

## Machine Learning

### Introduction :

- A subset of artificial intelligence known as machine learning

Focuses primarily on the creation of algorithms that enable a computer to independently learn from data and previous experiences.

Arthur Samuel first used the term "machine learning" in 1959.

Without being explicitly programmed, machine learning enables a machine to automatically learn from data, improve performance from experiences and predict things.

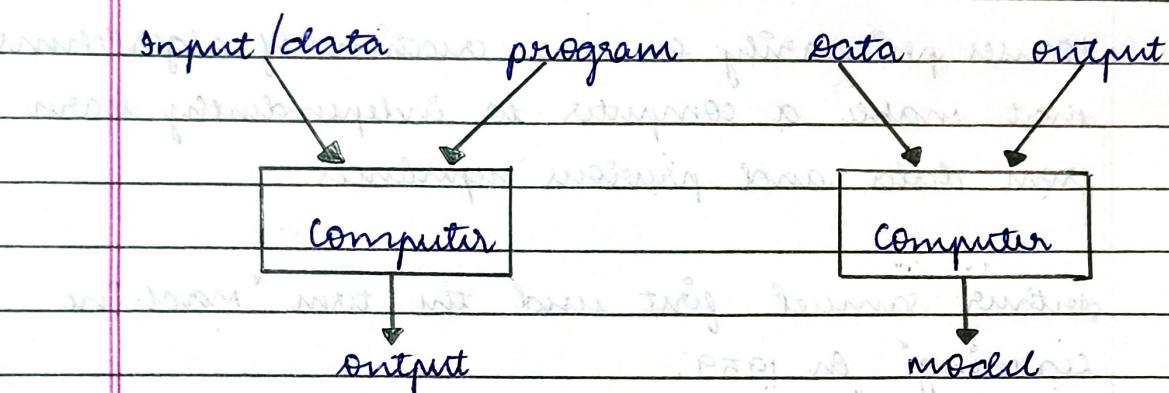
Machine learning algorithms create a mathematical model that, without being explicitly programmed aids in making predictions (or) decisions with the assistance of sample historical data (or) training data.

For the purpose of developing predictive models, machine learning brings together statistics and computer science.

Algorithms that learn from historical data are either constructed (or) utilized in machine learning

The performance will rise in proportion to the quantity of information we provide.

A machine can learn if it can gain more data to improve its performance.



# Algorithms Machine Learning

## Learning:

It is the process by which a system improves performance from experience.

"A branch of artificial intelligence concerned with the design and development of algorithms that allow computer to evolve behaviours based on empirical data"

Definition by Tom Mitchell (1998):

Machine learning is the study of algorithms that

- improves their performance P
  - at some task T

- with experience E

A user defined machine learning task is given by  $\langle P, T, E \rangle$

Examples:

1) Handwritten digit recognition problem

- Task T : Recognizing and classifying handwritten digits within images
- Performance P : percent of digits correctly classified.
- Experience E : a database of digits with given classification.

2) A robot driving learning problem

- Task T : driving on public four-lane highways using vision sensors.
- Performance P : average distance travel before an error [as judged by human overseer]
- Experience E : a sequence of images and steering commands recorded while observing a human driver.

why is machine learning important?

- Some tasks cannot be defined well, except by examples (e.g., recognizing people)
- Relationships and correlations can be hidden within large amounts of data. Machine learning / data mining may be able to find these relationships.

- Human designs often produce machines that don't work as well as desired in the environments in which they are used.
- The amount of knowledge available about certain tasks might be too large for explicit encoding by humans (e.g.; medical diagnostic).
- Environment change over time.
- New knowledge about the ~~task~~ tasks is constantly being discovered by humans. It may be difficult to continuously re-design system "by-hand".

### Areas of Influence for Machine Learning

- **Statistic :**  
How best to use sample drawn from unknown probability distributions to help decide from which distribution some new sample is drawn.
- **Brain models :**  
Non-linear elements with weighted inputs (Artificial Neural Networks) have been suggested as simple models of biological neurons.
- **Adaptive control theory:-**  
How to deal with controlling a process having unknown parameters that must be estimated during operations.
- **Psychology :-**  
How to model human performance on various learning tasks.

- Artificial Intelligence :-

How to write algorithms to acquire the knowledge humans are able to acquire as well as humans.

- Evolutionary models :-

How to model certain aspects of biological evolution to improve the performance of computer programs.

## Machine Learning

The term machine learning was coined by Arthur Samuel in 1959, an American pioneer in the field of computer gaming and artificial intelligence.

He stated that "it gives computers the ability to learn without being explicitly programmed" and in 1997, Tom Mitchell gave a "well-posed" mathematical and relational definition that

### 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.

Example for task T is - prediction, classification, decision making

Example for experience E is - data.

→ Example to predict future traffic : Rented-10  
definition

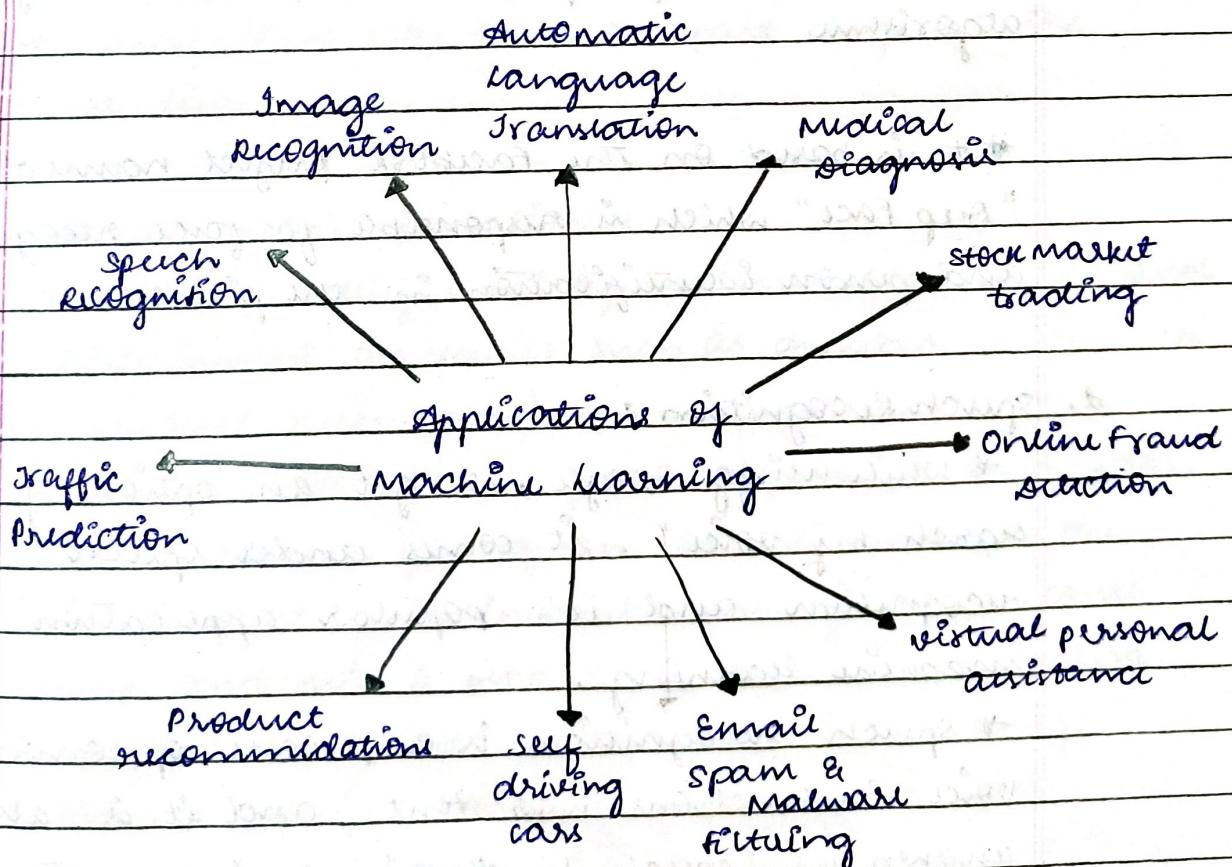
- If you want your program to predict for example ,
  - ✖ If you want your program to predict for traffic present at a busy intersection (task T).
    - you can run it through a machine learning algorithm with data about past traffic patterns (experience E) and ,
      - if it has successfully "learned"
      - it will then do better at predicting future traffic patterns (performance measure P)

The goal in the machine learning to recognize the pattern in the dataset , in general manner . After you recognize the patterns , you can use this information to model the data , to interpret the data (x) to predict the outcome of the new data which hasn't seen before .

Machine learning is a subfield of AI and ML algorithms are used in other related fields like natural language processing (NLP) and computer vision .

- Machine learning in layman's terms consider you are trying to toss a paper into a dustbin.
- after the first attempt, you realize that you have put too much force into it.
  - after the second attempt, you realize you are closer to the target but you need to increase your throw angle.
  - what is happening here is basically after every throw we are learning something and improving the end result.
  - we are programmed to learn from our experience.

## Applications of machine learning



### 1. Image Recognition :

\* It 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.

\* 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's 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.

### d. Speech Recognition :

\* While using Google, we get an option of "search by voice", it comes under speech recognition and it's 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 instruction.

### 3. 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 from Google map app and sensors.
  - \* Average time has taken on past days at the same time.

### 4. Product recommendations :

- \* ML 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.

## 5. Self-driving cars :

- \* One of the most exciting applications of machine learning is self-driving cars.
- \* ML 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.

## 6. Email spam and malware filtering:

\* whenever we receive a new email 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 filter
- Permission filters
- Some machine learning algorithms such as multi-layer perceptron, decision tree and naive Bayes classifier are used for email spam filtering and malware detection.

#### 7. Virtual Personal Assistant:

- \* we have various virtual personal assistants such as Google Assistant, Alexa, Cortana, Siri.
- \* As the name suggests, they help us in finding the information using our voice instruction.
- \* These assistants can help us in various ways just by our voice instruction such as play music, call someone, open an email, scheduling an appointment etc.
- \* These virtual assistants use machine learning algorithms as an important part.
- \* These assistants records our voice instructions, send it over the server on a cloud, and decode it using ML algorithms and act accordingly.

#### 8. Fraud account detection:

- \* Machine learning is making our online transactions 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 id's 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 & a fraud transaction.
- \* It is using unsupervised learning method to train the car models to detect people and object while driving.
- \* For each genuine transaction, the output is converted into some hash values, and these values

become the input for the next round. For each genuine transaction, there is a specific pattern which gets change for the fraud transaction hence, it detects it and makes our online transactions more secure.

#### 9. 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.

#### 10. medical diagnosis:

- \* In medical science, machine learning is used for disease diagnosis. 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.