



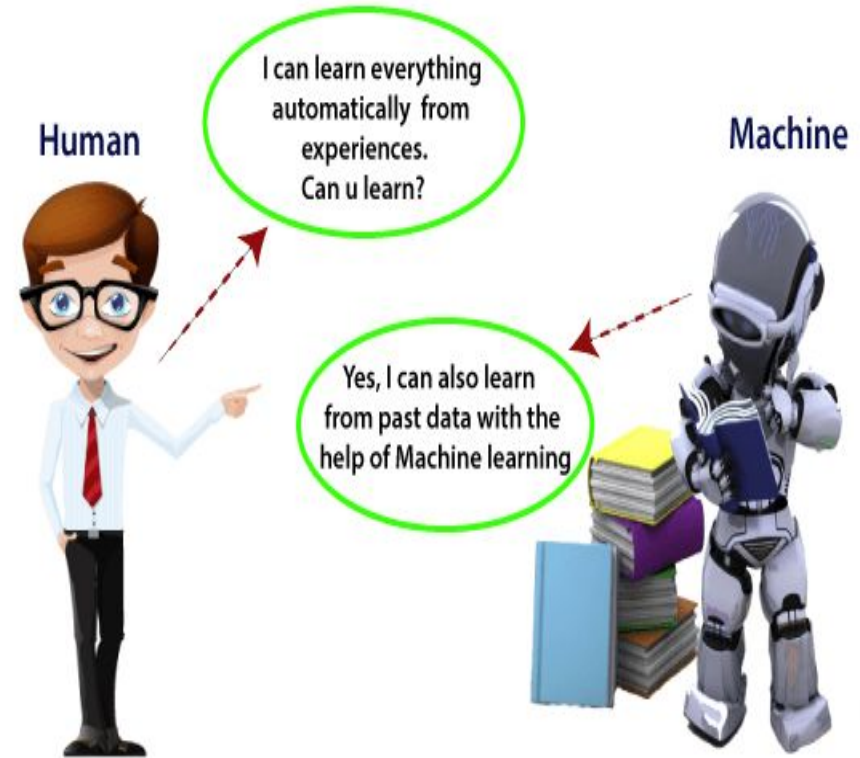
# Machine Learning

BCA SEM-6 (Gujarat University)

# Machine Learning

In the real world, **we are surrounded by humans who can learn everything from their experiences with their learning capability**, and **we have computers or machines which work on our instructions**.

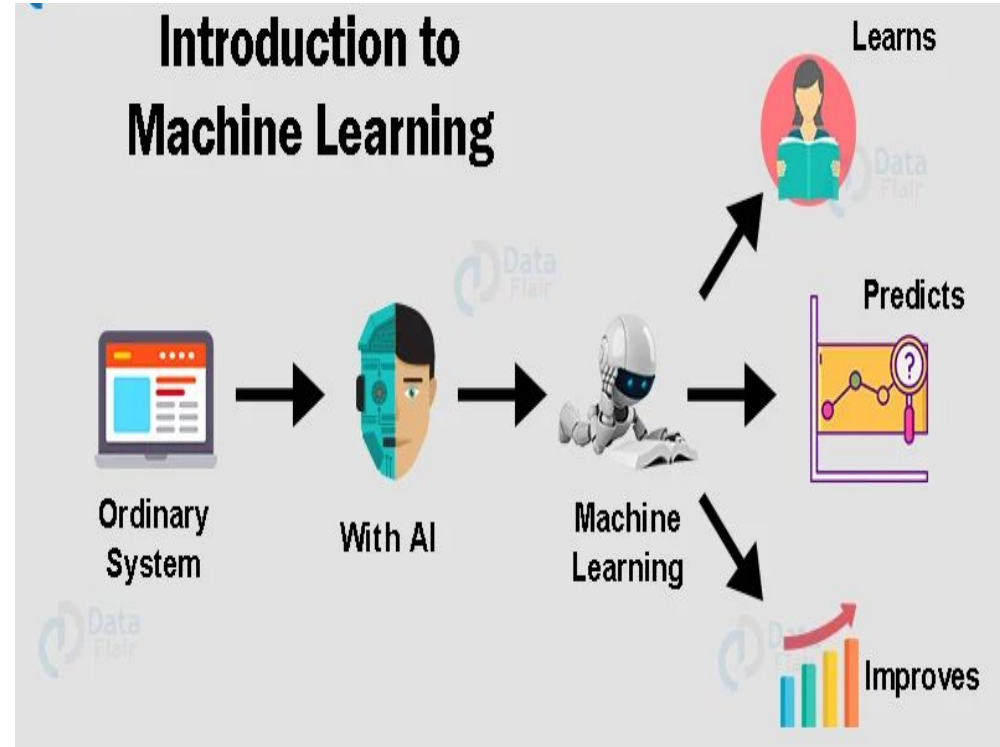
**But can a machine also learn from experiences or past data like a human does?** So here comes the role of **Machine Learning**.



# Machine Learning

Machine Learning is said as a subset of artificial intelligence that is **mainly concerned with the development of algorithms which allow a computer to learn from the data and past experiences on their own.**

The term machine learning was first introduced by **Arthur Samuel in 1959.**



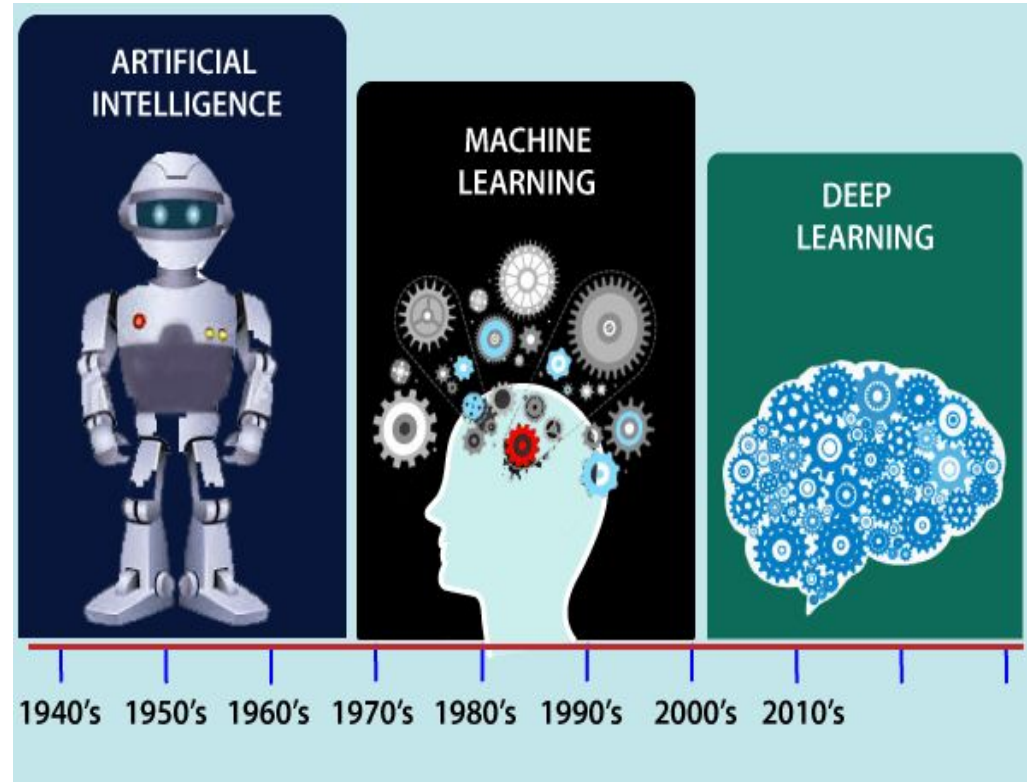
# History of Machine Learning

Before some years (about 40-50 years), **machine learning was science fiction, but today it is the part of our daily life.**

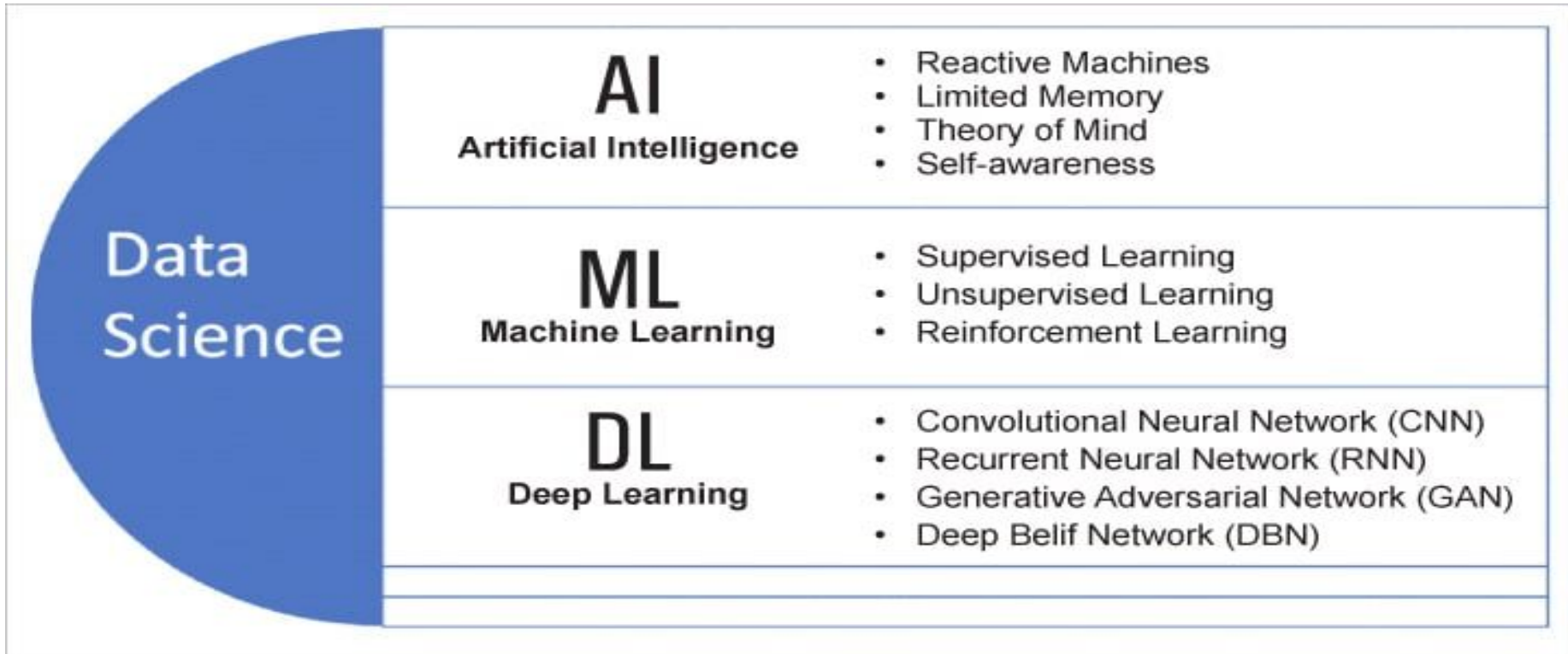
Machine learning is making our day to day life easy from Self-driving cars to Amazon virtual assistant "Alexa".

However, **the idea behind machine learning is so old and has a long history.**

**Some milestones are given which have occurred in the history of machine learning**



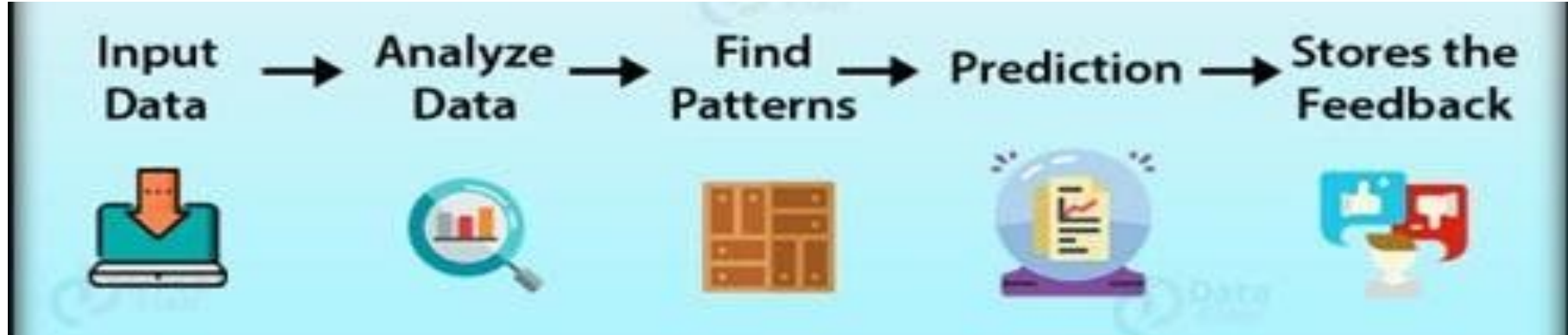
# Relationship of Machine Learning and AI



# Machine Learning in the bigger picture

Machine Learning is the **field of study that gives computers the capability to learn without being explicitly programmed.** ML is one of the most exciting technologies that one would have ever come across. As it is evident from the name, it gives the computer that makes it more similar to humans: *The ability to learn.*

## Working of Machine Learning



# Machine Learning in the bigger picture

## Types of Machine Learning Algorithms



Linear regression analysis is **used to predict the value of a variable based on the value of another variable**. **The variable you want to predict is called the dependent variable**. **The variable you are using to predict the other variable's value is called the independent variable**.

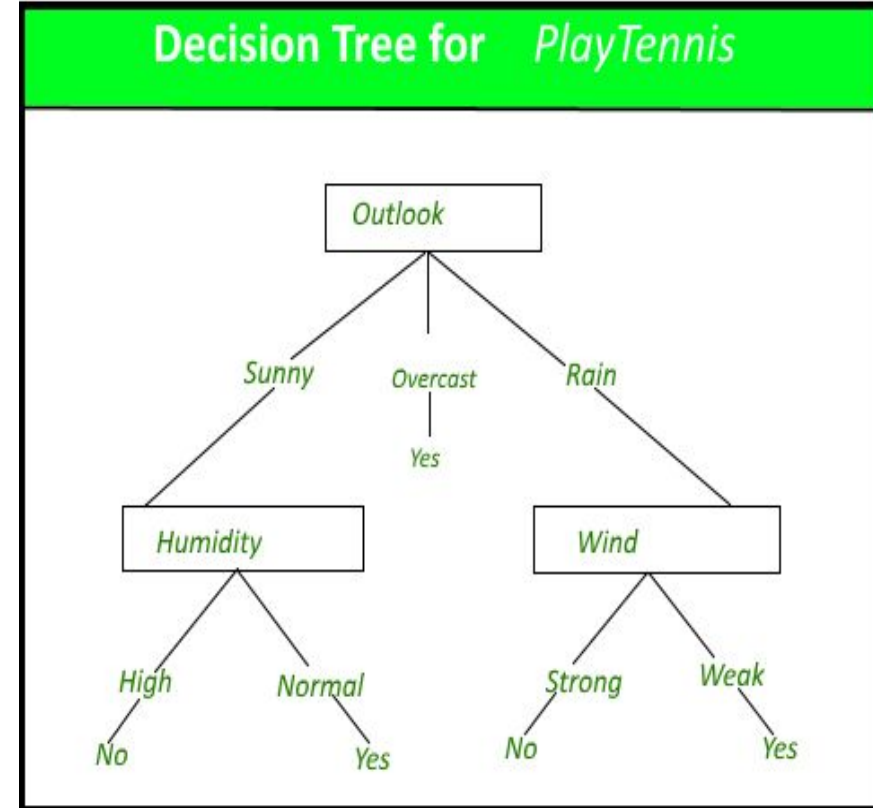
In this process, a relationship is established between independent and dependent variables by fitting them to a line. This line is known as the regression line and represented by a linear equation  $Y = a * X + b$ .

# Machine Learning in the bigger picture

## Types of Machine Learning Algorithms



A decision tree is a **non-parametric supervised learning algorithm**, which is **utilized for both classification and regression tasks**. It has a **hierarchical, tree structure**, which consists of a **root node, branches, internal nodes and leaf nodes**.





# Machine Learning in the bigger picture

## Types of Machine Learning Algorithms



Some best examples of the Naive Bayes Algorithm are **sentimental analysis, classifying new articles, and spam filtration**. **Classification algorithms are used for categorizing new observations into predefined classes for the uninitiated**

A Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature.

# Machine Learning in the bigger picture

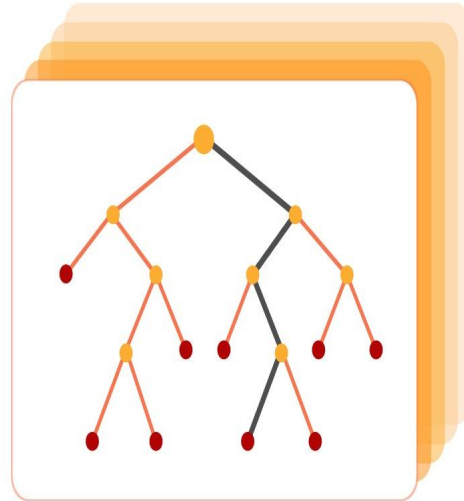
## Types of Machine Learning Algorithms

Outlook	Temp	Humidity	Windy	Play Golf
Rainy	Hot	High	False	No
Rainy	Hot	High	True	No
Overcast	Hot	High	False	Yes
Sunny	Mild	High	False	Yes
Sunny	Cool	Normal	False	Yes
Sunny	Cool	Normal	True	No
Overcast	Cool	Normal	True	Yes
Rainy	Mild	High	False	No
Rainy	Cool	Normal	False	Yes
Sunny	Mild	Normal	False	Yes
Rainy	Mild	Normal	True	Yes
Overcast	Mild	High	True	Yes
Overcast	Hot	Normal	False	Yes
Sunny	Mild	High	True	No

# Machine Learning in the bigger picture

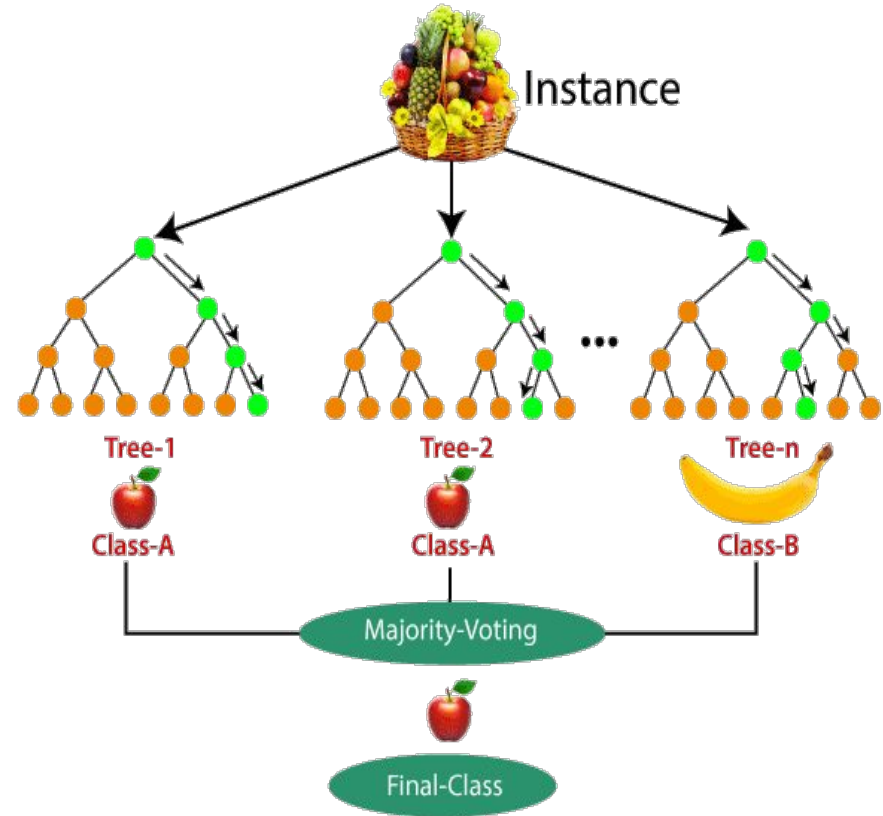
## Types of Machine Learning Algorithms

### RANDOM FOREST



A Random Forest Algorithm is a supervised machine learning algorithm which is extremely popular and is used for Classification and Regression problems in Machine Learning.

We know that a forest comprises numerous trees, and the more trees more it will be robust.



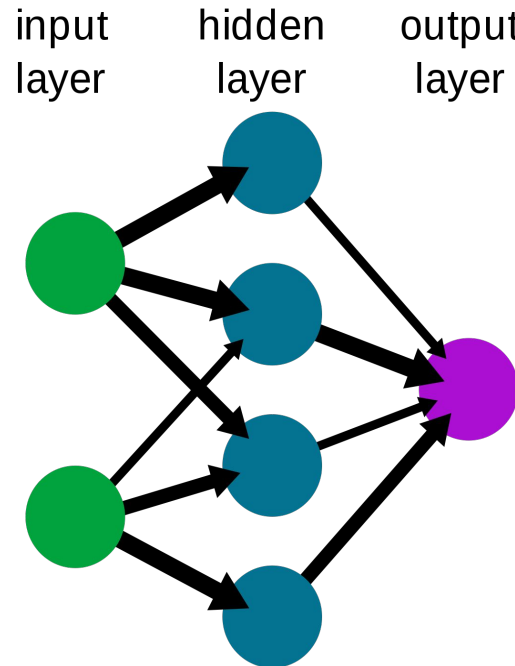
# Machine Learning in the bigger picture

## Neural Networks and Deep Learning

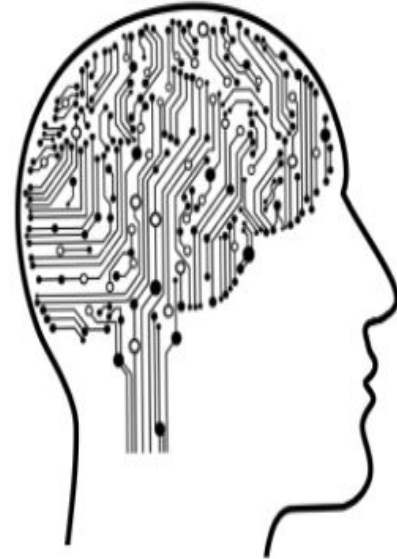
A neural network **is a method in artificial intelligence that teaches computers to process data in a way that is inspired by the human brain.**

It is a type of machine learning process, called Deep Learning, **that uses interconnected nodes or neurons in a layered structure that resembles the human brain.**

### A simple neural network



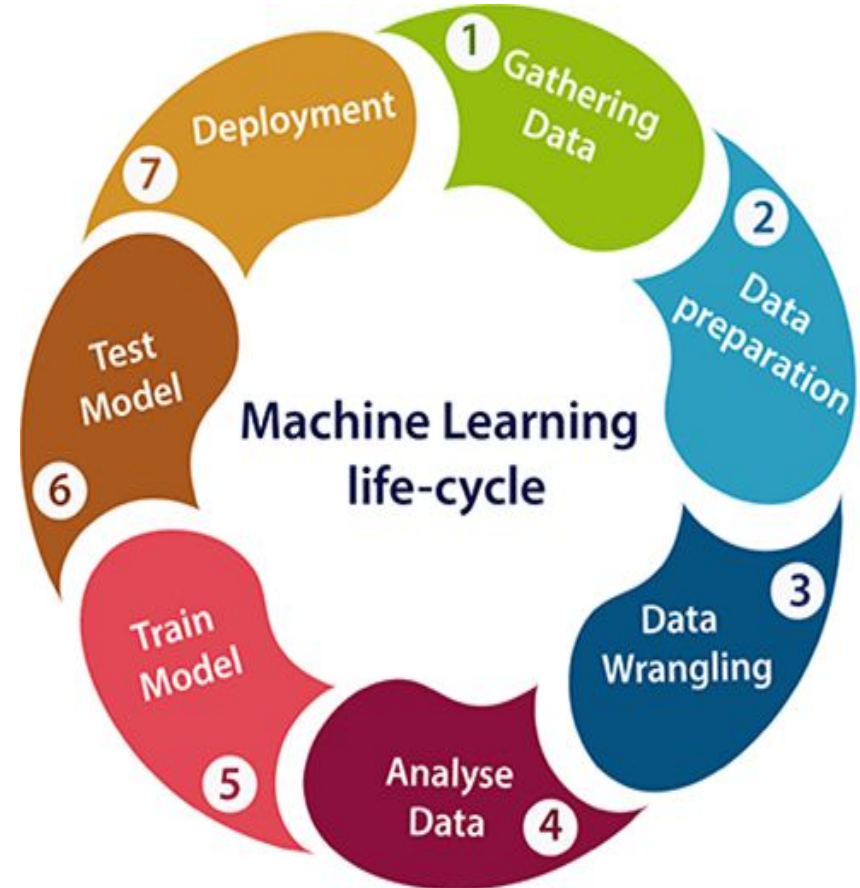
### Deep Learning



# Machine Learning Cycle

Machine learning life cycle **involves seven major steps, which are given below:**

- Gathering Data
- Data preparation
- Data Wrangling
- Analyse Data
- Train the model
- Test the model
- Deployment



# Machine Learning Cycle

- Data Gathering is the first step of the machine learning life cycle. **The goal of this step is to identify and obtain all data-related problems.**
- In this step, we need to identify the different data sources, as **data can be collected from various sources such as files, database, internet, or mobile devices.**

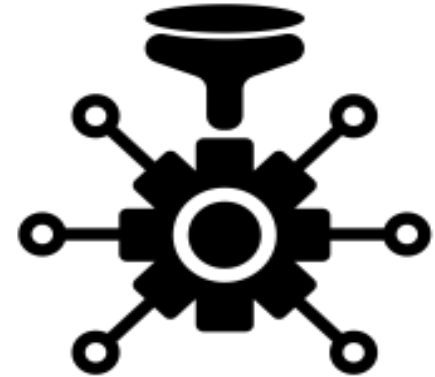
This step includes the below tasks:

- **Identify various data sources**
- **Collect data**
- **Integrate the data obtained from different sources**



# Machine Learning Cycle

- After collecting the data, we need to prepare it for further steps. **Data preparation is a step where we put our data into a suitable place and prepare it to use in our machine learning training.**
- 2
- **Data wrangling** is the process of cleaning and **Converting raw data into a useable format.** It is the process of cleaning the data, selecting the variable to use, and transforming the data in a proper format to **make it more suitable for analysis in the next step.**
- 3
- 1. Missing Values 2. Duplicate data 3. Invalid data 4. Noise

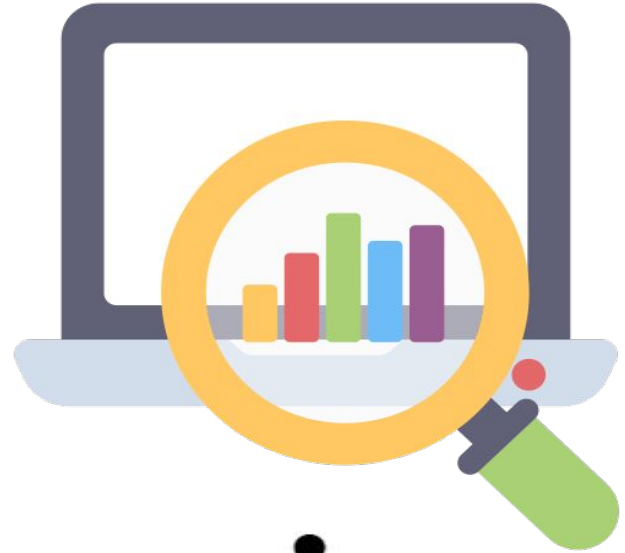


## 4 Machine Learning Cycle

Now the cleaned and prepared data is passed on to the analysis step. This step involves:

- Selection of analytical techniques
  - Building models
  - Review the result
- Now the next step is to **Train the Model**, in this step we train our model to improve its performance for better outcome of the problem.

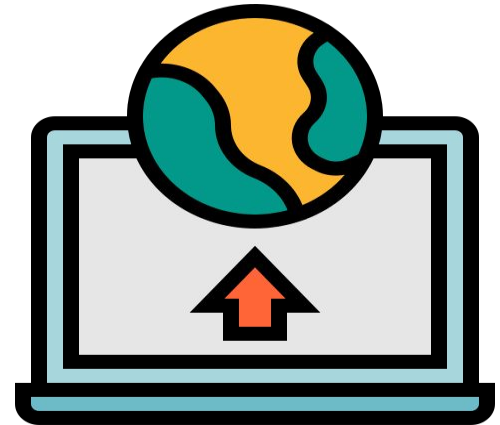
5 We use datasets to train the model using various machine learning algorithms. Training a model is required so that it can understand the various patterns, rules, and, features.





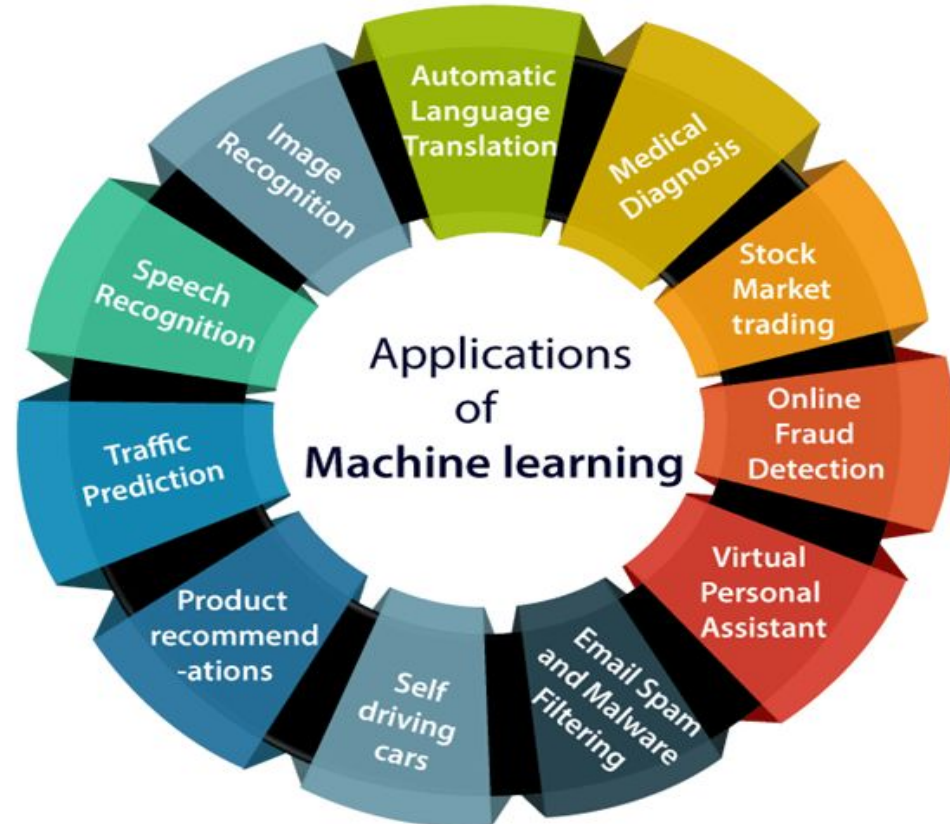
# Machine Learning Cycle

- 6 Once our machine learning model has been trained on a given dataset, **then we test the model. In this step, we check for the accuracy of our model by providing a test dataset to it.**
- Testing the model determines the percentage accuracy of the model as per the requirement of project or problem.
- 7 The last step of machine learning life cycle is deployment, where we deploy the model in the real-world system.



# Areas of Machine Learning

- Machine learning is a **buzzword for today's technology**, and it is growing very rapidly day by day.
- **We are using machine learning in our daily life even without knowing it such as Google Maps, Google assistant, Alexa, etc.**
- Below are some **most trending real-world applications** of Machine Learning:

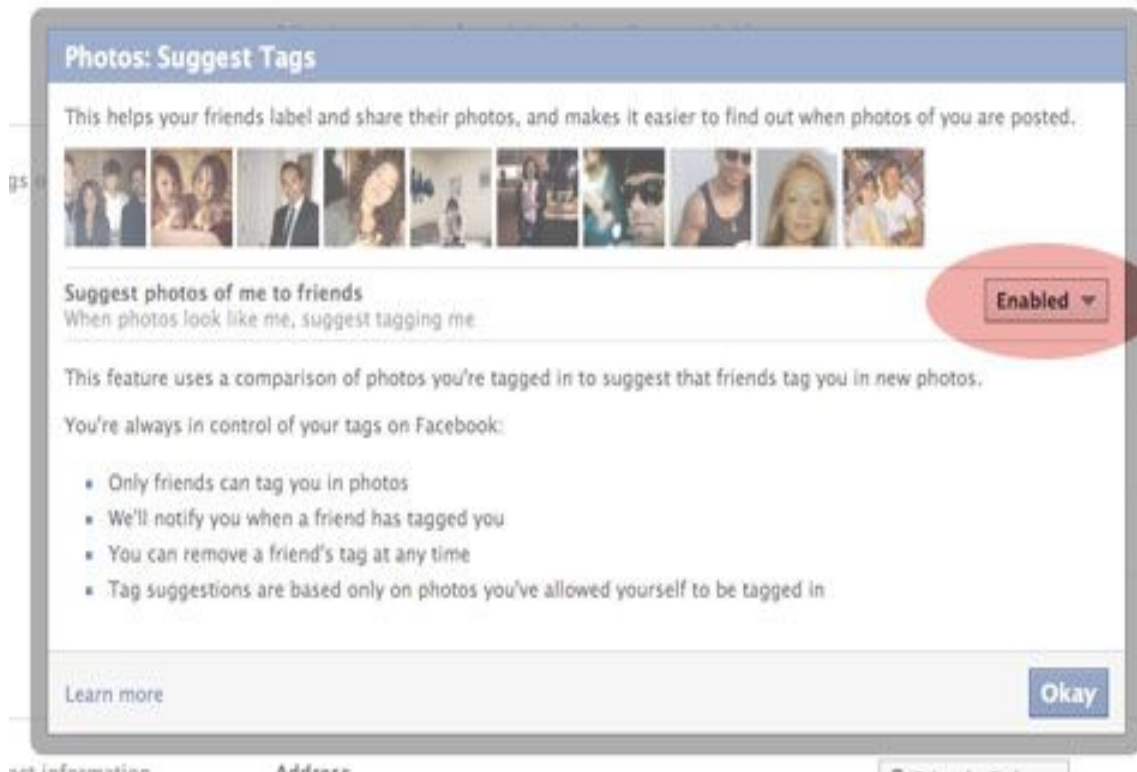


# Areas of Machine Learning - Image Recognition

**Image recognition** is one of the most common applications of machine learning.

It is used to identify objects, persons, places, digital images, etc.

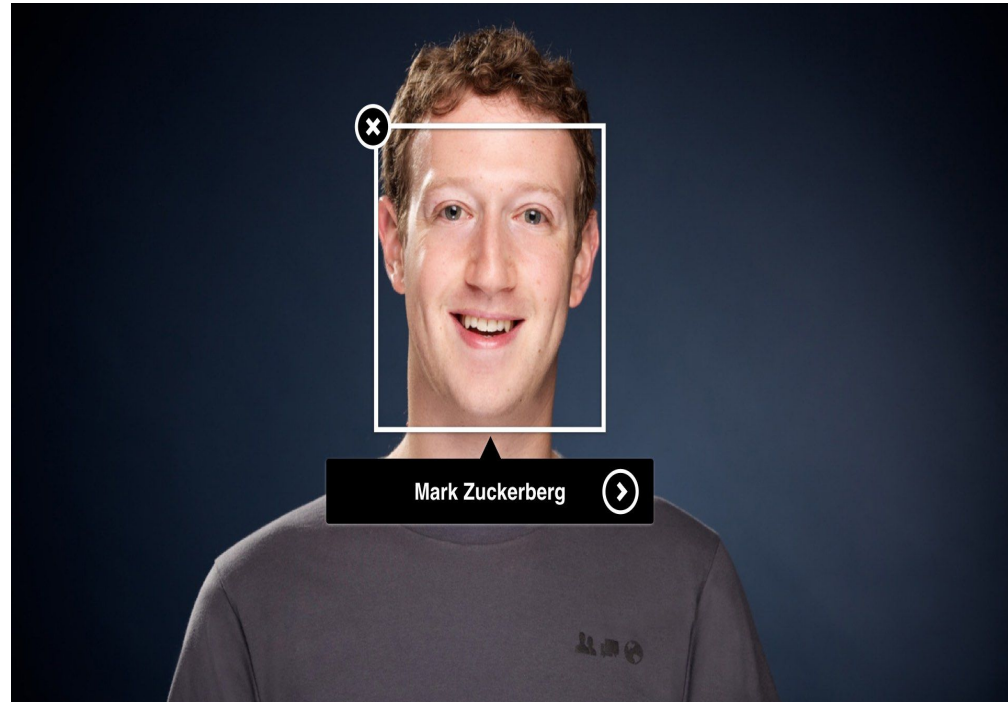
The popular use case of image recognition and face detection is, **Automatic friend tagging suggestion**:



# Areas of Machine Learning - Image Recognition

Facebook provides us a **feature of auto friend tagging suggestion**. Whenever we upload a photo with our Facebook friends, then we automatically get a **tagging suggestion with name**, and the technology behind this is machine learning **Face detection** and **Recognition algorithm**.

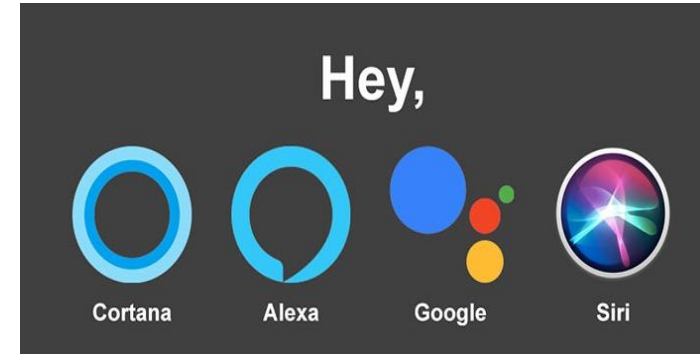
It is based on the Facebook project named **"Deep Face,"** which is **responsible for face recognition and person identification in the picture**.



# Areas of Machine Learning - Speech Recognition



- While using Google, we get an option of **"Search by voice,"** it comes under speech recognition, and it's a popular application of machine learning.
- Speech recognition **is a process of converting voice instructions into text**, and it is also known as "Speech to text", or "Computer speech recognition."
- At present, **Machine learning algorithms are widely used by various applications of speech recognition.** Google assistant, Siri, Cortana, and Alexa are using speech recognition technology to follow the voice instructions.



# Areas of Machine Learning - Traffic Prediction



If we want to visit a new place, we take help of Google Maps, which shows us the correct path with the shortest route and predicts the traffic conditions.

It predicts the traffic conditions such as whether traffic is cleared, slow-moving, or heavily congested with the help of two ways:

- Real Time location of the vehicle form  
Google Map app and sensors
- Average time has taken on past days at the  
same time.



# Areas of Machine Learning - Product Recommendation

- Machine learning is widely used by various e-commerce and entertainment companies such as Amazon, Netflix, etc., for product recommendation to the user. Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning.
- Google understands the user interest using various machine learning algorithms and suggests the product as per customer interest.





# Areas of Machine Learning - Self Driving Cars

- One of the **most exciting applications of machine learning is self-driving cars. Machine learning plays a significant role in self-driving cars.**
- **Tesla, the most popular car manufacturing company is working on self-driving car.**
- It is using **unsupervised learning method to train the car models to detect people and objects while driving.**

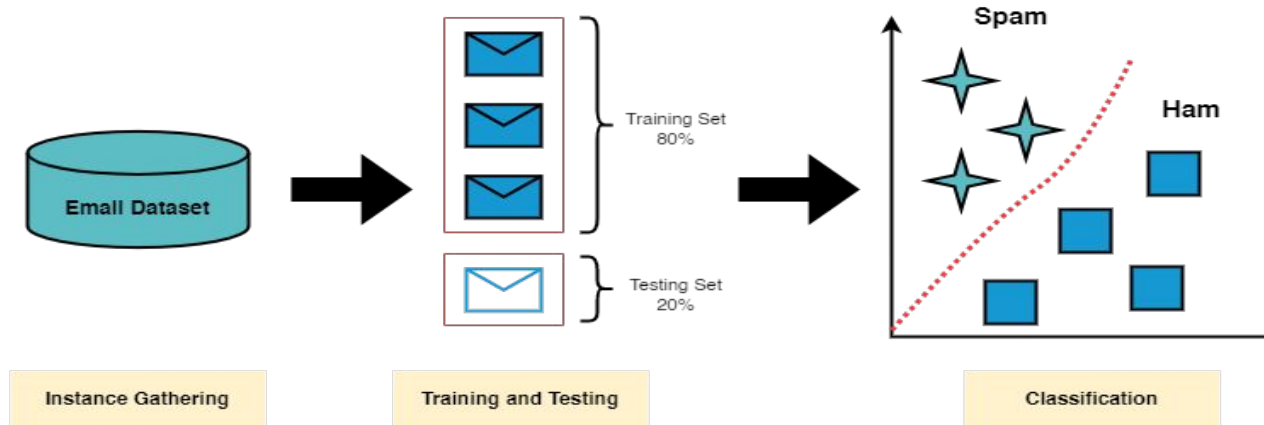




# Areas of Machine Learning - Email Spam and Malware Filtering

Whenever we receive a new email, **it is filtered automatically as important, normal, and spam**. We always receive an important mail in our inbox with the important symbol and spam emails in our spam box, and **the technology behind this is Machine learning**. Below are some spam filters used by Gmail:

- **Content Filter**
- **Header filter**
- **General blacklists filter**
- **Rules-based filters**
- **Permission filters**



# Areas of Machine Learning - Online Fraud Detection

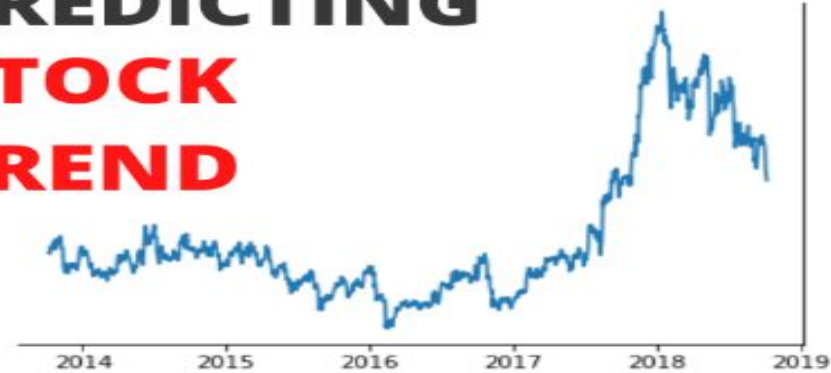
- Machine learning is making our online transaction safe and secure by detecting fraud transaction. Whenever we perform some online transaction, there may be various ways that a fraudulent transaction can take place such as fake accounts, fake ids, and steal money in the middle of a transaction.
- So to detect this, **Feed Forward Neural network** helps us by checking whether it is a genuine transaction or a fraud transaction.



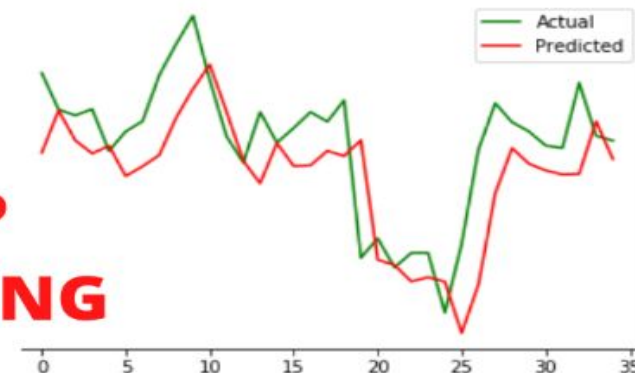
# Areas of Machine Learning - Stock Market Trading

- Machine learning is widely used in stock market trading.
- In the stock market, there is always a risk of up and downs in shares, so for this machine learning's long short term memory neural network is used for the prediction of stock market trends.

## PREDICTING STOCK TREND

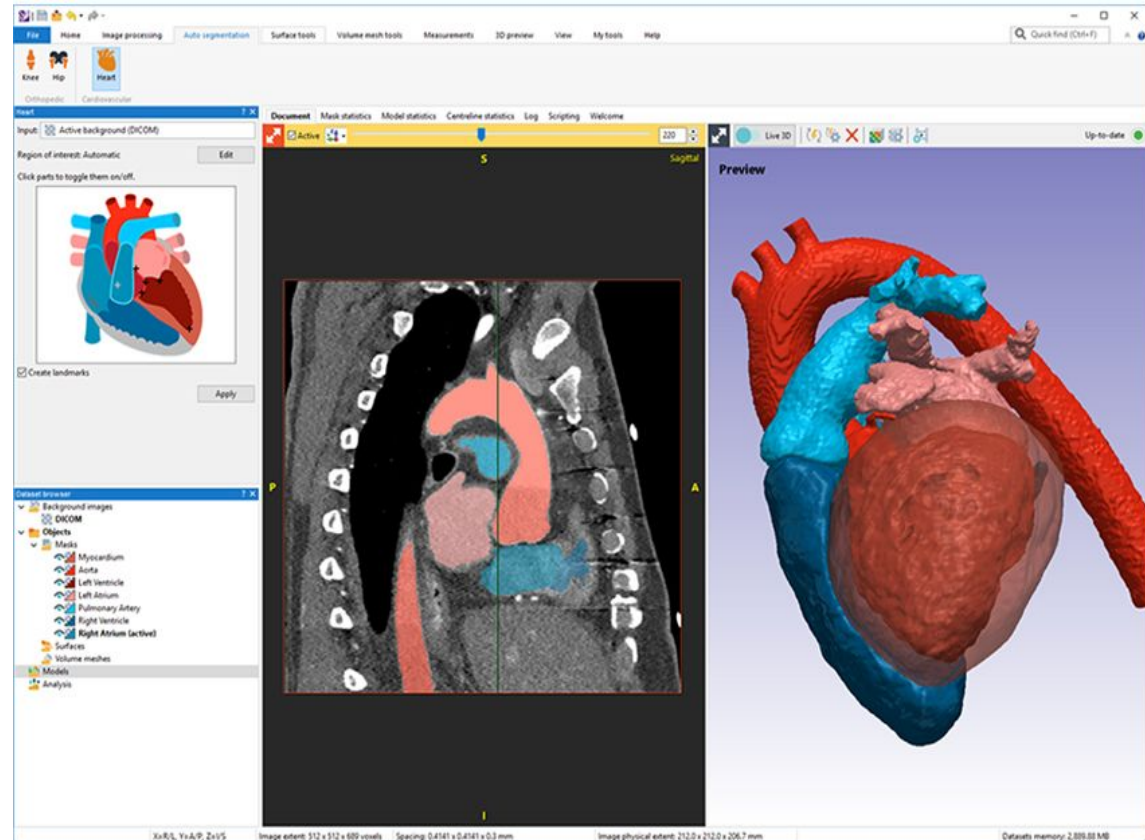


## with DEEP LEARNING



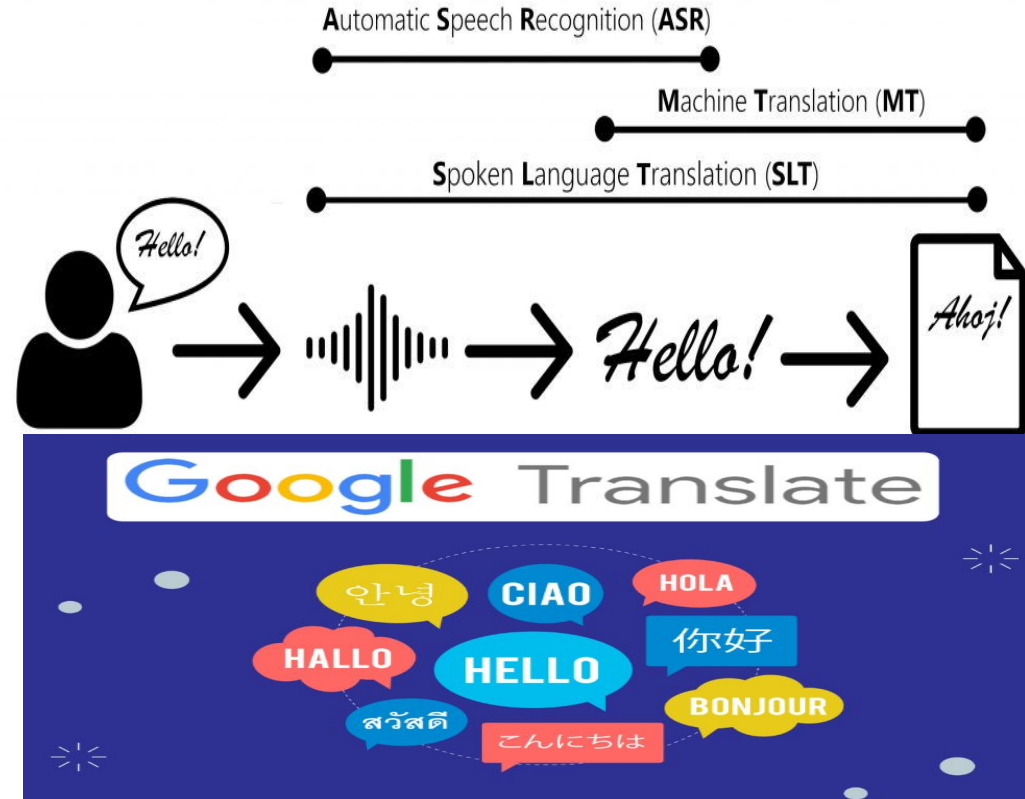
# Areas of Machine Learning - Medical Diagnosis

- In medical science, machine learning **is used for diseases diagnoses**. With this, **medical technology is growing very fast and able to build 3D models that can predict the exact position of lesions in the brain**.
- It helps in finding brain tumors and other brain-related diseases easily.



# Areas of Machine Learning - Automatic Language Translation

- Nowadays, if we visit a new place and we are not aware of the language then it is not a problem at all, as for this also machine learning helps us by converting the text into our known languages.
- Google's GNMT (Google Neural Machine Translation) provide this feature, which is a Neural Machine Learning that translates the text into our familiar language, and it called as Automatic Translation.

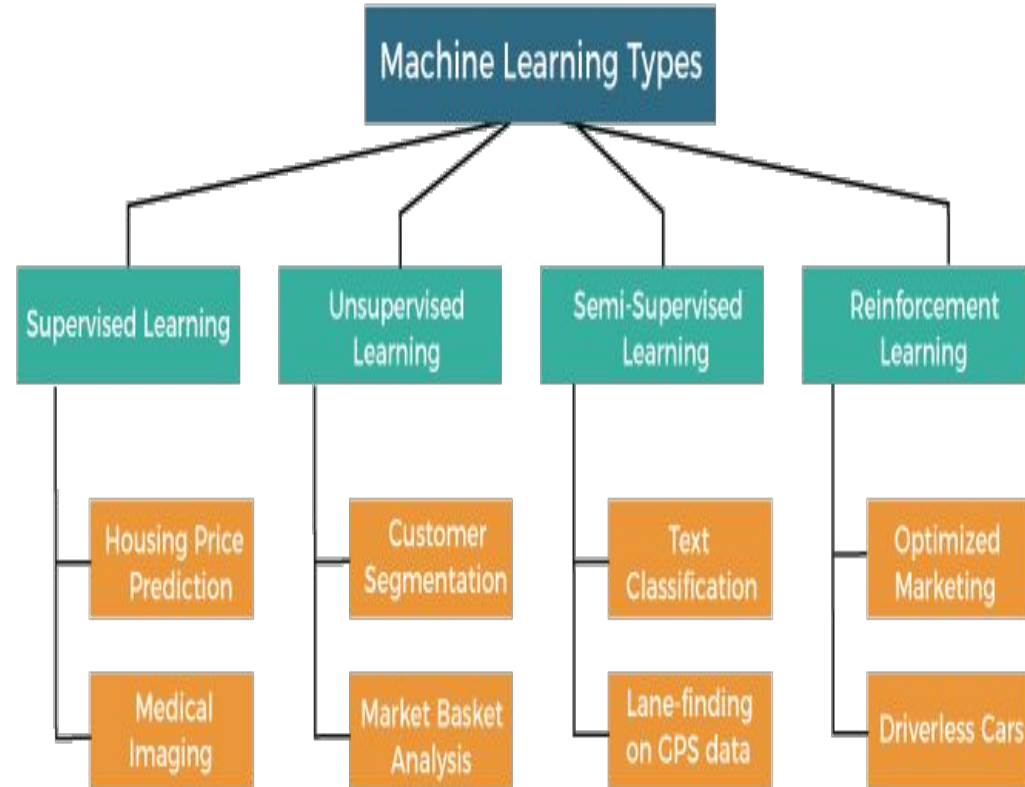


# Machine Learning Types

These **ML algorithms** help to solve different **business problems** like **Regression, Classification, Forecasting, Clustering, and Associations, etc.**

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

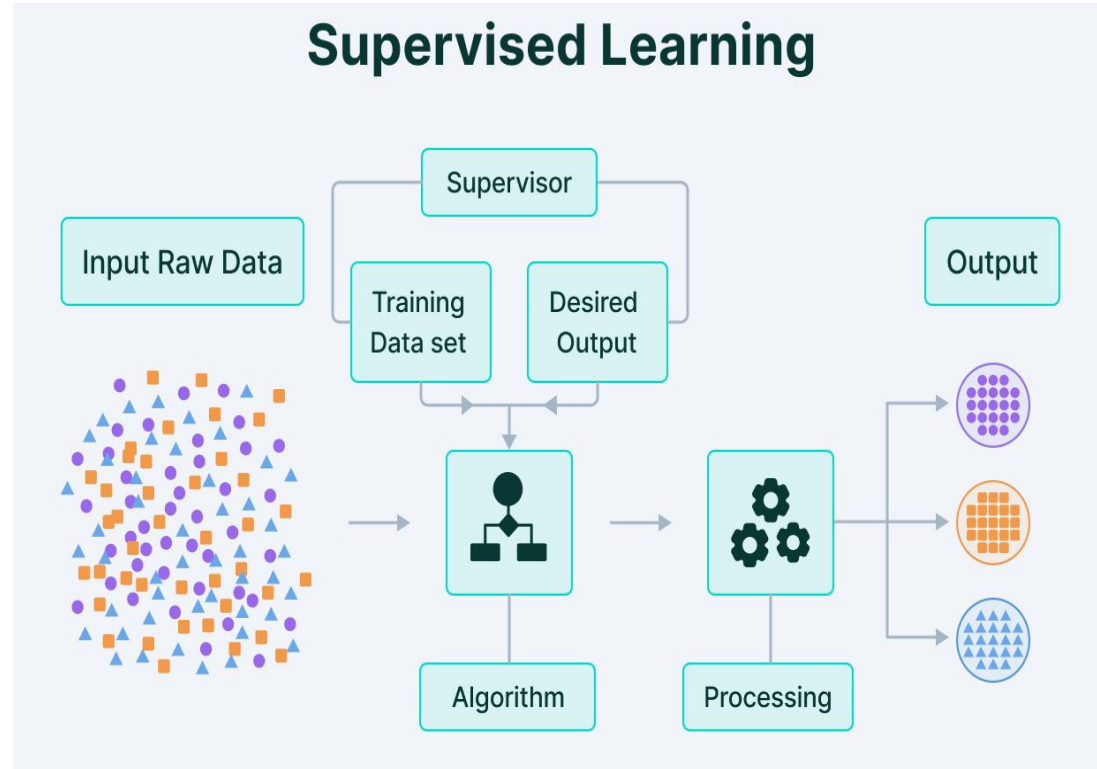
1. **Supervised Machine Learning**
2. **Unsupervised Machine Learning**
3. **Semi-Supervised Machine Learning**
4. **Reinforcement Learning**



# Grade of Supervision - Supervised Machine Learning

Supervised learning is the types of machine learning in **which machines are trained using well "labelled" training data, and on basis of that data, machines predict the output.**

**The labelled data means some input data is already tagged with the correct output.**

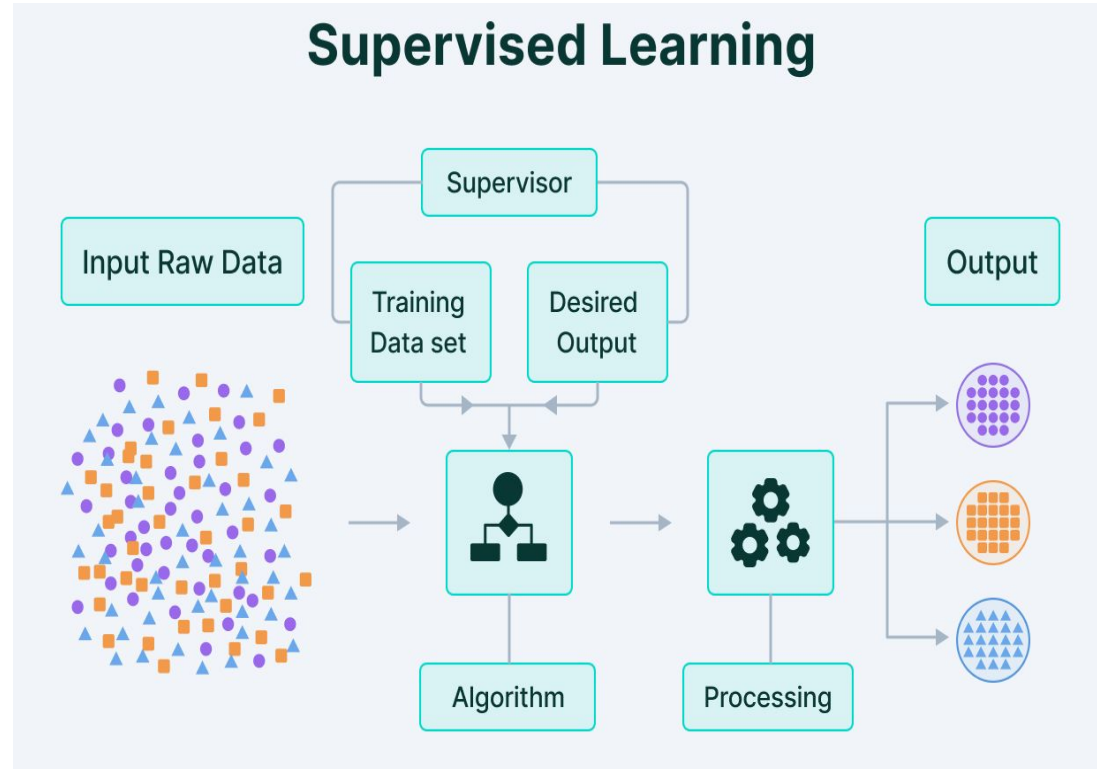




# Grade of Supervision - Supervised Machine Learning

In supervised learning, **the training data provided to the machines work as the supervisor that teaches the machines to predict the output correctly.**

**It applies the same concept as a student learns in the supervision of the Teacher.**

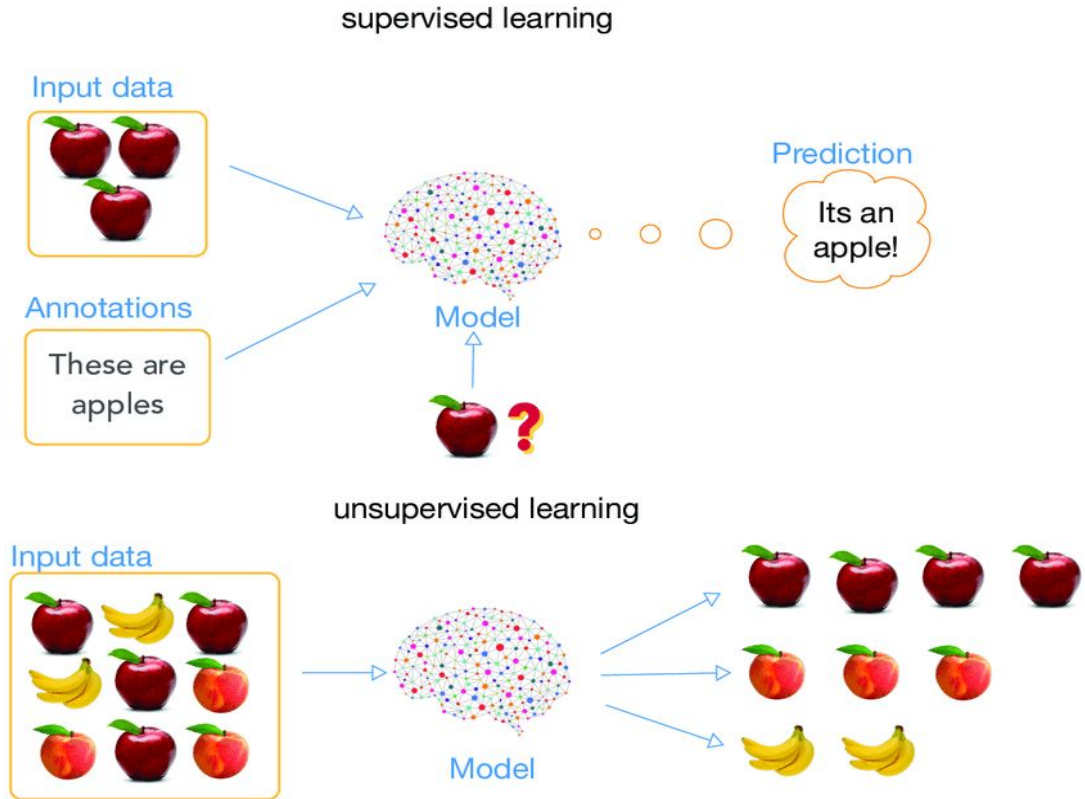




# Grade of Supervision - Supervised Machine Learning

Supervised learning is a process of **providing input data as well as correct output data to the machine learning model**. The aim of a supervised learning algorithm is to **find a mapping function to map the input variable( $x$ ) with the output variable( $y$ )**.

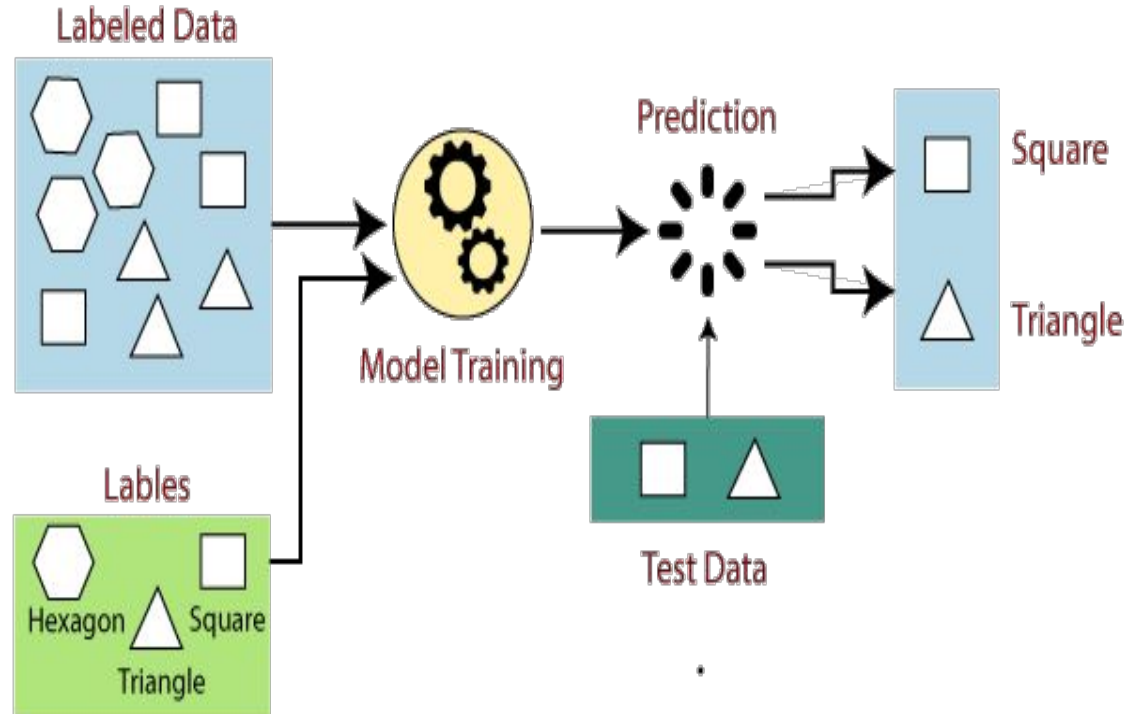
In the real-world, supervised learning can be used for **Risk Assessment, Image classification, Fraud Detection, spam filtering**, etc.



# How Supervised Learning Works ?

In supervised learning, **models are trained using labelled dataset**, where the model learns about each type of data. Once the training process is completed, the model is tested on the basis of test data (a subset of the training set), and then it predicts the output.

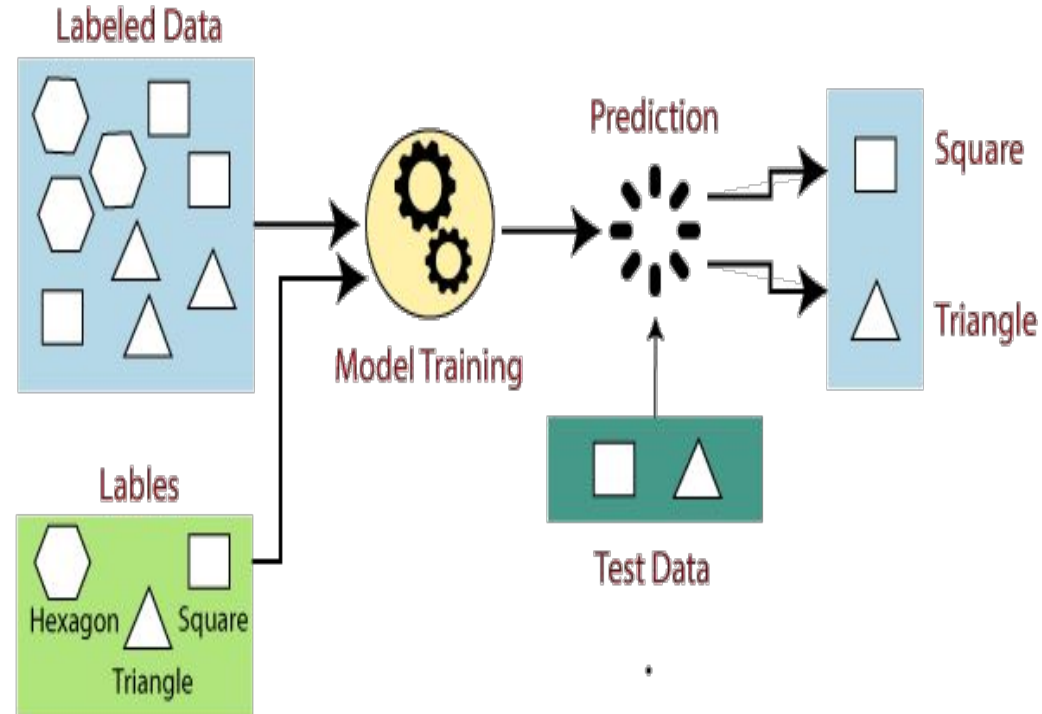
Suppose we have a dataset of different types of shapes which includes square, rectangle, triangle, and Polygon. Now the first step is that we need to train the model for each shape.



# How Supervised Learning Works ?

- If the given **shape has four sides**, and **all the sides are equal**, then it will be labelled as a **Square**.
- If the given **shape has three sides**, then it will be labelled as a **Triangle**.
- If the given **shape has six equal sides** then it will be labelled as **Hexagon**.

Now, **after training**, we test our model using **the test set**, and the task of the model is to **identify the shape**.



# Steps Involved in Supervised Learning

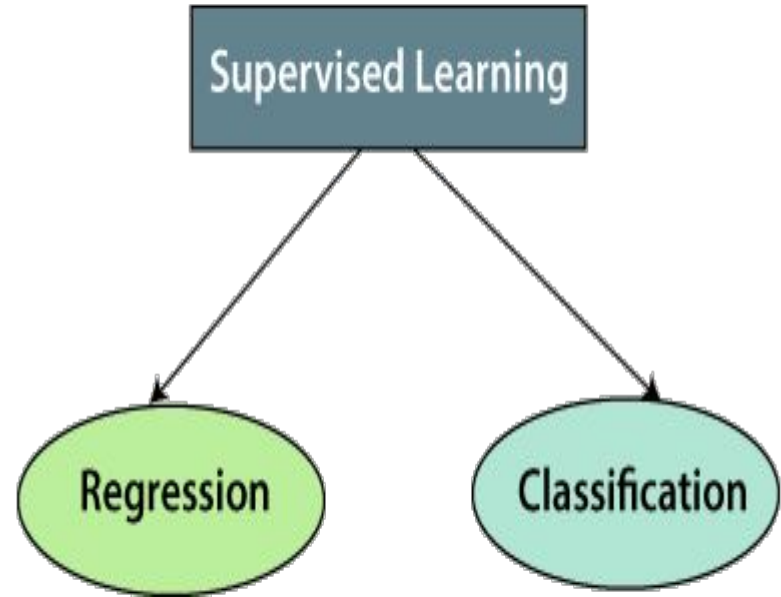
- **First Determine the type of training dataset**
- **Collect/Gather the labelled training data.**
- Split the training dataset into training **dataset, test dataset, and validation dataset.**
- **Determine the input features of the training dataset, which should have enough knowledge so that the model can accurately predict the output.**
- **Determine the suitable algorithm for the model, such as support vector machine, decision tree, etc.**
- **Execute the algorithm on the training dataset. Sometimes we need validation sets as the control parameters, which are the subset of training datasets.**
- **Evaluate the accuracy of the model by providing the test set. If the model predicts the correct output, which means our model is accurate.**

# Types of Supervised Machine Learning Algorithms

## 1. Regression

Regression algorithms are used **if there is a relationship between the input variable and the output variable. It is used for the prediction of continuous variables, such as Weather forecasting, Market Trends, etc.** Below are some popular Regression algorithms which come under supervised learning:

- Linear Regression
- Regression Trees
- Non-Linear Regression
- Bayesian Linear Regression
- Polynomial Regression



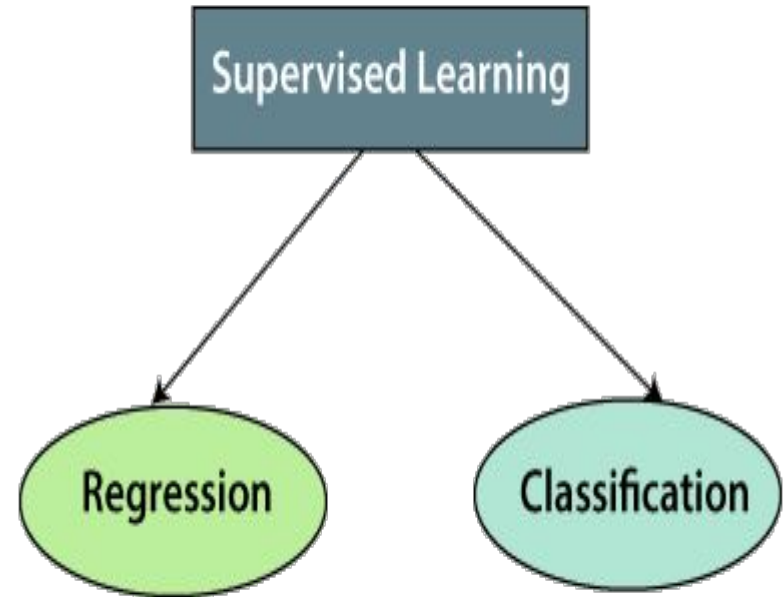
# Types of Supervised Machine Learning Algorithms



## 2. Classification

Classification algorithms are used when the output variable is categorical, which means there are two classes such as Yes-No, Male-Female, True-false, etc.

- Random Forest
- Decision Trees
- Logistic Regression
- Support vector Machines



# Advantage of Supervised Machine Learning Algorithms

- With the help of supervised learning, the model can predict the output on the basis of prior experiences.
- In supervised learning, **we can have an exact idea about the classes of objects.**
- **Supervised learning model helps us to solve various real-world problems** such as **fraud detection, spam filtering, etc.**



# Disadvantage of Supervised Machine Learning Algorithms

- Supervised learning models **are not suitable for handling the complex tasks.**
- Supervised learning **cannot predict the correct output if the test data is different from the training dataset.**
- **Training required lots of computation times.**
- In supervised learning, **we need enough knowledge about the classes of object.**





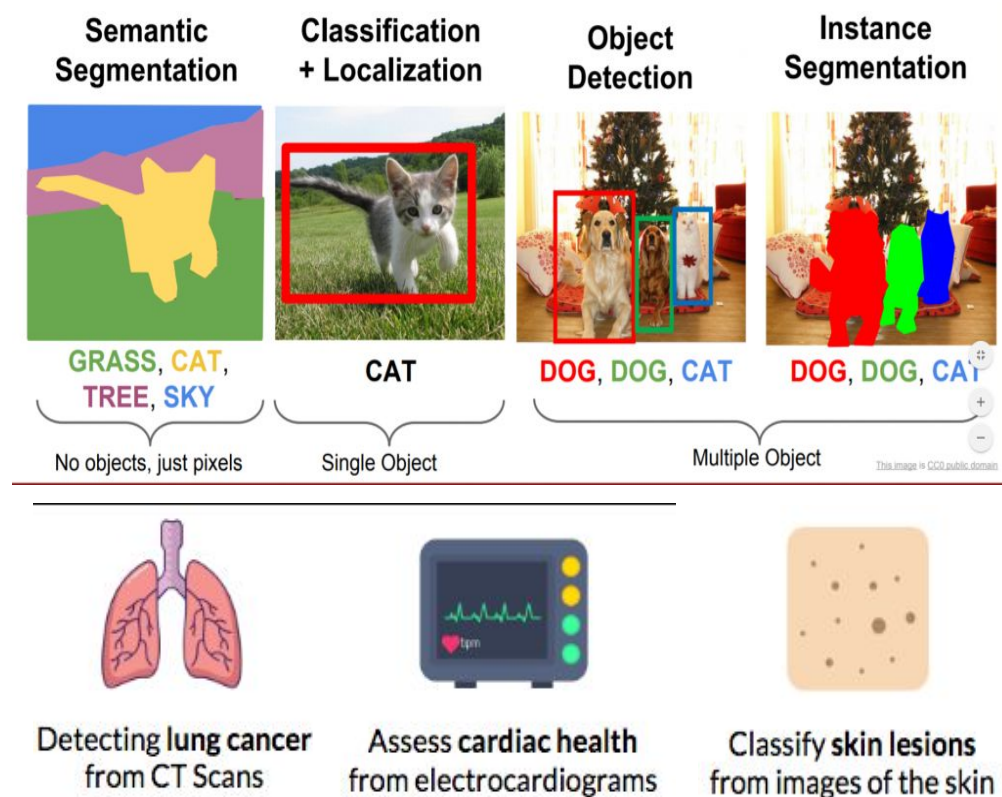
# Applications of Supervised Machine Learning Algorithms

## Image Segmentation:

Supervised Learning algorithms are used in image segmentation. **In this process, image classification is performed on different image data with predefined 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.**



# Applications of Supervised Machine Learning Algorithms



**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 spam detection & filtering, classification algorithms are used.** These algorithms classify an email as spam or not spam. The spam emails are sent to the spam folder.

**Speech Recognition** - Supervised learning algorithms are also used in **speech recognition**. **The algorithm is trained with voice data, and various identifications can be done using the same, such as voice-activated passwords, voice commands, etc.**

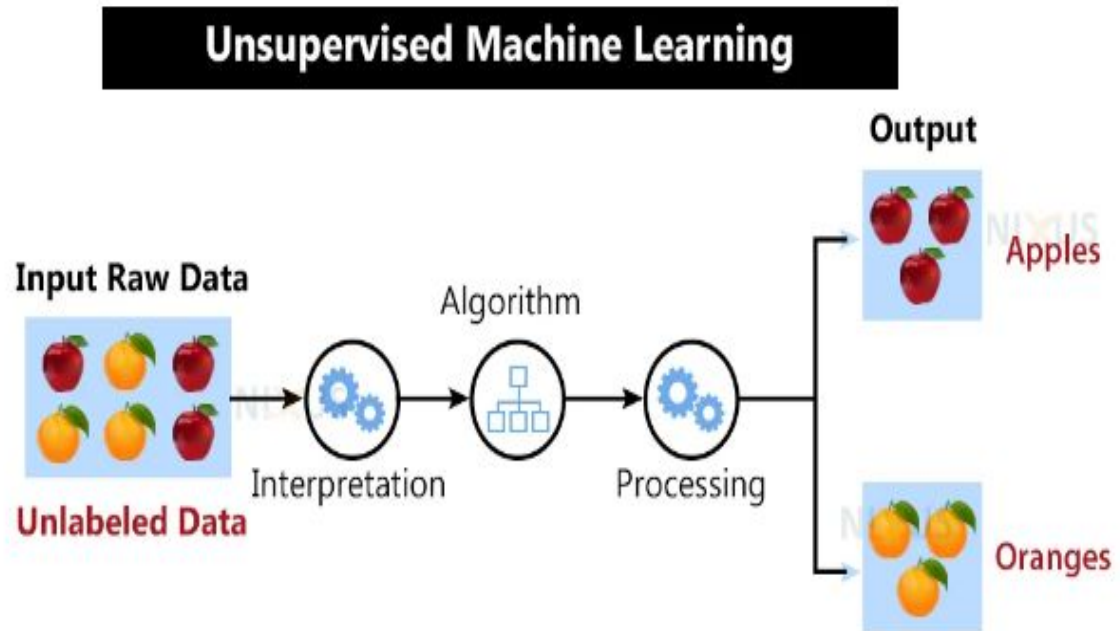


# Grade of Supervision - Unsupervised Machine Learning

As the name suggests,  
**Unsupervised learning is a machine learning technique in which models are not supervised using training dataset.**

Instead, **models itself find the hidden patterns and insights from the given data.**

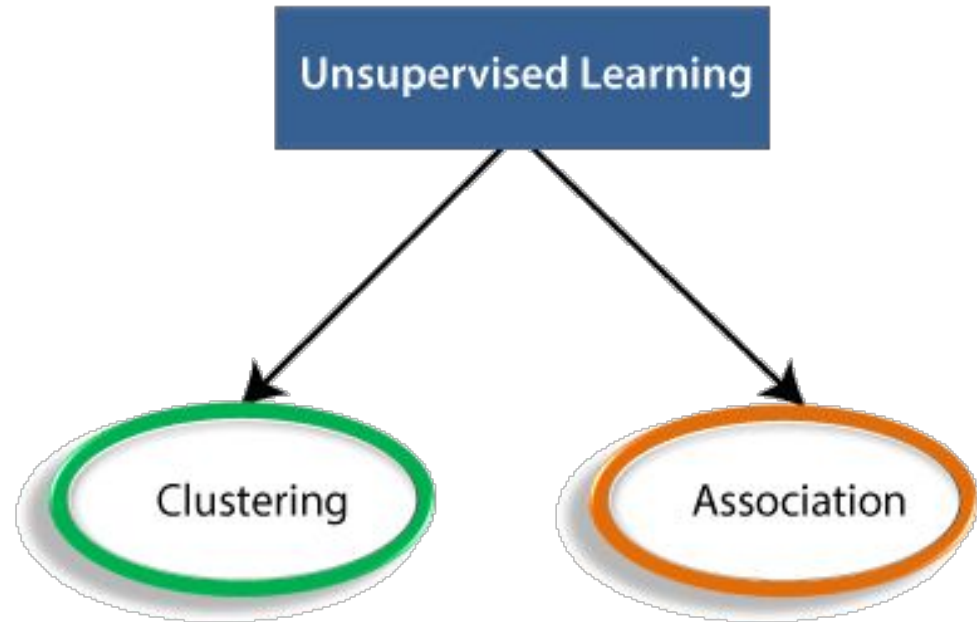
**It can be compared to learning which takes place in the human brain while learning new things.**



# Grade of Supervision - Unsupervised Machine Learning

Unsupervised learning cannot be directly applied to a regression or classification problem because unlike supervised learning, **we have the input data but no corresponding output data.**

The goal of unsupervised learning is to **find the underlying structure of dataset, group that data according to similarities, and represent that dataset in a compressed format.**



# Grade of Supervision - Unsupervised Machine Learning

Suppose the unsupervised learning algorithm is **given an input dataset containing images of different types of cats and dogs.**

**The algorithm is never trained upon the given dataset, which means it does not have any idea about the features of the dataset.**

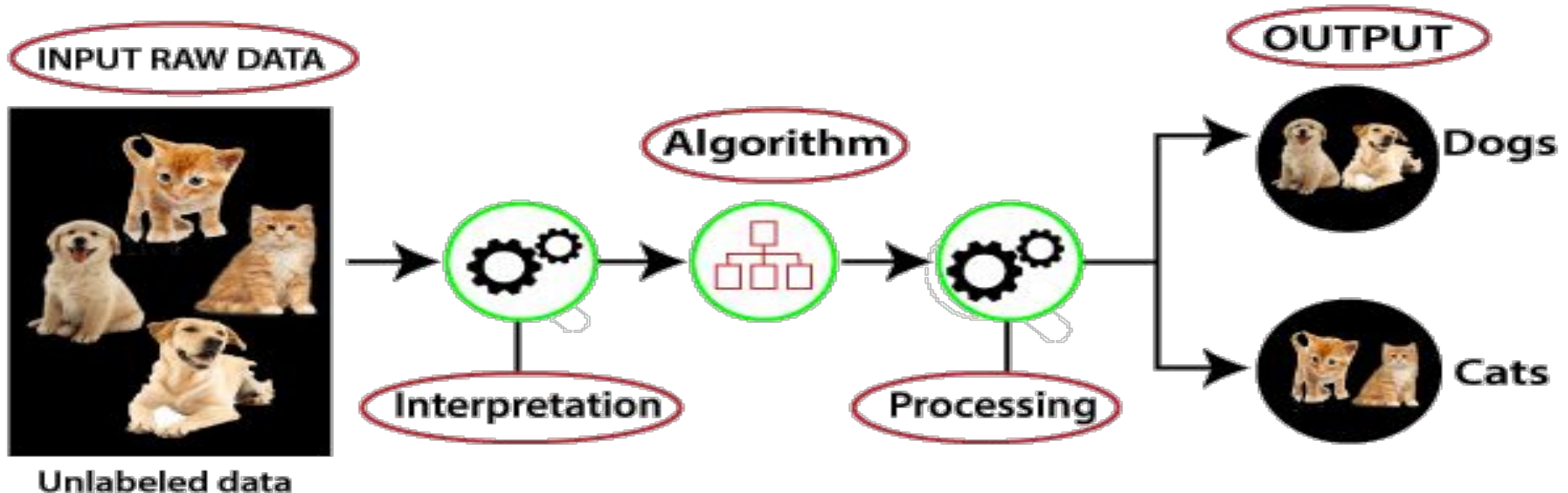
**The task of the unsupervised learning algorithm is to identify the image features on their own.**

Unsupervised learning algorithm will **perform this task by clustering the image dataset into the groups according to similarities between images.**



# Grade of Supervision - Unsupervised Machine Learning

Working of unsupervised learning can be understood by the below diagram:





# Grade of Supervision - Unsupervised Machine Learning

- **Clustering:** Clustering is a method of grouping the objects into clusters such that objects with most similarities remains into a group and has less or no similarities with the objects of another group. Cluster analysis finds the commonalities between the data objects and categorizes them as per the presence and absence of those commonalities.



**Association**  
People that buy X tend to buy Y  
People that buy A+B tend to buy C



- **Association:** An association rule is an unsupervised learning method which is used for finding the relationships between variables in the large database. It determines the set of items that occurs together in the dataset. Association rule makes marketing strategy more effective. Such as people who buy X item (suppose a bread) are also tend to purchase Y (Butter/Jam) item. A typical example of Association rule is Market Basket Analysis.

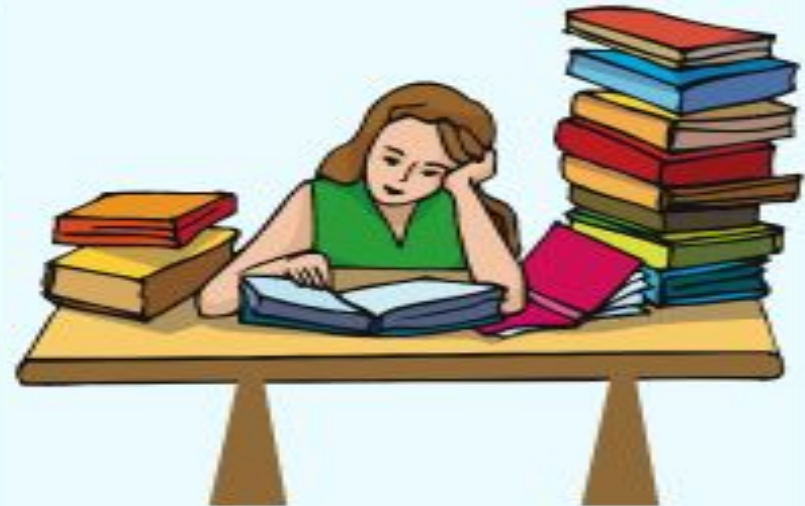


# Grade of Supervision - Supervised vs Unsupervised

## Supervised Learning



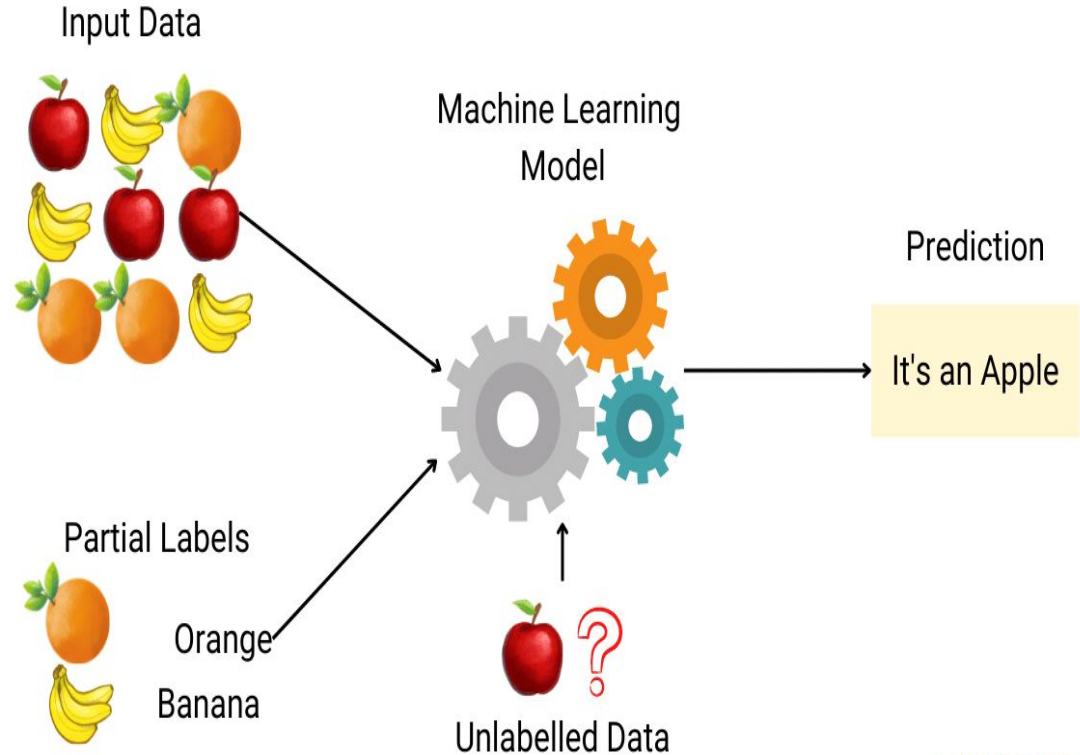
## Unsupervised Learning



# Grade of Supervision - Semi - Supervised Machine Learning

Semi-Supervised learning is a type of Machine Learning algorithm that lies between Supervised and Unsupervised machine learning.

It represents the intermediate ground between Supervised (With Labelled training data) and Unsupervised learning (with no labelled training data) algorithms and uses the combination of labelled and unlabeled data sets during the training period.



# Grade of Supervision - Semi - Supervised Machine Learning

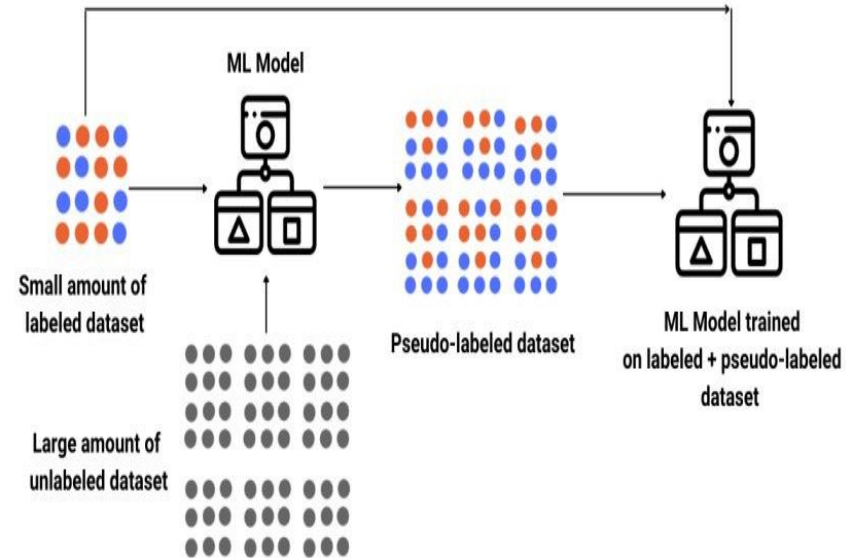
To overcome the drawbacks of supervised learning and unsupervised learning algorithms, the concept of Semi-supervised learning is introduced.

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 unlabeled data into labelled data.

It is because labelled data is a comparatively more expensive acquisition than unlabeled data.

## Semi-supervised learning use-case



# Grade of Supervision - Reinforcement Machine Learning

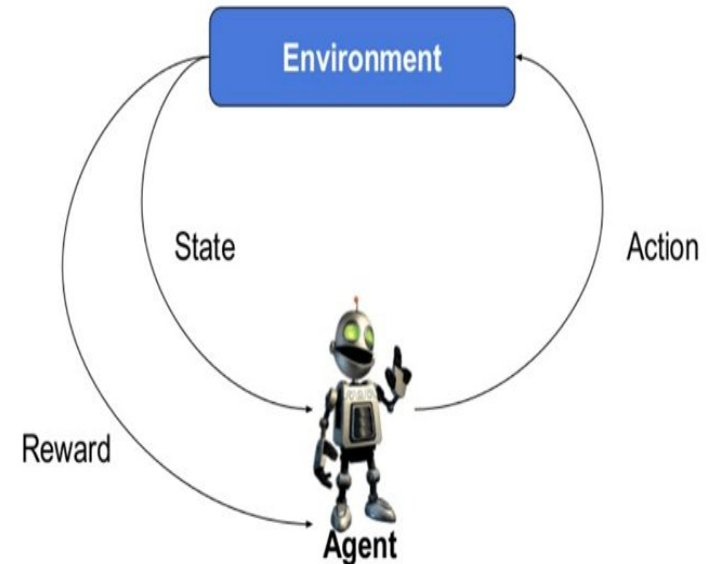


Reinforcement learning works on a feedback-based process, in which an AI agent (A software component) automatically explore its surrounding by hitting & trail, taking action, learning from experiences, and improving its performance.

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.

Typical RL scenario



# Grade of Supervision - Reinforcement Machine Learning

The reinforcement learning process is similar to a human being; for example, a child learns various things by experiences in his day-to-day life.

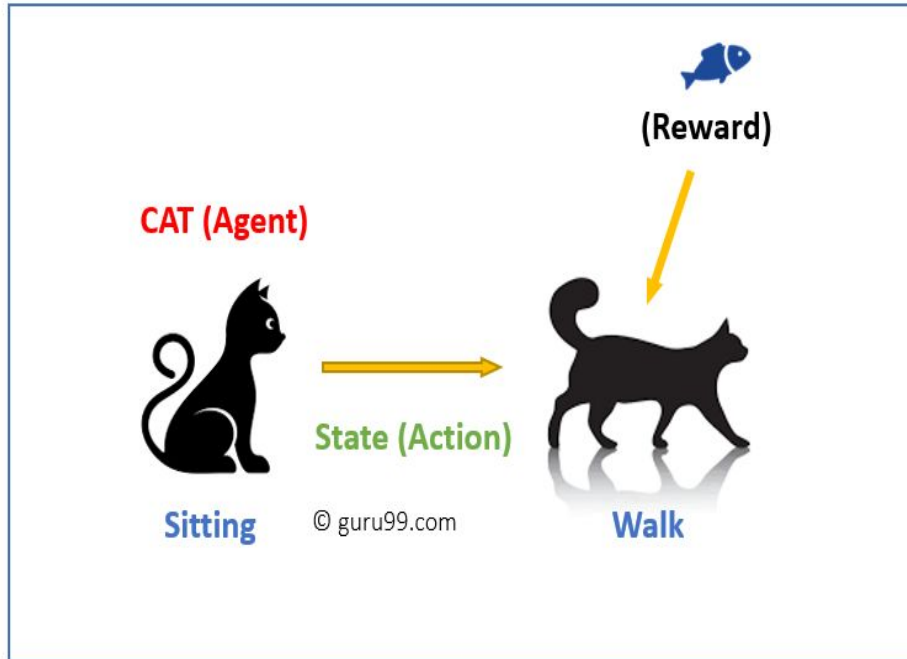
An example of reinforcement learning is to play a game, where the Game is the environment, moves of an agent at each step define states, and the goal of the agent is to get a high score.

Agent receives feedback in terms of punishment and rewards.



# Grade of Supervision - Reinforcement Machine Learning

House (environment)



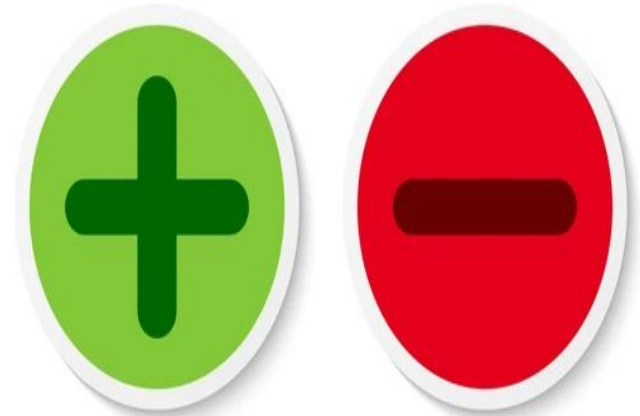
- As cat doesn't understand English or any other human language, we can't tell her directly what to do. Instead, we follow a different strategy.
- We emulate a situation, and the cat tries to respond in many different ways. If the cat's response is the desired way, we will give her fish.
- Now whenever the cat is exposed to the same situation, the cat executes a similar action with even more enthusiastically in expectation of getting more reward(food).
- That's like learning that cat gets from "what to do" from positive experiences.
- At the same time, the cat also learns what not do when faced with negative experiences.

# Grade of Supervision - Categories of Reinforcement Machine Learning



Reinforcement learning is categorized mainly into two types of methods/algorithms:

- **Positive Reinforcement Learning:** Positive reinforcement learning specifies **increasing the tendency that the required behaviour would occur again by adding something. It enhances the strength of the behaviour of the agent and positively impacts it.**
- **Negative Reinforcement Learning:** Negative reinforcement learning **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 case of Reinforcement Learning



- **Video Games:**

RL algorithms are much popular in gaming applications. It is used to gain superhuman 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 resources to wait for different jobs in order to minimize average job slowdown.



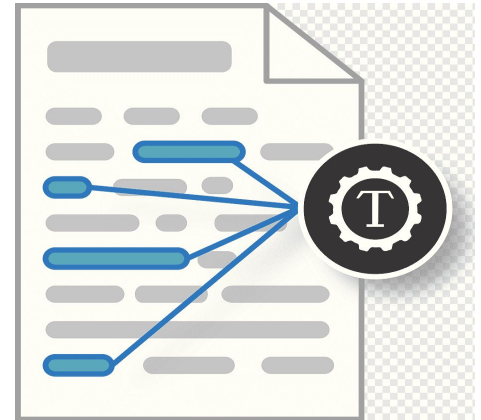
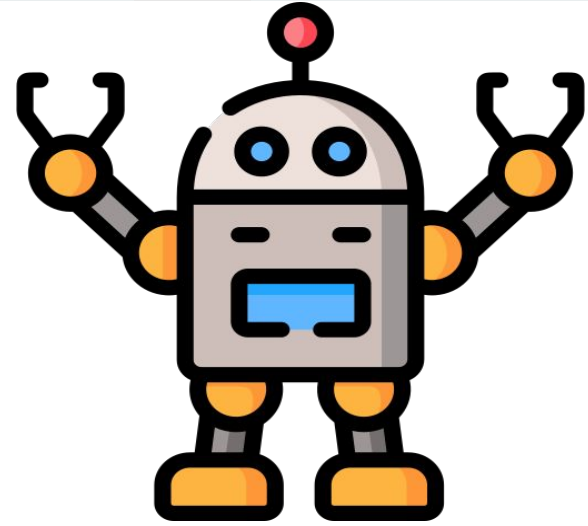
# Real World use case of Reinforcement Learning

- **Robotics:**

RL is widely being used in Robotics applications. 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 Machine learning technology.

- **Text Mining**

Text-mining, one of the great applications of NLP, is now being implemented with the help of Reinforcement Learning by Salesforce company.



## Case Study - Recommendation based Systems, At Microsoft, AI is a Big Big Deal



### Join the age of AI with Microsoft

Microsoft is committed to making the promise of AI real with advancements grounded in our mission to help every person on the planet to achieve more.

# Introducing the new Bing

**Ask real questions. Get complete answers. Chat and create.**

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### Ask anything

Ask your questions – short, long or anything in between. The more precise you ask, the better the answer.

Create a 3-course menu.

Help plan my special anniversary trip.

What art ideas can I do with my kid?

## Case Study - Recommendation based Systems, At Microsoft, AI is a Big Big Deal



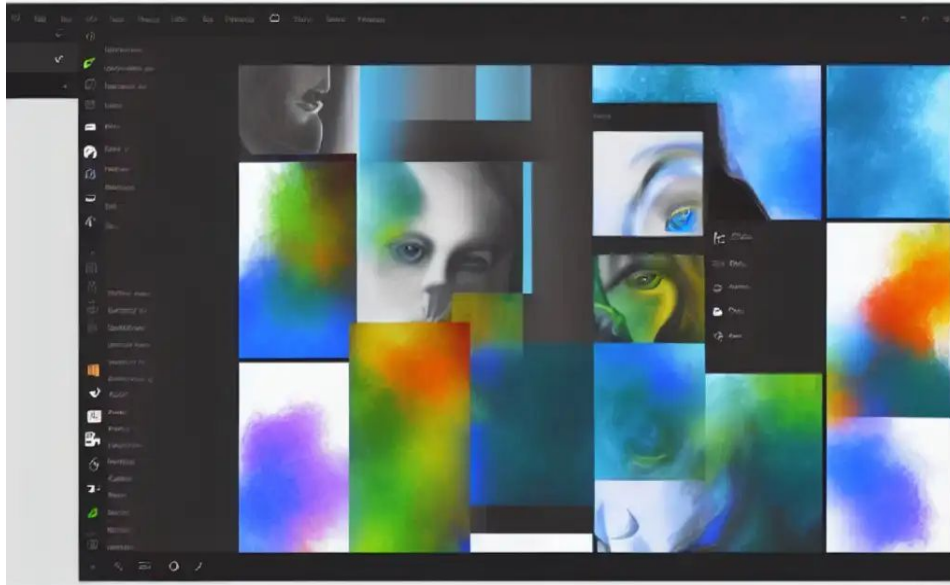
Can you help  
me write a  
story?

I need some  
help with my  
coding.

I need a big  
fast car.

## Case Study - Recommendation based Systems, At Microsoft, AI is a Big Big Deal

### Microsoft is bringing DALL-E 2's fantastical AI art to Windows and Edge



## Case Study - Recommendation based Systems, At Microsoft, AI is a Big Big Deal

# Microsoft announces major investment in artificial intelligence startup OpenAI

Science Jan 23, 2023 12:45 PM EST



Microsoft says it is making a “multiyear, multibillion dollar investment” in the artificial intelligence startup OpenAI, **maker of ChatGPT** and other tools that can write readable text and generate new images.



## Case Study - Recommendation based Systems, At Microsoft, AI is a Big Big Deal

Azure AI is a robust framework for developing machine learning, conversational AI, data analytics, robotics, IoT, and more.



# Thank You !!

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