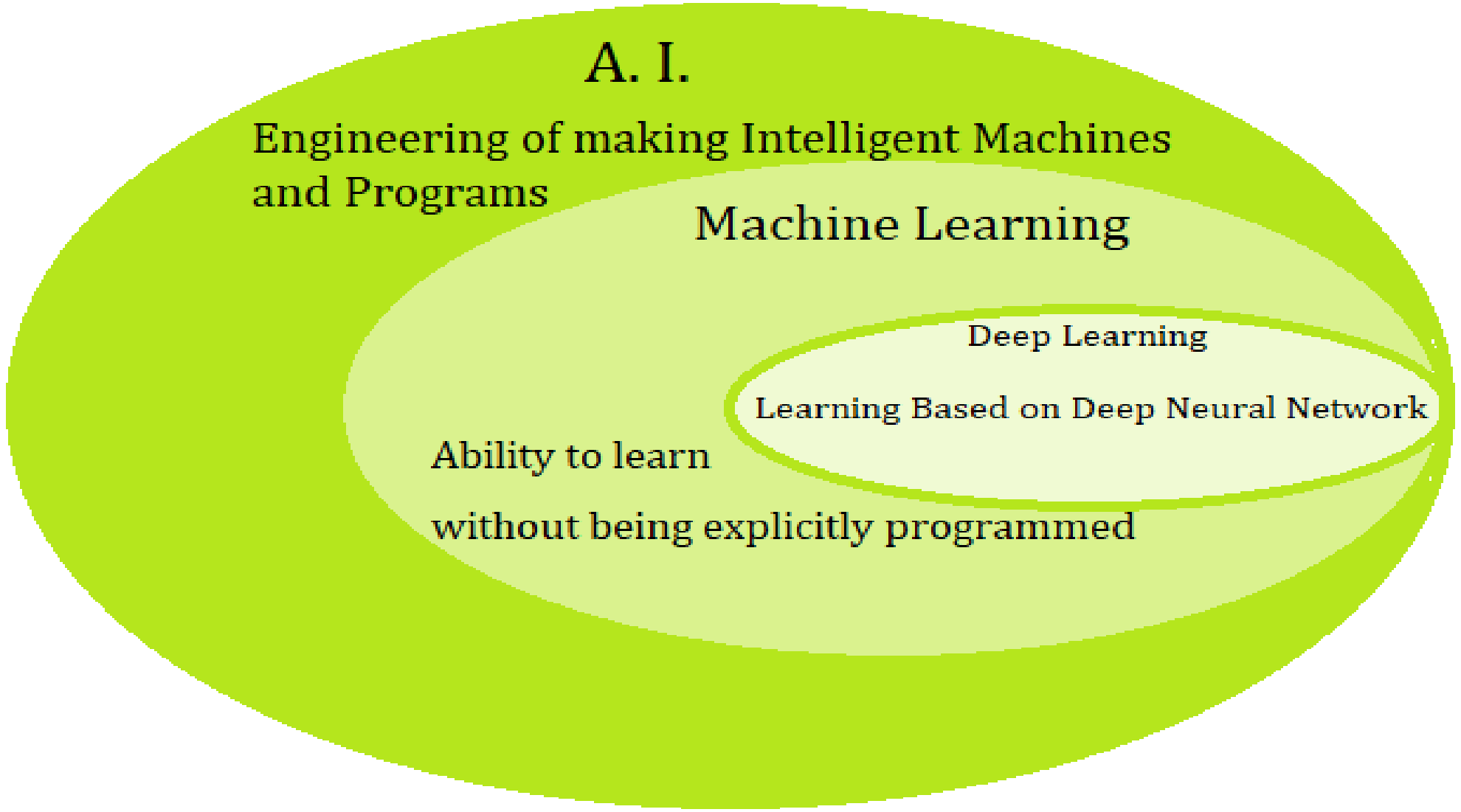
INTRODUCTION TO MACHINE LEARNING

WHAT IS LEARNING?

- *"Learning denotes changes in a system that ... enable a system to do the same task ... more efficiently the next time."* - **Herbert Simon**
- *"Learning is constructing or modifying representations of what is being experienced."* - **Ryszard Michalski**
- *"Learning is making useful changes in our minds."* - **Marvin Minsky**

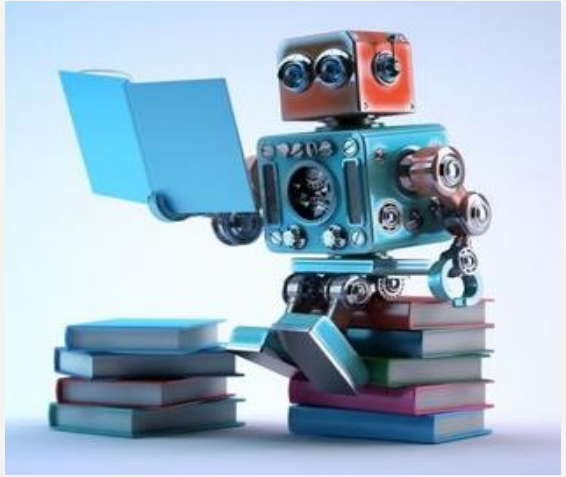
"Machine learning refers to a system capable of the autonomous acquisition and integration of knowledge."

MACHINE LEARNING



MACHINE LEARNING – A DEFINITION

"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 "* - **Tom Mitchell**



LEARNING…

- Most perception (Input Processing) in the brain may be due to one learning algorithm.
- Build learning algorithms that mimic the brain
- Most human intelligence is due to one learning algorithm
- Learning from tagged data (Supervised Learning)
- Learning from untagged data (Unsupervised Learning)
- Bigger Data – More training is better
- Deep Learning

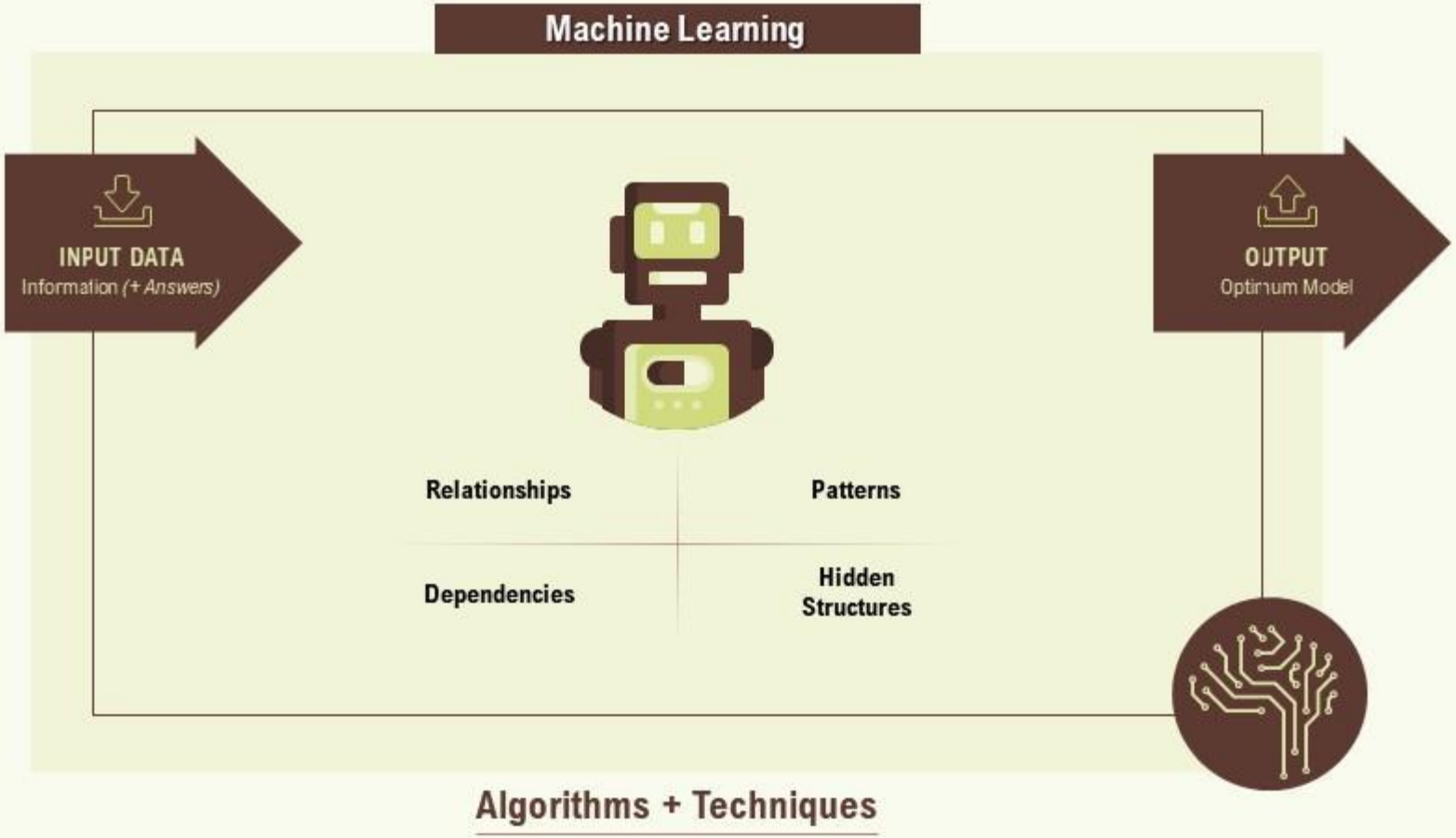
MACHINE LEARNING (ML)

- ML is a branch of artificial intelligence:
  - Uses computing based systems to make sense out of data
    - Extracting patterns, fitting data to functions, classifying data, etc
  - ML systems can learn and improve
    - With historical data, time and experience
  - Bridges theoretical computer science and real noise data.

WHY MACHINE LEARNING?

- **No human experts**
  - Industrial/Manufacturing control
  - Mass spectrometer analysis, drug design, astronomic discovery
- **Black-box human expertise**
  - Face/Handwriting/Speech Recognition
  - Driving a car, Flying a plane
- **Rapidly changing phenomena**
  - Credit scoring, Financial Modeling
  - Diagnosis, Fraud Detection
- **Need for customization/personalization**
  - Personalized news reader
  - Movie/Book Recommendation

Machine Learning Description



Machine Learning Process

STEP 1

Gathering data from various sources

STEP 2

Cleaning data to have homogeneity

STEP 3

Model Building- Selecting the right ML algorithm

STEP 4

Gaining insights from the model's results

STEP 5

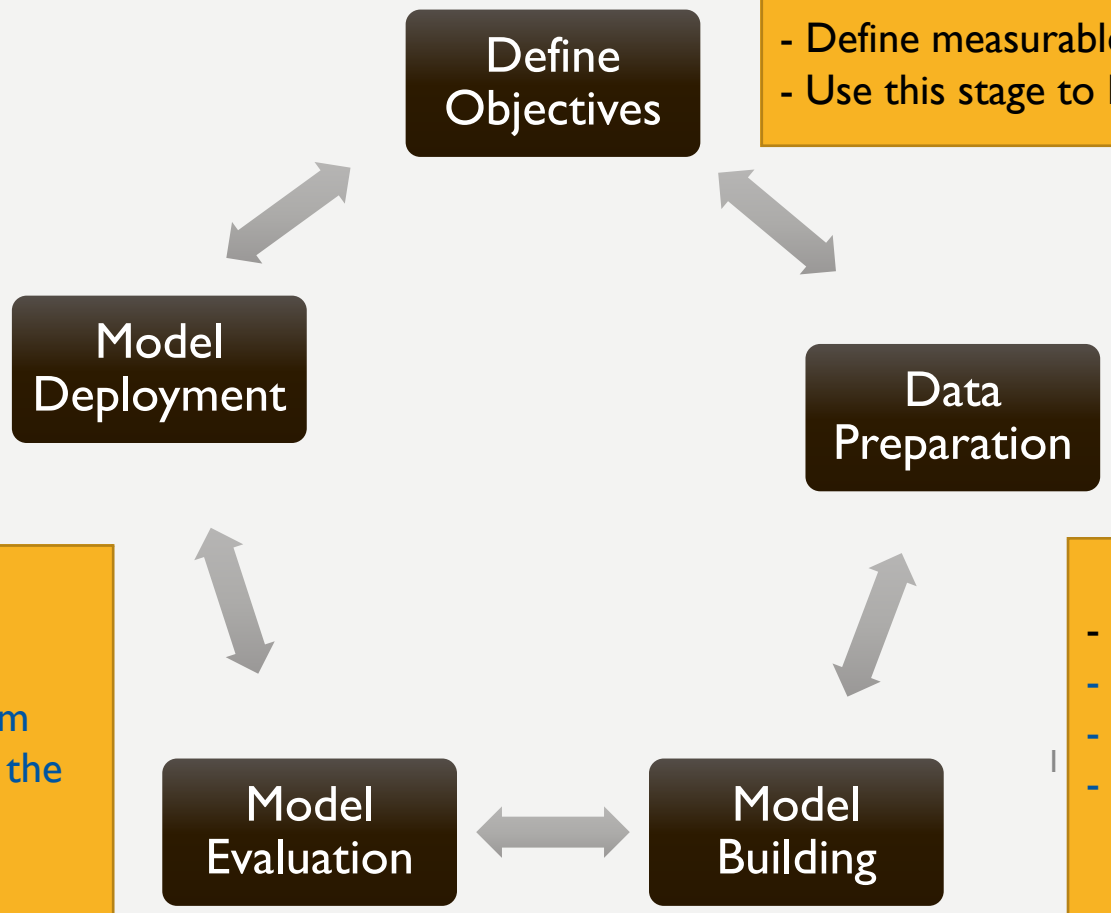
Data Visualization- Transforming results into visuals graphs

The Machine Learning Life Cycle

1. **Define Project Objectives**
   - ☐ Specify business problem
   - ☐ Acquire subject matter expertise
   - ☐ Define unit of analysis and prediction target
   - ☐ Prioritize modeling criteria
   - ☐ Consider risks and success criteria
   - ☐ Decide whether to continue
2. **Acquire & Explore Data**
   - ☐ Find appropriate data
   - ☐ Merge data into single table
   - ☐ Conduct exploratory data analysis
   - ☐ Find and remove any target leakage
   - ☐ Feature engineering
3. **Model Data**
   - ☐ Variable selection
   - ☐ Build candidate models
   - ☐ Model validation and selection
4. **Interpret & Communicate**
   - ☐ Interpret model
   - ☐ Communicate model insights
5. **Implement, Document & Maintain**
   - ☐ Set up batch or API prediction system
   - ☐ Document modeling process for reproducibility
   - ☐ Create model monitoring and maintenance plan

Image Source: https://www.datarobot.com/wiki/machine-learning-life-cycle/

MACHINE LEARNING AS A PROCESS



- Define measurable and quantifiable goals
- Use this stage to learn about the problem

- Normalization
- Transformation
- Missing Values
- Outliers

- Data Splitting
- Features Engineering
- Estimating Performance
- Evaluation and Model Selection

- Study models accuracy
  - Work better than the naïve approach or previous system
- Do the results make sense in the context of the problem

BRIEF HISTORY OF MACHINE LEARNING

1950
Alan Turing created the "Turing Test"

1952
Arthur Samuel wrote the first computer learning program

1957
Frank Rosenblatt designed the first neural network for computers

1967
The "nearest neighbor" algorithm was written

1981
Gerald Dejong introduced the concept of Explanation Based Learning (EBL)

1985
AT&T created the first research group dedicated to machine learning

1992
Jay Wilpon and team from AT&T deployed the first nationwide automated speech recognition

1996
Patrick Haffner and the team at AT&T proposed the first convolutional neural network

1997
Another group of AT&T researchers invented the Adaboost algorithm

2001
AT&T deployed natural language understanding in IVR systems

2011
A large community of researchers started to work on deep neural networks

2014
Google and Facebook made machine learning, and in particular deep learning, their pivotal technology

2015
Interactions acquired AT&T's Watson

2017
Interactions acquired Digital Roots

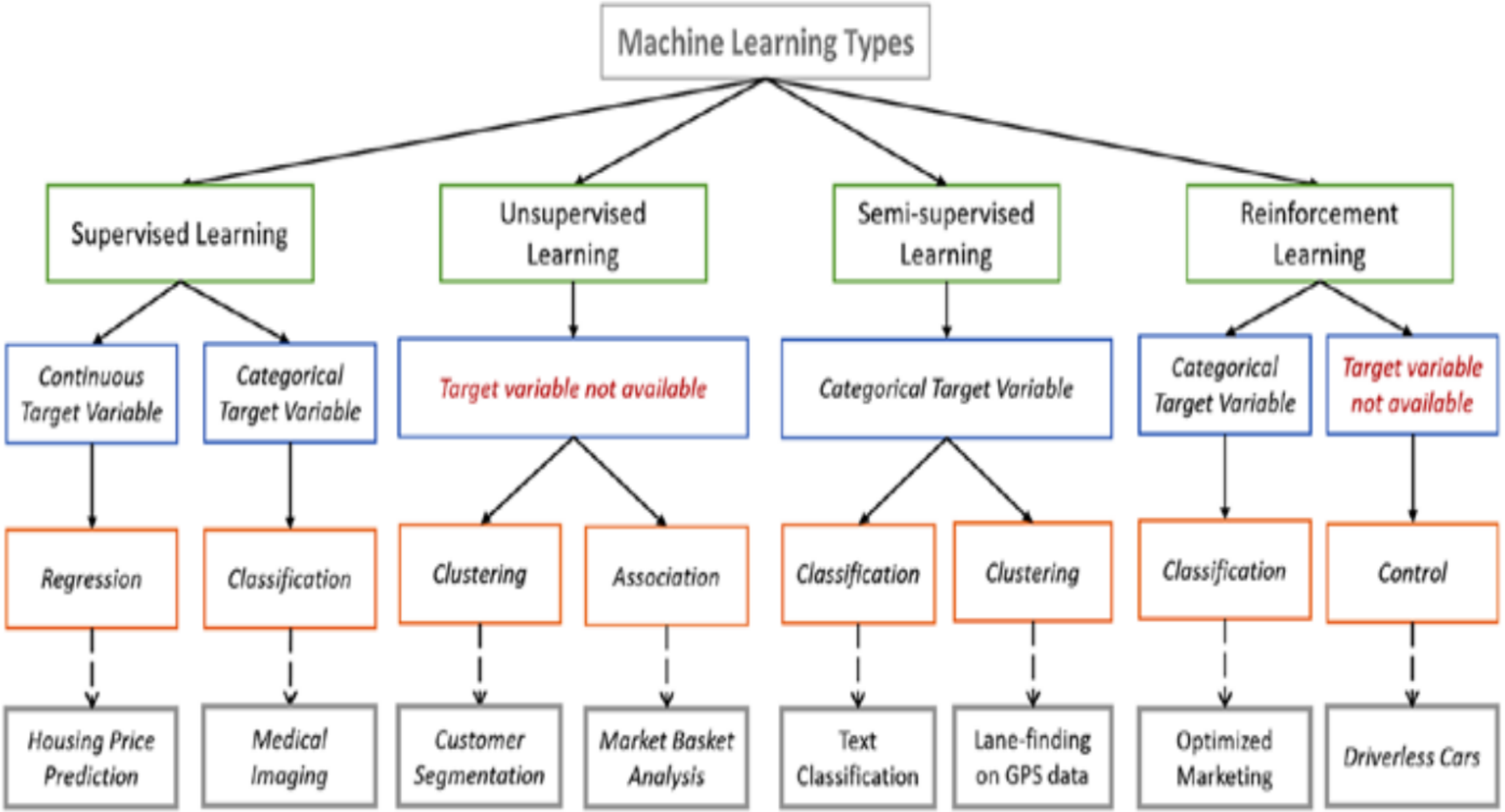
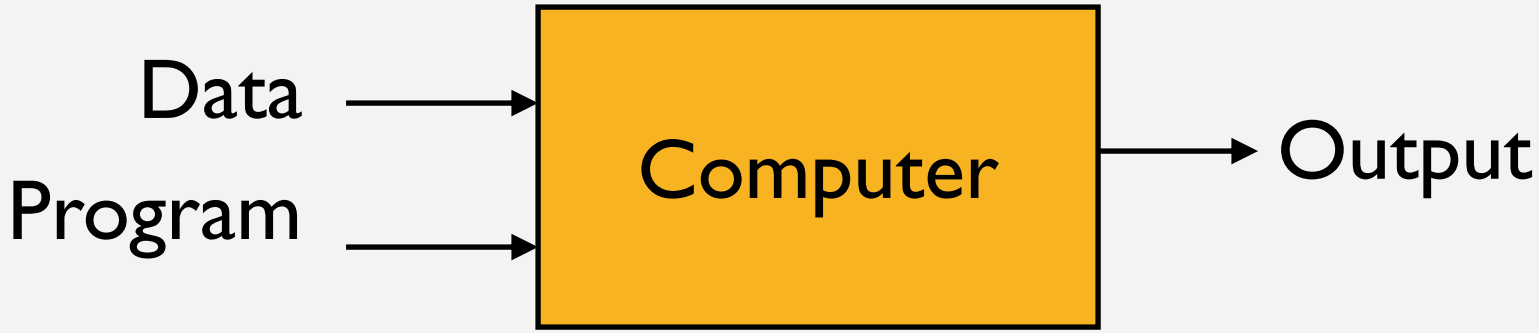
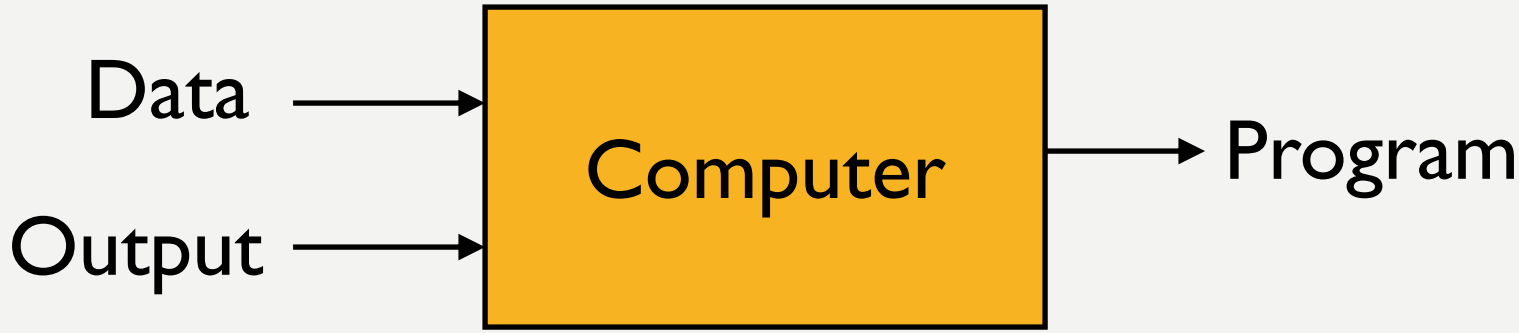


Image Source: https://towardsdatascience.com/types-of-machine-learning-algorithms-you-should-know-953a08248861

Traditional Programming



Machine Learning



MAGIC?

No, more like gardening

- **Seeds** = Algorithms
- **Nutrients** = Data
- **Gardener** = You
- **Plants** = Programs

APPLICATIONS OF ML IN HEALTHCARE

- Predictive Analytics
- Assistive Robots (Spline Surgery)
- Virtual Nursing Assistance (Assist the Patients)
- Administrative Tasks
- Lots of aids will be provided
  - Medical outcomes analysis
  - Cancer Identification
- Scarcity of Nurses and Doctors can be eliminated
- Predicting Cardiovascular risks
- Predicting medical events

APPLICATIONS OF ML IN AGRICULTURE

- Crop is ready or not and Quality of Crop
- Segregation of crop based on quality (Crop Classification)
- Predicting Crop Yield
- Irrigations Schedule
- Disease detection from the plants
- Predicting the approximate weight of the crop
- Health monitoring of the crop
- Analyzing and Predicting the Profit from the crop

OTHER APPLICATIONS OF ML

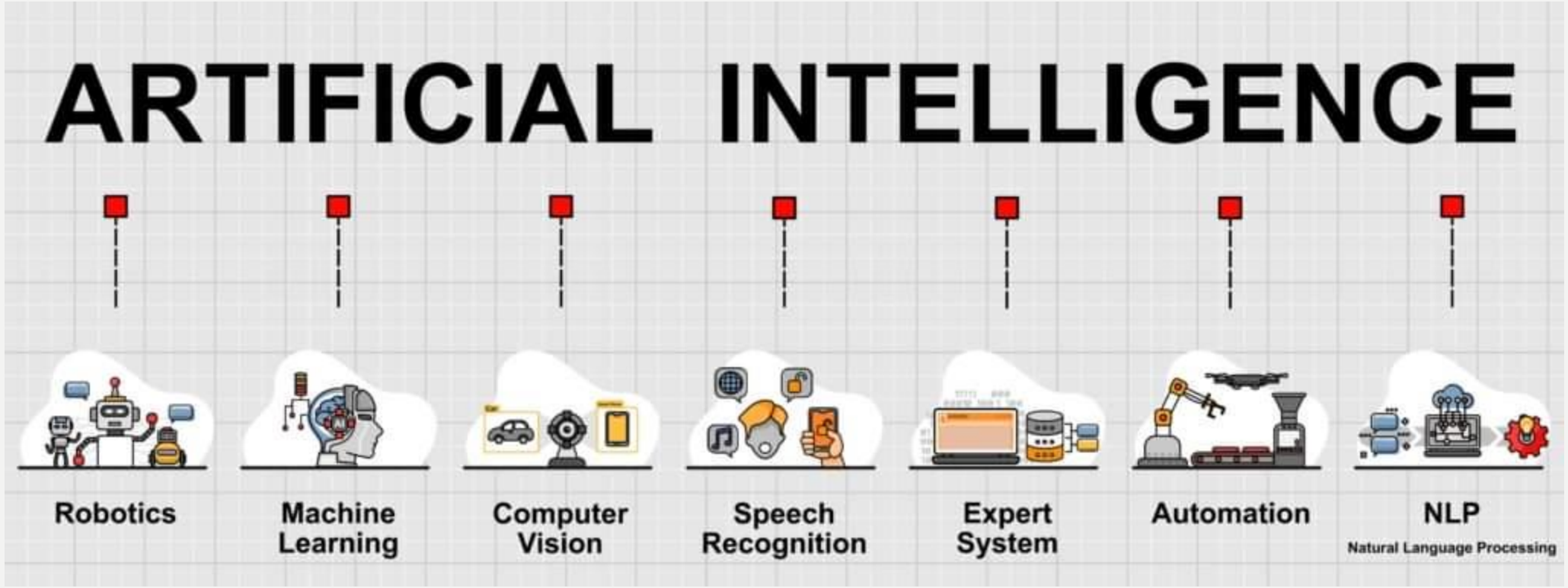
- Recognizing the mood of the person
- Sentiment Analysis
- Object Recognition and Classification
- Scene and Context categorization of the outdoor image
- Generating Handwriting from notes
- Traffic Monitoring
- Facial Expression Recognition
- Identification of fake news

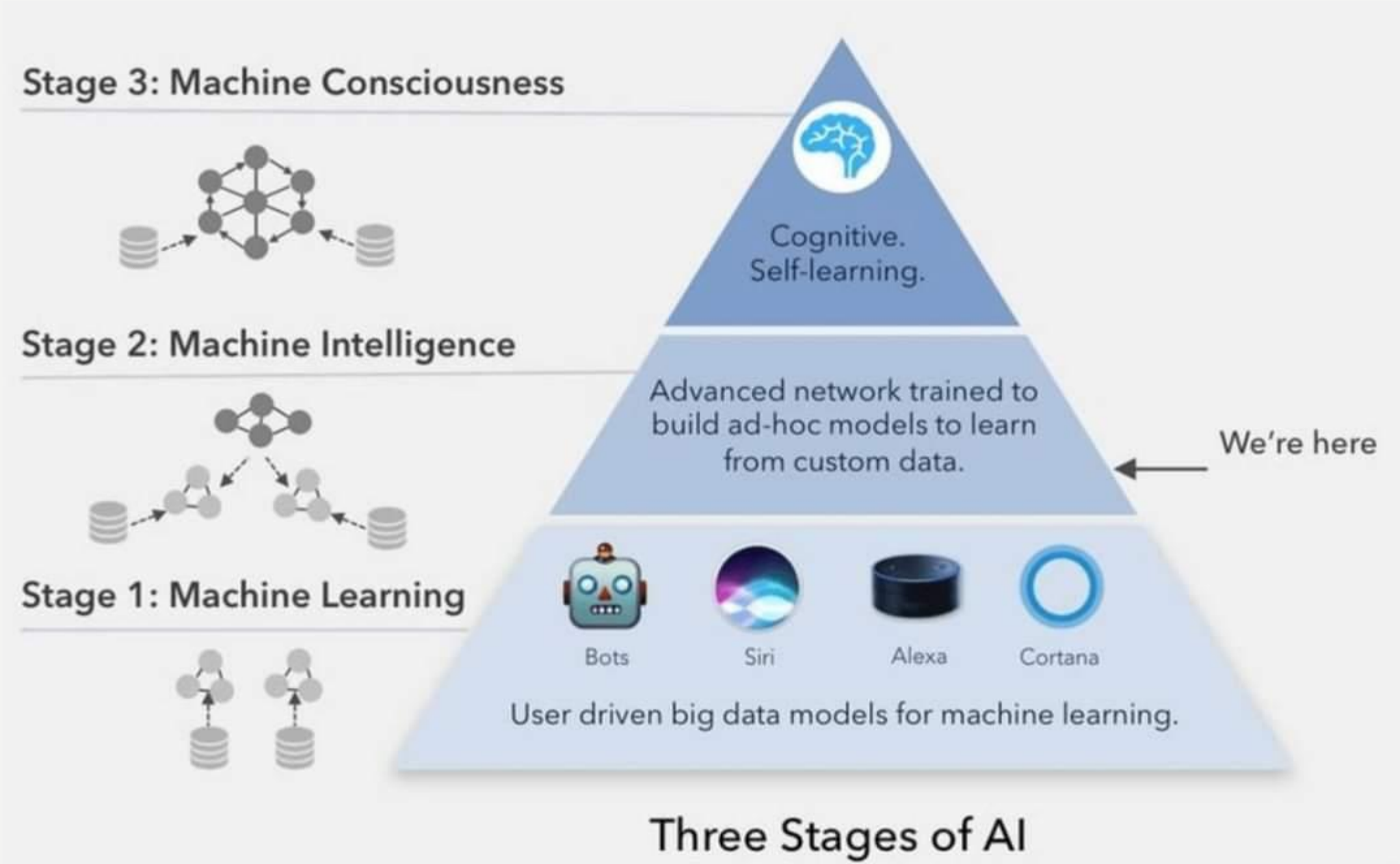
TYPES OF LEARNING

- **Supervised (inductive) learning**
  - Training data includes desired outputs
- **Unsupervised learning**
  - Training data does not include desired outputs
- **Semi-supervised learning**
  - Training data includes a few desired outputs
- **Reinforcement learning**
  - Rewards from sequence of actions

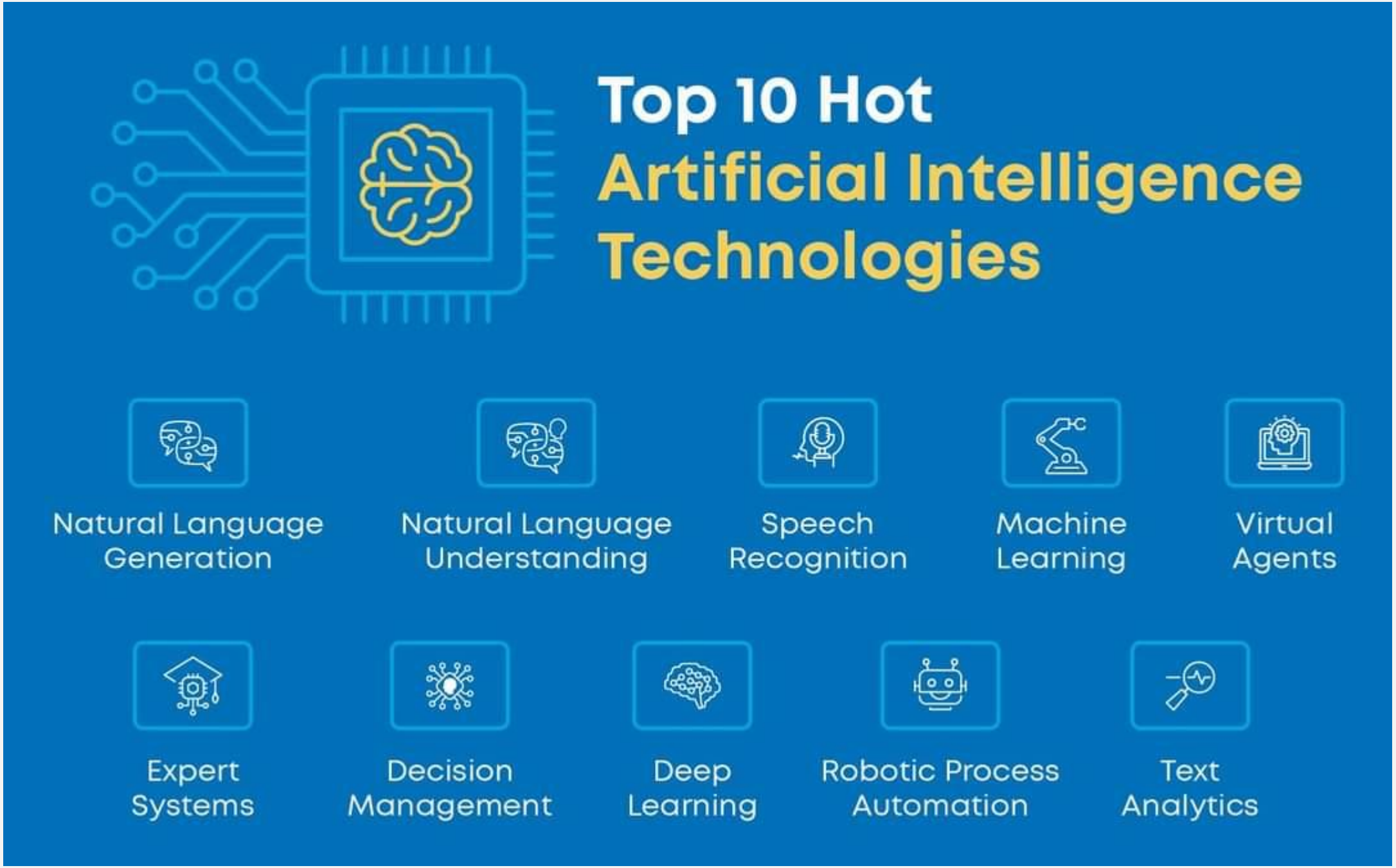
DIMENSIONS OF LEARNING SYSTEMS

- Type of feedback
  - Supervised (labeled examples)
  - Unsupervised (unlabeled examples)
  - Semi supervised (labeled examples and unlabeled examples)
  - Reinforcement (reward)

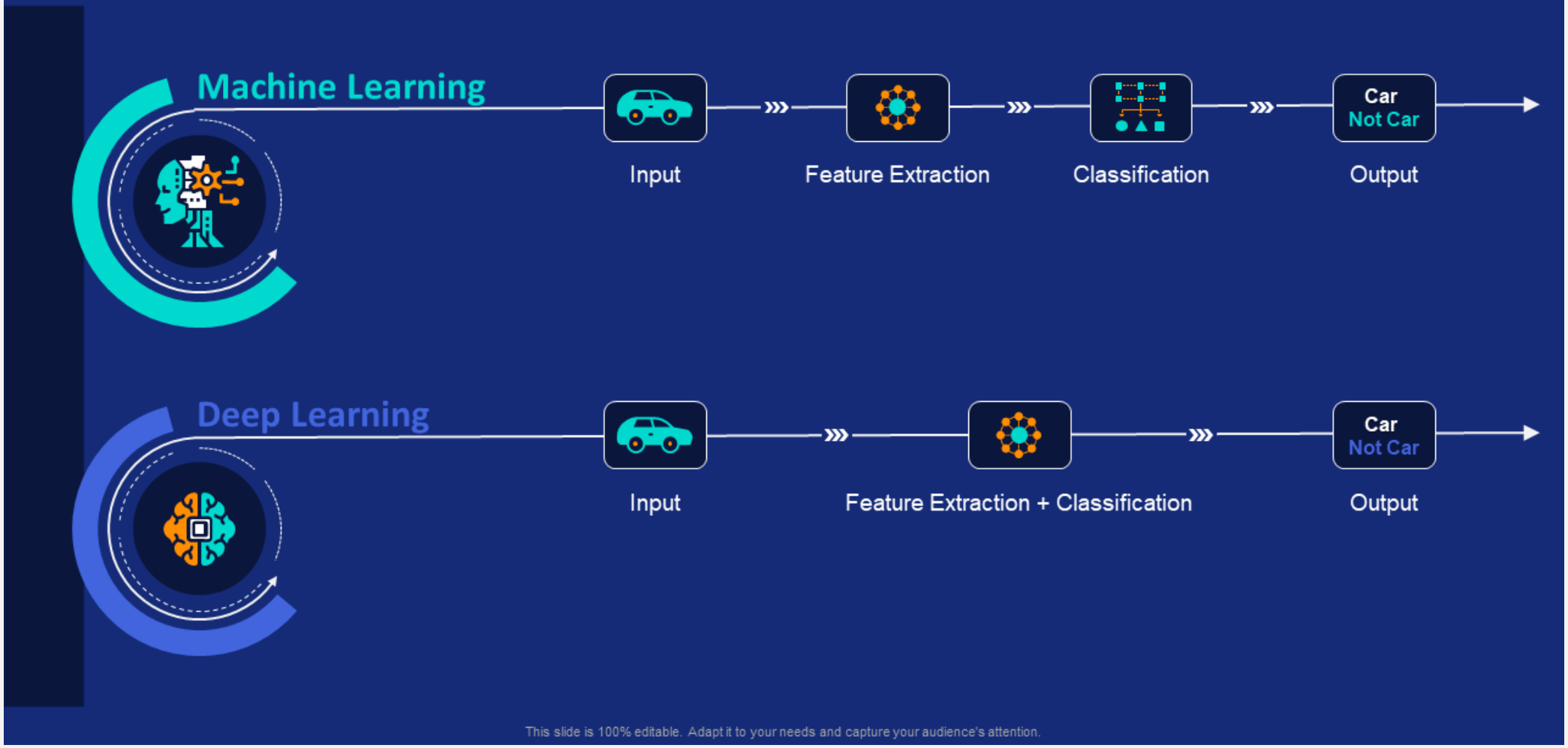

ARTIFICIAL INTELLIGENCE
Robotics
Machine Learning
Computer Vision
Speech Recognition
Expert System
Automation
NLP
Natural Language Processing



Three Stages of AI


Top 10 Hot
Artificial Intelligence
Technologies
Natural Language Generation
Natural Language Understanding
Speech Recognition
Machine Learning
Virtual Agents
Expert Systems
Decision Management
Deep Learning
Robotic Process Automation
Text Analytics

Difference between Machine Learning and Deep Learning



DIFFERENCE BETWEEN ML AND DL

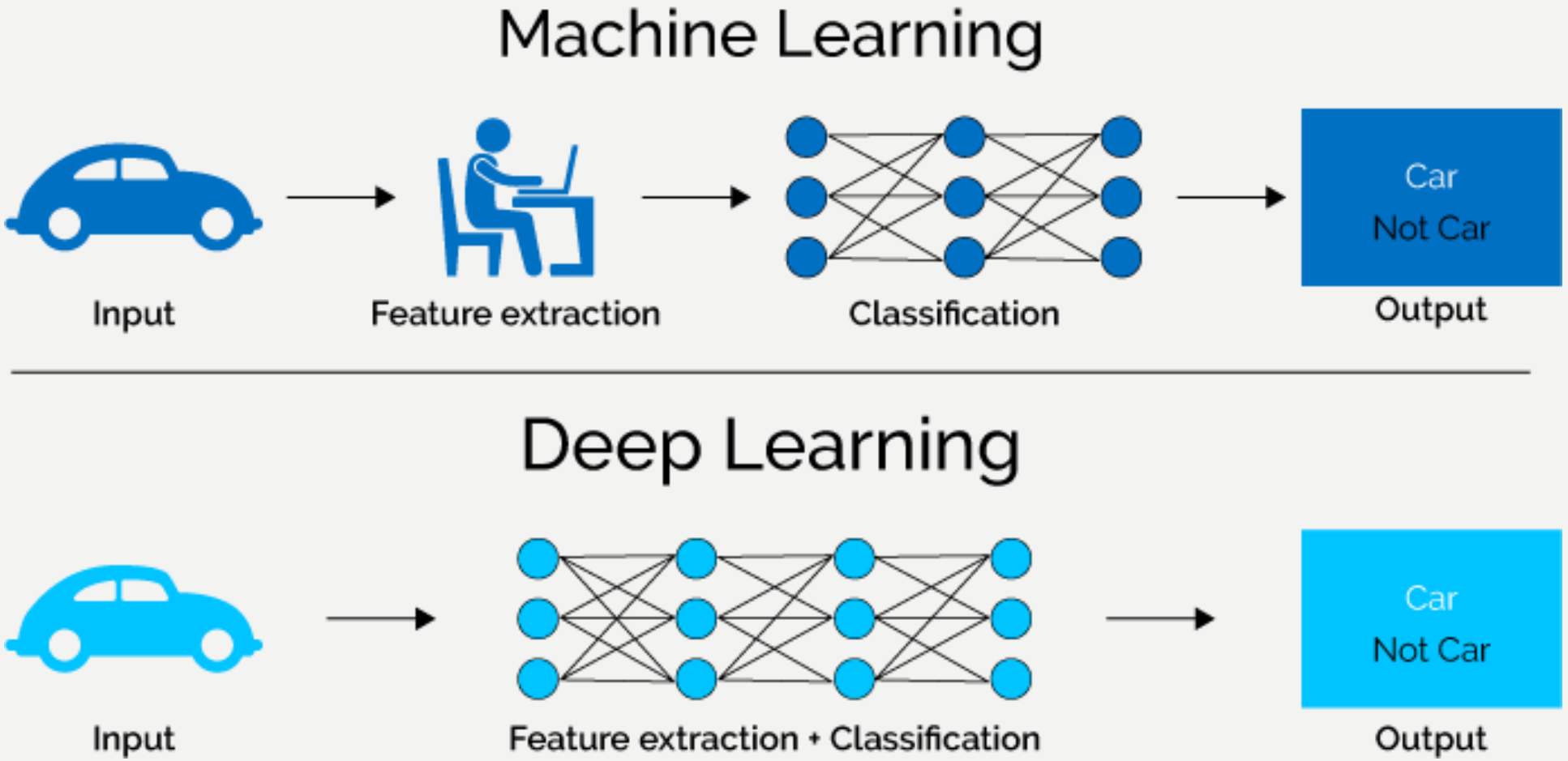
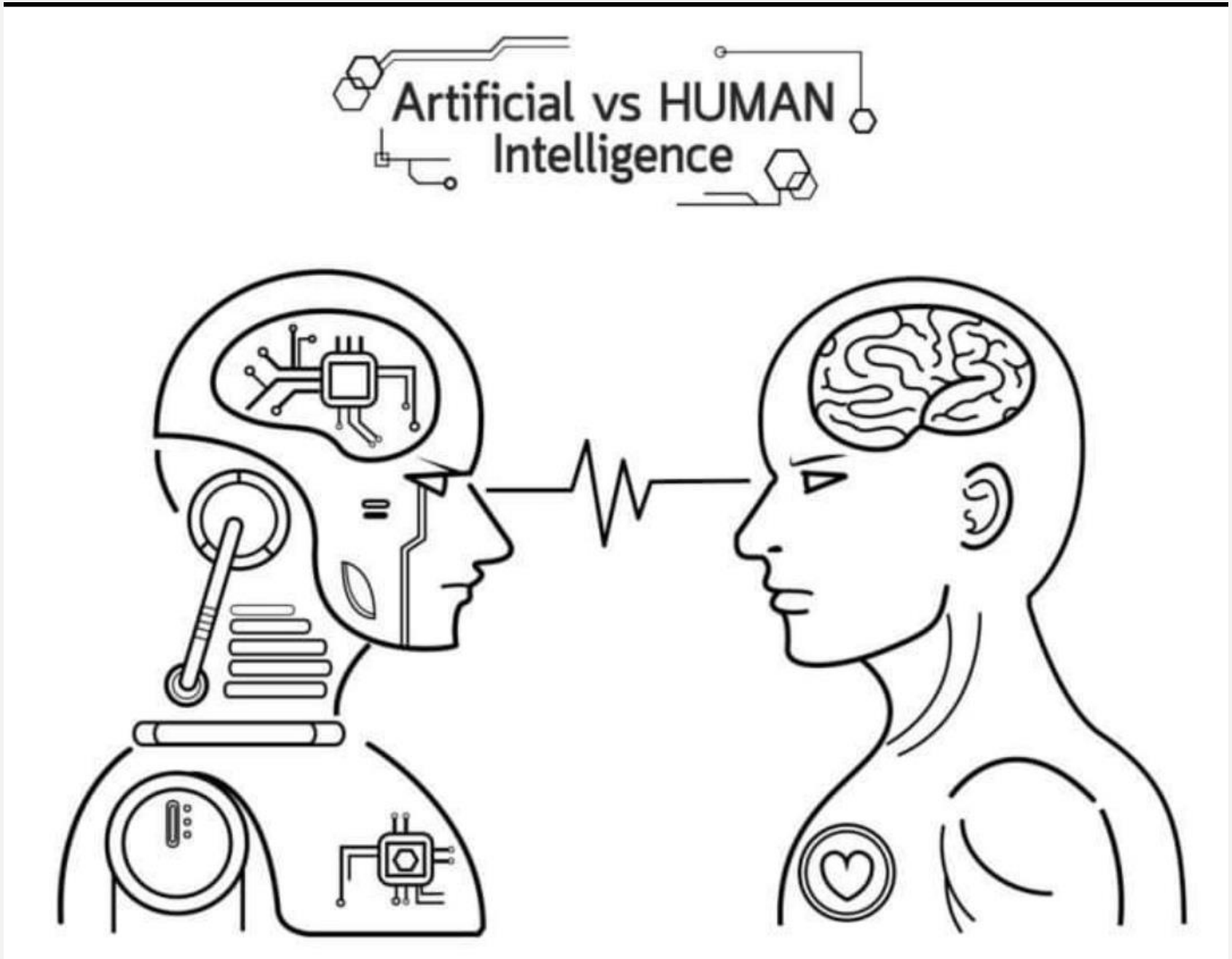


Image Source: https://www.xenonstack.com/blog/log-analytics-with-deep-learning-and-machine-learning

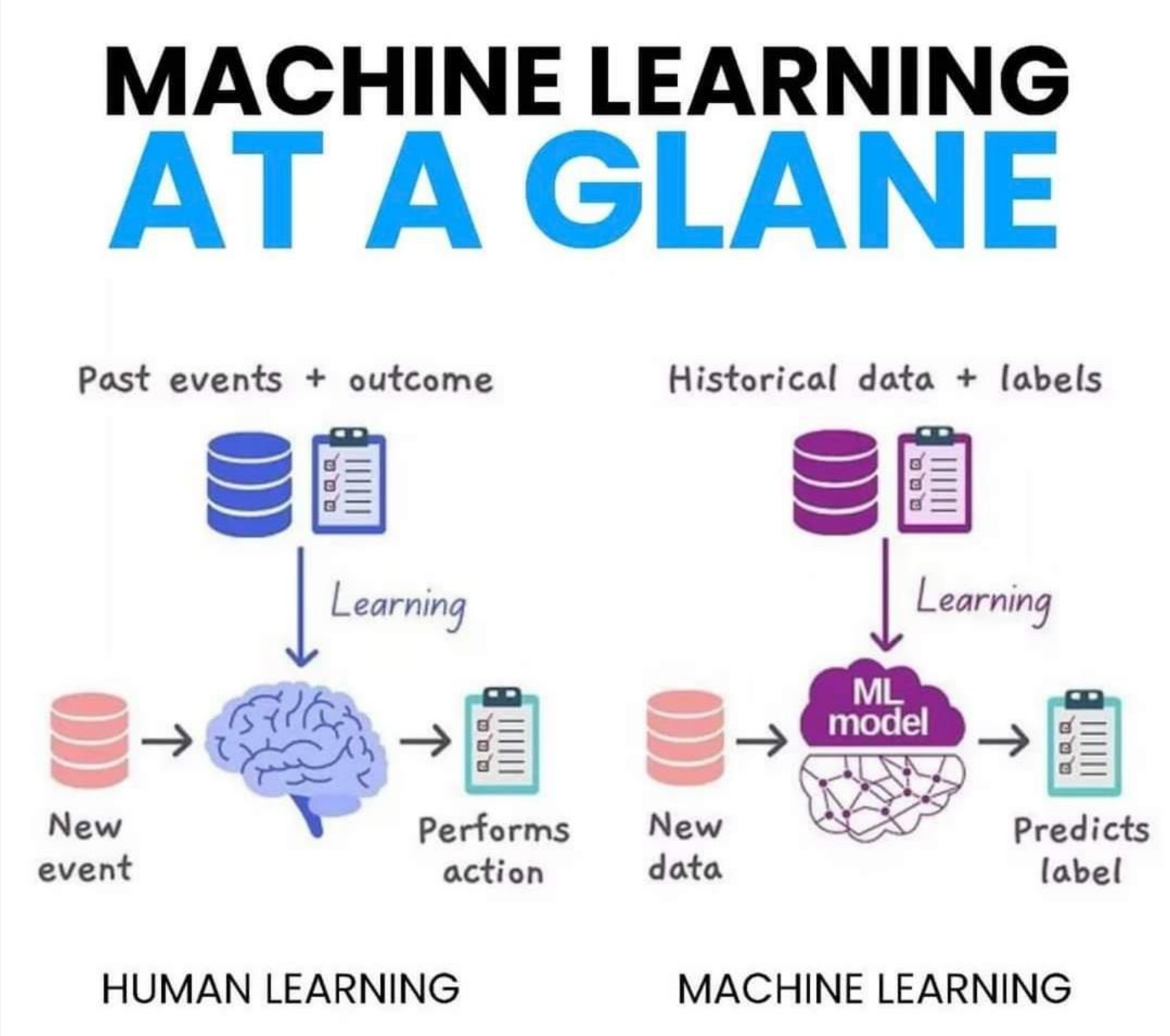

Artificial vs HUMAN
Intelligence

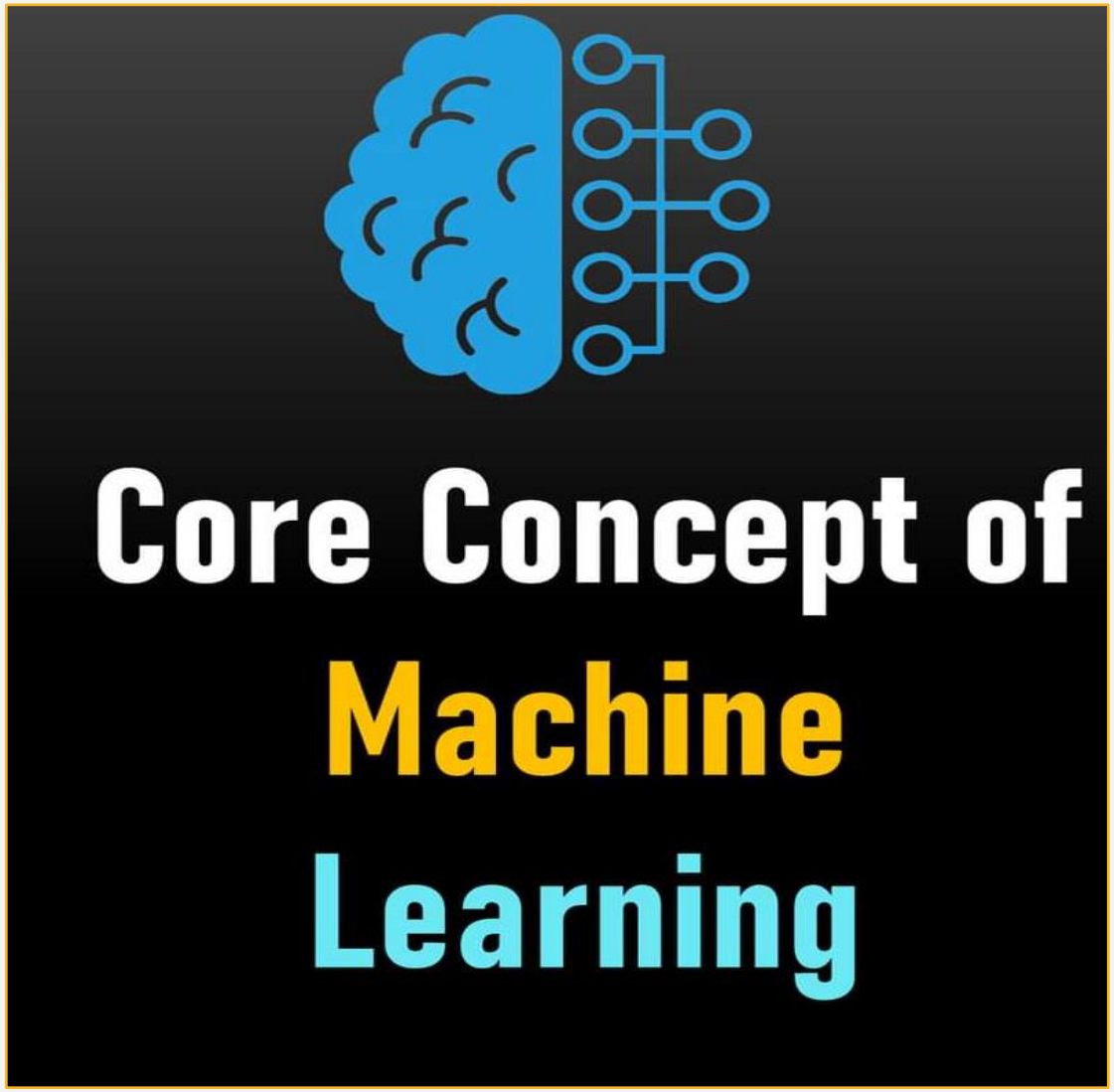
Artificial Intelligence

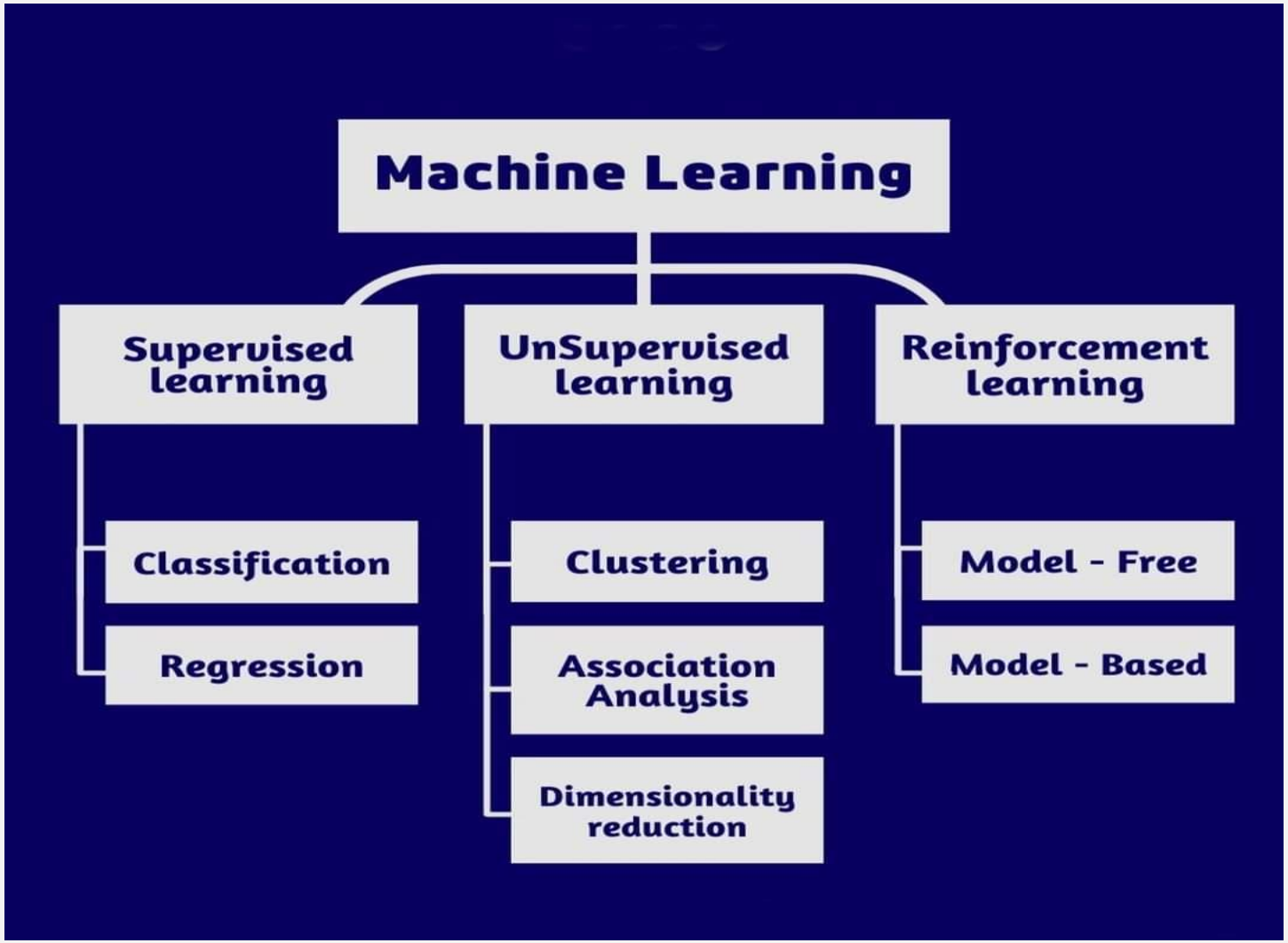
- AI machine depend on the data given to them.
- AI takes much more time to adjust to unused changes.
- Modern Computer normally uses 2 watts energy.
- Machines can handle more data at a speedier rate.
- Artificial Intelligence aims to build machines that can mimic human behavior and perform human-like actions.

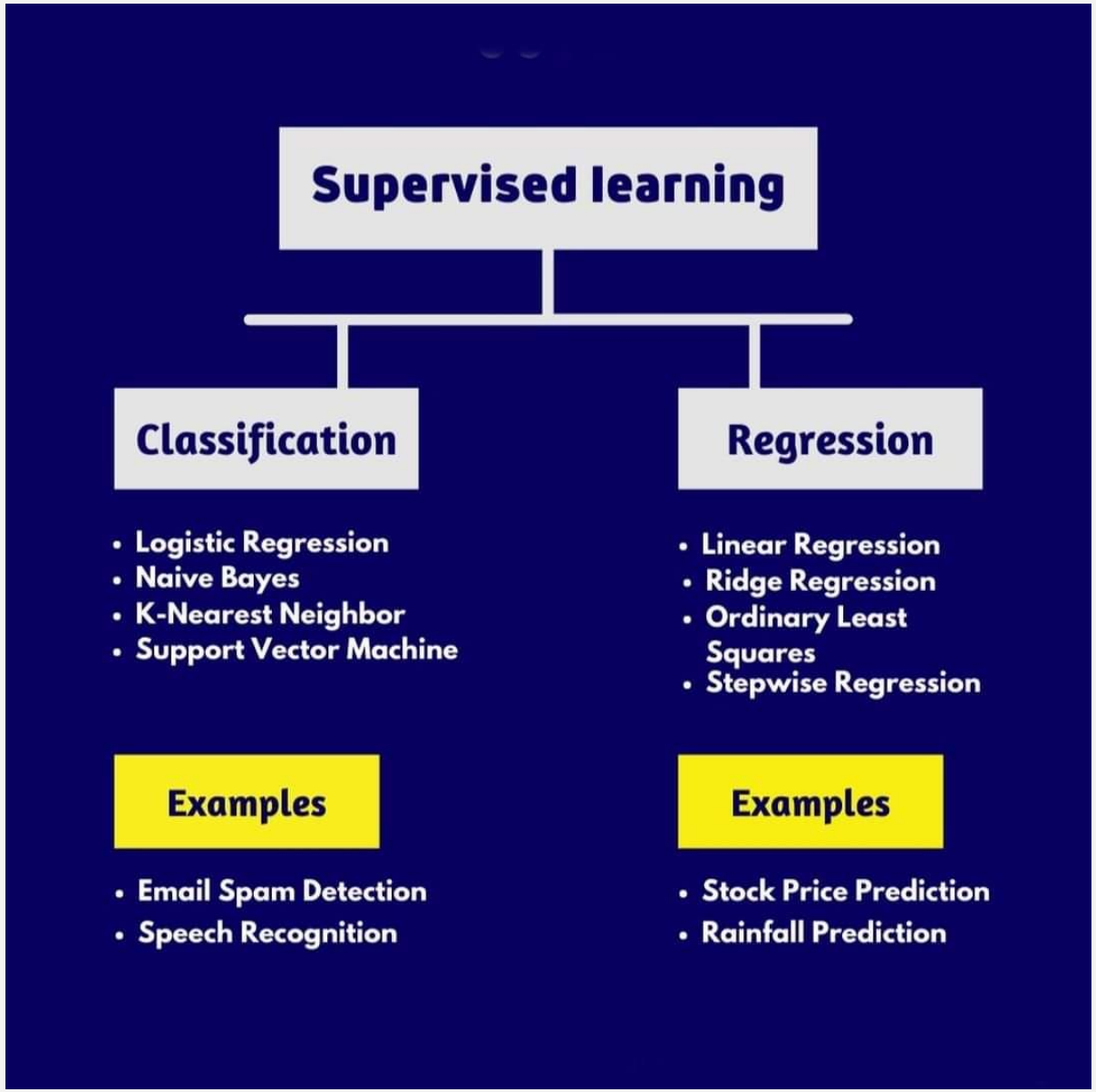
Human Intelligence

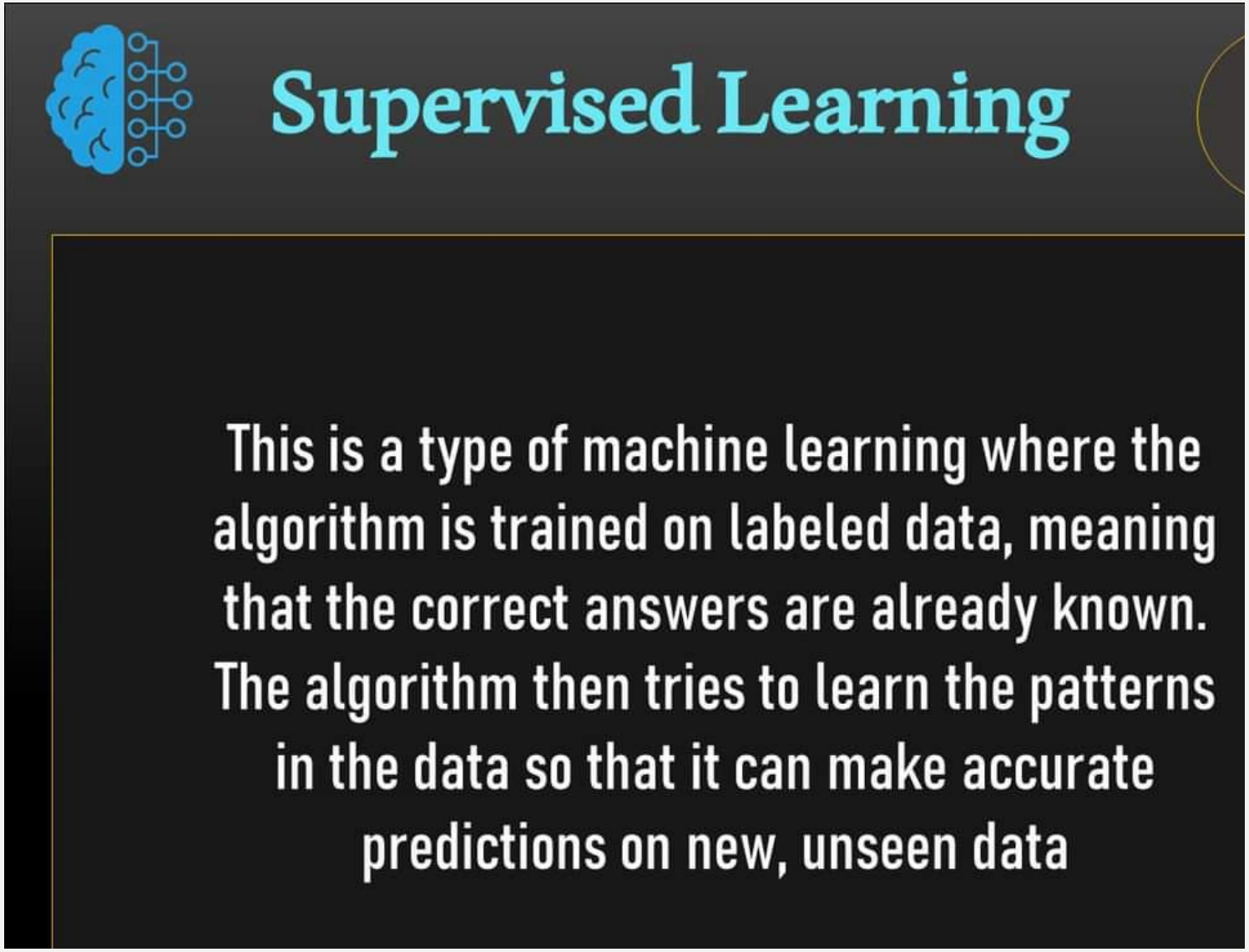
- Human beings use brain power.
- Human beings can adopt to changes easily.
- Human beings use about 25 watts.
- Humans cannot beat the speed of computers.
- While Human Intelligence aims to adapt to new environments by utilizing a combination of different cognitive processes.


MACHINE LEARNING
AT A GLANE
Past events + outcome
Learning
New event
Performs action
HUMAN LEARNING
Historical data + labels
Learning
ML model
New data
Predicts label
MACHINE LEARNING

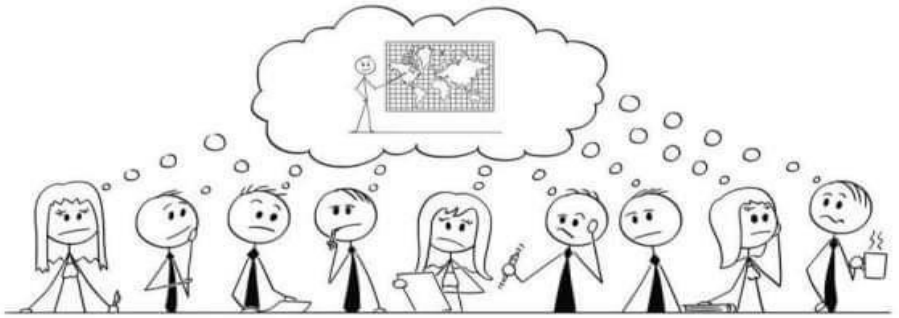

Core Concept of
Machine
Learning


Machine Learning
Supervised learning
UnSupervised learning
Reinforcement learning
Classification
Regression
Clustering
Association Analysis
Dimensionality reduction
Model - Free
Model - Based


Supervised learning
Classification
Logistic Regression
Naive Bayes
K-Nearest Neighbor
Support Vector Machine
Examples
Email Spam Detection
Speech Recognition
Regression
Linear Regression
Ridge Regression
Ordinary Least Squares
Stepwise Regression
Examples
Stock Price Prediction
Rainfall Prediction

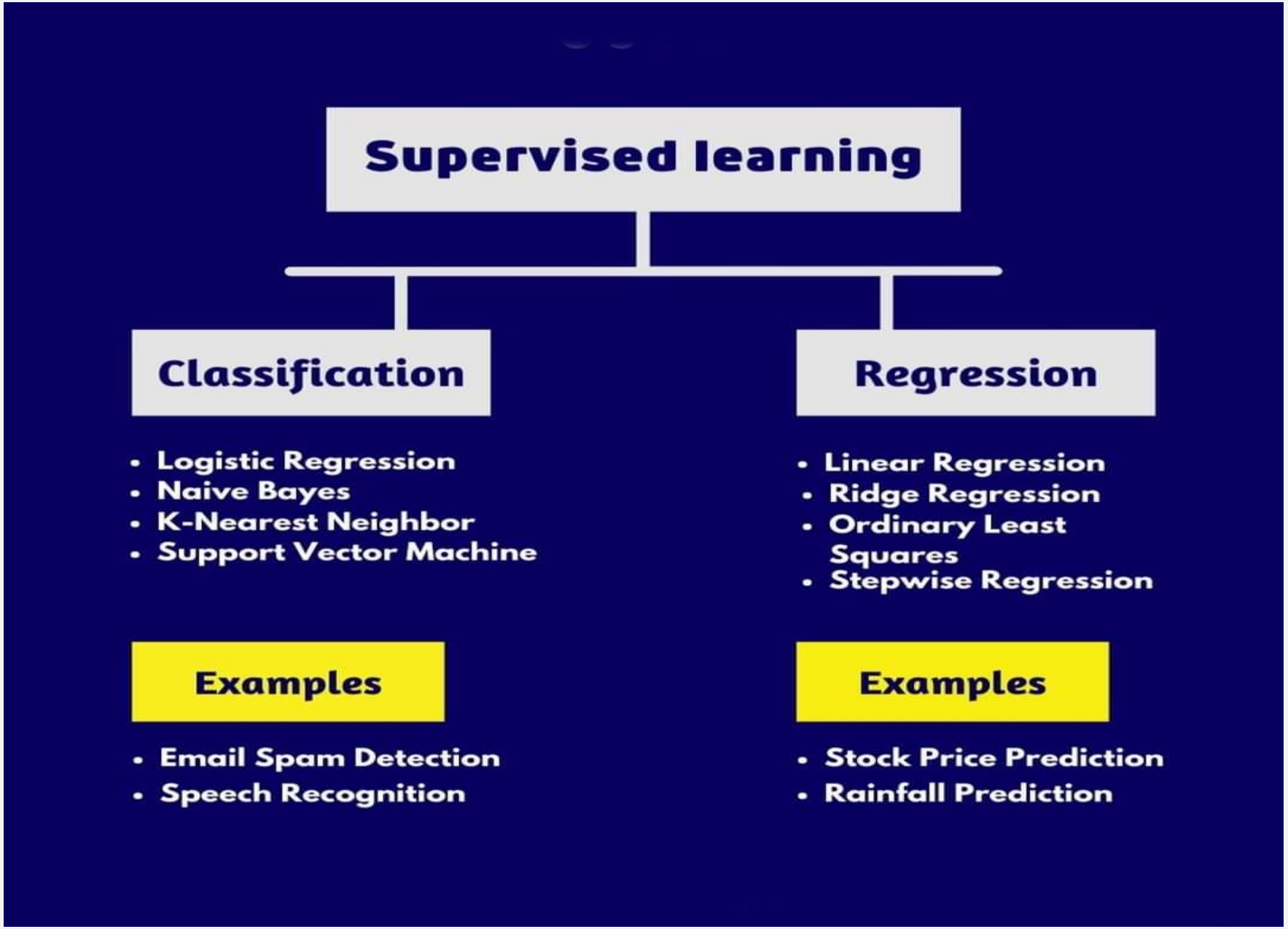

Supervised Learning
This is a type of machine learning where the algorithm is trained on labeled data, meaning that the correct answers are already known. The algorithm then tries to learn the patterns in the data so that it can make accurate predictions on new, unseen data

Supervised learning



Supervised learning is an approach to creating artificial intelligence (AI), where the program is given labelled input data and the expected output results.

The AI system is specifically told what to look for, thus the model is trained until it can detect the underlying patterns and relationships, enabling it to yield good results when presented with never-before-seen data.


Supervised learning
Classification
Logistic Regression
Naive Bayes
K-Nearest Neighbor
Support Vector Machine
Examples
Email Spam Detection
Speech Recognition
Regression
Linear Regression
Ridge Regression
Ordinary Least Squares
Stepwise Regression
Examples
Stock Price Prediction
Rainfall Prediction

Unsupervised Learning:

2

In contrast to supervised learning, unsupervised learning algorithms are trained on unlabeled data. The goal of these algorithms is to find patterns and structure in the data without the guidance of a known set of correct answers.

Neural Networks: Neural networks are a type of machine learning model inspired by the structure of the human brain. They are composed of layers of interconnected nodes, each of which performs a simple mathematical operation. By combining these operations, neural networks can learn to solve complex problems

UnSupervised learning

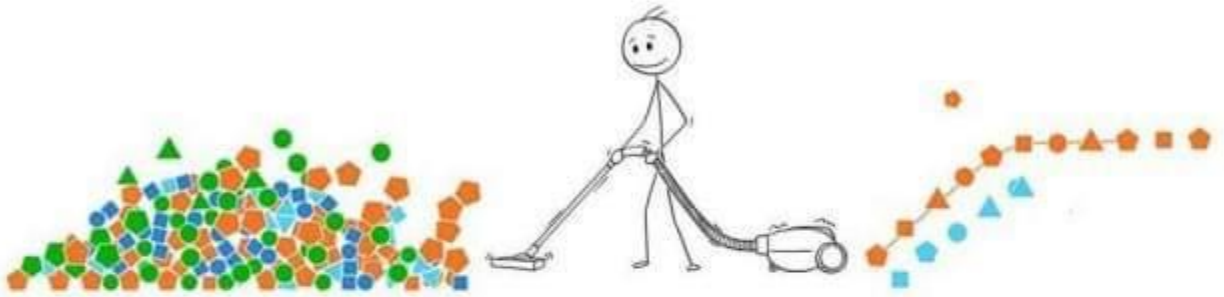
In unsupervised learning, a dataset is provided without labels, and a model learns useful properties of the structure of the dataset. We do not tell the model what it must learn, but allow it to find patterns and draw conclusions from the unlabeled data.

The algorithms in unsupervised learning are more difficult than in supervised learning since we have little or no information about the data. Unsupervised learning tasks typically involve grouping similar examples together, dimensionality reduction, and density estimation.

Some Broad ML Tasks

- Classification: assign a category to each item (e.g., document classification).
- Regression: predict a real value for each item (prediction of stock values, economic variables).
- Ranking: order items according to some criterion (relevant web pages returned by a search engine).
- Clustering: partition data into 'homogenous' regions (analysis of very large data sets).
- Dimensionality reduction: find lower-dimensional manifold preserving some properties of the data.

Data wrangling



Data wrangling is the process of gathering, selecting, cleaning, structuring and enriching raw data into the desired format for better decision making in less time.

If you want to create an efficient ETL pipeline (extract, transform, and load) or create beautiful data visualizations, you should be prepared to do a lot of data wrangling- Springboard.

Data Imputation

0	2	5.0	3.0	6.0	NaN
1	9	NaN	9.0	0.0	7.0
2	19	17.0	NaN	9.0	NaN
3	7	10.0	3.0	6.0	4.0
4	2	8.0	10.0	NaN	3.0

0	2.0	5.0	3.00	6.00	4.666667
1	9.0	10.0	9.00	0.00	7.000000
2	19.0	17.0	6.25	9.00	4.666667
3	7.0	10.0	3.00	6.00	4.000000
4	2.0	8.0	10.00	5.25	3.000000

Data imputation is the substitution of estimated values for missing or inconsistent data items (fields). The substituted values are intended to create a data record that does not fail edits.

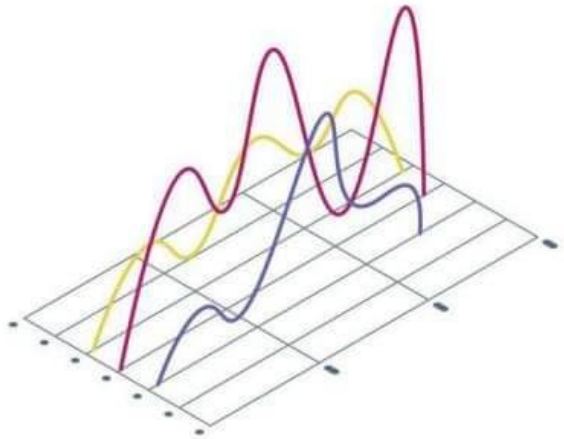
The most common technique is mean imputation, where you take the mean of the existing data in the field and fill in the blanks with this.

Classification

A classification algorithm tries to determine the class or the category of the data it is presented with.

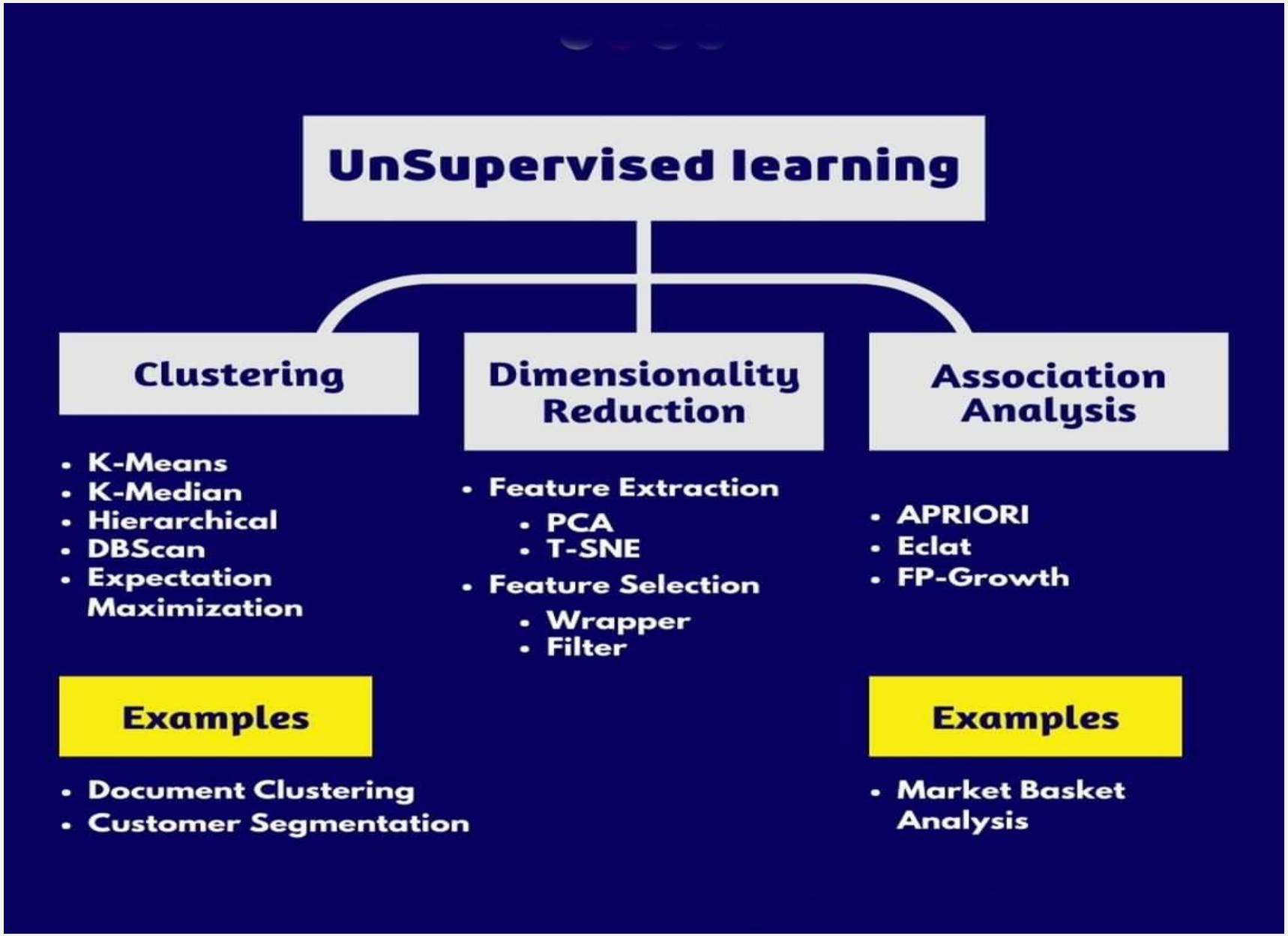
Many times, an object might belong to several categories, and the AI needs to determine what those categories are and how much confidence the algorithm has in its predictions.

Regression

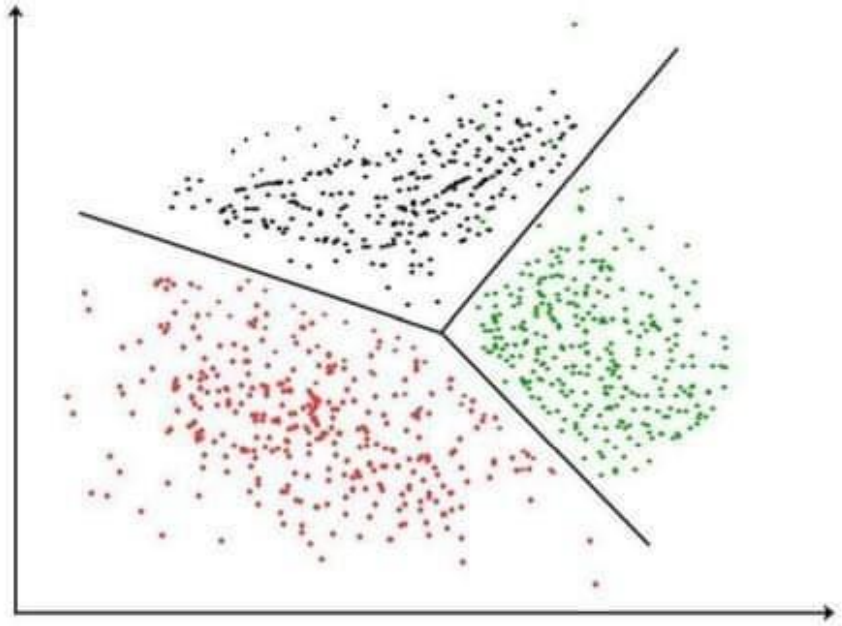


Regression is the type of Supervised Learning in which labelled data is used, and this data is used to make predictions in a continuous form.

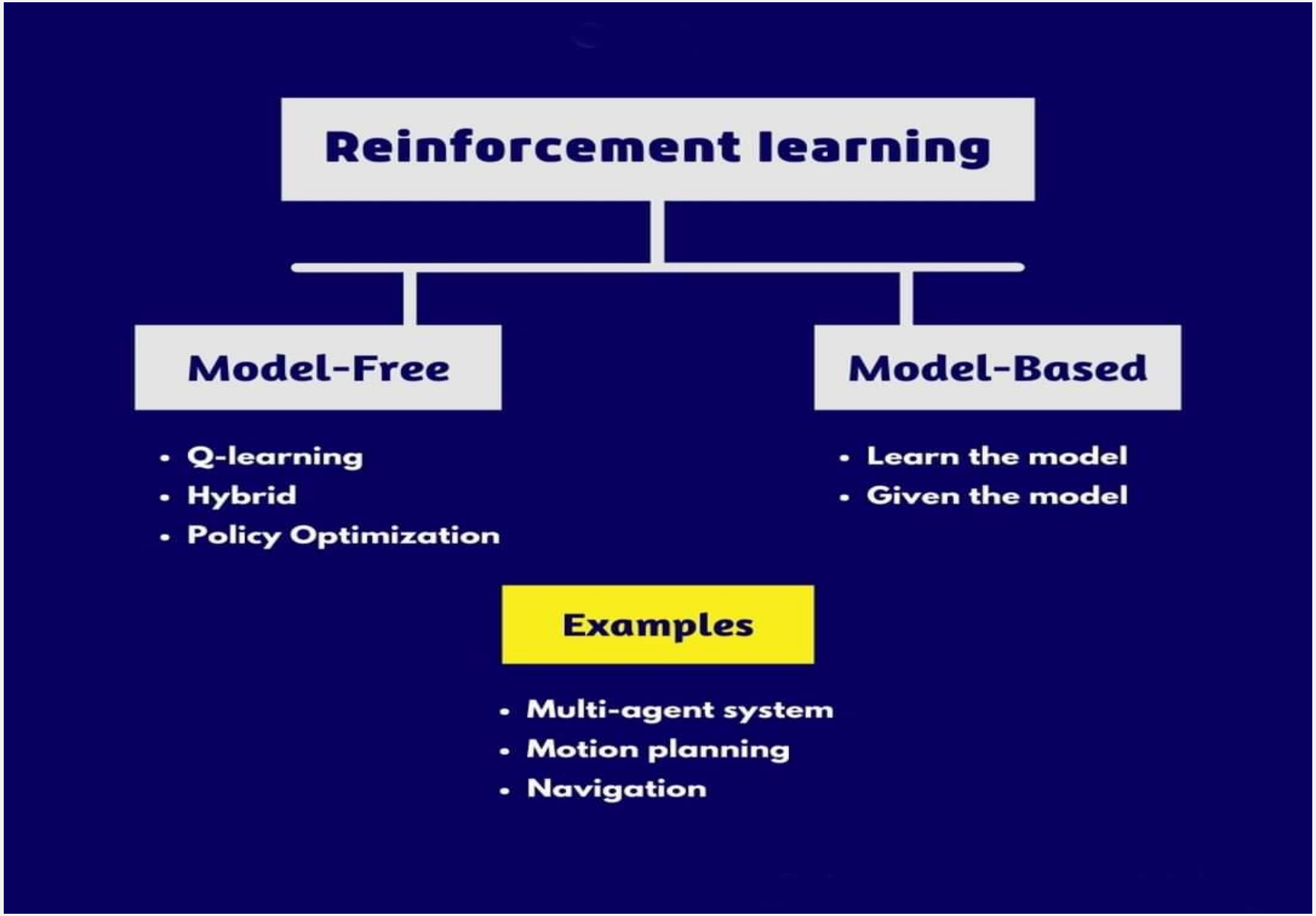
Regression problems include types where the output variables are set as a real number. The format for this problem often follows a linear format.


UnSupervised learning
Clustering
Dimensionality Reduction
Association Analysis
K-Means
K-Median
Hierarchical
DBScan
Expectation Maximization
Feature Extraction
PCA
T-SNE
Feature Selection
Wrapper
Filter
APRIORI
Eclat
FP-Growth
Examples
Document Clustering
Customer Segmentation
Examples
Market Basket Analysis

Clustering



Clustering is the task of dividing the population or data points into a number of groups such that data points in the same groups are more similar to other data points in the same group than those in other groups. In simple words, the aim is to segregate groups with similar traits and assign them into clusters.


Reinforcement learning
Model-Free
Q-learning
Hybrid
Policy Optimization
Model-Based
Learn the model
Given the model
Examples
Multi-agent system
Motion planning
Navigation

Neural Networks

3

Neural networks are a type of machine learning model inspired by the structure of the human brain. They are composed of layers of interconnected nodes, each of which performs a simple mathematical operation. By combining these operations, neural networks can learn to solve complex problems

Deep Learning

4

Deep learning is a subset of machine learning that uses deep neural networks with many layers. These networks are particularly good at recognizing patterns in large, complex datasets, and have been used to achieve state-of-the-art results in fields like computer vision and natural language processing

Feature Engineering

5

Feature engineering is the process of selecting and transforming the input data to a machine learning algorithm in order to improve its performance. This often involves selecting the most relevant features (or variables) for the problem at hand, as well as transforming them in a way that makes them easier for the algorithm to learn from

Model Evaluation

6

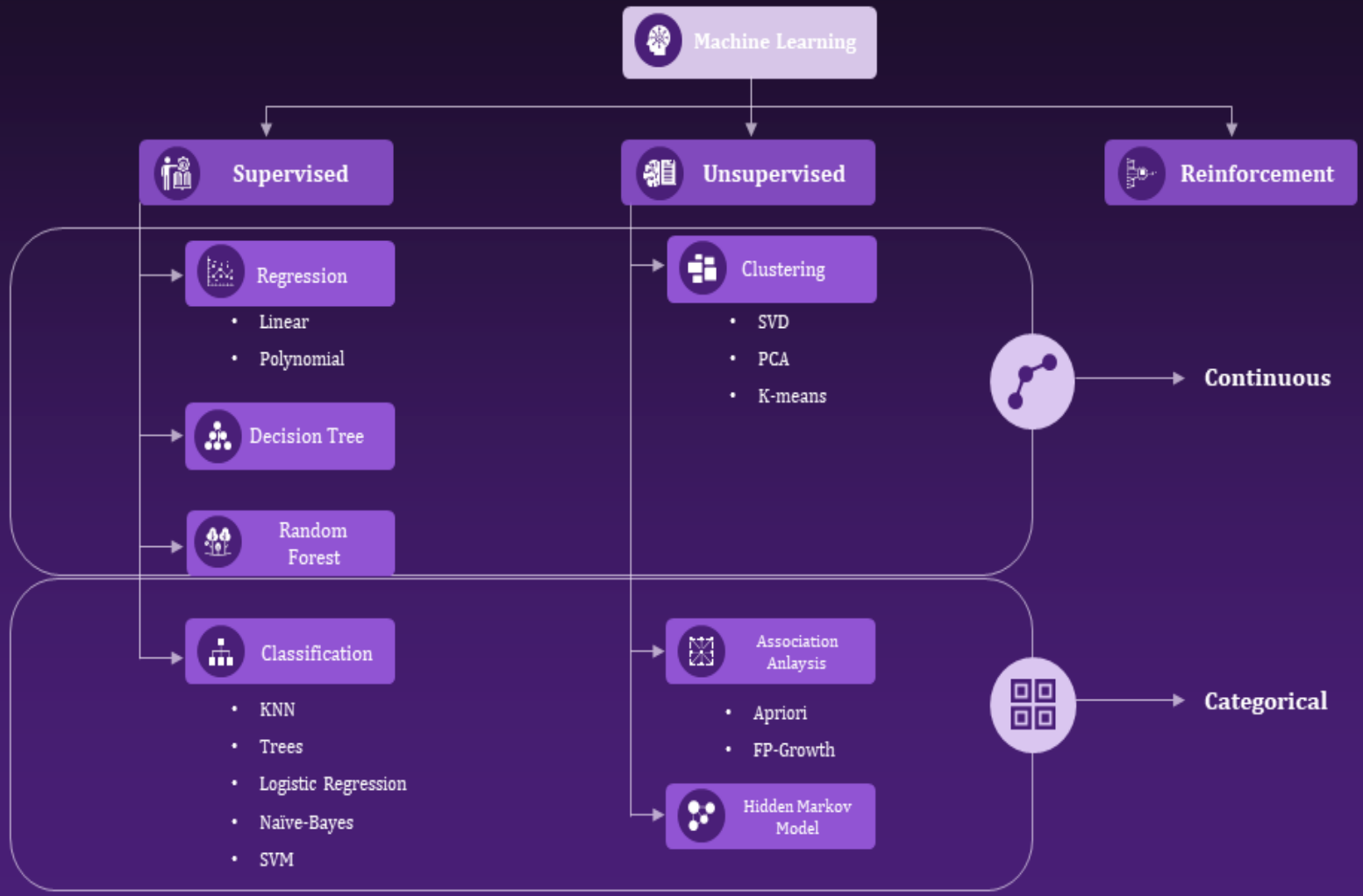
Once a machine learning model has been trained, it is important to evaluate its performance on a separate set of data that was not used in the training process. This can help to identify any issues with the model, and guide further improvements

Bias and Fairness

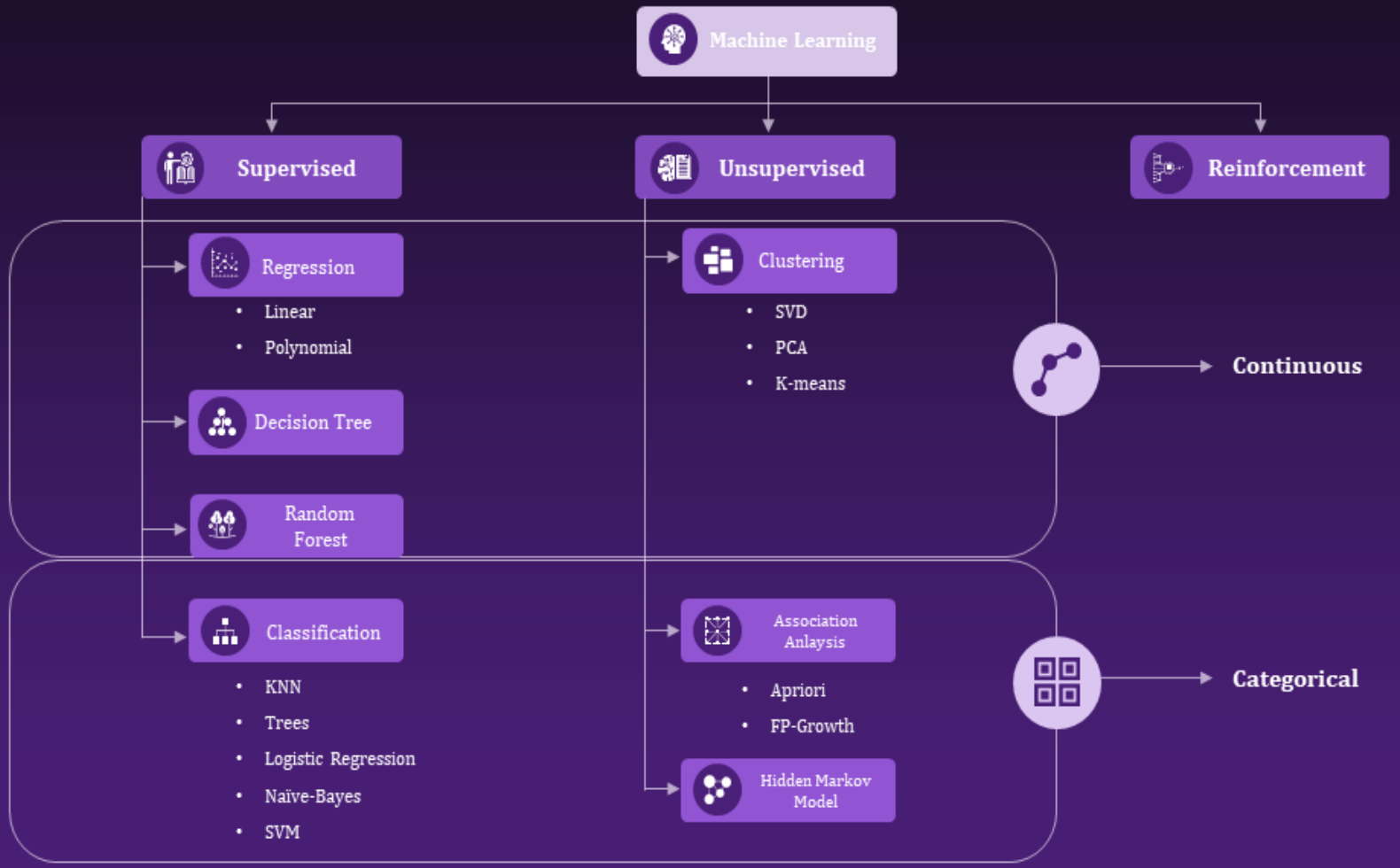
7

Machine learning algorithms can suffer from bias, meaning that they may produce inaccurate or unfair results. It is important to be aware of these issues and to take steps to mitigate them, such as using representative and diverse datasets, and carefully evaluating the output of the model to ensure it is fair and unbiased

Machine Learning Algorithms

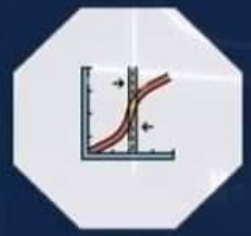


Machine Learning Algorithms

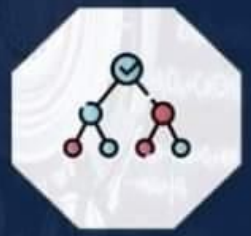


9 Machine Learning Algorithms

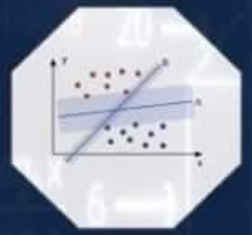
Linear Regression



Logistic Regression



Decision Tree

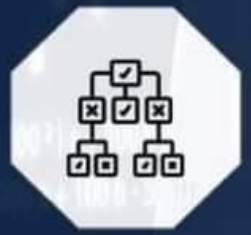


SVM

KNN

Dimensionality Reduction

K-means



Random Forest

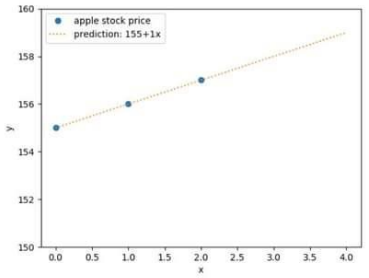
Naive Bayes

[Cheat Sheet] 6 Pillar Machine Learning Algorithms

Complete Course: https://academy.finxter.com/

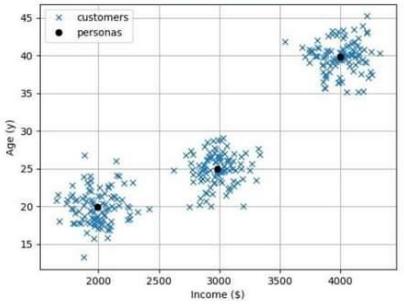
Linear Regression

https://blog.finxter.com/logistic-regression-in-one-line-python/



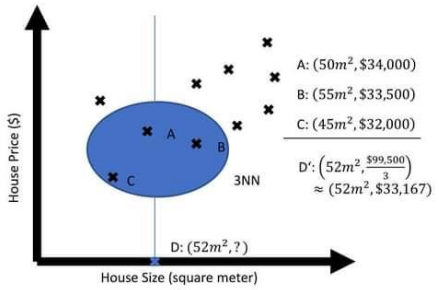
K-Means Clustering

https://blog.finxter.com/tutorial-how-to-run-k-means-clustering-in-1-line-of-python/



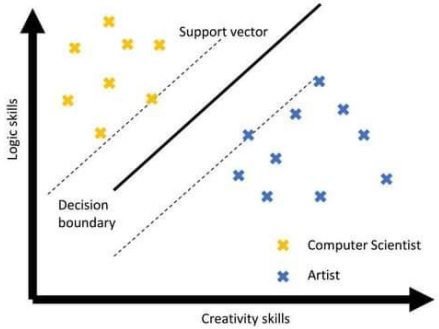
K Nearest Neighbors

https://blog.finxter.com/k-nearest-neighbors-as-a-python-one-liner/



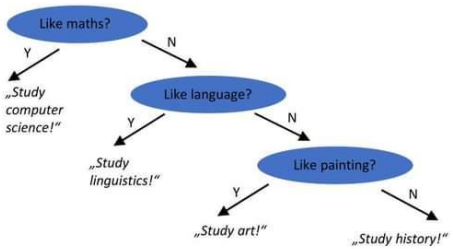
Support Vector Machine Classification

https://blog.finxter.com/support-vector-machines-python/



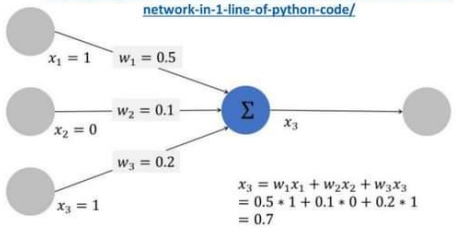
Decision Tree Classification

https://blog.finxter.com/decision-tree-learning-in-one-line-python/



Multilayer Perceptron

https://blog.finxter.com/tutorial-how-to-create-your-first-neural-network-in-1-line-of-python-code/



$x_3 = w_1x_1 + w_2x_2 + w_3x_3$
$= 0.5 * 1 + 0.1 * 0 + 0.2 * 1$
$= 0.7$

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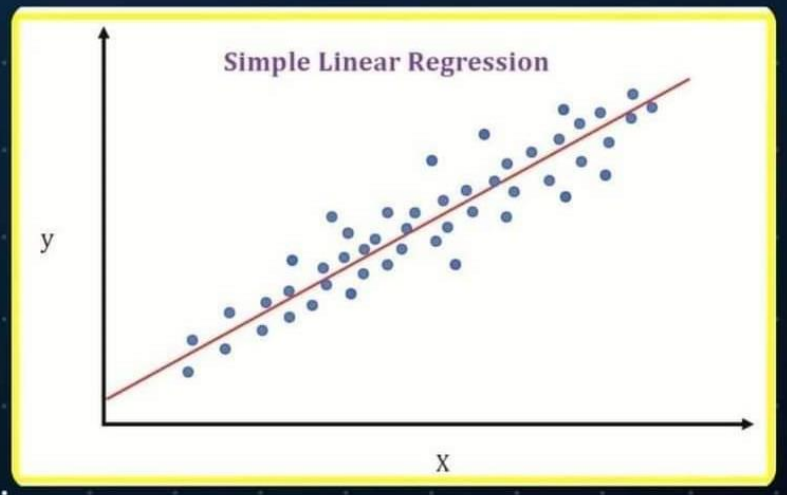
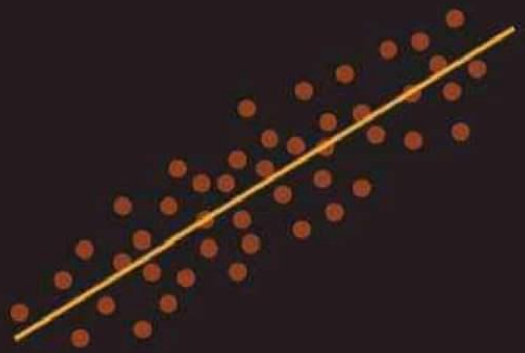
„Continuous Improvement in Your Coffee Break Python!"

1. Linear Regression

👉 Linear regression is a predictive statistical approach for modelling relationship between a dependent variable with a given set of independent variables.





Linear Regression

GOOD

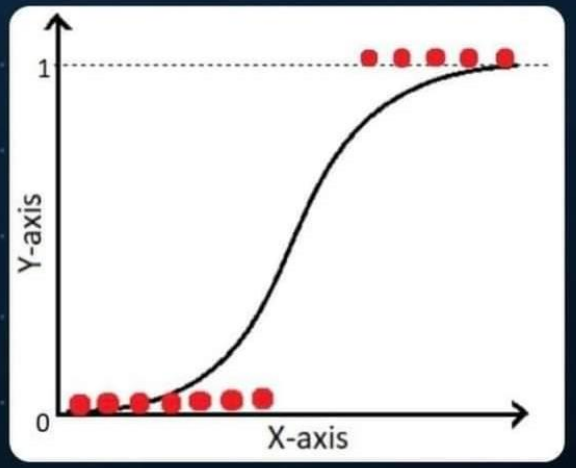
- Simple to implement and efficient to train.
- Overfitting can be reduced by regularization.
- Performs well when the dataset is linearly separable.

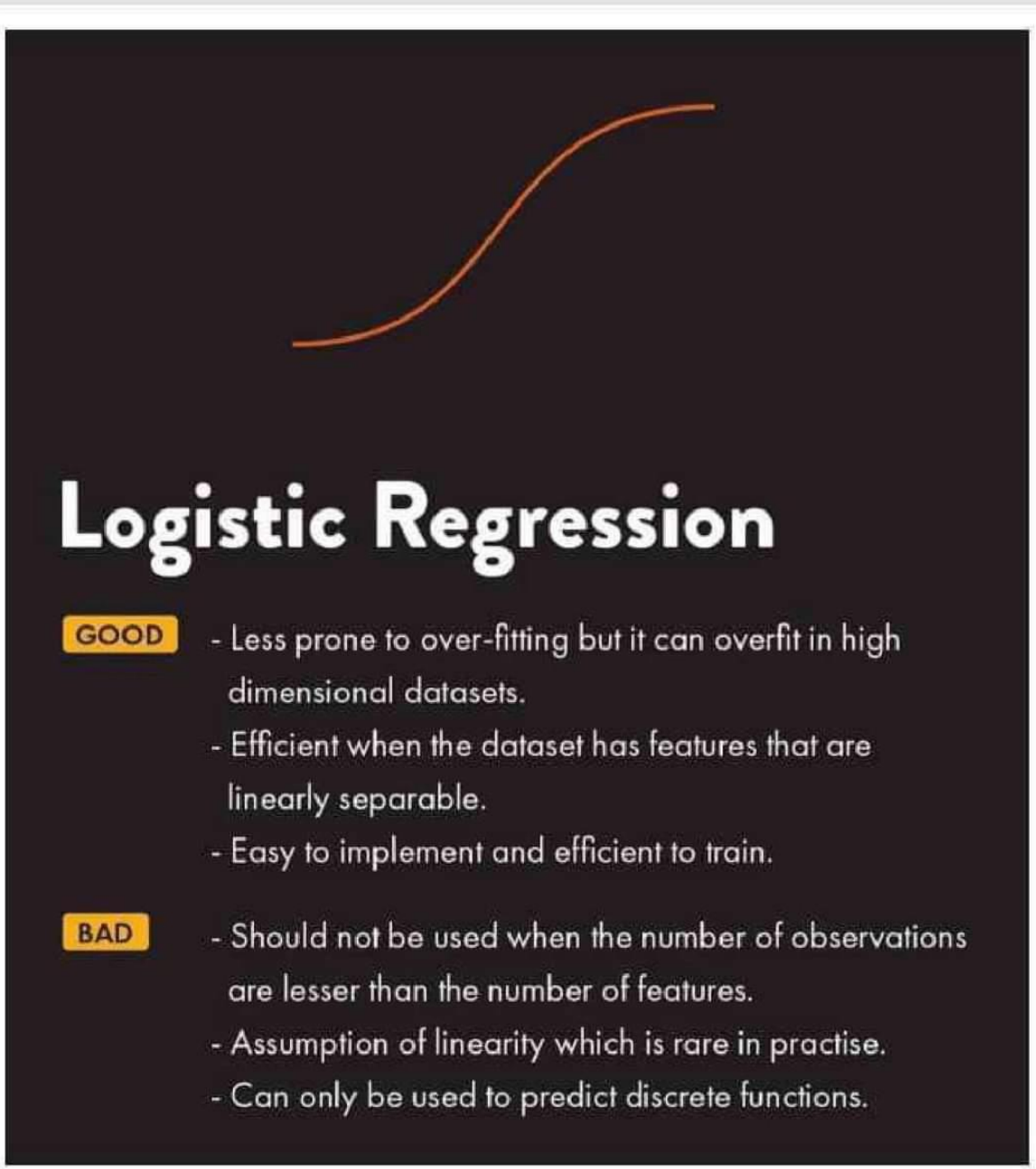
BAD

- Assumes that the data is independent which is rare in real life.
- Prone to noise and overfitting.
- Sensitive to outliers.

2. Logistic Regression

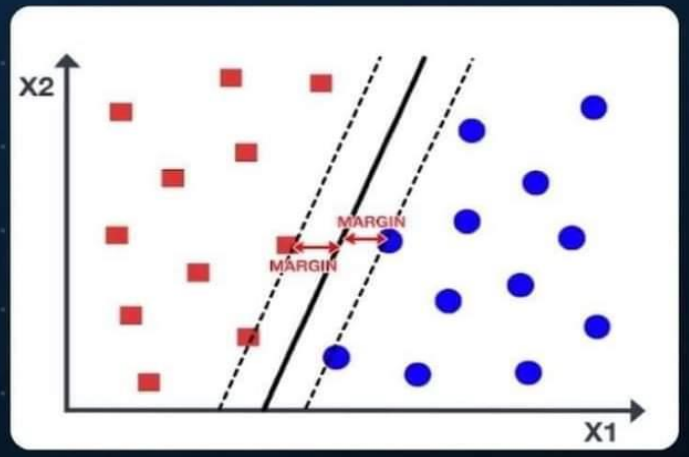
👉 Logistic Regression is a Supervised learning algorithm widely used for classification. It is used to predict a binary outcome (1/ 0, Yes/ No, True/ False) given a set of independent variables.

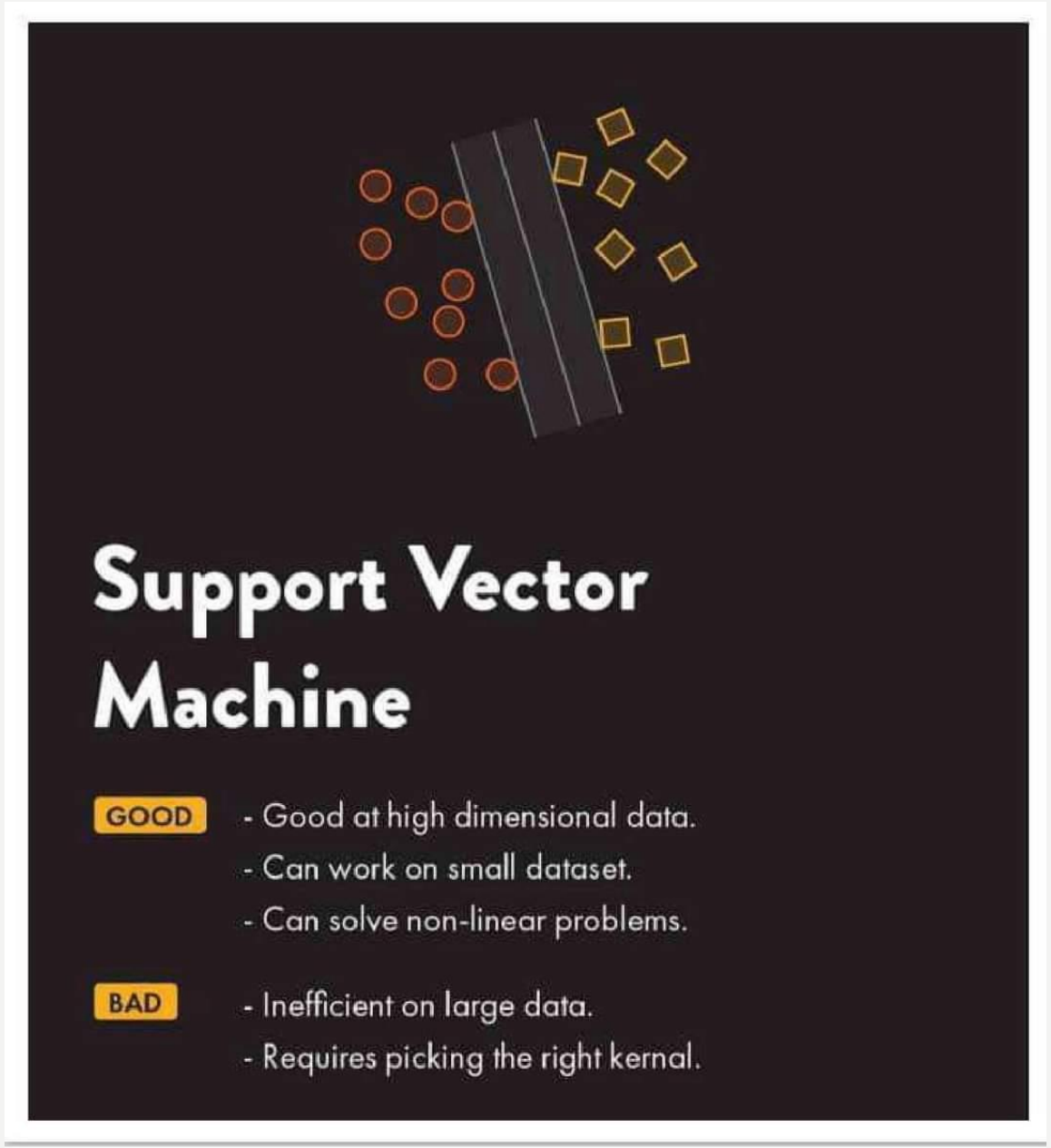



Logistic Regression
GOOD
- Less prone to over-fitting but it can overfit in high dimensional datasets.
- Efficient when the dataset has features that are linearly separable.
- Easy to implement and efficient to train.
BAD
- Should not be used when the number of observations are lesser than the number of features.
- Assumption of linearity which is rare in practise.
- Can only be used to predict discrete functions.

3. SVM

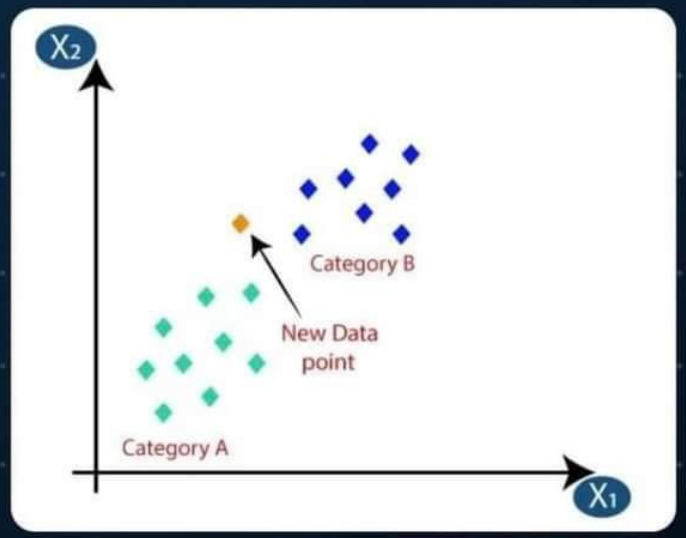
👉 Support vector machines (SVMs) are a set of supervised learning methods used for classification, regression and outlier detection.

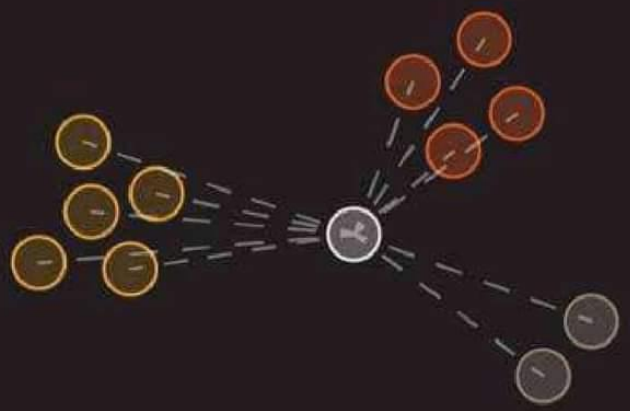



Support Vector Machine
GOOD
- Good at high dimensional data.
- Can work on small dataset.
- Can solve non-linear problems.
BAD
- Inefficient on large data.
- Requires picking the right kernal.

4. K-Nearest

👉 K- Nearest Neighbors is a Supervised machine learning algorithm which can be used for classification as well as regression. It does not make an assumption about the underlying data distribution pattern.





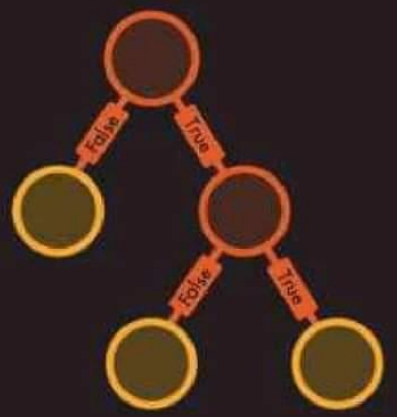
K Nearest Neighbour

GOOD

- Can make predictions without training.
- Time complexity is O(n).
- Can be used for both classification and regression.

BAD

- Does not work well with large dataset.
- Sensitive to noisy data, missing values and outliers.
- Need feature scaling.
- Choose the correct K value.



Decision Tree

GOOD

- Can solve non-linear problems.
- Can work on high-dimensional data with excellent accuracy.
- Easy to visualize and explain.

BAD

- Overfitting. Might be resolved by random forest.
- A small change in the data can lead to a large change in the structure of the optimal decision tree.
- Calculations can get very complex.

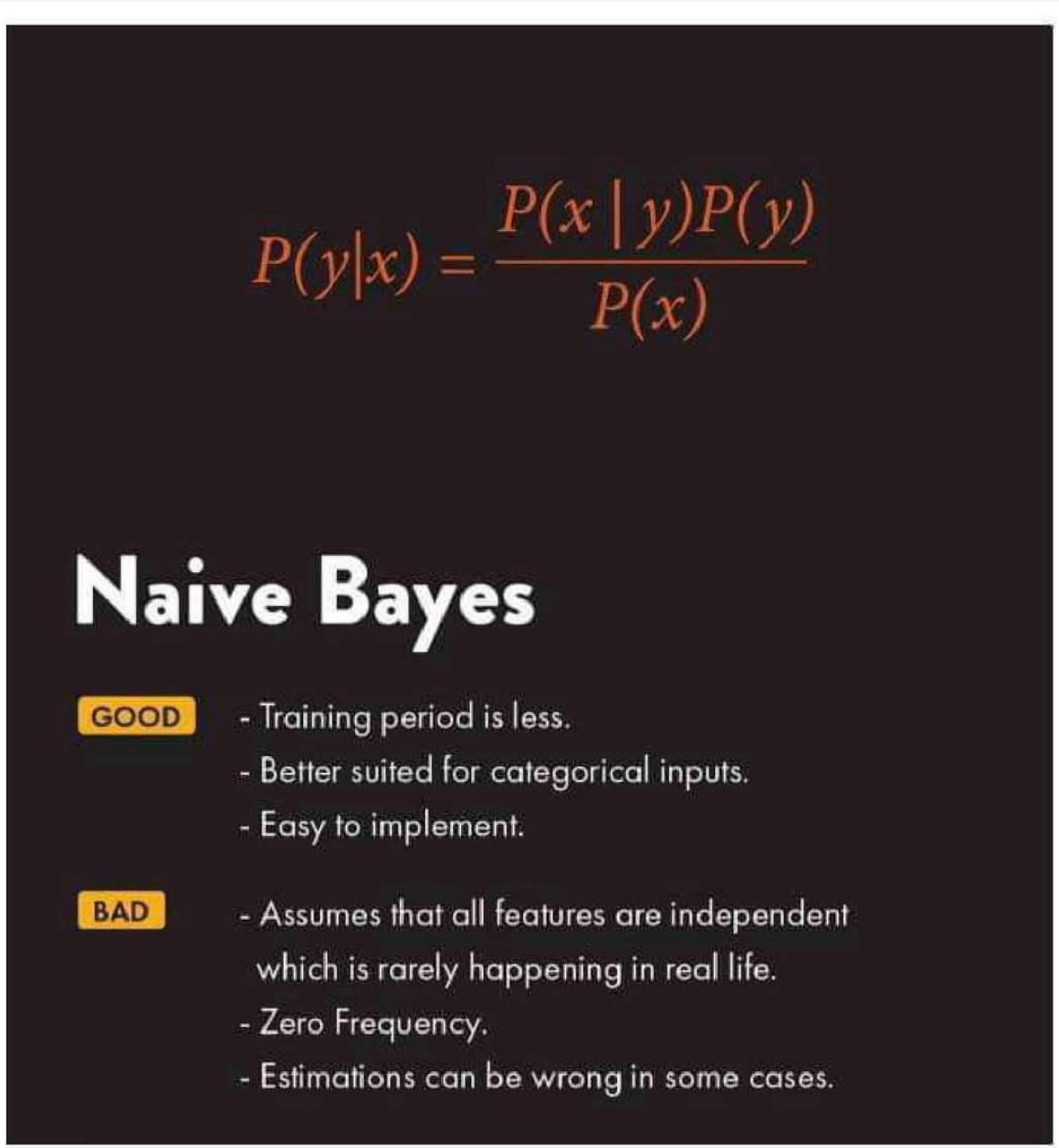
K Means

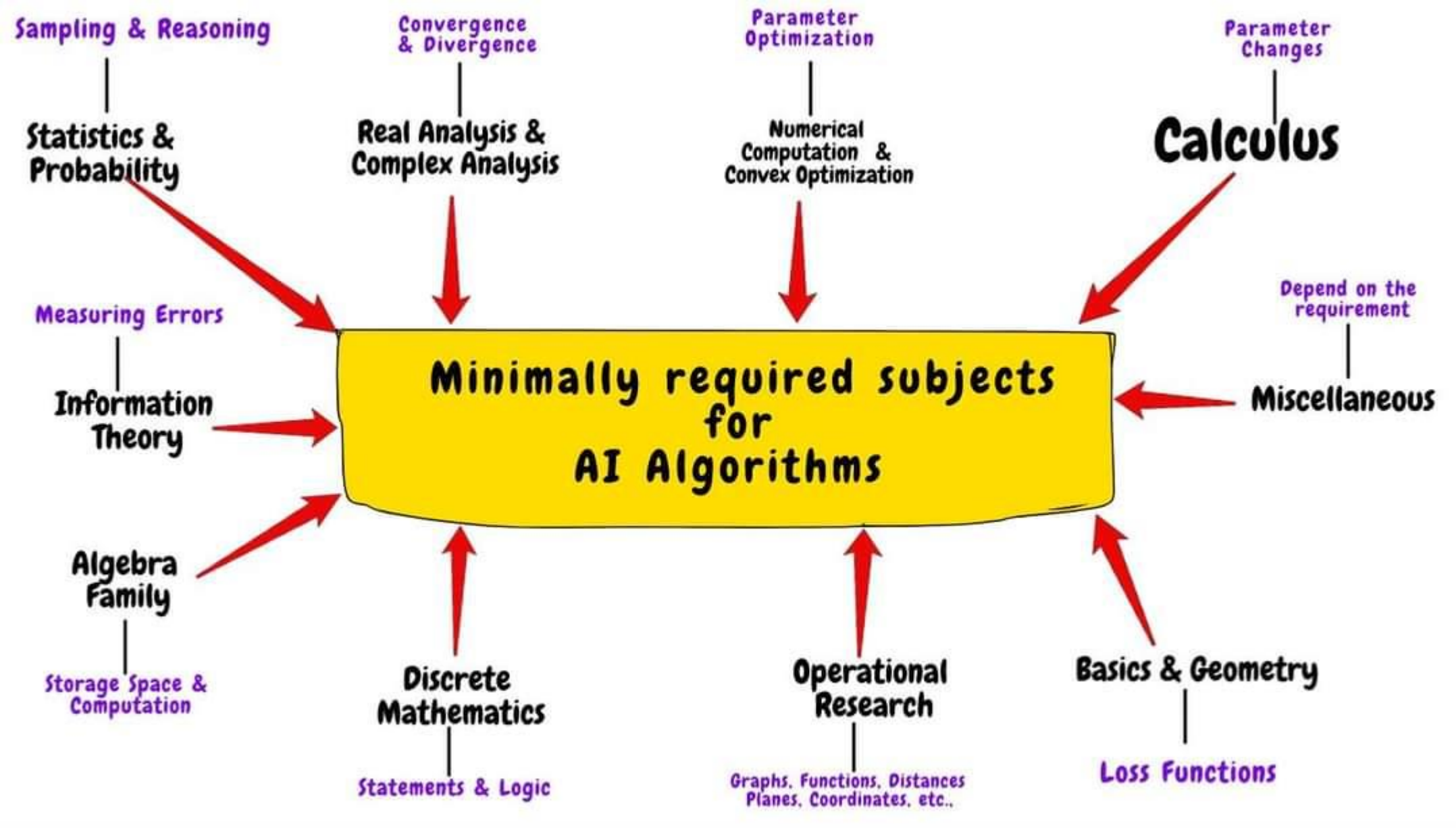
GOOD

- Simple to implement.
- Scales to large data sets.
- Guarantees convergence.
- Easily adapts to new examples.
- Generalizes to clusters of different shapes and sizes.

BAD

- Sensitive to the outliers.
- Choosing the k values manually is tough.
- Dependent on initial values.
- Scalability decreases when dimension increases.


$P(y|x) = \frac{P(x \mid y)P(y)}{P(x)}$
Naive Bayes
GOOD
- Training period is less.
- Better suited for categorical inputs.
- Easy to implement.
BAD
- Assumes that all features are independent which is rarely happening in real life.
- Zero Frequency.
- Estimations can be wrong in some cases.


Sampling & Reasoning
Statistics & Probability
Convergence & Divergence
Real Analysis & Complex Analysis
Parameter Optimization
Numerical Computation & Convex Optimization
Parameter Changes
Calculus
Measuring Errors
Information Theory
Minimally required subjects for AI Algorithms
Depend on the requirement
Miscellaneous
Algebra Family
Storage Space & Computation
Discrete Mathematics
Statements & Logic
Operational Research
Graphs, Functions, Distances Planes, Coordinates, etc.,
Basics & Geometry
Loss Functions

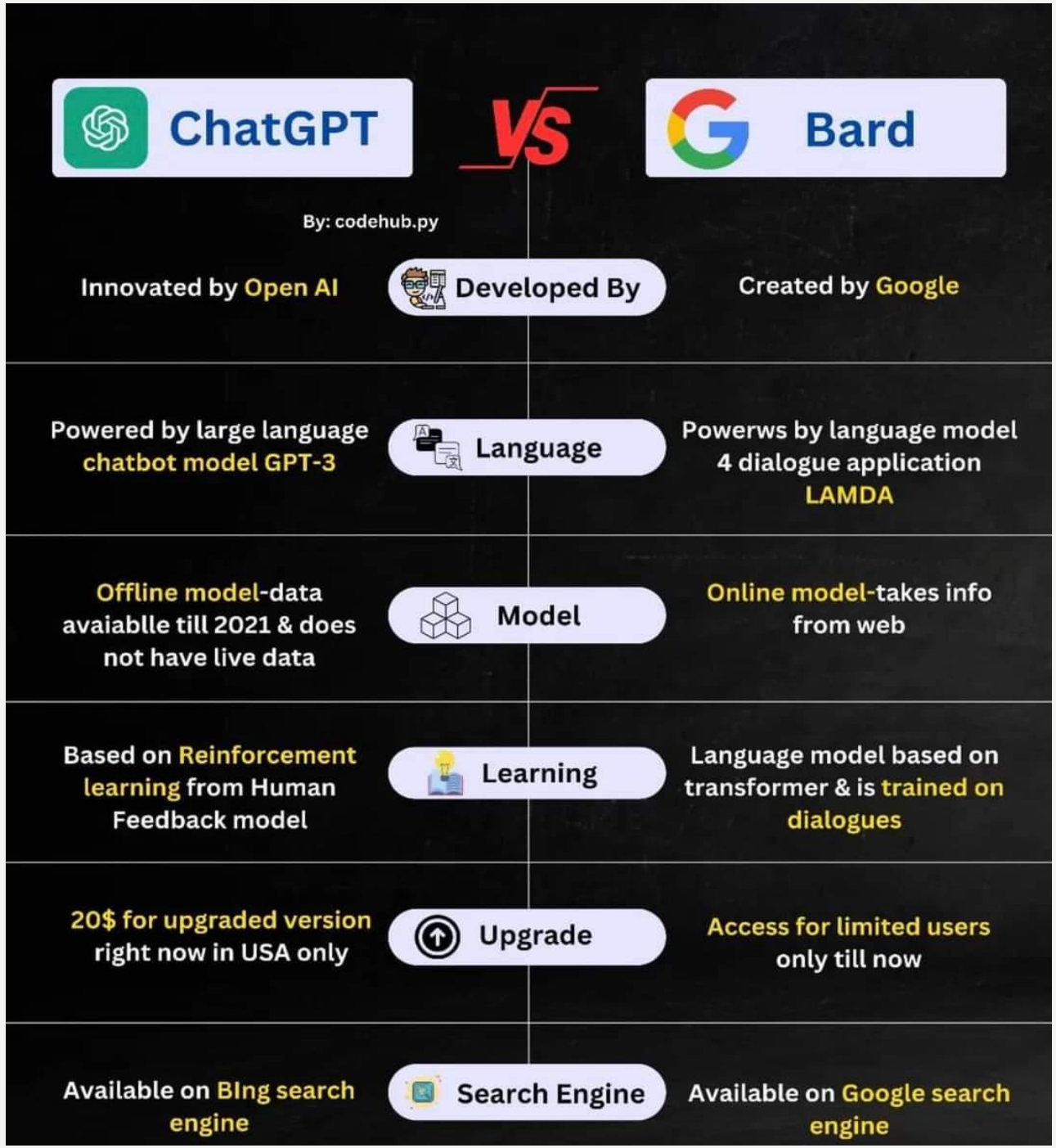
Linas Beliūnas
@linas.beliunas

OpenAI just released **GPT-4**. It:

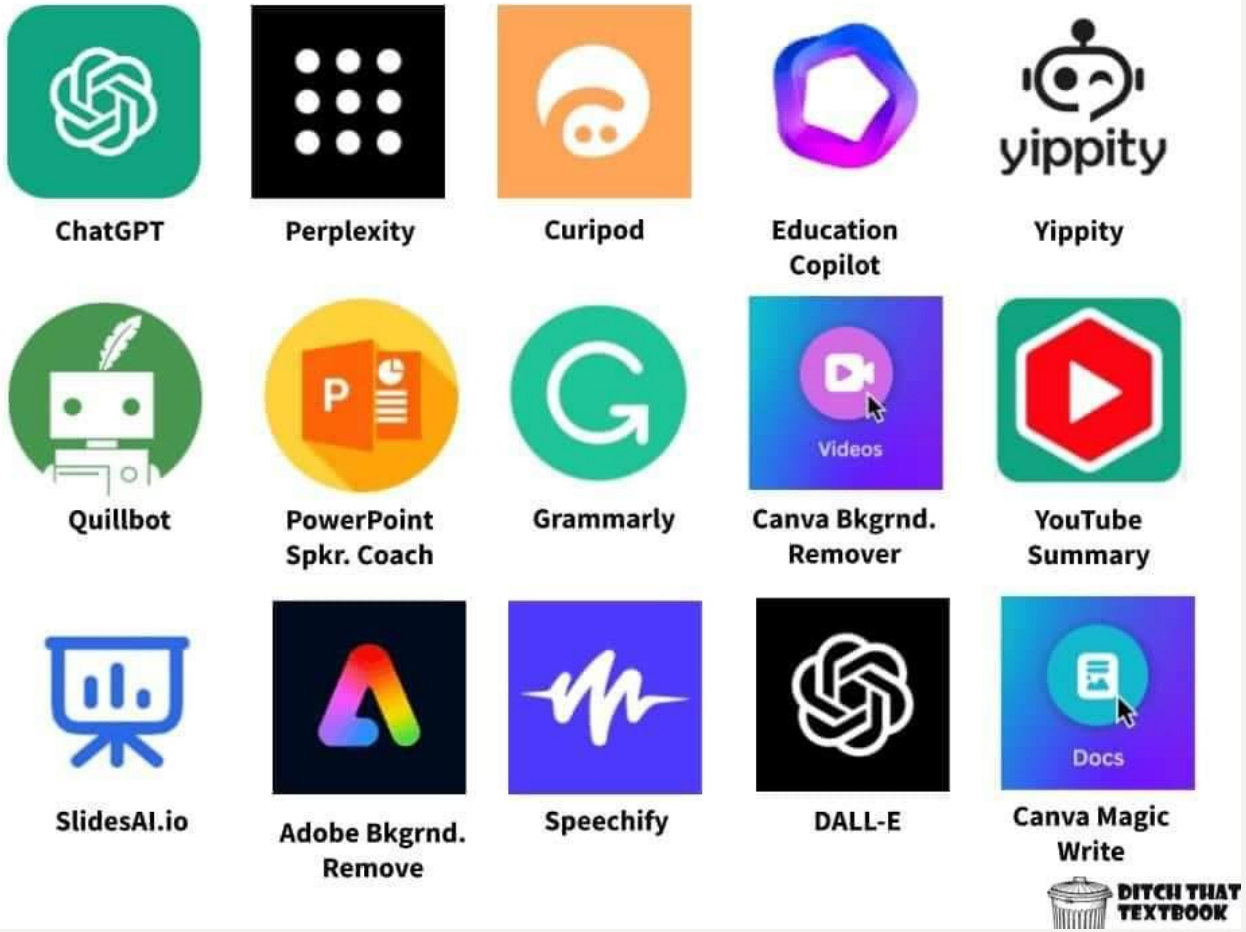
- Is multimodal (can see & listen)
- Passes basically every exam with flying colors
- Has advanced reasoning capabilities
- Will solve difficult problems with mind-blowing accuracy.

The world will never be the same again.


What AI Models
Is Google Bard
Trained On
BARD

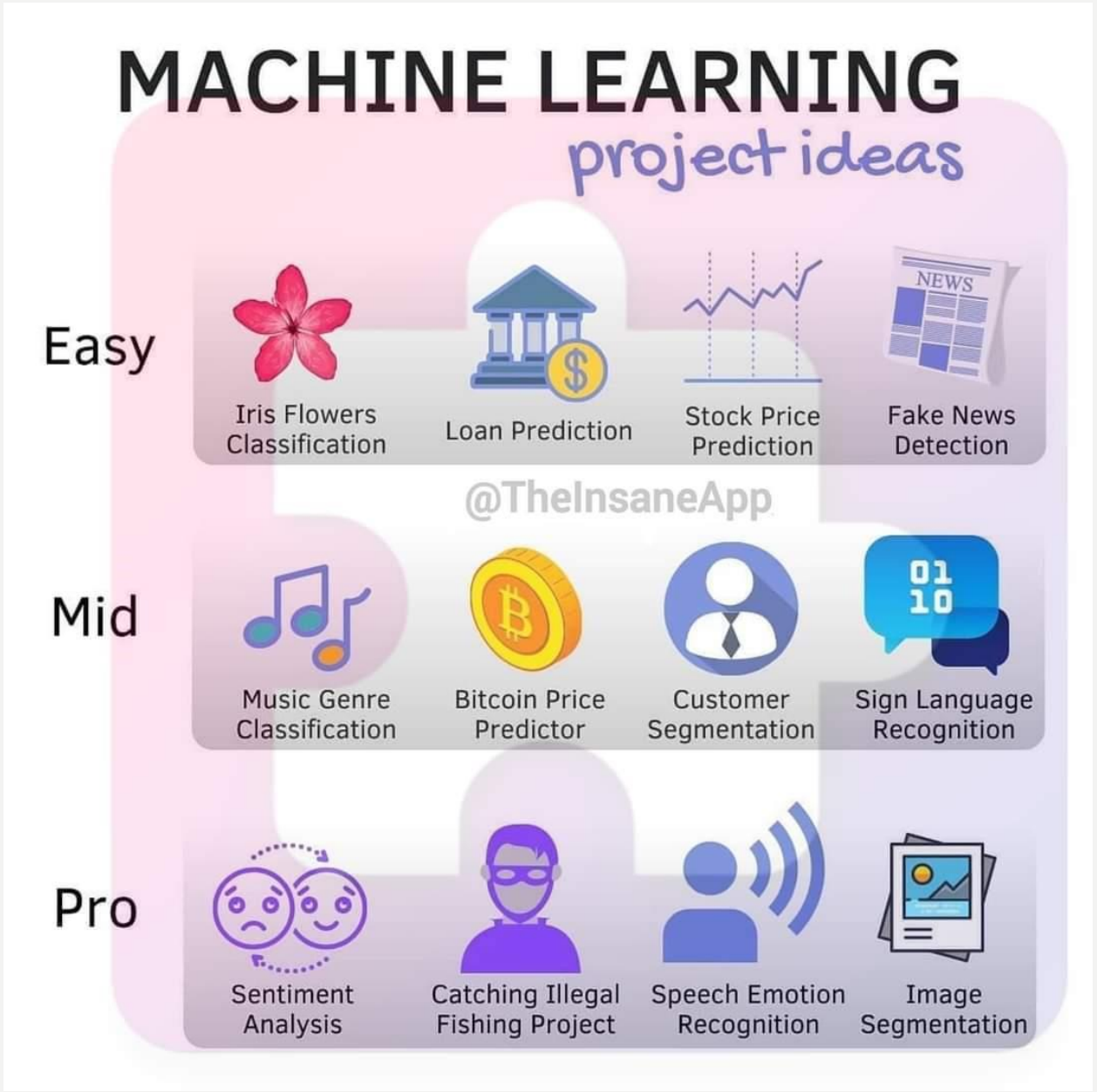

ChatGPT
VS
Bard
By: codehub.py
Innovated by Open AI
Developed By
Created by Google
Powered by large language chatbot model GPT-3
Language
Powerws by language model 4 dialogue application LAMDA
Offline model-data avaiablle till 2021 & does not have live data
Model
Online model-takes info from web
Based on Reinforcement learning from Human Feedback model
Learning
Language model based on transformer & is trained on dialogues
20$ for upgraded version right now in USA only
Upgrade
Access for limited users only till now
Available on BIng search engine
Search Engine
Available on Google search engine

15 AI tools to use in the classroom



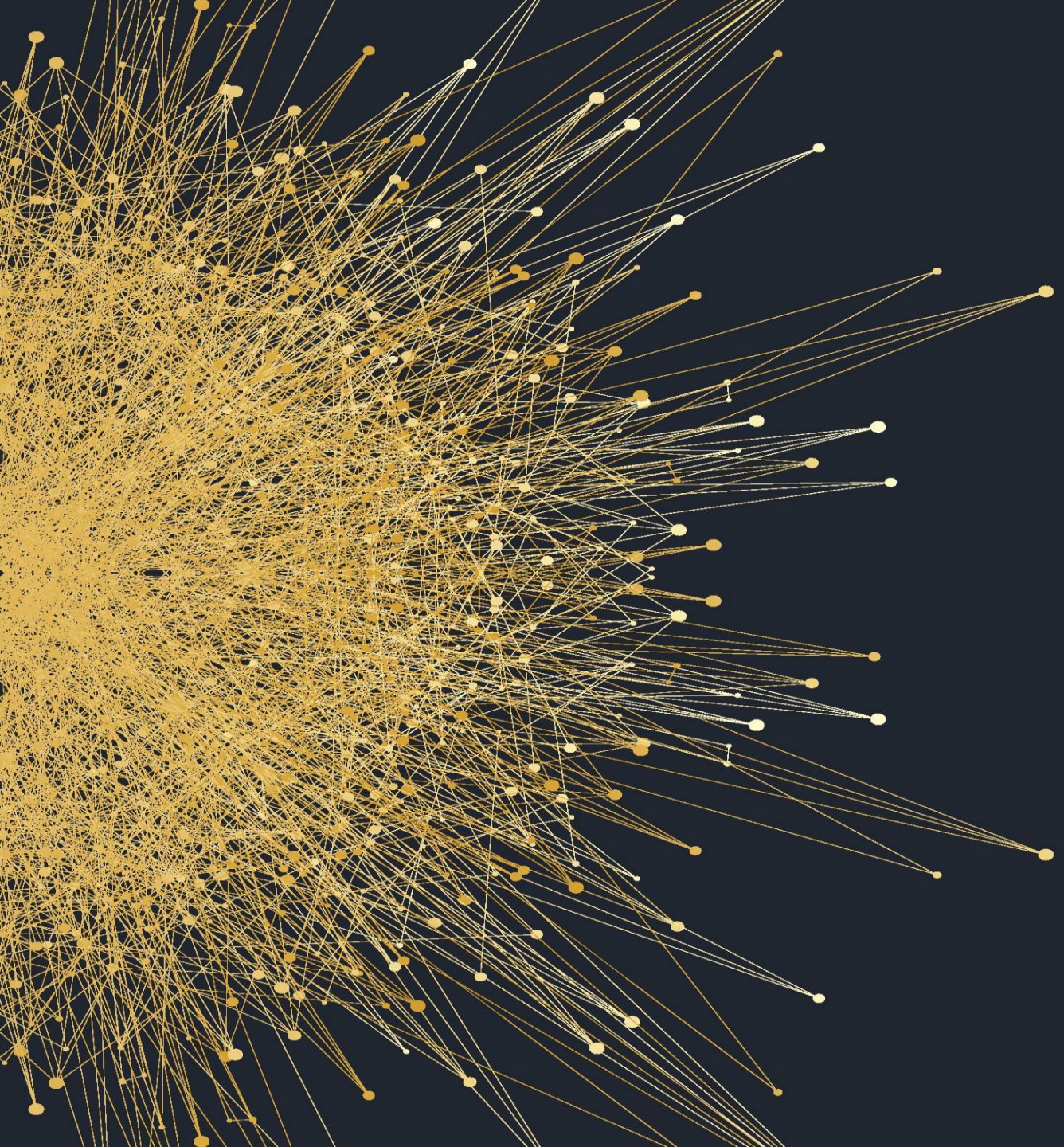

AN OVERVIEW OF CURRENT GENERATIVE A.I. TOOLS
TEXT
ChatGPT
Jasper
frase
copy.ai
Writesonic
grammarly
Flowrite
Notion
text.cortex
GooseAI
Rytr
IMAGE
Midjourney
Stable Diffusion
Playground
WONDER-AI
DALL·E 2
imagen
AUDIO
RESEMBLE.AI
descript
MURF.AI
Big Speak
VIDEO
runway
Phenaki
Fliki
synthesia
OTHER
WOMBO
EbSynth
GitHub
replit
THEDEPTOFNEXT.COM


MAGIC LOGIX
Chat GPT
copy.ai
SMARTLY.IO
Best
AI TOOLS
for
DIGITAL
MARKETING
Writesonic
Jasper
QuillBot
LetsEnhance.io
MidJourney


MACHINE LEARNING
project ideas
Easy
Iris Flowers Classification
Loan Prediction
Stock Price Prediction
NEWS
Fake News Detection
@TheInsaneApp
Mid
Music Genre Classification
Bitcoin Price Predictor
Customer Segmentation
01 10
Sign Language Recognition
Pro
Sentiment Analysis
Catching Illegal Fishing Project
Speech Emotion Recognition
Image Segmentation

PYTHON LIBRARIES FOR MACHINE LEARNING

Machine Learning	Visualization	Mathematics for Data Science	Data Manipulation & Analysis
TensorFlow	matplotlib	SciPy	pandas
scikit-learn	Bokeh	NumPy	Scrapy
PYTORCH	plotly	Natural Language ToolKit	
Keras	Seaborn	StatsModels Statistics in Python	
XGBoost CatBoost LightGBM	pydot	spaCy	
dist-keras elephas spark-deep-learning		gensim	
eli5			



Thank you!

Any Question..?