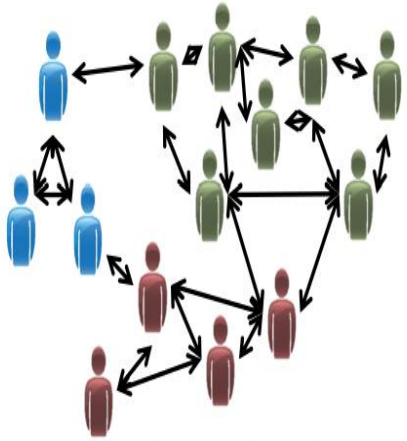
Google Developer Student Clubs

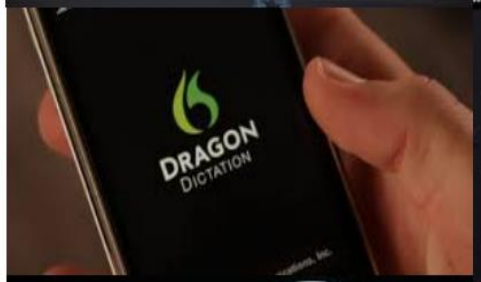
MNNIT Allahabad

ML STUDY JAM 2023

Organize computing clusters

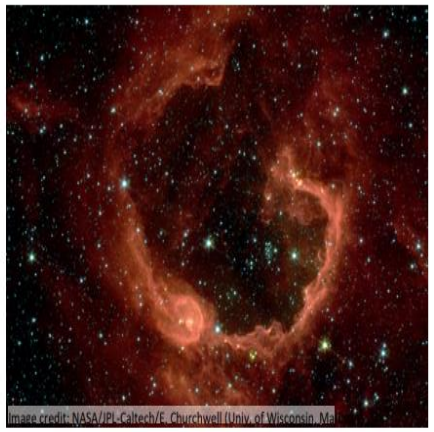


Social network analysis



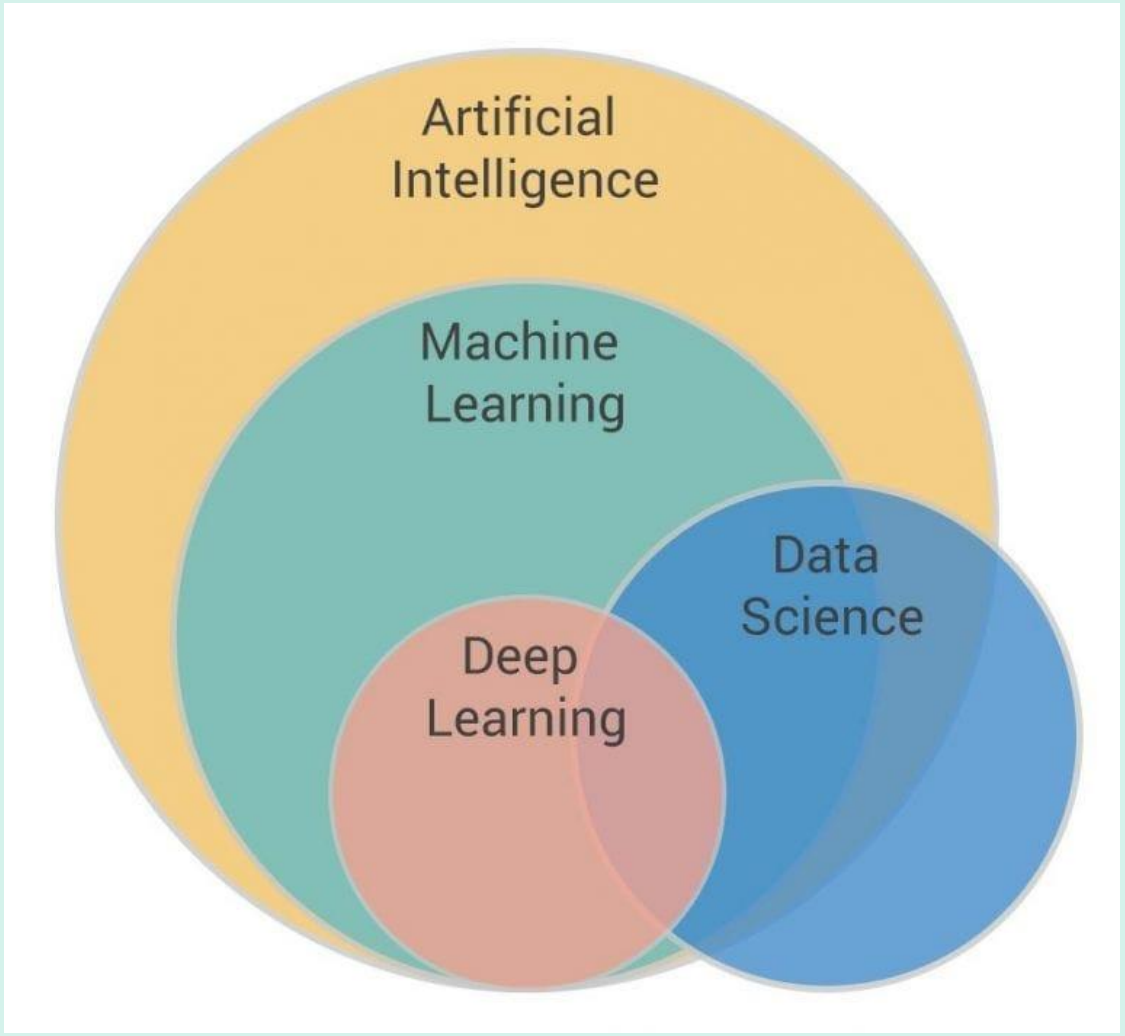
e credit: Li Deng, MS Research

Market segmentation



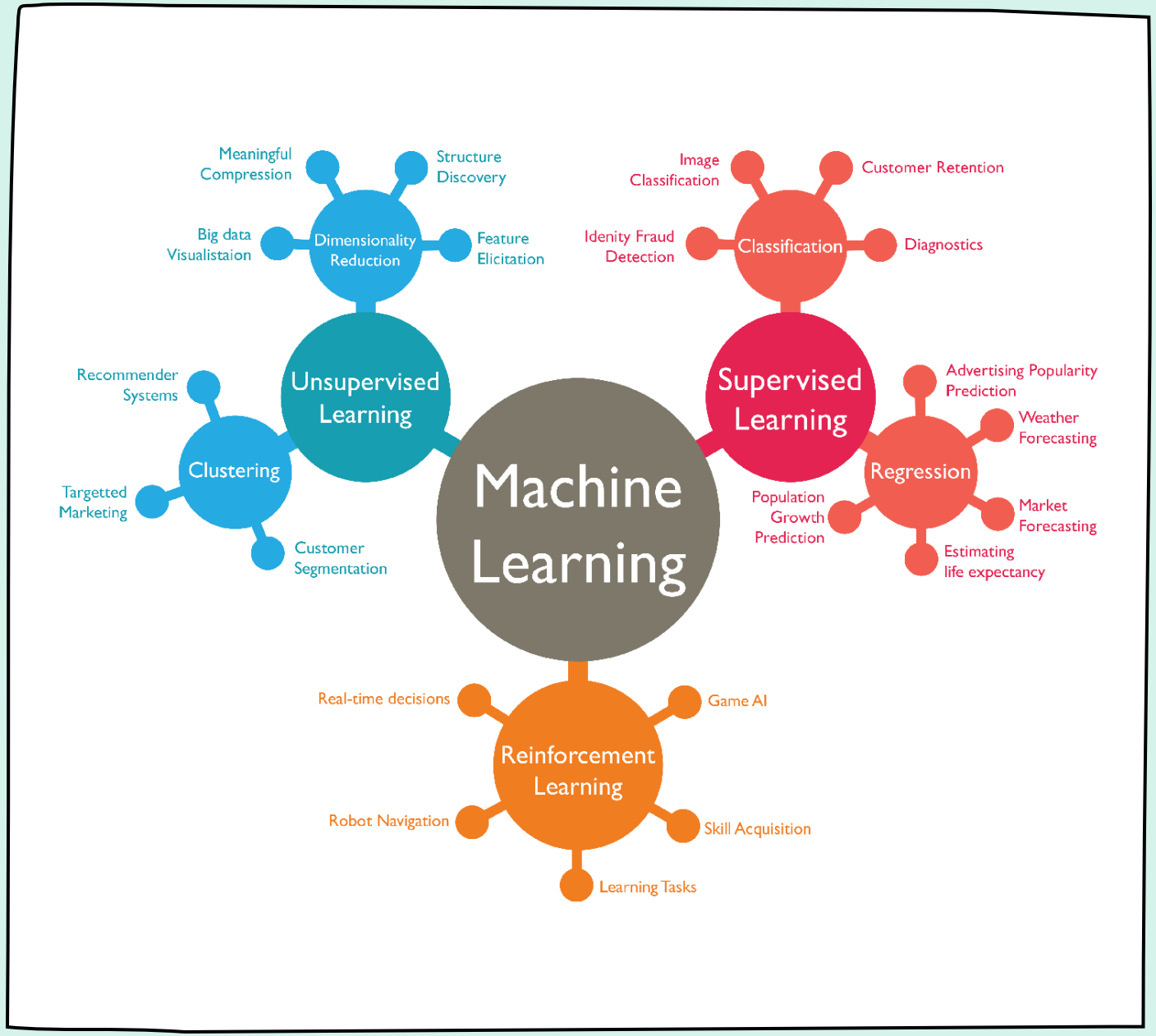
Astronomical data analysis


Multimedia
Security
Handwriting recognition
Recommender systems
Face detection
CRM (Customer relationship management)
Personalization
Image processing
Computer vision
Natural language processing
Marketing
Text summarization
Manufacturing
Computer Security
Search engine
Face tracking
Sentiment analysis
Market basket analysis
Information retrieval
Face recognition
Diagnosis
Game
Bioinformatics
Speech recognition
Gene expression
E-commerce
Medicine
Anomaly detection
Human interaction
Intrusion detection system
Collaborative filtering
Object recognition
Fraud detection
Spam

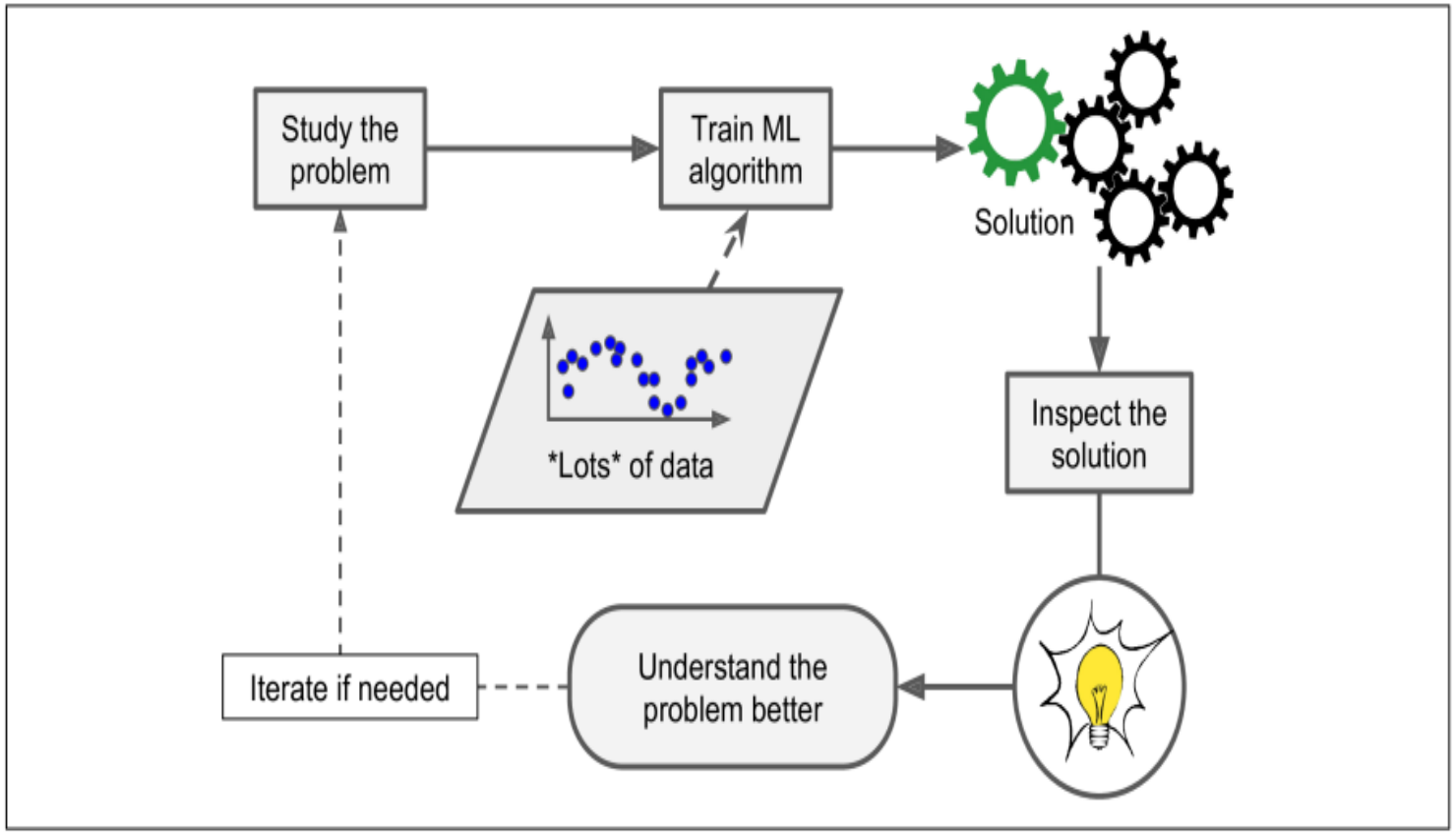


WHAT IS MACHINE LEARNING?

- *Machine learning is an application of AI that enables systems to learn and improve from experience without being explicitly programmed.*
- *A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E.*



TYPES OF MACHINE LEARNING



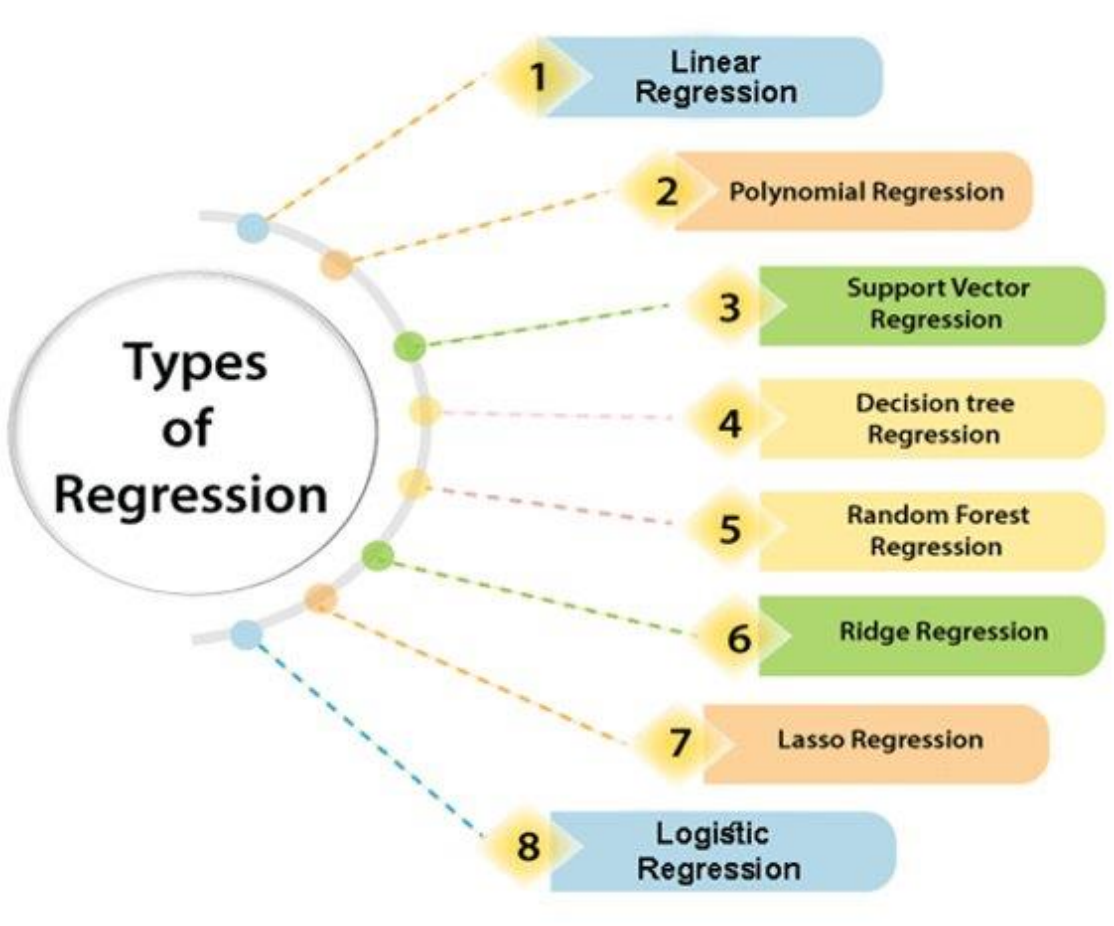
A TYPICAL MACHINE LEARNING WORKFLOW

SUPERVISED LEARNING

Supervised learning is a type of machine learning method in which we provide sample labeled data to the machine learning system in order to train it, and on that basis, it predicts the output.

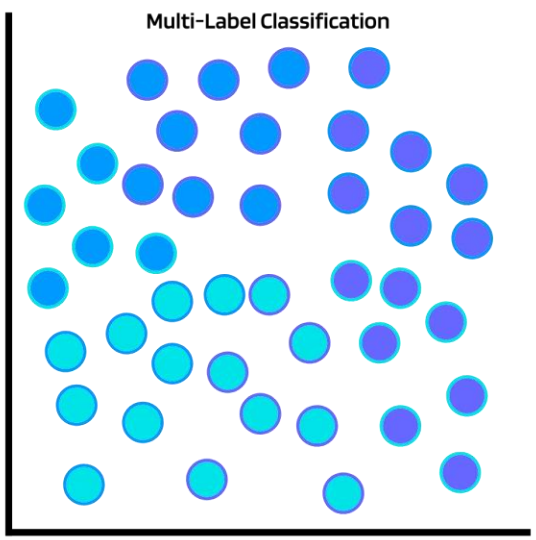
Types of Supervised Learning:

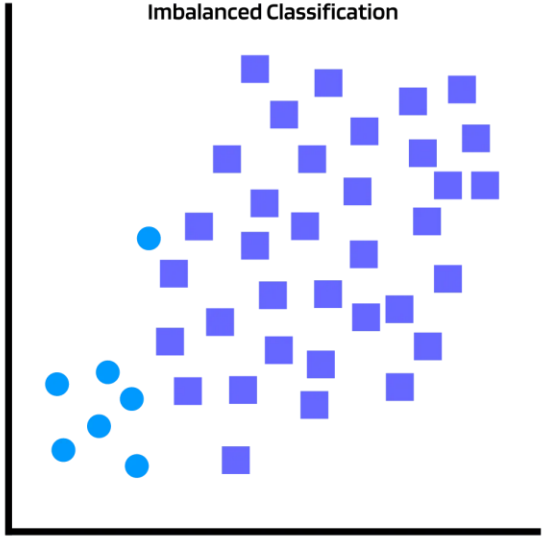
- *Regression*
- *Classification*
- *Naïve Bayesian Model*
- *Random Forest Model*
- *Neural Networks*
- *Support Vector Machines*

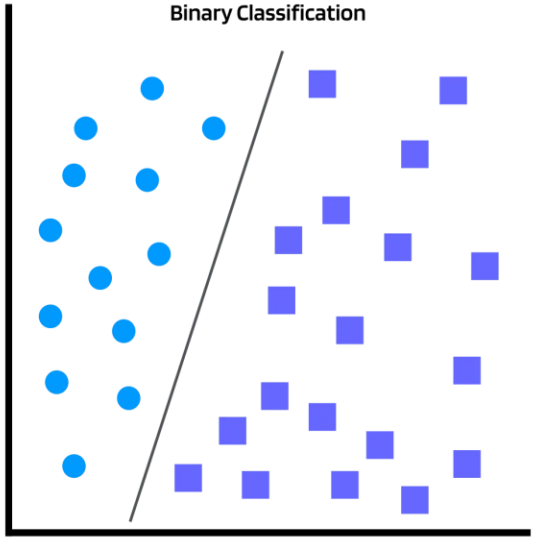


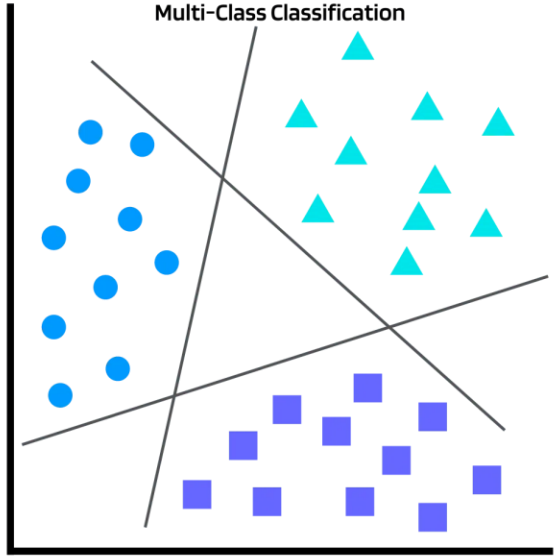
REGRESSION

A regression is a statistical technique that relates a dependent variable to one or more independent (explanatory) variables.









CLASSIFICATION

Classification is a type of supervised learning technique in machine learning that involves assigning a label or category to input data based on its features.

UNSUPERVISED LEARNING

Unsupervised learning is a learning method in which a machine learns without any supervision.

In unsupervised learning, we don't have a predetermined result. The machine tries to find useful insights from the huge amount of data. It can be further classifieds into two categories of algorithms:

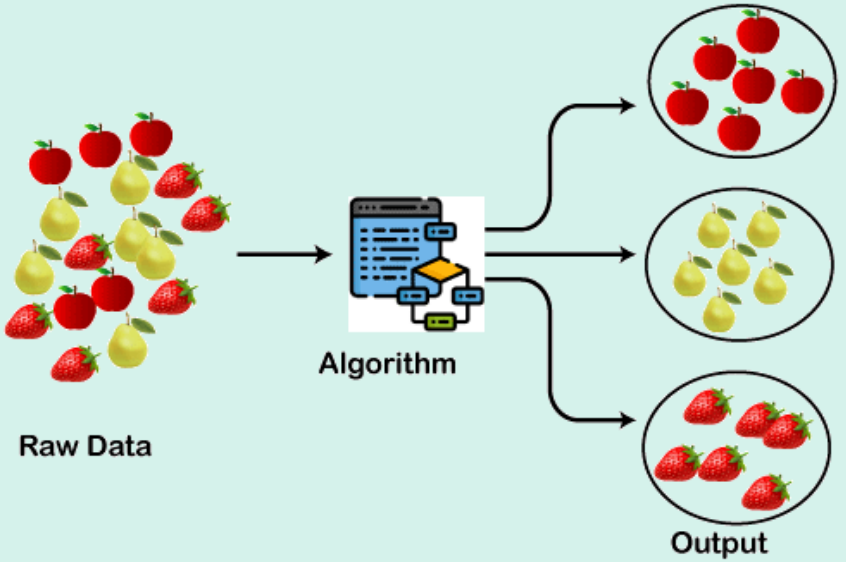
- *Clustering*
- *Anomaly Detection and Novelty detection*
- *Dimensionality Reduction*

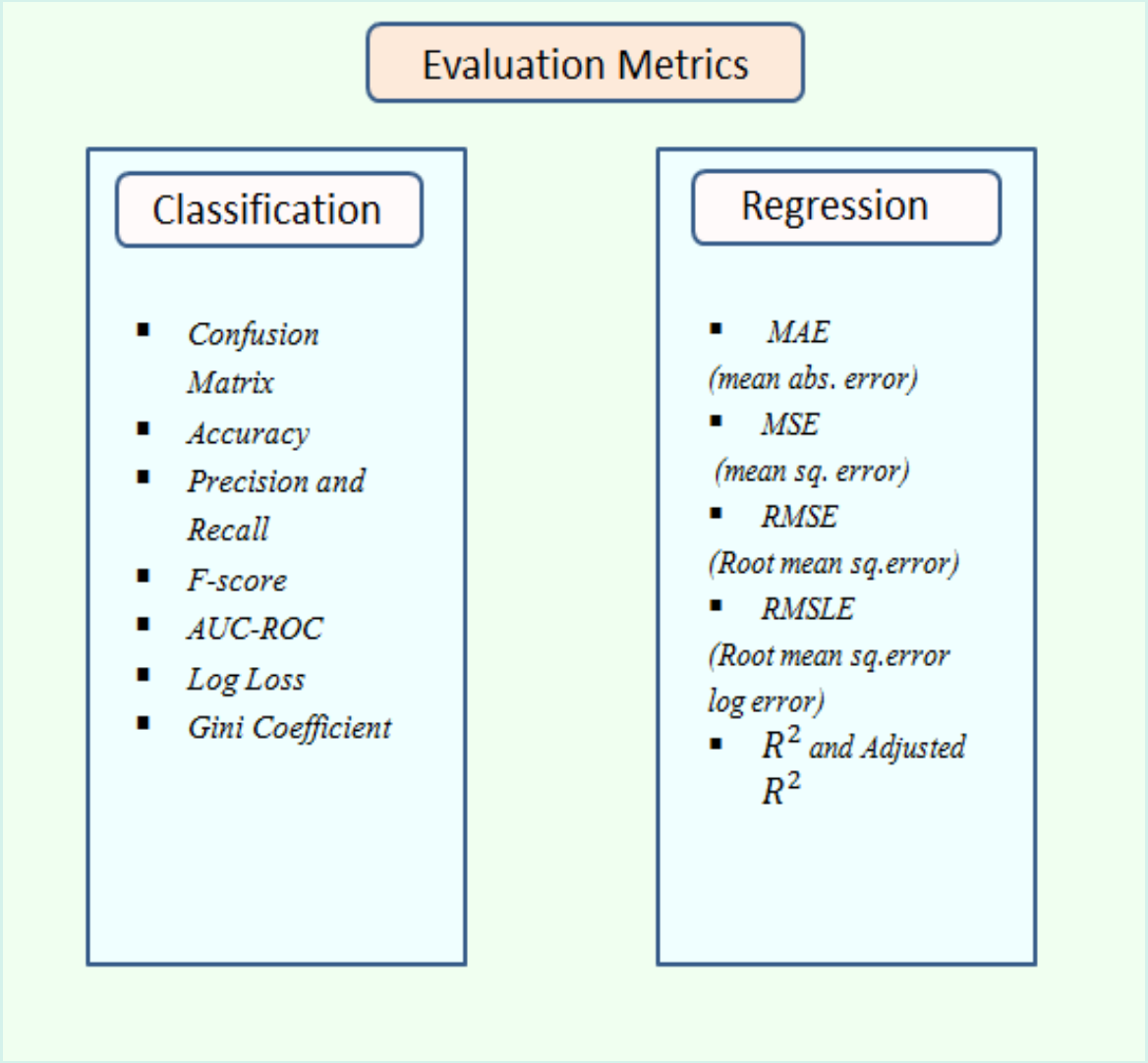
CLUSTERING

A way of grouping the data points into different clusters, consisting of similar data points. The objects with the possible similarities remain in a group that has less or no similarities with another group.

Some common applications for clustering include the following:

- *market segmentation*
- *social network analysis*
- *search result grouping*
- *medical imaging*
- *image segmentation*
- *anomaly detection*



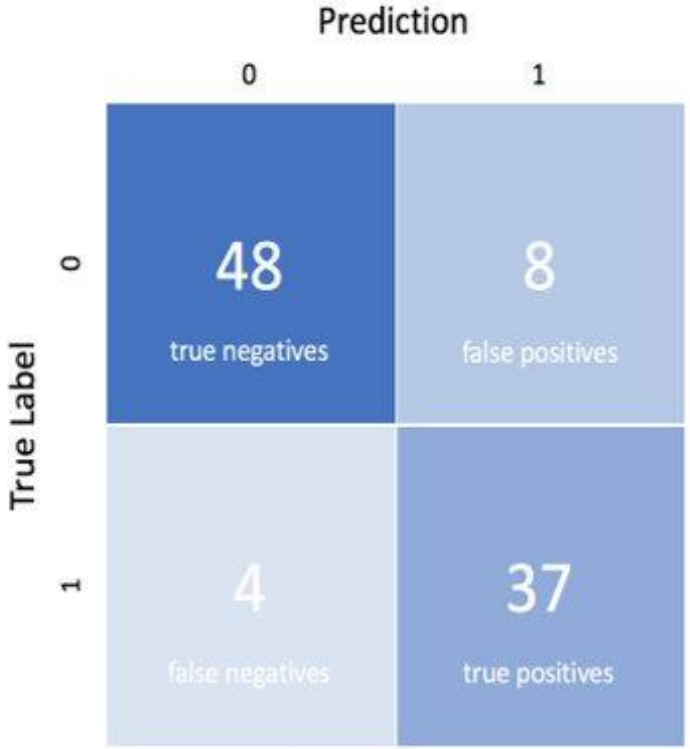


MODEL EVALUATION

Model evaluation is the process that uses some metrics which help us to analyze the performance of the model.

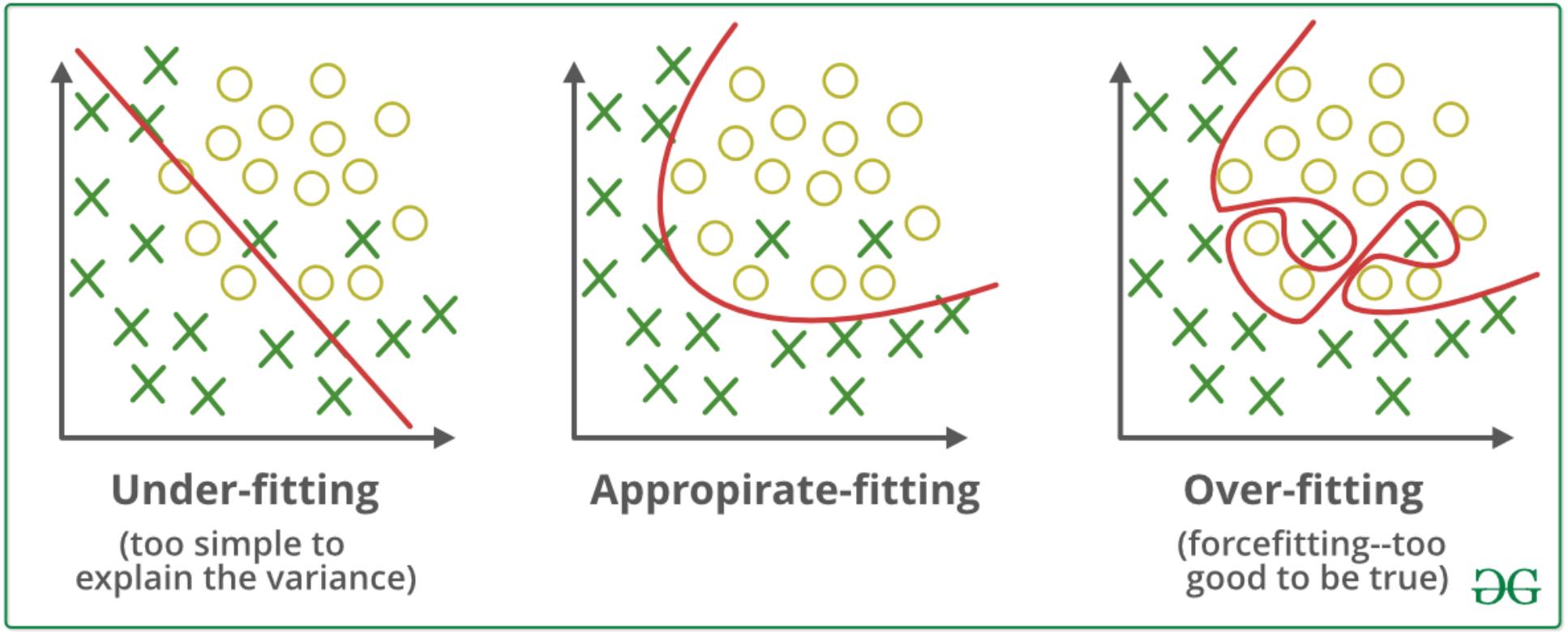
WHICH METRIC?? WHICH MODEL??

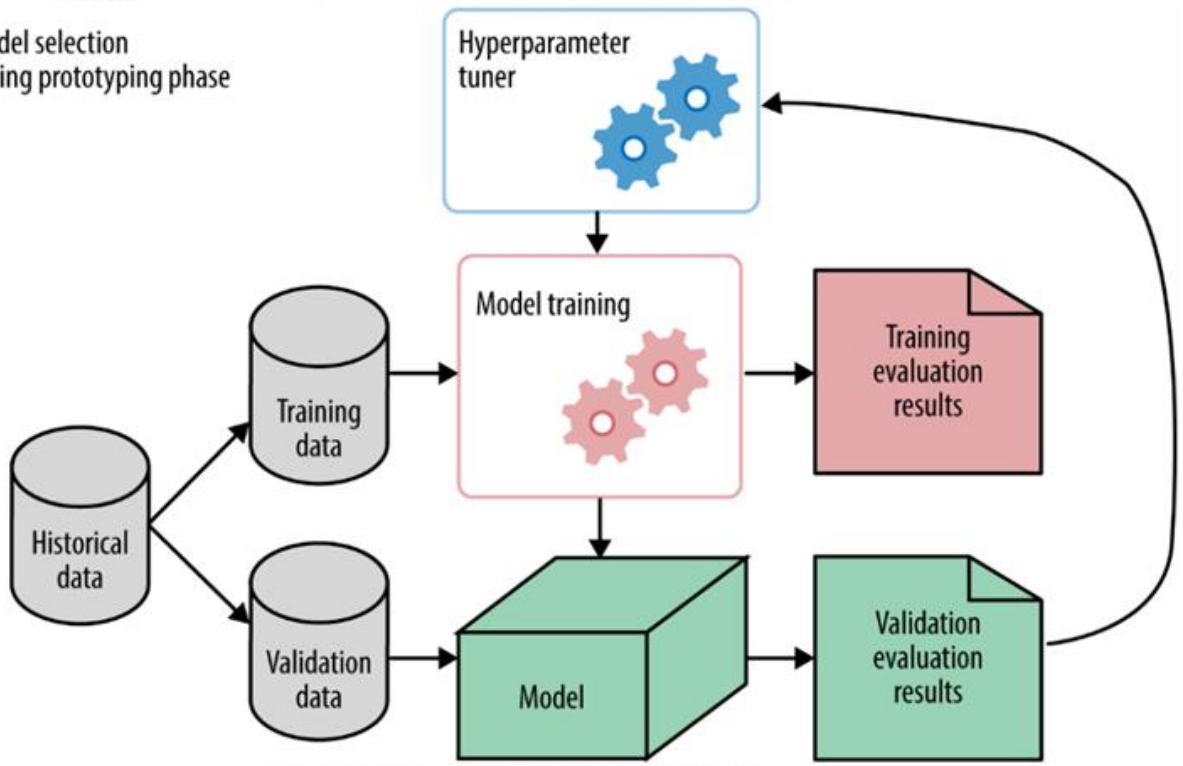
LET'S DO SOME BASIC MATHS!!



Metric	Formula
True positive rate, recall	$\frac{TP}{TP+FN}$
False positive rate	$\frac{FP}{FP+TN}$
Precision	$\frac{TP}{TP+FP}$
Accuracy	$\frac{TP+TN}{TP+TN+FP+FN}$
F-measure	$\frac{2 \cdot precision \cdot recall}{precision + recall}$

DID OUR MODEL STUDIED A LOT?



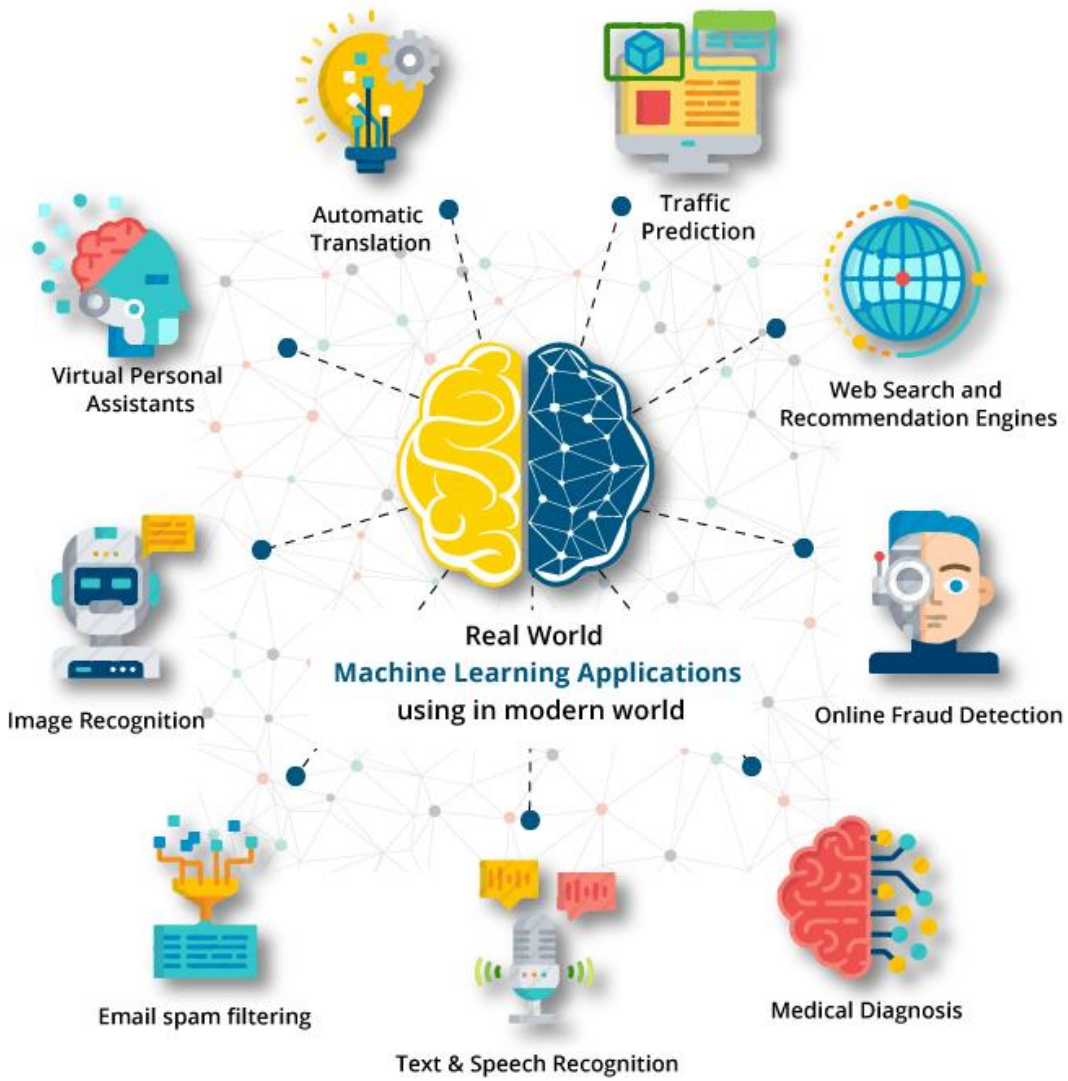


HYPERPARAMETER TUNING

A Machine Learning model is defined as a mathematical model with a number of parameters that need to be learned from the data.

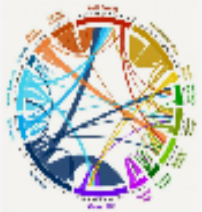
Hyperparameters are parameters that cannot be directly learned from the regular training process. These parameters express important properties of the model such as its complexity or how fast it should learn.

REAL WORLD APPLICATIONS OF DEEP LEARNING



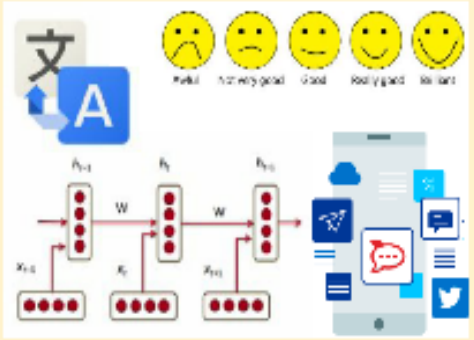
Deep Learning-based Applications

Social Network Analysis



Autonomous Driving

Natural Language Processing

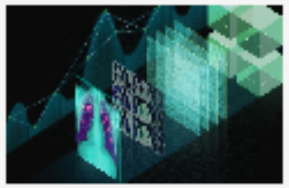


Sentiment Classification
Entity Extraction
Translation

Visual Data Processing

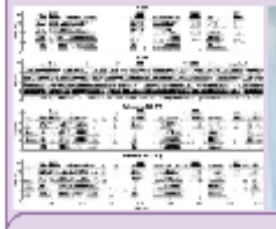
Computer Vision
Multimedia Data Analysis

Biomedicine



Disaster

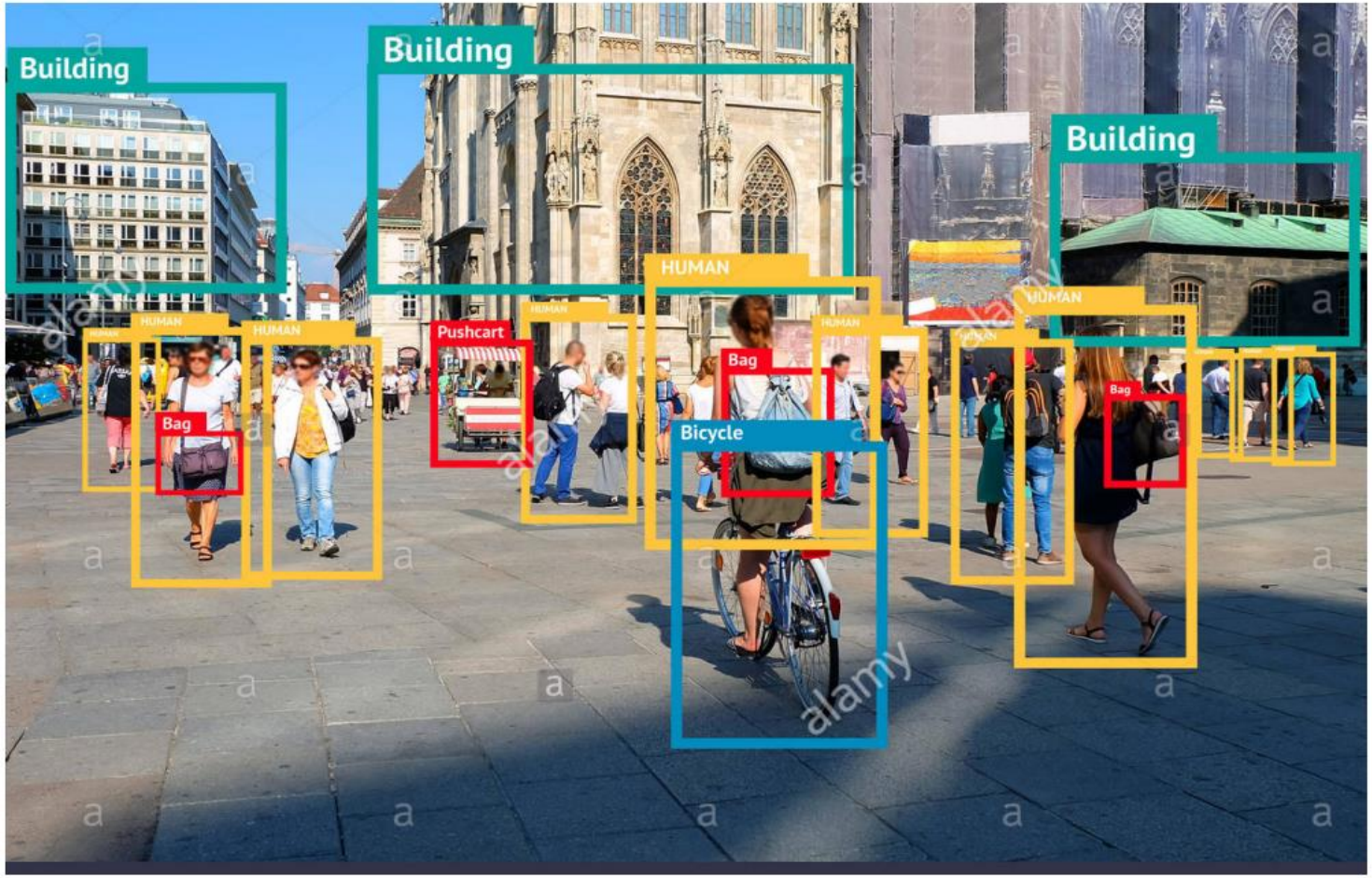
Speech and Audio Processing



Speech Enhancement
Speech Recognition

Information Retrieval

Image segmentation & recognition



Breakthroughs with neural networks

AlphaGo

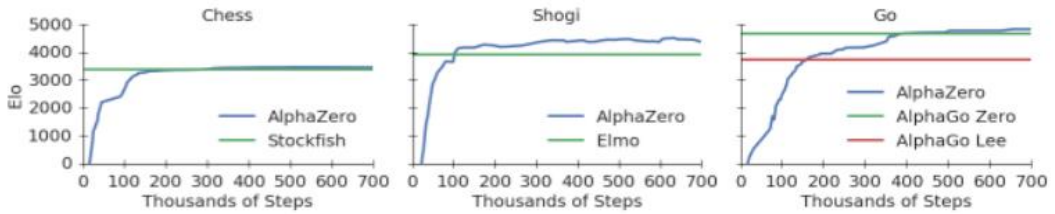


Figure 1: Training *AlphaZero* for 700,000 steps. Elo ratings were computed from evaluation games between different players when given one second per move. **a** Performance of *AlphaZero* in chess, compared to 2016 TCEC world-champion program *Stockfish*. **b** Performance of *AlphaZero* in shogi, compared to 2017 CSA world-champion program *Elmo*. **c** Performance of *AlphaZero* in Go, compared to *AlphaGo Lee* and *AlphaGo Zero* (20 block / 3 day) (*29*).

Breakthroughs with neural networks

ThisPersonDoesNotExist.com uses AI to generate endless fake faces

Hit refresh to lock eyes with another imaginary stranger

By James Vincent | Feb 15, 2019, 7:38am EST

SHARE

A few sample faces — all completely fake — created by ThisPersonDoesNotExist.com

https://www.theverge.com/tldr/2019/2/15/18226005/ai-generated-fake-people-portraits-thispersondoesnotexist-stylegan

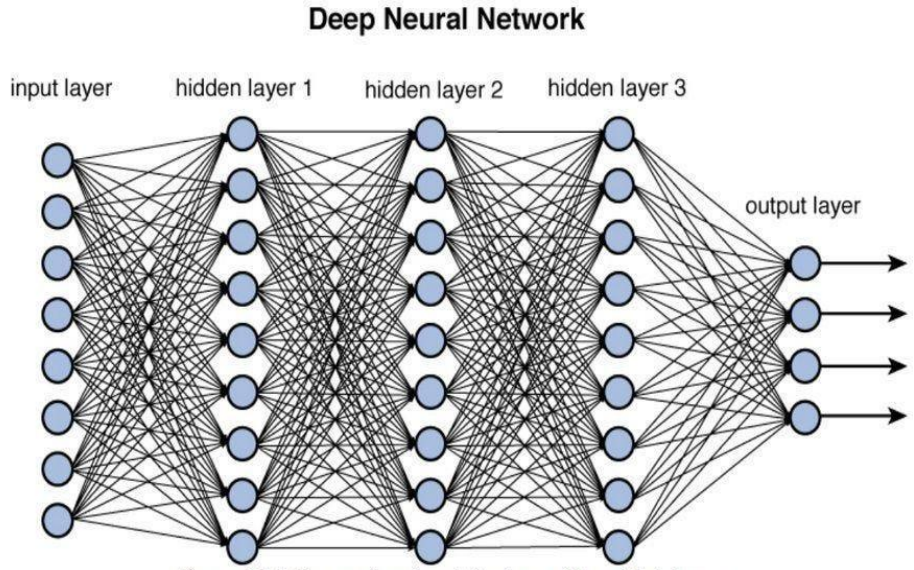
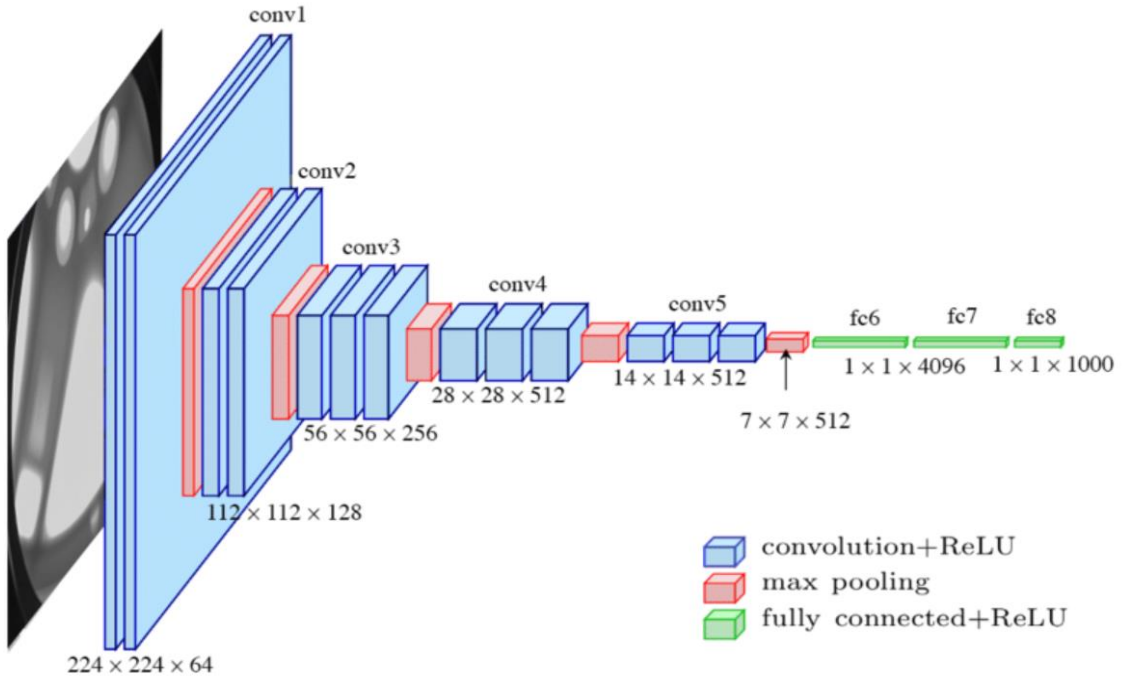
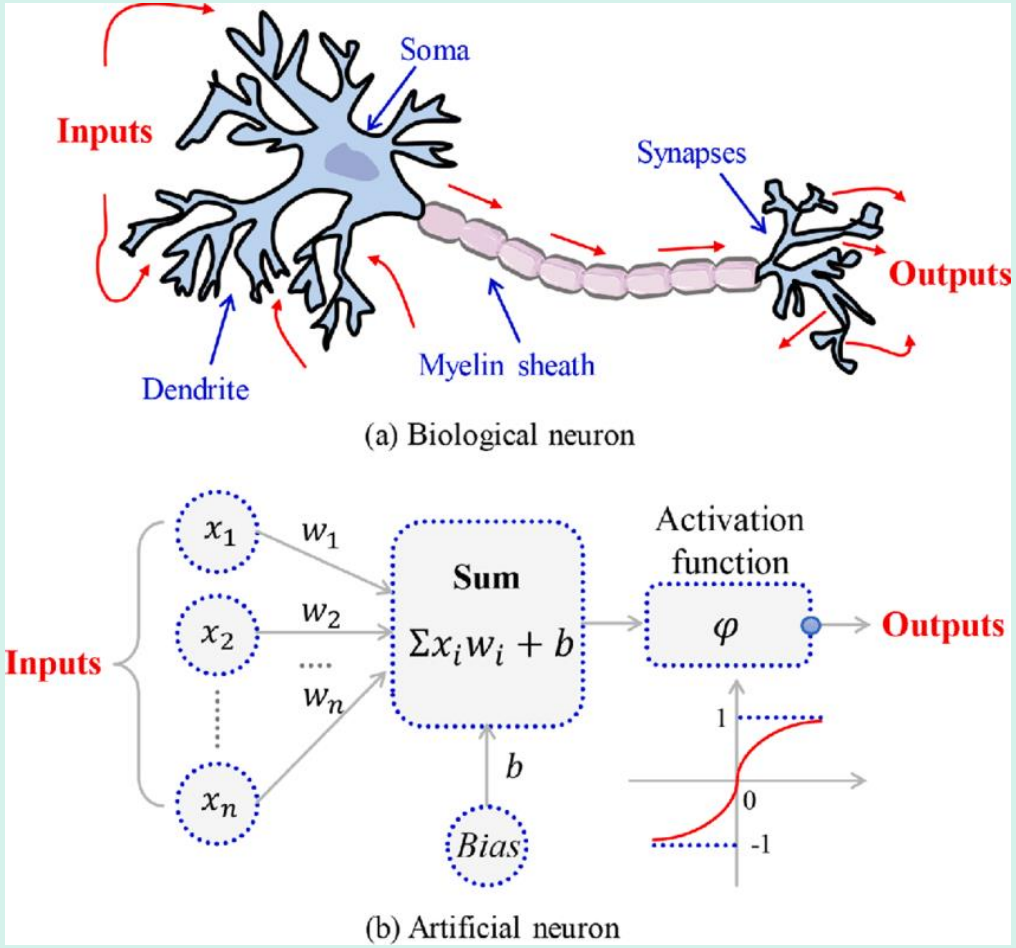


Figure 12.2 Deep network architecture with multiple layers.



DEEP LEARNING

Deep learning is a subset of machine learning, which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain-albeit far from matching its ability-allowing it to "learn" from large amounts of data.

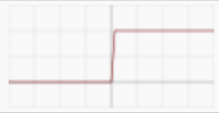
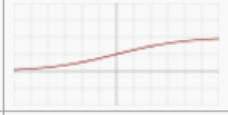
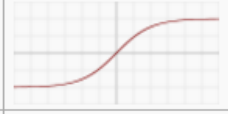
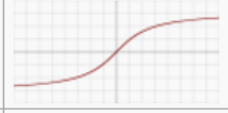


BIOLOGICAL OR ARTIFICICAL NEURON??

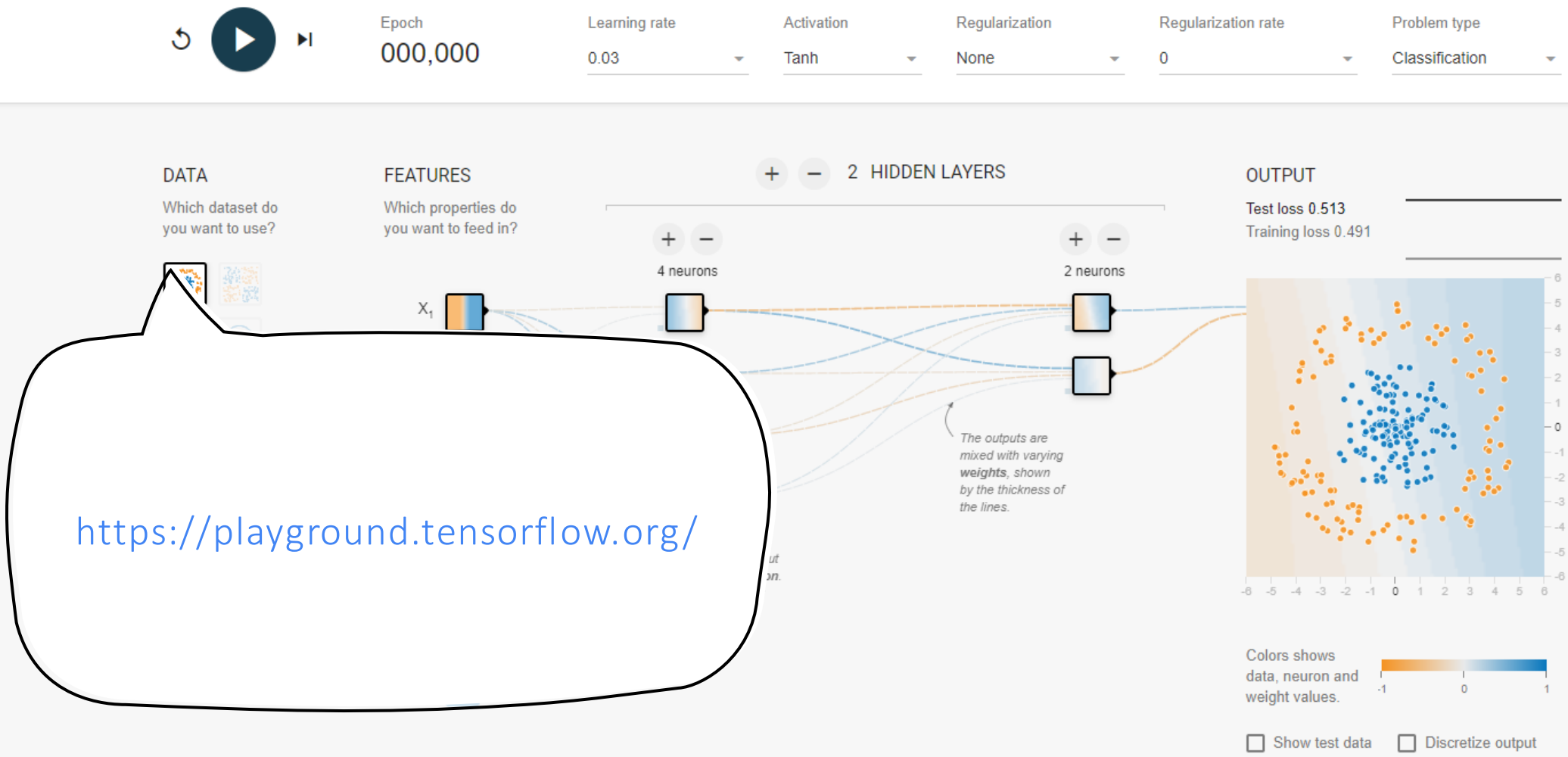
- Receives n-inputs
- Multiplies each input by its weight
- Applies activation function to the sum of results
- Output results

TYPES OF ACTIVATION FUNCTIONS

In artificial neural networks, the activation function of a node defines the output of that node given an input or set of inputs.

Name	Plot	Equation	Derivative
Identity		$f(x) = x$	$f'(x) = 1$
Binary step		$f(x) = \begin{cases} 0 & \text{for } x < 0 \\ 1 & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0 & \text{for} \\ ? & \text{for} \end{cases}$
Logistic (a.k.a Soft step)		$f(x) = \frac{1}{1+e^{-x}}$	$f'(x) = f(x)(1-f($
TanH		$f(x) = \tanh(x) = \frac{2}{1+e^{-2x}} - 1$	$f'(x) = 1 - f(x)^2$
ArcTan		$f(x) = \tan^{-1}(x)$	$f'(x) = \frac{1}{x^2+1}$
Rectified Linear Unit (ReLU)		$f(x) = \begin{cases} 0 & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0 & \text{for } x < \\ 1 & \text{for } x \geq \end{cases}$
Parameteric Rectified Linear Unit (PReLU)[2]		$f(x) = \begin{cases} \alpha x & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} \alpha & \text{for } x < \\ 1 & \text{for } x \geq \end{cases}$
Exponential Linear Unit (ELU)[3]		$f(x) = \begin{cases} \alpha(e^x - 1) & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} f(x) + \alpha & \text{fo} \\ 1 & \text{fo} \end{cases}$
SoftPlus		$f(x) = \log_e(1+e^x)$	$f'(x) = \frac{1}{1+e^{-x}}$

Tinker With a **Neural Network** Right Here in Your Browser.
Don't Worry, You Can't Break It. We Promise.



CONCLUSION

Recap of topics covered

Future of machine learning and AI

Resources for further learning.

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https://github.com/gdsc-mnnita/