

## Basic Concepts in Machine Learning

Machine Learning is continuously growing in the IT world and gaining strength in different business sectors. Although Machine Learning is in the developing phase, it is popular among all technologies. It is a field of study that makes computers capable of automatically learning and improving from experience. Hence, Machine Learning focuses on the strength of computer programs with the help of collecting data from various observations. In this article, "Concepts in Machine Learning", we will discuss a few basic concepts used in Machine Learning such as what is Machine Learning, technologies and algorithms used in Machine Learning, Applications and example of Machine Learning, and much more. So, let's start with a quick introduction to machine learning.

What is Machine Learning?

Machine Learning is defined as a technology that is used to train machines to perform various actions such as predictions, recommendations, estimations, etc., based on historical data or past experience.

Machine Learning enables computers to behave like human beings by training them with the help of past experience and predicted data.

- **Task:** A task is defined as the main problem in which we are interested. This task/problem can be related to the predictions and recommendations and estimations, etc.
- **Experience:** It is defined as learning from historical or past data and used to estimate and resolve future tasks.
- **Performance:** It is defined as the capacity of any machine to resolve any machine learning task or problem and provide the best outcome for the same. However, performance is dependent on the type of machine learning problems.

Techniques in Machine Learning

Machine Learning techniques are divided mainly into the following 4 categories:

### 1. Supervised Learning

Supervised learning is applicable when a machine has sample data, i.e., input as well as output data with correct labels. Correct labels are used to check the correctness of the model using some labels and tags. Supervised learning technique helps us to predict future events with the help of past experience and labeled examples. Initially, it analyses the known training dataset, and later it introduces an inferred function that makes predictions about output values. Further, it also predicts errors during this entire learning process and also corrects those errors through algorithms.

Example: Let's assume we have a set of images tagged as "dog". A machine learning algorithm is trained with these dog images so it can easily distinguish whether an image is a dog or not.

### 2. Unsupervised Learning

In unsupervised learning, a machine is trained with some input samples or labels only, while output is not known. The training information is neither classified nor labeled; hence, a machine may not always provide correct output compared to supervised learning.

Although Unsupervised learning is less common in practical business settings, it helps in exploring the data and can draw inferences from datasets to describe hidden structures from unlabeled data.

Example: Let's assume a machine is trained with some set of documents having different categories (Type A, B, and C), and we have to organize them into appropriate groups. Because the machine is provided only with input samples or without output, so, it can organize these datasets into type A, type B, and type C categories, but it is not necessary whether it is organized correctly or not.

### 3. Reinforcement Learning

Reinforcement Learning is a feedback-based machine learning technique. In such type of learning, agents (computer programs) need to explore the environment, perform actions, and on the basis of their actions, they get rewards as feedback. For each good action, they get a positive reward, and for each bad action, they get a negative reward. The goal of a Reinforcement learning agent is to maximize the positive rewards. Since there is no labeled data, the agent is bound to learn by its experience only.

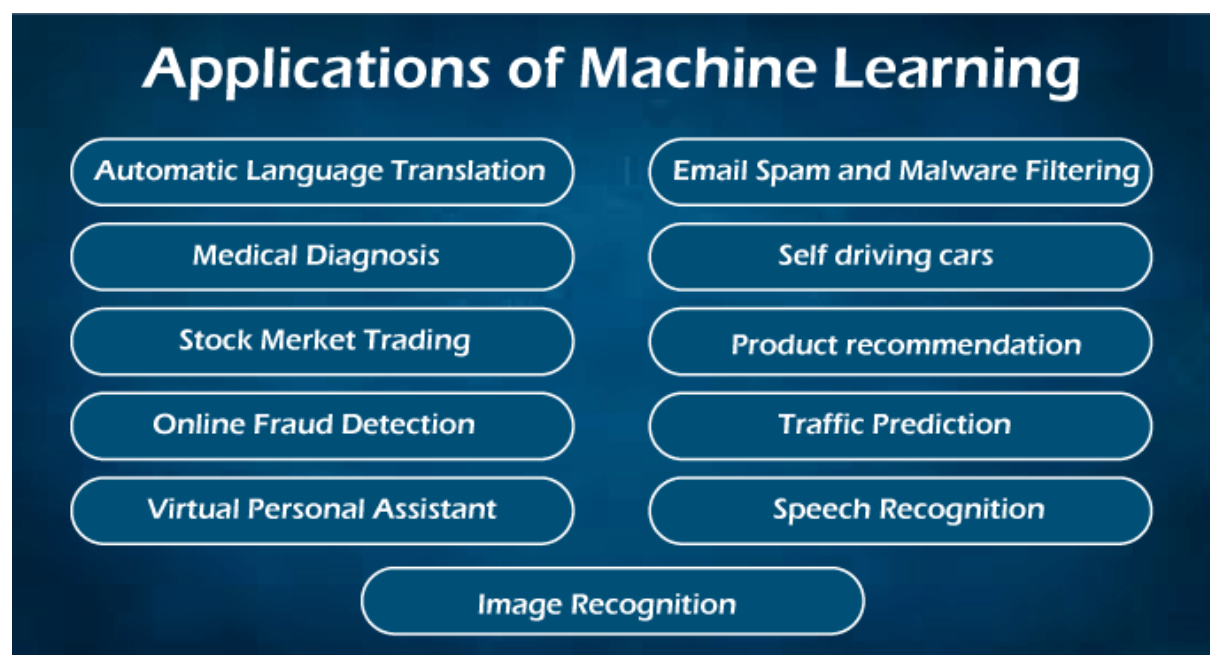
### 4. Semi-supervised Learning

Semi-supervised Learning is an intermediate technique of both supervised and unsupervised learning. It performs actions on datasets having few labels as well as unlabeled data. However, it generally contains unlabeled data. Hence, it also reduces the cost of the machine learning model as labels are costly, but for corporate purposes, it may have few labels. Further, it also increases the accuracy and performance of the machine learning model.

Semi-supervised learning helps data scientists to overcome the drawback of supervised and unsupervised learning. Speech analysis, web content classification, protein sequence classification, text documents classifiers, etc., are some important applications of Semi-supervised learning.

#### Applications of Machine Learning

Machine Learning is widely being used in approximately every sector, including healthcare, marketing, finance, infrastructure, automation, etc. There are some important real-world examples of machine learning, which are as follows:



#### Healthcare and Medical Diagnosis:

Machine Learning is used in healthcare industries that help in generating neural networks. These self-learning neural networks help specialists for providing quality treatment by analyzing external data on a patient's condition, X-rays, CT scans, various tests, and screenings. Other than treatment, machine learning is also helpful for cases like automatic billing, clinical decision supports, and development of clinical care guidelines, etc.

#### **Marketing:**

Machine learning helps marketers to create various hypotheses, testing, evaluation, and analyze datasets. It helps us to quickly make predictions based on the concept of big data. It is also helpful for stock marketing as most of the trading is done through bots and based on calculations from machine learning algorithms. Various Deep Learning Neural network helps to build trading models such as Convolutional Neural Network, Recurrent Neural Network, Long-short term memory, etc.

#### **Self-driving cars:**

This is one of the most exciting applications of machine learning in today's world. It plays a vital role in developing self-driving cars. Various automobile companies like Tesla, Tata, etc., are continuously working for the development of self-driving cars. It also becomes possible by the machine learning method (supervised learning), in which a machine is trained to detect people and objects while driving.

#### **Speech Recognition:**

Speech Recognition is one of the most popular applications of machine learning. Nowadays, almost every mobile application comes with a voice search facility. This "Search By Voice" facility is also a part of speech recognition. In this method, voice instructions are converted into text, which is known as Speech to text" or "Computer speech recognition.

Google assistant, SIRI, Alexa, Cortana, etc., are some famous applications of speech recognition.

#### **Traffic Prediction:**

Machine Learning also helps us to find the shortest route to reach our destination by using Google Maps. It also helps us in predicting traffic conditions, whether it is cleared or congested, through the real-time location of the Google Maps app and sensor.

#### **Image Recognition:**

Image recognition is also an important application of machine learning for identifying objects, persons, places, etc. Face detection and auto friend tagging suggestion is the most famous application of image recognition used by Facebook, Instagram, etc. Whenever we upload photos with our Facebook friends, it automatically suggests their names through image recognition technology.

#### **Product Recommendations:**

Machine Learning is widely used in business industries for the marketing of various products. Almost all big and small companies like Amazon, Alibaba, Walmart, Netflix, etc., are using machine learning techniques for products recommendation to their users. Whenever we search for any products on their websites, we automatically get started with lots of advertisements for similar products. This is also possible by Machine Learning algorithms that learn users' interests and, based on past data, suggest products to the user.

#### **Automatic Translation:**

Automatic language translation is also one of the most significant applications of machine learning that is based on sequence algorithms by translating text of one language into other desirable languages. Google GNMT (Google Neural Machine Translation) provides this feature, which is Neural Machine Learning. Further, you can also translate the selected text on images as well as complete documents through Google Lens.

#### **Virtual Assistant:**

A virtual personal assistant is also one of the most popular applications of machine learning. First, it records out voice and sends to cloud-based server then decode it with the help of machine learning algorithms. All big companies like Amazon, Google, etc., are using these features for playing music, calling someone, opening an app and searching data on the internet, etc.

#### **Email Spam and Malware Filtering:**

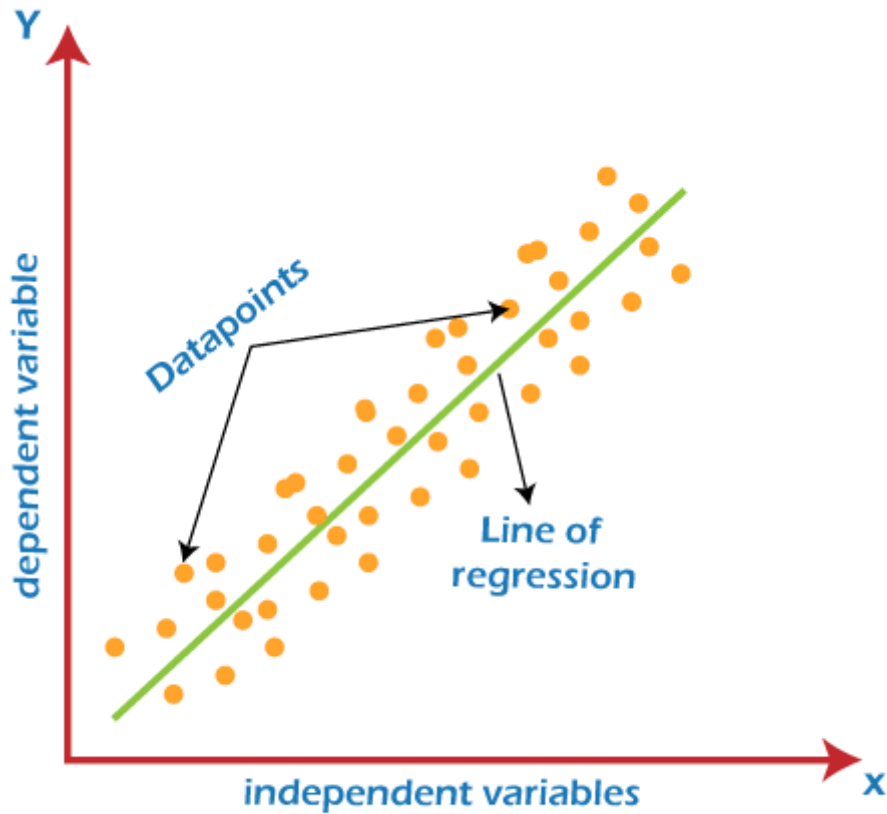
Machine Learning also helps us to filter various Emails received on our mailbox according to their category, such as important, normal, and spam. It is possible by ML algorithms such as Multi-Layer Perceptron, Decision tree, and Naïve Bayes classifier.

### **Machine Learning Algorithms**

#### **Linear Regression**

Linear Regression is one of the simplest and popular machine learning algorithms recommended by a data scientist. It is used for predictive analysis by making predictions for real variables such as experience, salary, cost, etc.

It is a statistical approach that represents the linear relationship between two or more variables, either dependent or independent, hence called Linear Regression. It shows the value of the dependent variable changes with respect to the independent variable, and the slope of this graph is called as Line of Regression.



Linear Regression can be expressed mathematically as follows:

$$y = a_0 + a_1x + \epsilon$$

Y= Dependent Variable

X= Independent Variable

$a_0$ = intercept of the line (Gives an additional degree of freedom)

$a_1$  = Linear regression coefficient (scale factor to each input value).

$\epsilon$  = random error

The values for x and y variables are training datasets for Linear Regression model representation.

Types of Linear Regression:

- Simple Linear Regression
- Multiple Linear Regression

#### **Applications of Linear Regression:**

Linear Regression is helpful for evaluating the business trends and forecasts such as prediction of salary of a person based on their experience, prediction of crop production based on the amount of rainfall, etc