

## Types of Machine Learning:

Machine learning is a subset of AI, which enables the machine to automatically learn from data, improve performance from past experiences and make predictions.

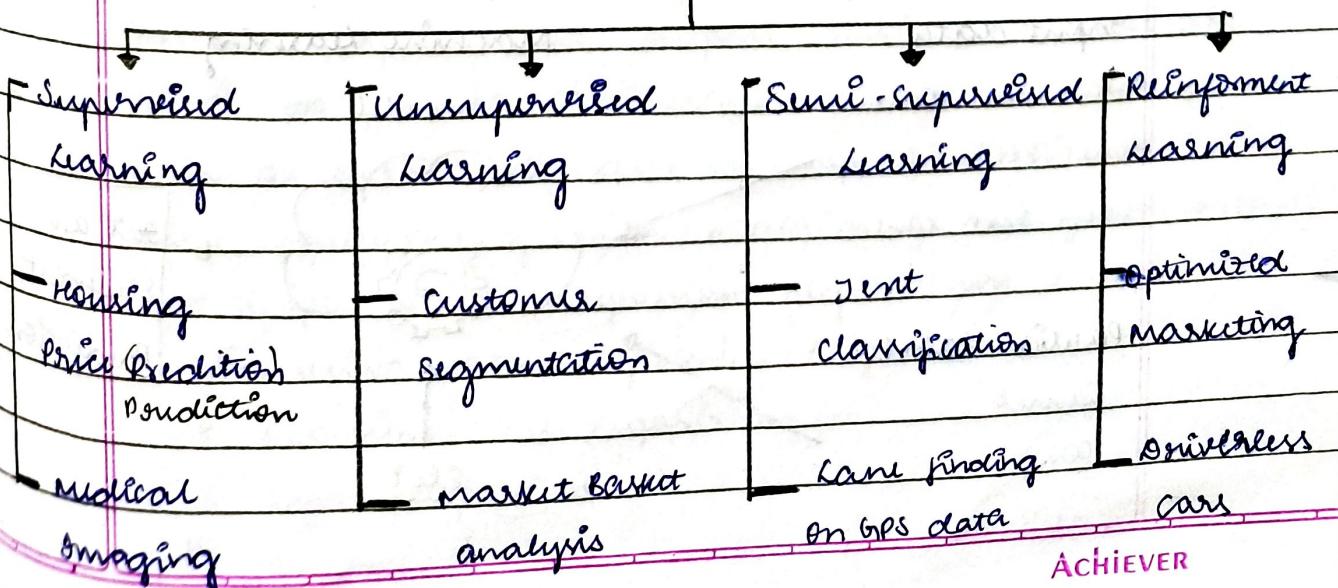
Machine learning contains a set of algorithms that work on a huge amount of data.

Data is fed to these algorithms to train them, and on the basis of training, they build the model & perform a specific task.

Based on the methods and way of learning, machine learning is divided into mainly four types, which are:

1. Supervised machine learning
2. Unsupervised machine learning
3. Semi-supervised machine learning
4. Reinforcement learning

### Machine Learning



## 1) Supervised Machine Learning

- It is based on supervision
- It means in the supervised learning technique we train the machines using the "labelled" dataset, and based on the training, the machine predicts the output.
- The labelled data specifies that some of the inputs are already mapped to the output.
- First, we train the machine with the input and corresponding output, and then we ask the machine to predict the output using the test dataset.
- The main goal of the supervised learning technique is to map the input variable ( $x$ ) with the output variable ( $y$ )
- Some real-world application of supervised learning are
  - \* Risk assessment
  - \* Fraud detection
  - \* Spam filtering

Input data

Ele cow cam

cow ele ele

cam cam cow

Machine learning

model

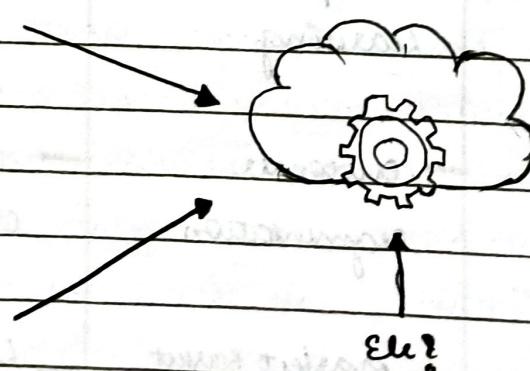
It's an Elephant
Prediction

Partial Labels

Camel

cow

Ele?



categories of supervised machine learning.

They can be classified into two types of problems, which are given below

### a) classification :

- Classification algorithms are used to solve the classification problems in which the output variable is categorical, such as "Yes" or No, male (or) female, Red (or) Blue etc.
- The classification algorithm predict the categories present in the dataset.
- Some real-world examples of classification algorithms are spam detection, email filtering etc.
- Algorithm
  - \* Random Forest Algorithm
  - \* Decision Tree Algorithm
  - \* Logistic Regression Algorithm.
  - \* Support Vector Machine Algorithm.

### b) regression :

- Regression algorithms are used to solve regression problems in which there is a linear relationship between input and output variables. They are used to predict continuous output variable, such as market trends, weather prediction
- Some popular regression algorithms are given below:
  - \* Simple Linear Regression Algorithms
  - \* Multivariate Regression Algorithms
  - \* Decision Tree Algorithms
  - \* Lasso Regression

## Advantages of supervised learning:

- since supervised learning work with the labelled dataset so we can know an exact idea about the classes of object.
- These algorithms are helpful in predicting the output on the basis of prior experience.

## Disadvantages of supervised learning:

- These algorithms are not able to cover complex tasks.
- It may predict the wrong output if the test data is different from the training data.
- It requires lots of computational time to train the algorithm.

## Applications of supervised learning

- **Image Segmentation:**  
Supervised learning algorithm are used in image segmentation. In this process, image classification is performed on different image data with pre-defined labels.
- **Medical diagnosis:**  
Supervised algorithms are also used in the medical field for diagnosis purposes. It is done by using medical images and past labelled data with labels for disease conditions. With such a process, the machine can identify a disease for the new patients.

- Fraud Detection :

Supervised learning classification algorithms are used for identifying fraud transactions, fraud customers etc. It is done by using historic data to identify the patterns that can lead to possible fraud.

- spam detection :

In this and filtering classification algorithm are used. These algorithms classify an email as spam (or) not spam. The spam emails are sent to the spam folder.

- speech recognition :

The algorithm is trained with voice data and various identifications can be done using the same, such as voice-activated password, voice commands etc.

- Unsupervised machine learning

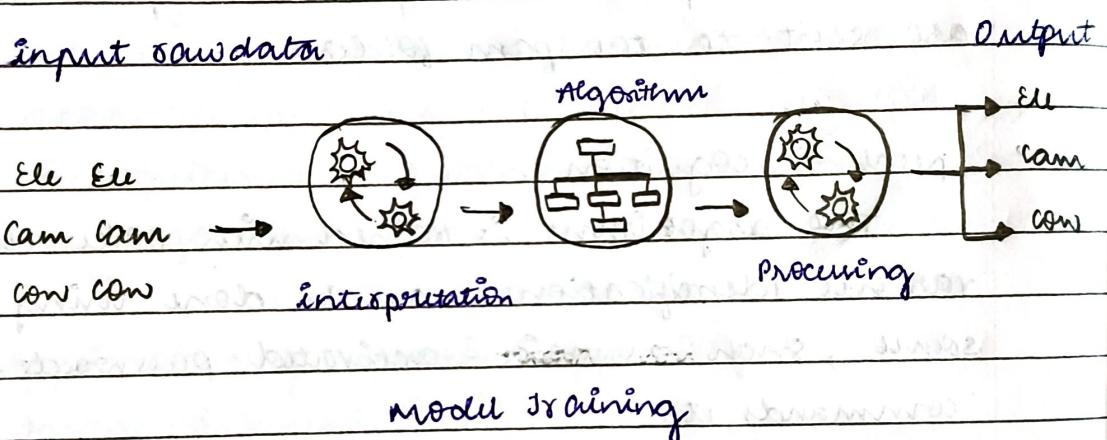
It is different from the supervised learning technique, as its name suggests, there is no need for supervision.

- It means, in unsupervised machine learning the machine is trained using the unlabelled output without any supervision.

- In unsupervised learning, the models are trained with the data that is neither classified nor labelled and the model acts on that data.

without any supervision.

- The main aim of the unsupervised learning algorithm is to group (or) categories the unsupervised dataset according to the similarities, patterns and differences.
- Machines are instructed to find the hidden patterns from the input dataset.  
ex: Fruit Basket.



Categories of Unsupervised Machine Learning  
They are classified into 2 types, which are given below

### a) Clustering :

- This technique is used when we want to find the inherent groups from the data.
- It is a way to group the objects into a cluster such that the objects with the most similarities remain in one group and have fewer (or) no similarities with the objects of other groups.

- An example of clustering algorithms is grouping the customers by their purchasing behaviour etc.
- some algorithms are:
  - \* K - means clustering Algorithm
  - \* mean - shift algorithm
  - \* DBSCAN Algorithm
  - \* Principal component analysis
  - \* Independent component Analysis.

by association :

- association rule learning is an unsupervised learning technique , which finds interesting relations among variables within a large dataset.
- The main aim of this learning algorithms is to find the dependency of one data item on another data item and map those variables accordingly so that it can generate maximum profit.
- This algorithm is mainly applied in market basket analysis , web usage mining , continuous production etc.
- some popular algorithms of association rule learning are Apriori algorithm , Eclat , FP - growth algorithm .

### Advantages :

- These algorithms can be used for complicated tasks compared to the supervised ones because these algorithms work on the unlabelled dataset.
- unsupervised algorithms are preferable for various tasks as getting the unlabelled dataset is easier as compared to the labelled dataset.

### Disadvantages :

- The output of an unsupervised algorithm can be less accurate as the dataset is not labelled, and algorithms are not trained with the exact output in prior.
- working with unsupervised learning is more difficult as it works with the unlabelled dataset that doesn't map with the output.

### Applications :

#### • Network analysis -

unsupervised learning is used for identifying plagiarism and copy right in document network analysis of text data for scholarly articles.

#### • Recommendation system :

Recommendation system widely uses unsupervised learning techniques for building recommendation applications for different web applications and e-commerce websites.

- **Anomaly detection :**

It is a popular application of unsupervised learning, which can identify unusual data points within the dataset. It is used to discover fraudulent transactions.

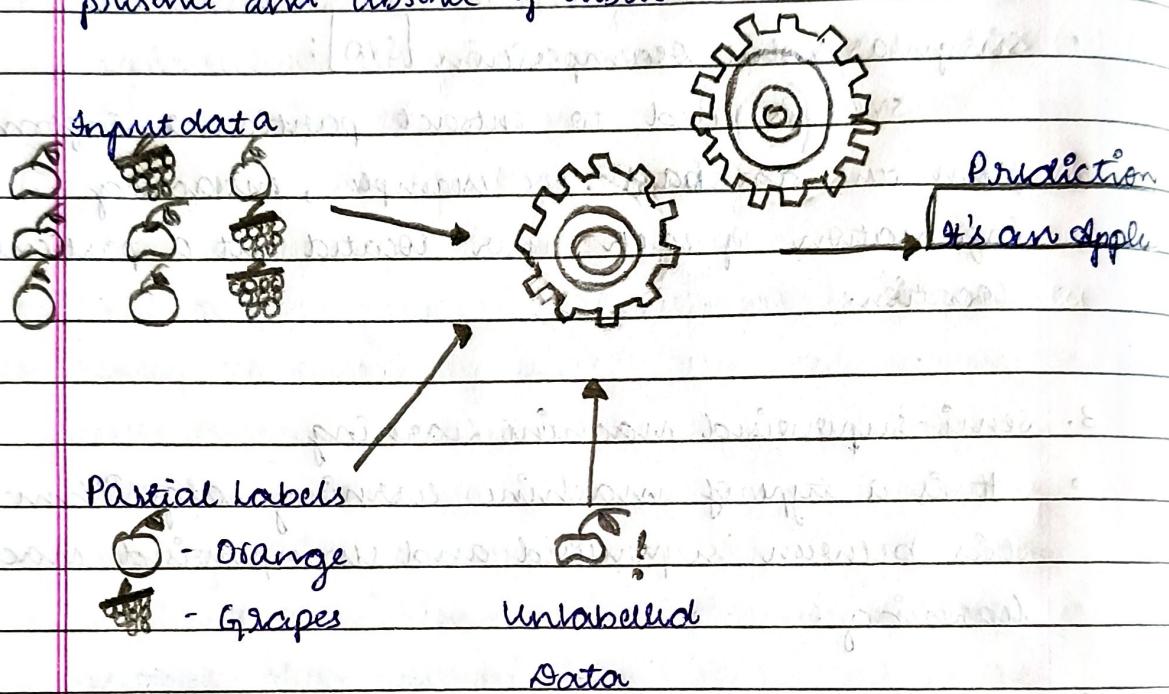
- **Singular Value Decomposition [SVD] :**

SVD is used to extract particular information from the database. For example, extracting information of each user located at a particular location.

### 3. Semi-supervised machine learning

- It is a type of machine learning algorithm that lies between supervised and unsupervised machine learning.
- It represents the intermediate ground between supervised (with labelled data) and unsupervised learning (with no labelled training data) algorithms and uses the combination of labelled and unlabelled datasets during the training period.
- Although semi-supervised learning is the middle ground between supervised and unsupervised learning and operates on the data that consists of a few labels, it mostly consists of unlabelled data.

- As labels are costly, but for corporate purpose they may have few labels
- It is completely different from supervised and unsupervised learning as they based on the presence and absence of labels.



#### Advantages :

- It is simple and easy to understand the algorithm
- It is highly efficient
- It is used to solve drawbacks of supervised and unsupervised learning algorithms.

#### Disadvantages :

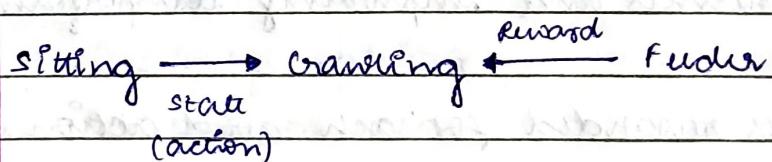
- After iterations results may not be stable.
- we cannot apply these algorithms to network level data
- accuracy is low.

#### 4. Reinforcement Learning

- To overcome the drawbacks of supervised learning and unsupervised learning algorithms the concept of semi-supervised learning is introduced.
- The main aim of semi-supervised learning is to effectively use all the available data, rather than only labelled data like in supervised learning.  
Initially, similar data is clustered along with an unsupervised learning algorithm, and further, it helps to label the unlabelled data into labelled data.
- It is because labelled data is a comparatively more expensive acquisition than unlabelled data.
- Reinforcement learning works on a feedback based process, in which an AI agent (a software component) automatically explores its surroundings by hitting and trail, taking action, learning from experiences and improving its performance.
- Agent gets rewarded for each good action and get punished for each bad action, hence the goal of reinforcement learning agent is to maximize the rewards.
- In reinforcement learning, there is no labelled data like supervised learning, and agents learn from their experiences only.  
ex: Game playing by children.

- Due to its way of working, reinforcement learning is employed in different fields such as game theory, Operation Research, Information theory, multi-agent systems.
- A reinforcement learning problem can be formalized using Markov Decision Process (MDP)
- In MDP, the agent constantly interacts with the environment and performs actions, at each action, the environment responds and generates a new state.
- Reinforcement learning is a machine learning paradigm that focuses on how agents learn to interact with an environment to maximize cumulative rewards.

Baby (agent)



- Algorithms and approaches in Reinforcement learning :
  - \* Q-learning
  - \* Deep Q-networks (DQN)
  - \* Policy Gradient methods
  - \* Proximal Policy Optimization (PPO)

## Categories of Reinforcement Learning

They are of two types

### a) Positive Reinforcement Learning -

It specifies increasing the tendency that the required behaviour would occur again by adding something. It enhances the strength of the behaviours of the agent and positively impacts it.

### b) Negative Reinforcement Learning -

It works exactly opposite to the positive RL.

It increases the tendency that the specific behaviour would occur again by avoiding the negative condition.

## Real-world Use cases of Reinforcement Learning :

- Video Games :

RL algorithms are much popular in gaming applications. It is used to gain super-human performance. Some popular games that use RL algorithms are AlphaGo and AlphaGo Zero.

- Resource Management :

The "Resource management with deep Reinforcement Learning" paper showed that how to use RL in computer to automatically learn and schedule resource to wait for different jobs in order to minimize average job slowdown.

- Robotics :

RL is widely being used in robotics application. Robots are used in the industrial and manufacturing area, and these robots are made more powerful with reinforcement learning. There are different industries that have their vision of building intelligent robots using AI and ML technology.

- Text mining :

It is one of the great applications of NLP, is now being implemented with the help of reinforcement learning by salesforce company.

#### Advantages:

- It helps in solving complex real-world problems which are difficult to be solved by general techniques.
- The learning model of RL is similar to the learning of human beings, hence most accurate results can be found.
- Helps in achieving long term results.

#### Disadvantages:

- RL algorithms are not preferred for simple problems.
- RL algorithms require huge data and computations.
- Too much reinforcement learning can lead to an overload of states which can weaken the results.