Q1 MACHINE LEARNING

Machine learning is a Field of study that allow a Computer to learn without being explicitly programmed. Using machine learning we don't provide explicit instruction to computer for reading to some special situations . We need to provide training to the computer to find real time solutions for specific Problem. The Chess game is a famous example where machine learning is being used to play game

• Training Data:

The Machine Learning model is built using the training data. The training data helps the model to identify key trends and patterns essential to predict the output.

• Testing Data: After the model is trained, it must be tested to evaluate how accurately it can predict an outcome. This is done by the testing data set.

Future Scope of Machine Learning

Automotive Industry:The automotive industry is one of the areas where Machine Learning is excelling by changing the definition of safe driving. These self-driving cars are built using Machine Learning, IoT sensors, high-definition cameras, voice recognition systems, etc.

Robotics: Robotics is one of the fields that always gain the interest of researchers as well as the common. Researchers all over the world are still working on creating robots that mimic the human brain. They are using neural networks, AI, ML, computer vision, and many other technologies in this research.

Safer Healthcare: We have been seeing significant growth in machine learning being used to predict and support COVID-19 strategies. The healthcare industry itself has been long using ML for a wide range of purposes, we believe that the future scope of machine learning will undertake more complex use cases.

Q) What is Regression ? Explain with its Types

Ans) Regression analysis is a statistical method to model the relationship between a dependent (target) and independent (predictor) variables with one or more independent variables. More specifically, Regression analysis helps us to understand how the value of the dependent variable is changing corresponding to an independent variable when other independent variables are held fixed. It predicts continuous/real values such as temperature, age, salary, price, etc.

Example: Suppose there is a marketing company A, who does various advertisement every year and get sales on that. The below list shows the advertisement made by the company in the last 5 years and the corresponding sales:

Now, the company wants to do the advertisement of $200 in the year 2019 and wants to know the prediction about the sales for this year. So to solve such type of prediction problems in machine learning, we need regression analysis.

Types of Regression

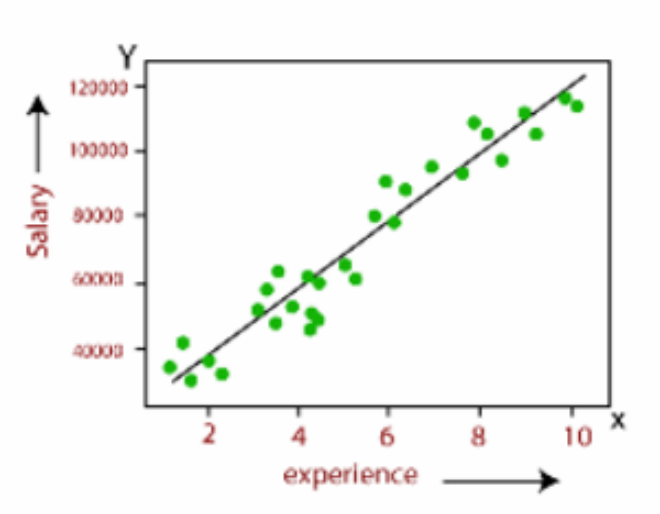
Linear Regression:

o Linear regression is a statistical regression method which is used for predictive analysis.

o It is one of the very simple and easy algorithms which works on regression and shows the relationship between the continuous variables.

o It is used for solving the regression problem in machine learning.

o Linear regression shows the linear relationship between the independent variable (X-axis) and the dependent variable (Y-axis), hence called linear regression.



o Suppose there is a dataset which consists of datapoints which are present in a non-linear fashion, so for such case, linear regression will not best fit to those datapoints. To cover such datapoints, we need Polynomial regression.

Logistic Regression:

This type of statistical model (also known as logit model) is often used for classification and predictive analytics. Logistic regression estimates the probability of an event occurring, such as voted or didn't vote, based on a given dataset of independent variables. Since the outcome is a probability, the dependent variable is bounded between 0 and 1. In logistic regression, a logit transformation is applied on the odds—that is, the probability of success divided by the probability of failure. This is also commonly known as the log odds, or the natural logarithm of odds, and this logistic function is represented by the following formulas:

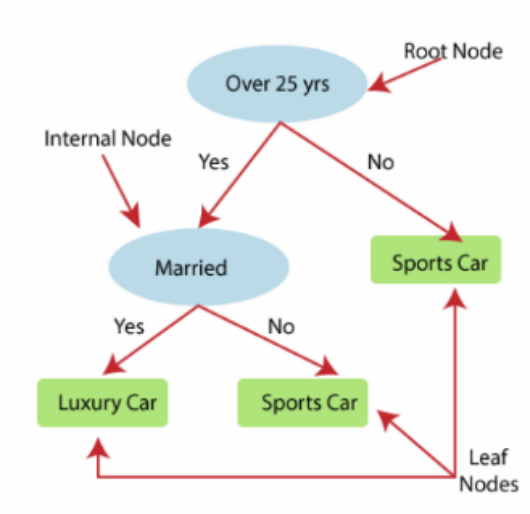
Logit(y) = 1/(1+ e^(z)).

Decision Tree Regression:

o Decision Tree is a supervised learning algorithm which can be used for solving both classification and regression problems.

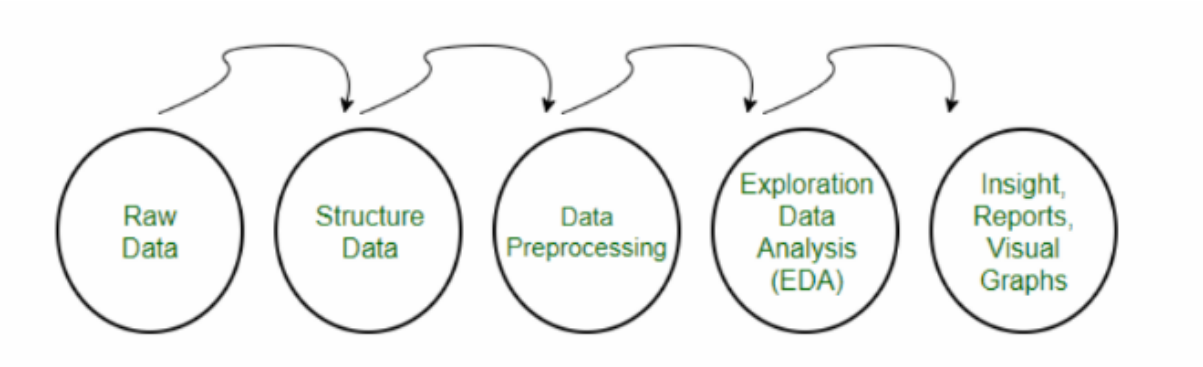
o It can solve problems for both categorical and numerical data

o Decision Tree regression builds a tree-like structure in which each internal node represents the "test" for an attribute, each branch represent the result of the test, and each leaf node represents the final decision or result.



What is the role of preprocessing of data in machine learning? Why it is needed? Explain the unsupervised model of machine learning in detail with an example.

Ans) Pre-processing refers to the transformations applied to our data before feeding it to the algorithm. Data Preprocessing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis.



Need of Data Preprocessing

• For achieving better results from the applied model in Machine Learning projects the format of the data has to be in a proper manner. Some specified Machine Learning model needs information in a specified format, for example, Random Forest algorithm does not support null values, therefore to execute random forest algorithm null values have to be managed from the original raw data set.

• Another aspect is that the data set should be formatted in such a way that more than one Machine Learning and Deep Learning algorithm are executed in one data set, and best out of them is chosen.

Why is Data preprocessing important?

Preprocessing of data is mainly to check the data quality. The quality can be checked by the following

- Accuracy: To check whether the data entered is correct or not.
- Completeness: To check whether the data is available or not recorded.
- Consistency: To check whether the same data is kept in all the places that do or do not match.
- Timeliness: The data should be updated correctly.
- Believability: The data should be trustable.
- Interpretability: The understandability of the data.

Major Tasks in Data Preprocessing:

1. Data cleaning
2. Data integration
3. Data reduction

Data cleaning:

Data cleaning is the process to remove incorrect data, incomplete data and inaccurate data from the datasets, and it also replaces the missing values.

Data integration:

The process of combining multiple sources into a single dataset. The Data integration process is one of the main components in data management.

Data reduction:

This process helps in the reduction of the volume of the data which makes the analysis easier yet produces the same or almost the same result. This reduction also helps to reduce storage space.

Data Transformation:

The change made in the format or the structure of the data is called data transformation. This step can be simple or complex based on the requirements.

Types Of Machine Learning .. / Classification of Machine Learning Models:

- **) Supervised Machine Learning**

As its name suggests, Supervised machine learning 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.

Here, the labelled data specifies that some of the inputs are already mapped to the output. More preciously, we can say; 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.

Let's understand supervised learning with an example. Suppose we have an input dataset of cats and dog images. So, first, we will provide the training to the machine to understand the images, such as the shape & size of the tail of cat and dog, Shape of eyes, colour, height (dogs are taller, cats are smaller), etc. After completion of training, we input the picture of a cat and ask the machine to identify the object and predict the output. Now, the machine is well trained, so it will check all the features of the object, such as height, shape, colour, eyes, ears, tail, etc., and find that it's a cat. So, it will put it in the Cat category. This is the process of how the machine identifies the objects in Supervised Learning.

-) Unsupervised Machine Learning

Unsupervised learning 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 unlabeled dataset, and the machine predicts the 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 unsorted dataset according to the similarities, patterns, and differences. Machines are instructed to find the hidden patterns from the input dataset.

Let's take an example to understand it more preciously; suppose there is a basket of fruit images, and we input it into the machine learning model. The images are totally unknown to the model, and the task of the machine is to find the patterns and categories of the objects.

So, now the machine will discover its patterns and differences, such as colour difference, shape difference, and predict the output when it is tested with the test dataset.

Reinforcement Learning

- Reinforcement Learning is a feedback-based Machine learning technique in which an agent learns to behave in an environment by performing the actions and seeing the results of actions. For each good action, the agent gets positive feedback, and for each bad action, the agent gets negative feedback or penalty.

- In Reinforcement Learning, the agent learns automatically using feedbacks without any labeled data, unlike supervised learning.

- Since there is no labeled data, so the agent is bound to learn by its experience only.

- RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such as game-playing, robotics, etc.

• The agent interacts with the environment and explores it by itself. The primary goal of an agent in reinforcement learning is to improve the performance by getting the maximum positive rewards.

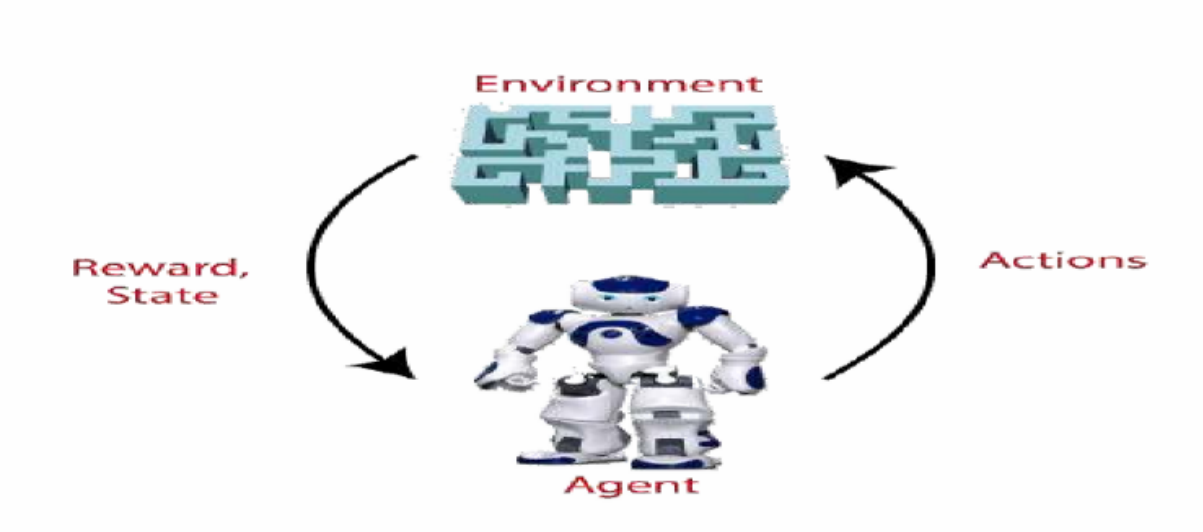
• The agent learns with the process of hit and trial, and based on the experience, it learns to perform the task in a better way. Hence, we can say that "Reinforcement learning is a type of machine learning method where an intelligent agent (computer program) interacts with the environment and learns to act within that." How a Robotic dog learns the movement of his arms is an example of Reinforcement learning.

• It is a core part of Artificial intelligence, and all AI agent works on the concept of reinforcement learning. Here we do not need to pre-program the agent, as it learns from its own experience without any human intervention.

• Example: Suppose there is an AI agent present within a maze environment, and his goal is to find the diamond. The agent interacts with the environment by performing some actions, and based on those actions, the state of the agent gets changed, and it also receives a reward or penalty as feedback.

• The agent continues doing these three things (take action, change state/remain in the same state, and get feedback), and by doing these actions, he learns and explores the environment.

• The agent learns that what actions lead to positive feedback or rewards and what actions lead to negative feedback penalty. As a positive reward, the agent gets a positive point, and as a penalty, it gets a negative point.



Terms used in Reinforcement Learning

o Agent(): An entity that can perceive/explore the environment and act upon it.

o Environment(): A situation in which an agent is present or surrounded by. In RL, we assume the stochastic environment, which means it is random in nature.

o Action(): Actions are the moves taken by an agent within the environment.

o State(): State is a situation returned by the environment after each action taken by the agent.

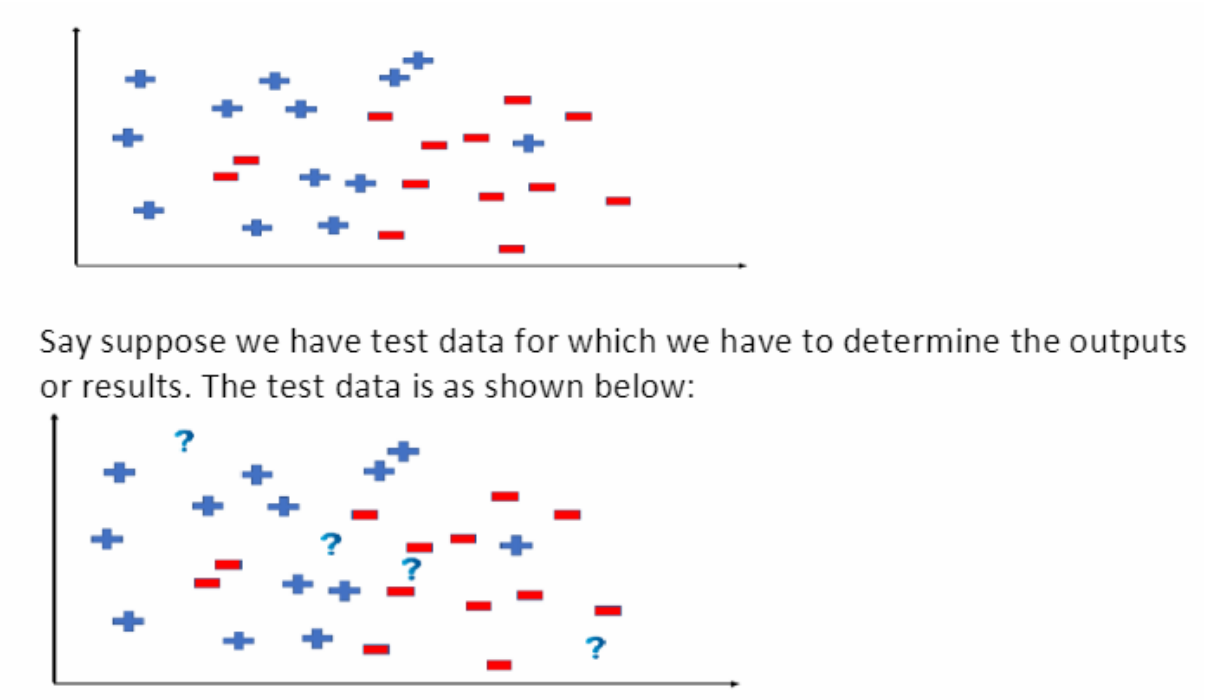
Discuss linear regression with an example. Explain the role of hypothesis function in machine learning models.

ANS) This assumption in Machine learning is known as Hypothesis or in other words The hypothesis is defined as the supposition or proposed explanation based on insufficient evidence or assumptions. It is just a guess based on some known facts but has not yet been proven. A good hypothesis is testable, which results in either true or false.

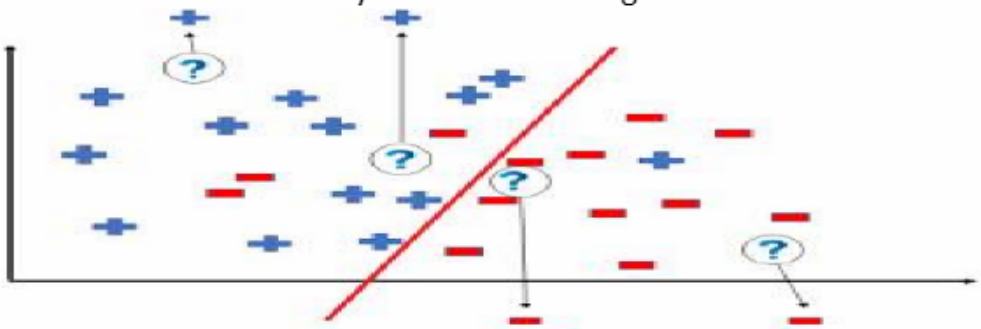
Example: Let's understand the hypothesis with a common example. Some scientist claims that ultraviolet (UV) light can damage the eyes then it may also cause blindness.

In this example, a scientist just claims that UV rays are harmful to the eyes, but we assume they may cause blindness. However, it may or may not be possible. Hence, these types of assumptions are called a hypothesis.

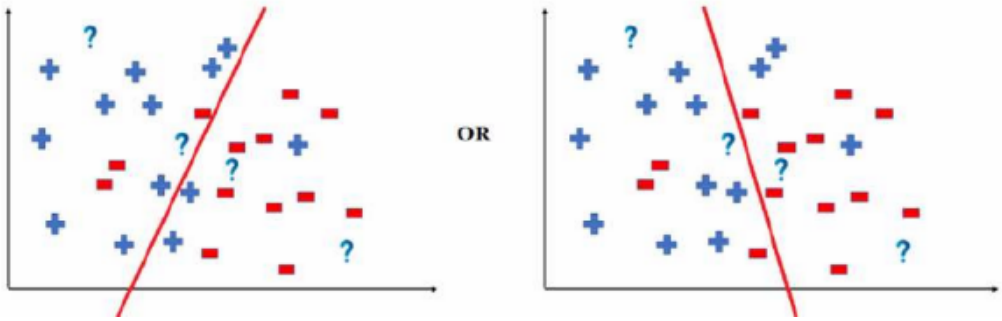
Hypothesis function and testing



We can predict the outcomes by dividing the coordinate as shown below:
So the test data would yield the following result:

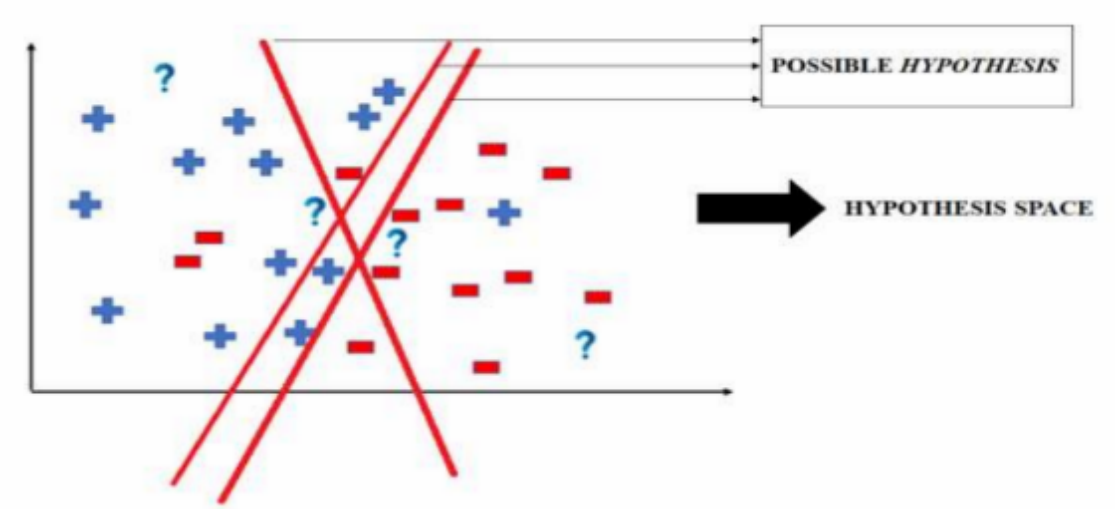


But note here that we could have divided the coordinate plane as:



The way in which the coordinate would be divided depends on the data, algorithm and constraints.

All these legal possible ways in which we can divide the coordinate plane to predict the outcome of the test data composes of the Hypothesis Space. Each individual possible way is known as the hypothesis. Hence, in this example the hypothesis space would be like:



Gradient Descent in Machine Learning

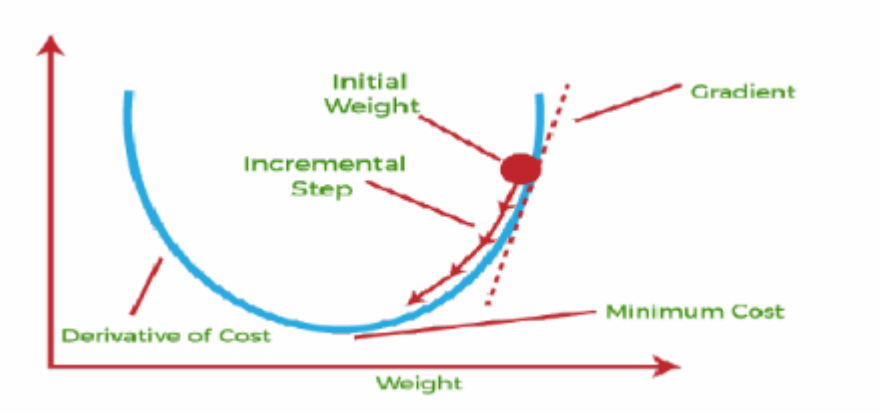
Gradient Descent is known as one of the most commonly used optimization algorithms to train machine learning models by means of minimizing errors between actual and expected results. Further, gradient descent is also used to train Neural Networks.

Gradient Descent is defined as one of the most commonly used iterative optimization algorithms of machine learning to train the machine learning and deep learning models. It helps in finding the local minimum of a function.

The best way to define the local minimum or local maximum of a function using gradient descent is as follows:

o If we move towards a negative gradient or away from the gradient of the function at the current point, it will give the local minimum of that function.

o Whenever we move towards a positive gradient or towards the gradient of the function at the current point, we will get the local maximum of that function.



Differentiate between classification and regression.

Regression Algorithm	Classification Algorithm
In Regression, the output variable must be of continuous nature or real value.	In Classification, the output variable must be a discrete value.
The task of the regression algorithm is to map the input value (x) with the continuous output variable(y).	The task of the classification algorithm is to map the input value(x) with the discrete output variable(y).
Regression Algorithms are used with continuous data.	Classification Algorithms are used with discrete data.
In Regression, we try to find the best fit line, which can predict the output more accurately.	In Classification, we try to find the decision boundary, which can divide the dataset into different classes.
Regression algorithms can be used to solve the regression problems such as Weather Prediction, House price prediction, etc.	Classification Algorithms can be used to solve classification problems such as Identification of spam emails, Speech Recognition, Identification of cancer cells, etc.
The regression can be further divided into Linear and Non-linear Regression.	The Classification algorithms can be divided into Binary Classifier and Multi-class Classifier.