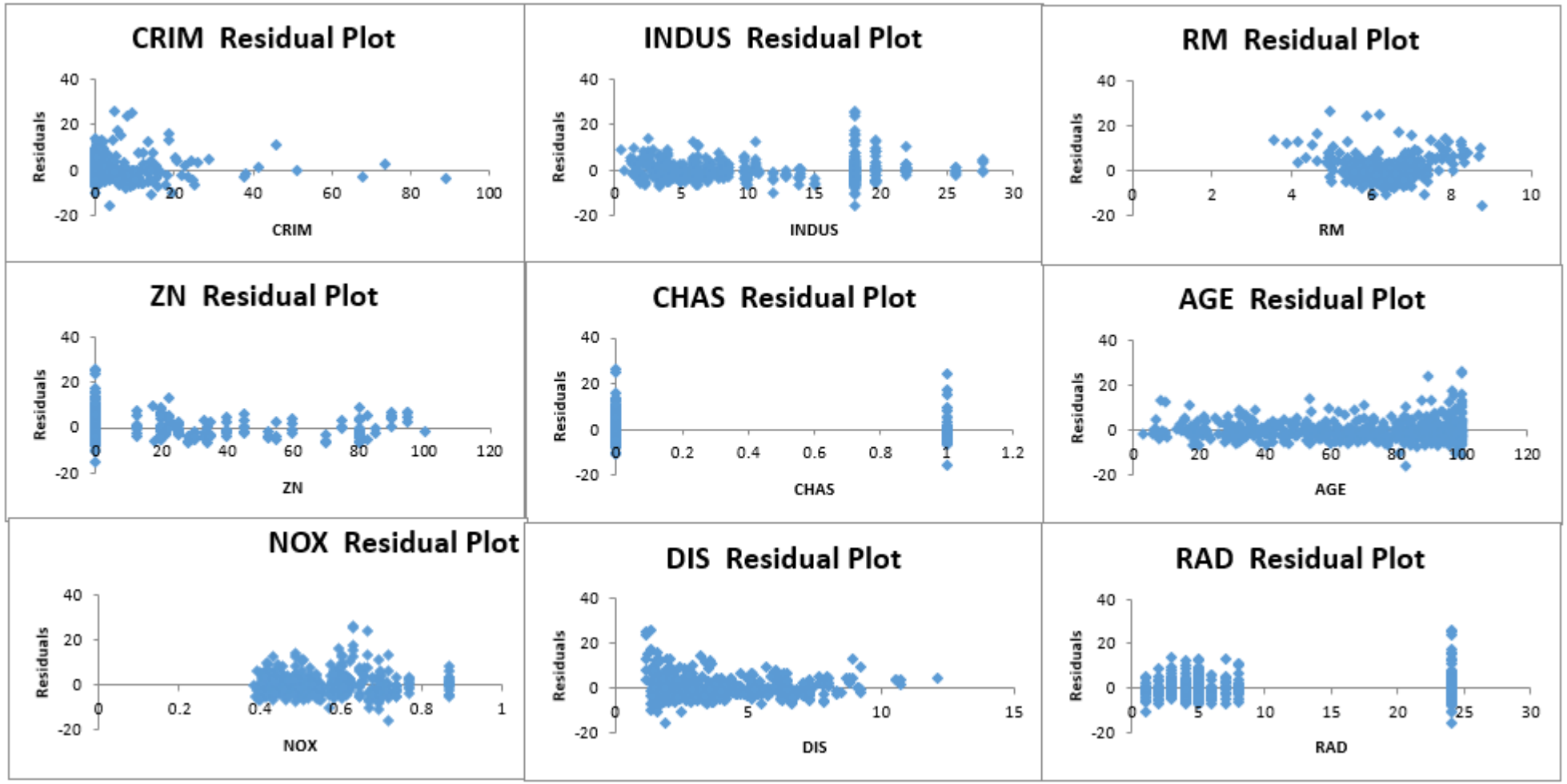
$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots\ldots + \beta nXn$$

- Y is a dependent variable.
- X1, X2, …., Xn are independent variables.
- β0, β1,…, βn are the regression coefficients.
- βj (1<=j<=n) is the slope or weight that specifies the factor by which Xj has an impact on Y.

https://i.stack.imgur.com/ADwJJ.png

Linear Regression

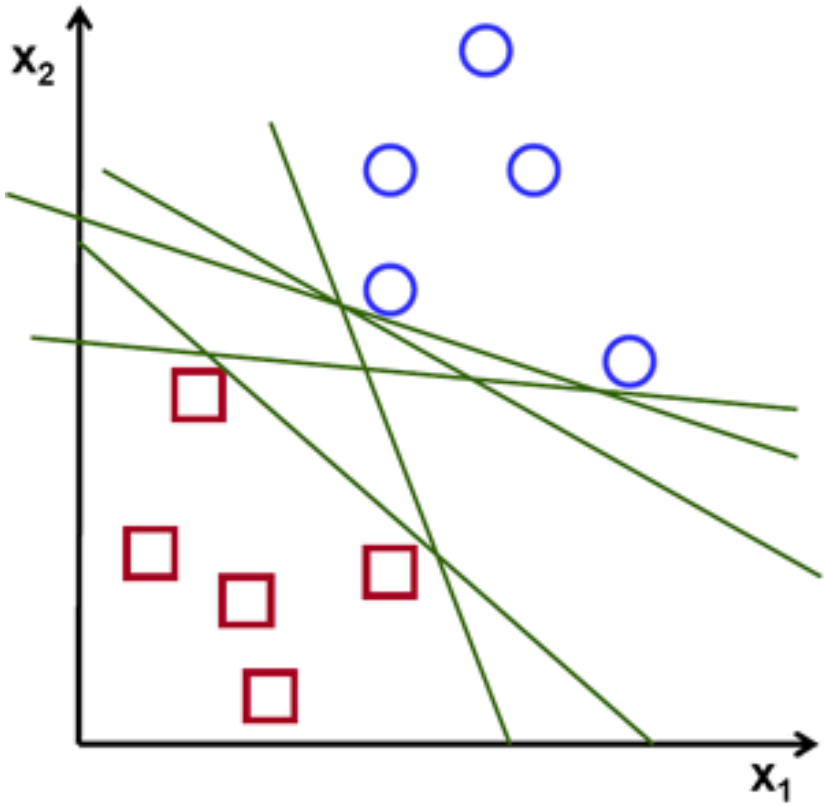
Ex. Multiple Linear Regression

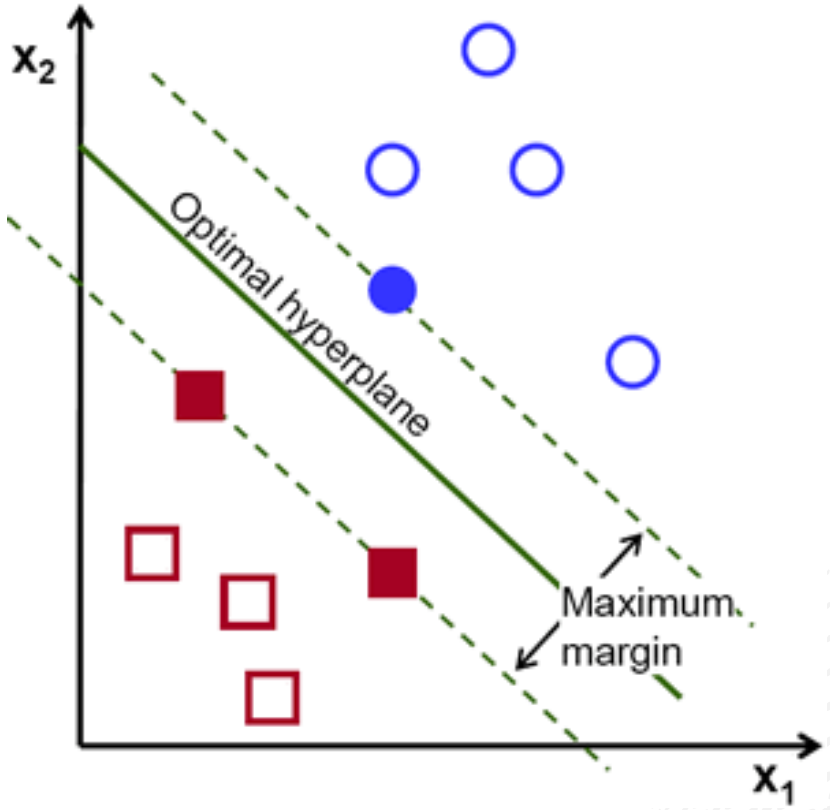


https://github.com/khwanck/IntroductionML

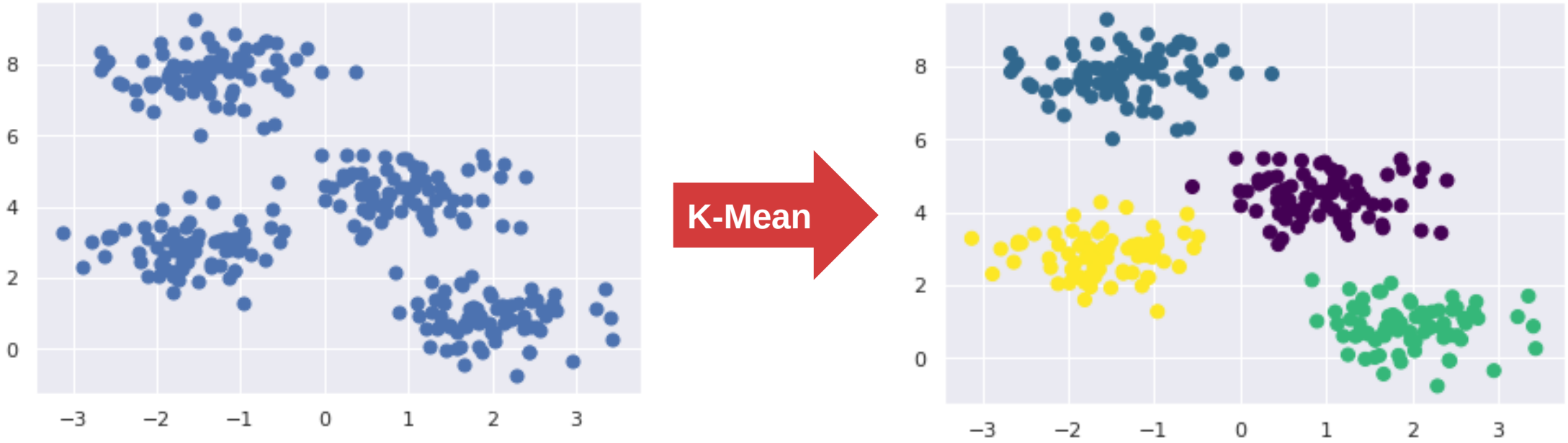
Support-Vector Machines

The objective of the support vector machine algorithm is to find a hyperplane in an N-dimensional space(N — the number of features) that distinctly classifies the data points.





K-Mean Clustering

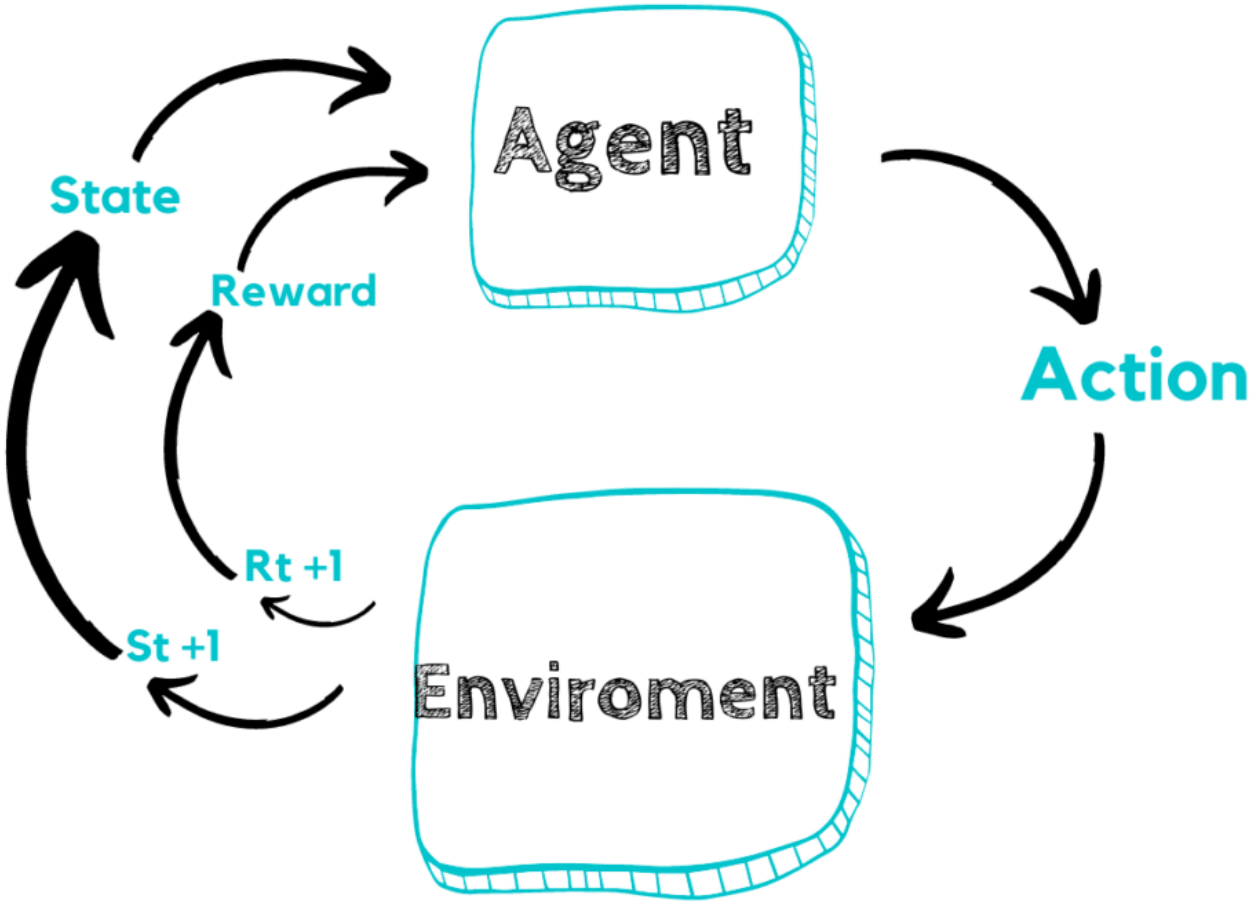


Principal Component Analysis

Noise in Dataset

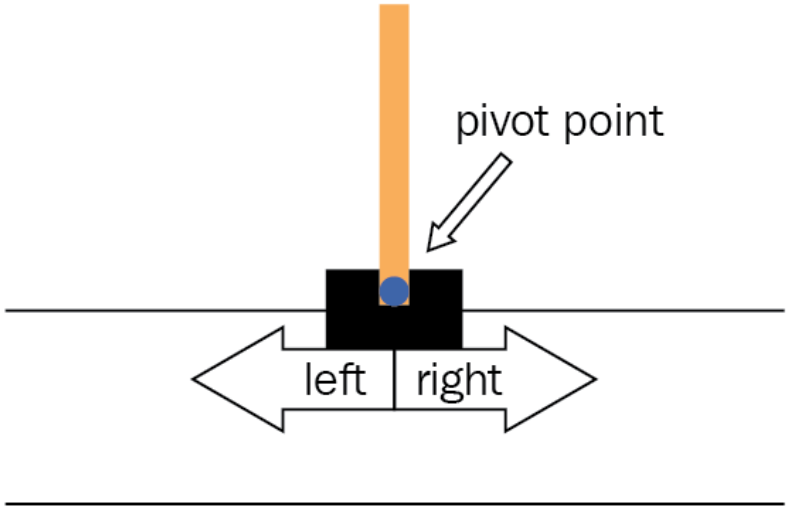
PCA as Noise Filtering

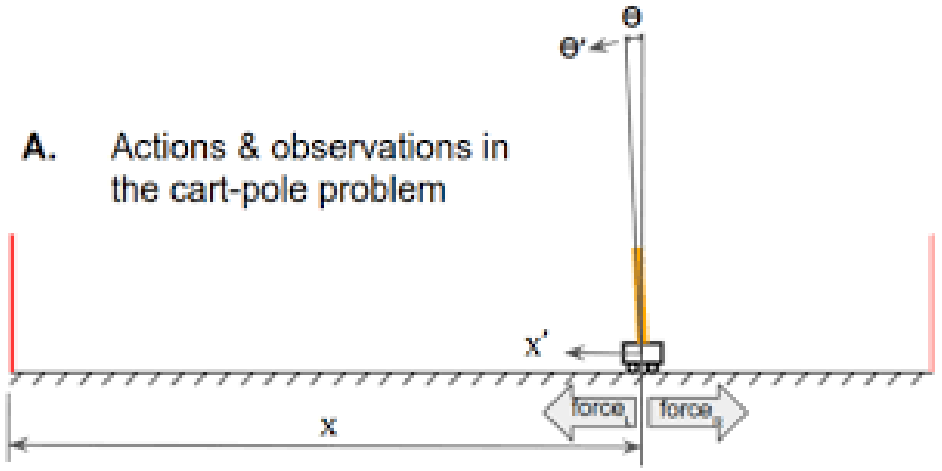
Reinforcement Learning



Reinforcement Learning

Cartpole using RL





Thanks !