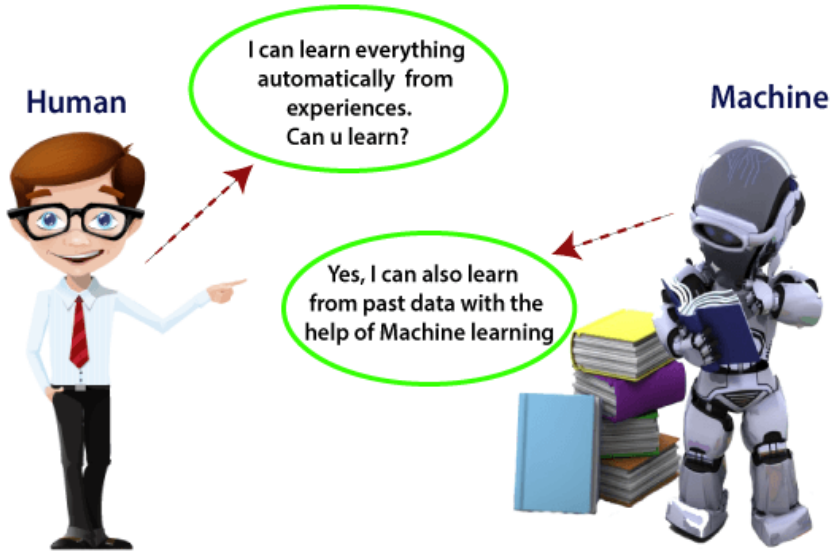
# Artificial Intelligence

Dr. Mubashir Ahmad (Ph.D.)

# What is 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**.



# What is Machine Learning?

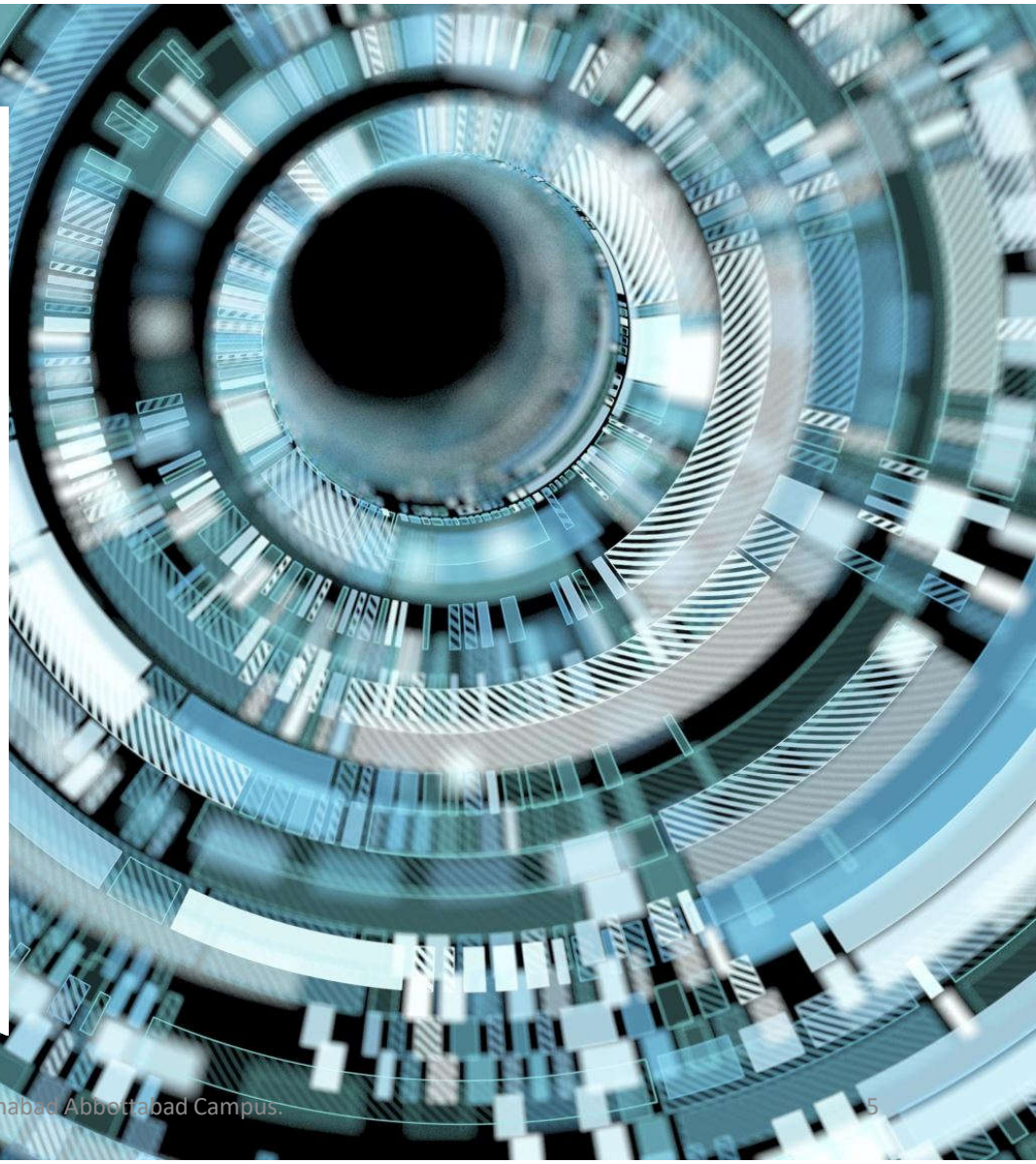
- Machine Learning is defined as a technology that is used to train machines to perform various actions such as predictions, recommendations, estimations, etc., based on historical data or past experience.
- Machine Learning is said as a subset of **artificial intelligence** that is mainly concerned with the development of algorithms that 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**.

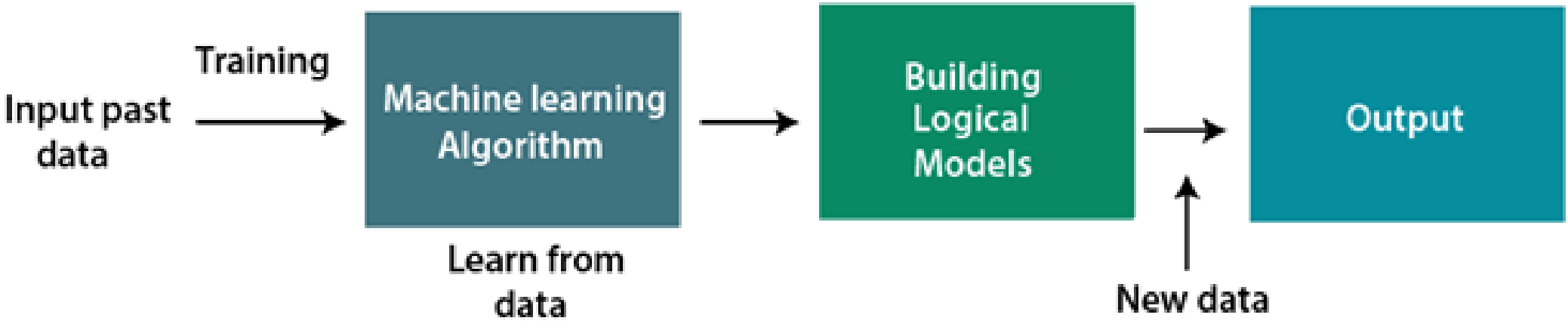
# What is Machine Learning?

- Machine learning (ML) is a subdomain of artificial intelligence (AI) that focuses on developing systems that learn—or improve performance—based on the data they ingest. Artificial intelligence is a broad word that refers to systems or machines that resemble human intelligence. Machine learning and AI are frequently discussed together, and the terms are occasionally used interchangeably, although they do not signify the same thing. A crucial distinction is that, while all machine learning is AI, not all AI is machine learning.
- Machine learning enables a machine to automatically learn from data, improve performance from experiences, and predict things without being explicitly programmed.

# What is Machine Learning?

- With the help of sample historical data, which is known as **training data**, machine learning algorithms build a **mathematical model** that helps in making predictions or decisions without being explicitly programmed.
- Machine learning brings computer science and statistics together for creating predictive models. Machine learning constructs or uses the algorithms that learn from historical data. The more we will provide the information, the higher will be the performance.






# Machine Learning working

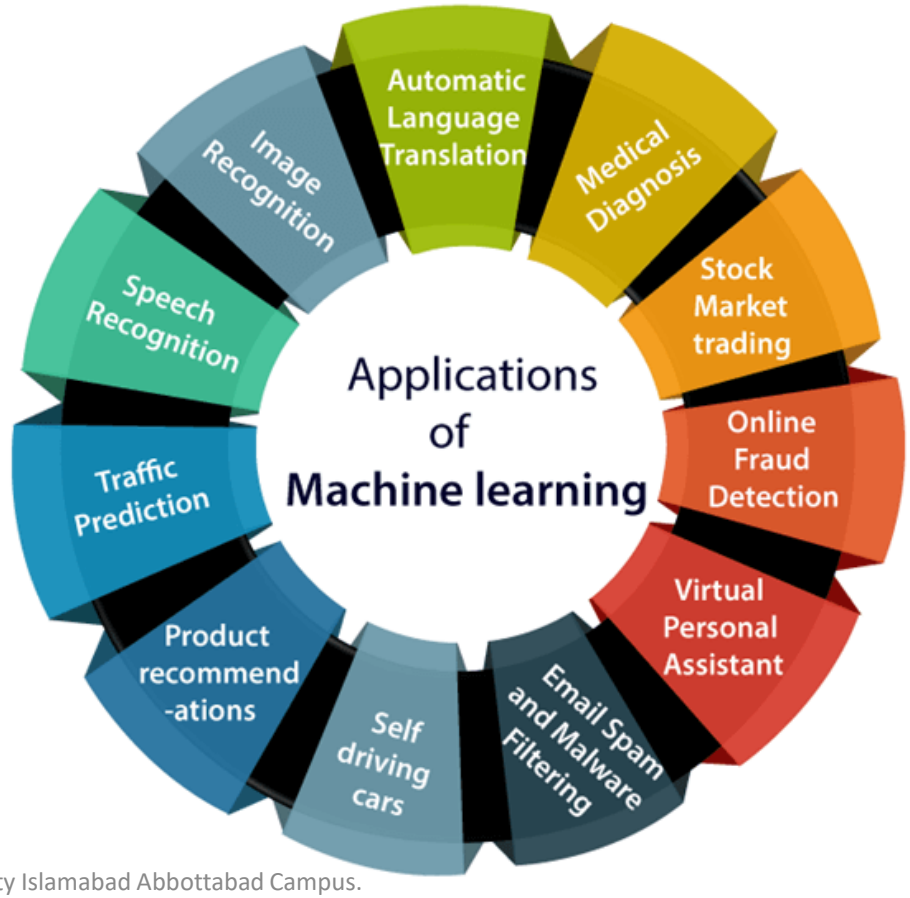
- A Machine Learning system **learns from historical data, builds the prediction models, and whenever it receives new data, predicts the output for it**. The accuracy of predicted output depends upon the amount of data, as the huge amount of data helps to build a better model that predicts the output more accurately.
- Suppose we have a complex problem, where we need to perform some predictions, so instead of writing a code for it, we just need to feed the data to generic algorithms, and with the help of these algorithms, the machine builds the logic as per the data and predict the output. Machine learning has changed our way of thinking about the problem.

# Features of Machine Learning:

- Machine learning is data-driven technology. A large amount of data is generated by organizations on a daily basis. So, by notable relationships in data, organizations make better decisions.
- The machine can learn itself from past data and automatically improve.
- From the given dataset it detects various patterns on data.
- For big organizations branding is important and it will become more easy to target a relatable customer base.

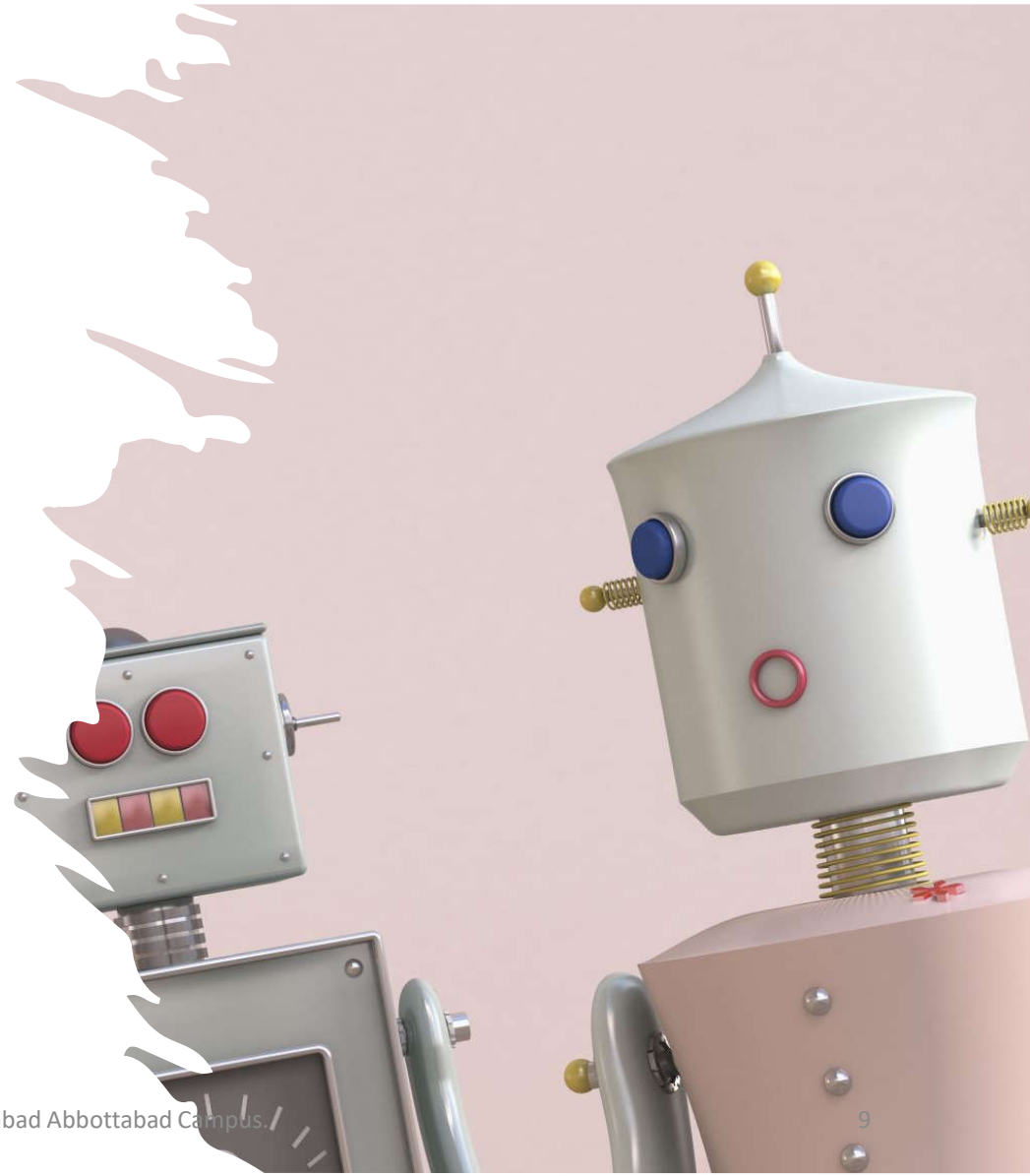
# Applications of Machine learning

- 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 lives even without knowing it such as Google Maps, Google Assistant, Alexa, etc. Below are some most trending real-world applications of Machine Learning:



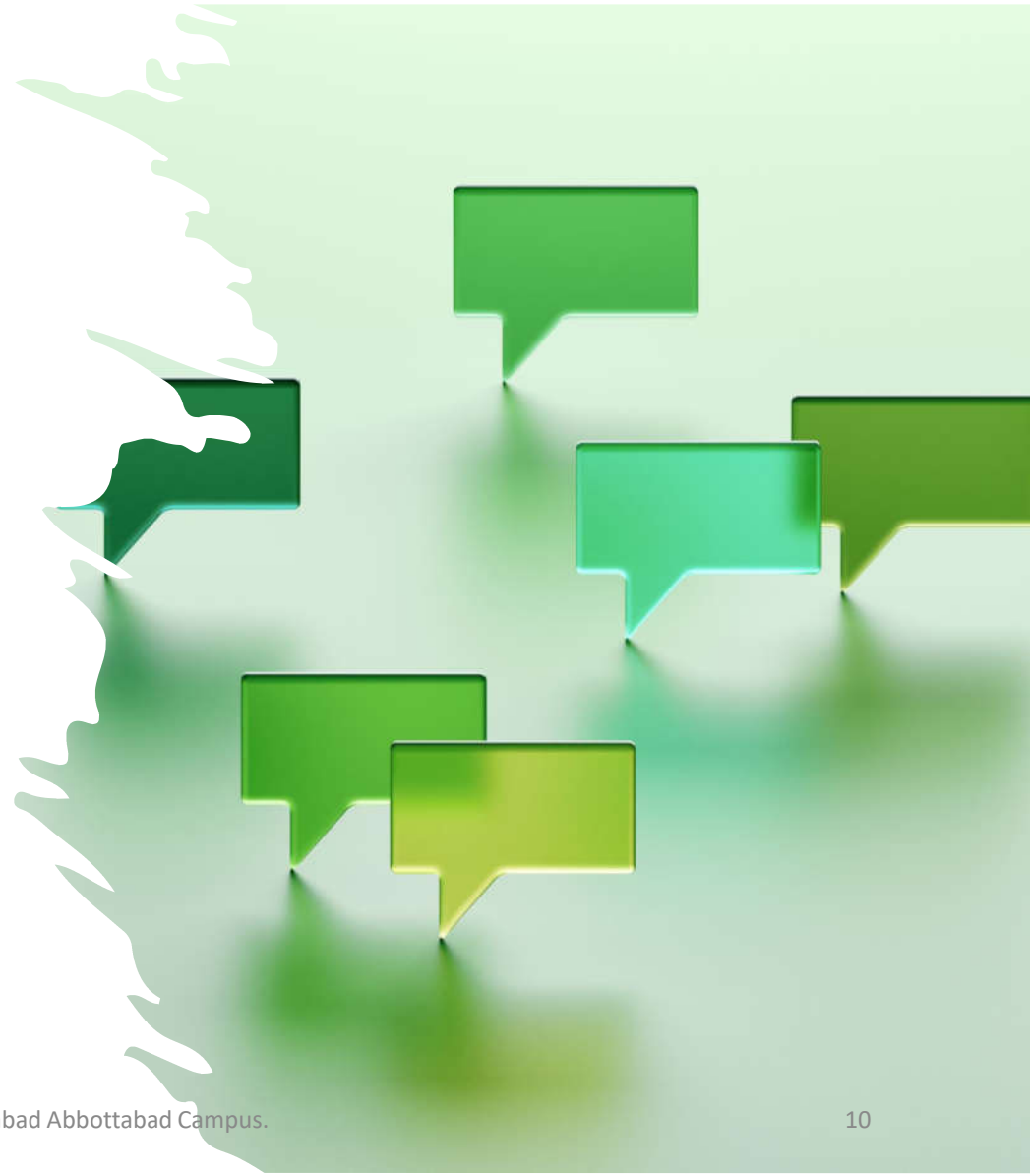
# Image Recognition:

- 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**:
- Facebook provides us with a feature of auto friend tagging suggestions. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with a 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.



# 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.



# Product recommendations:

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

# Email Spam and Malware Filtering:

- Whenever we receive a new email, it is filtered automatically as important, normal, and spam. We always receive important mail in our inbox with the important symbols 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
- Some machine learning algorithms such as **Multi-Layer Perceptron**, **Decision tree**, and **Naïve Bayes classifier** are used for email spam filtering and malware detection.

# Medical Diagnosis:

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

# 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, Also machine learning helps us by converting the text into our known languages. Google's GNMT (Google Neural Machine Translation) provides this feature, which is Neural Machine Learning that translates the text into our familiar language, and it is called automatic translation.
- The technology behind the automatic translation is a sequence-to-sequence learning algorithm, which is used with image recognition and translates the text from one language to another language.

# 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.

# The Machine Learning Concepts

- 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.

# The Machine Learning Concepts

- Simply speaking, **machine learning can be used to model our beliefs about real-world events**. For example, let's say a person comes to a doctor with a certain blood report. A doctor based on his belief system learned using his/her experience & and knowledge, predicts (decides essentially) whether the person is suffering from a disease or otherwise.
- When the human belief system is not good enough for reasons such as evaluating a large amount of different data to arrive at a decision, we can, then, replace the "human belief system" with an AI/machine learning system (one or more models) and "experience and knowledge" with data which is fed into this AI / ML system.

# The Machine Learning Concepts

- Doctors can also use ML models trained using past data along with their experience & and intelligence to predict whether the person suffers from a disease or not.
- When human and machine learning intelligence is used in combination, it is also termed as **an augmented system.** When the system can rely solely on AI-based decisions, the system can be called **an autonomous system**. How well these beliefs correspond with reality is what is learned by the doctor over a period of time.
- In the machine learning world, we have a "**cost function**" or **"loss function"** that is learned to ensure that the prediction is closer to reality.

# The Machine Learning Concepts

- Technically speaking, machine learning is a technology where in machine learns to perform a prediction/estimation task based on past experience represented by a historical data set. There are three key aspects of machine learning which are the following:
- **Task**: The task can be related to prediction problems such as classification, regression, clustering, etc.
- **Experience**: Experience represents the historical dataset.
- **Performance**: The goal is to perform better in the prediction tasks based on the past datasets. Different performance measures exist for different kinds of machine learning problems.

# The Machine Learning Concepts

- Mathematically speaking, building machine learning models is about **approximating mathematical functions** (equations) representing real-world scenarios. These mathematical functions are also referred to as "**mathematical models**" or just **models**.
- Machine learning models are mathematical equations/functions that represent or model real-world problems/scenarios. The reason why machine learning models are called function approximations is because it will be extremely difficult to find exact functions which can be used to exactly represent the real-world and predict or estimate real-world scenarios.

# The Machine Learning Concepts

- Here is an illustration of a simple mathematical function which can be learned using the data.

$$y = f(x)$$

A simple function could be like this:

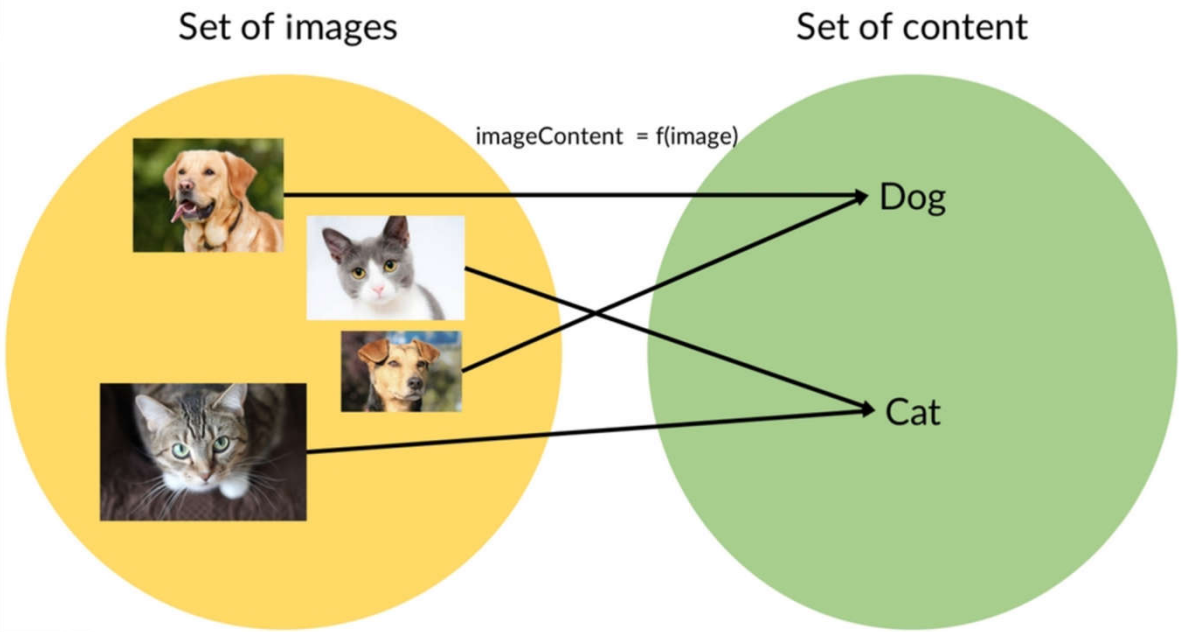
$$f(x) = 4 * x$$

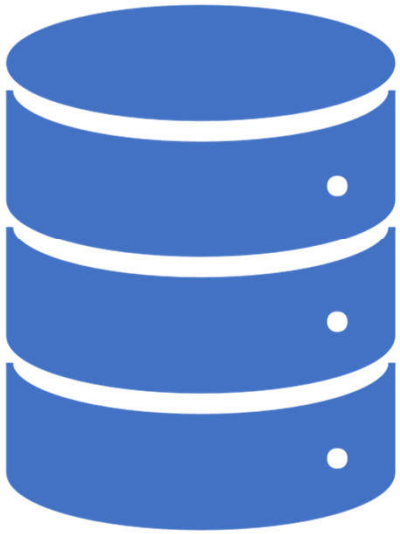
In this case, we can give the function an input, $x$, and it would quadruple it:

$$y = f(2) = 8$$

# The Machine Learning Concepts

- The function could as well be used to map the image to the image content or label. Here is the illustration:
- **imageContent = f(image)**





# Supervised and unsupervised machine learning

- Machine Learning is divided into two main areas: supervised learning and unsupervised learning.
- One of the most widespread uses of supervised learning is to make future predictions based on behaviors or characteristics that have been seen in the data already stored (historical data).
- Supervised learning makes it possible to search for patterns in historical data by relating all fields to a special field, called “the target field”. For example, e-mails are labeled as “spam” or “legitimate” by users.
- The prediction process begins with an analysis of which characteristics or patterns the emails that were already marked with both tags have.

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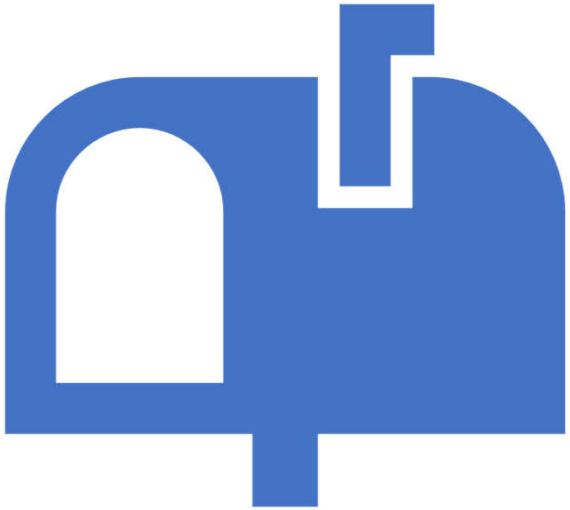
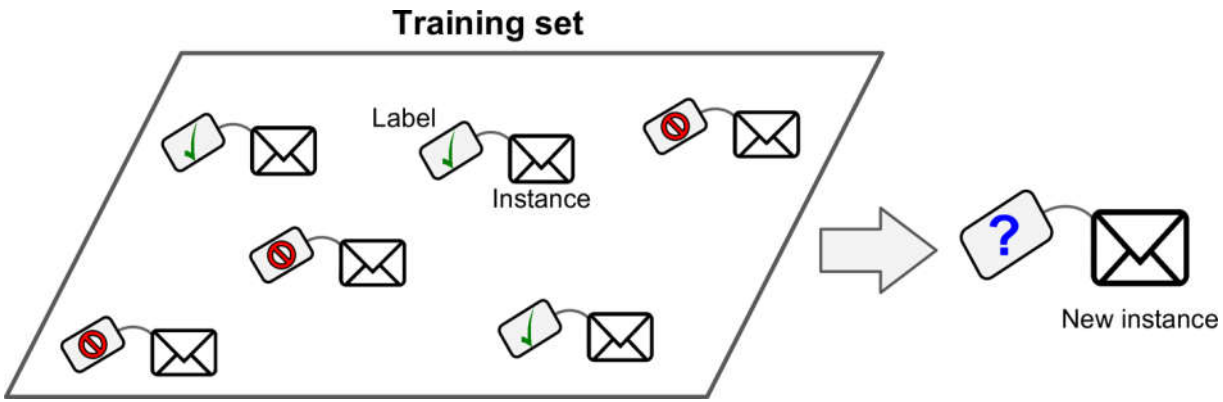
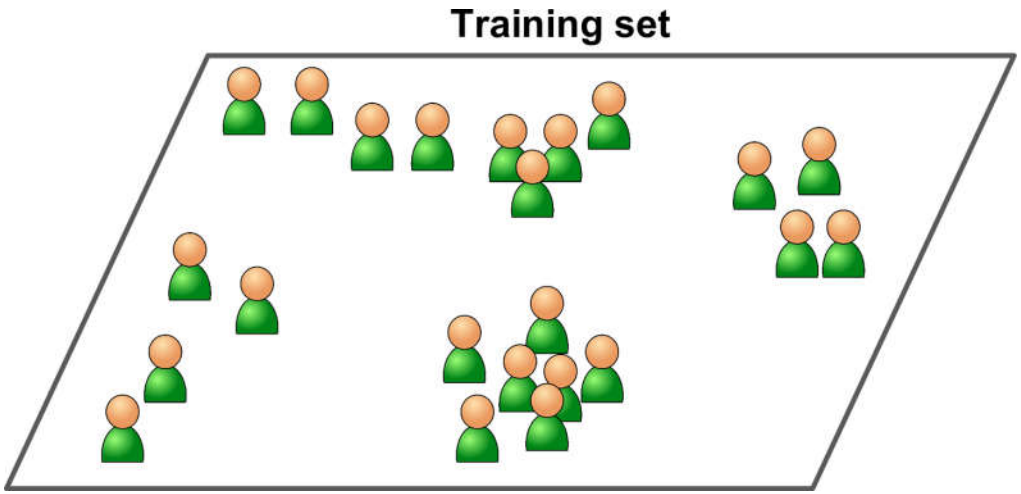
# Supervised and unsupervised machine learning

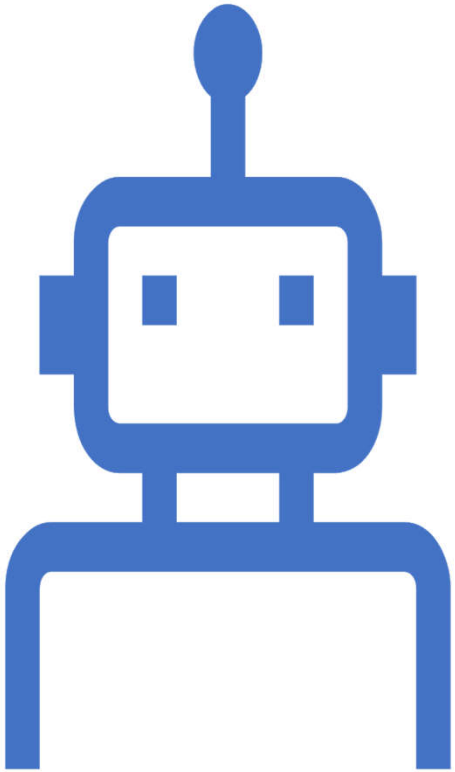


- Once all patterns have been determined (this phase is called “learning”), new mails that have never been marked as spam or legitimate are compared with patterns and classified (defined) as “spam” or “legitimate” based on their characteristics.
- On the other hand, unsupervised learning uses historical data that has no target field. The aim is to explore the data and find some structure or to organize it. For example, it is often used to group customers with characteristics or behaviors similar to those of **highly segmented marketing campaigns.**



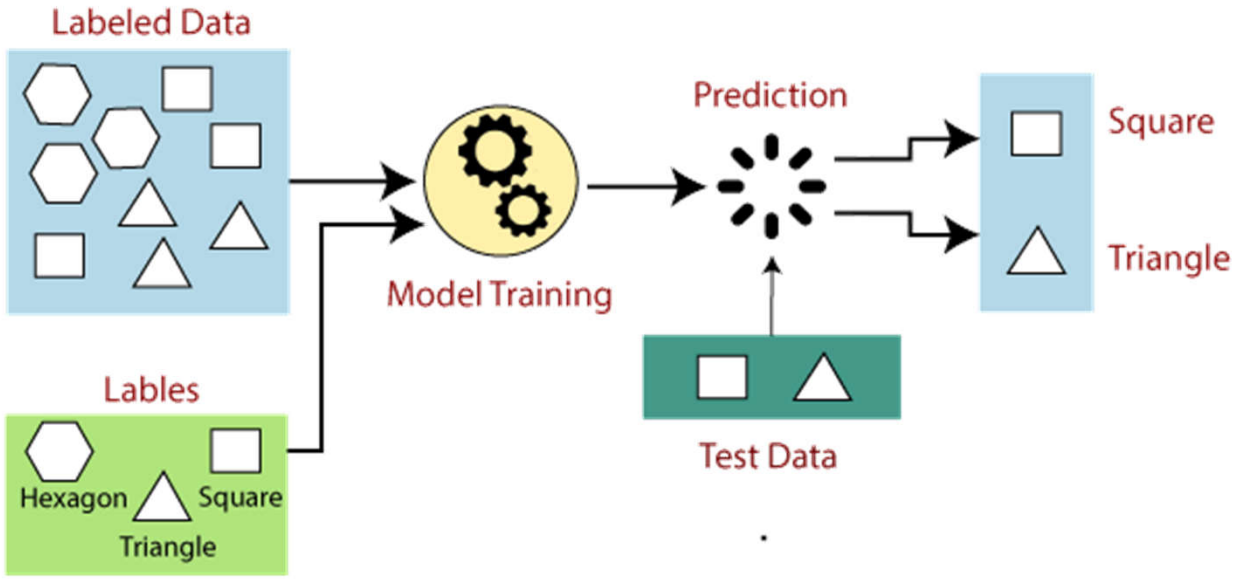

# Supervised and unsupervised machine learning



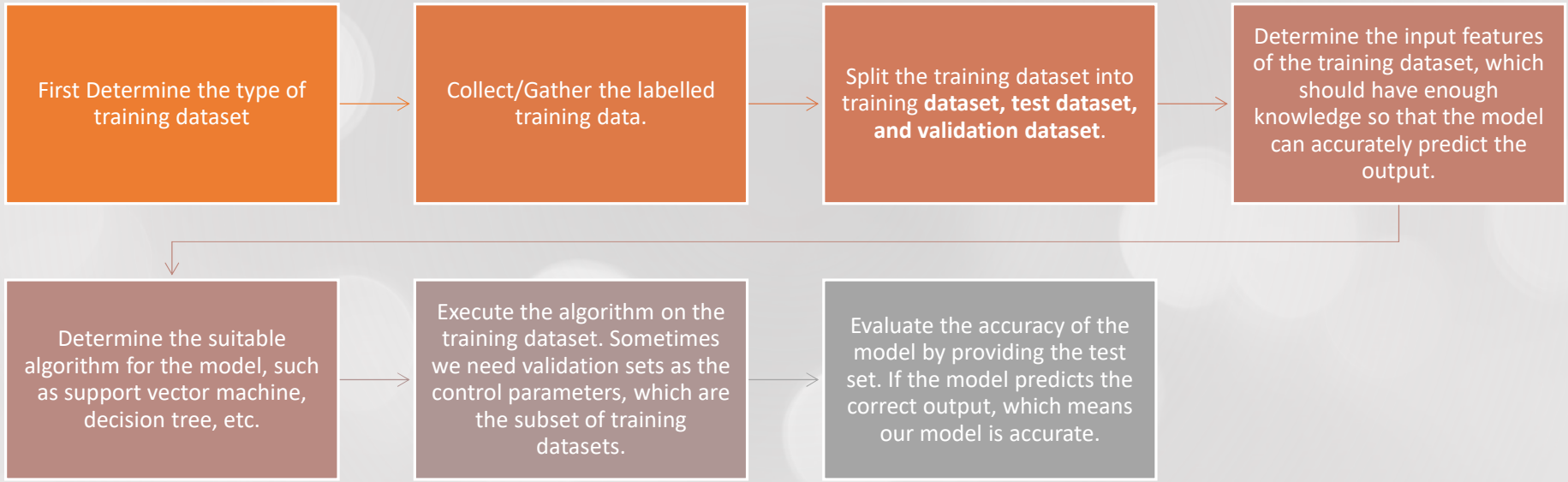
# Supervised machine learning

- In *supervised learning*, the training data you feed to the algorithm includes the desired solutions, called *labels.*
- A typical supervised learning task is *classification*. The spam filter is a good example of this: it is trained with many example emails along with their *class* (spam or ham), and it must learn how to classify new emails.
- Another typical task is to predict a *target* numeric value, such as the price of a car, given a set of *features* (mileage, age, brand, etc.) called *predictors*. This sort of task is called *regression*

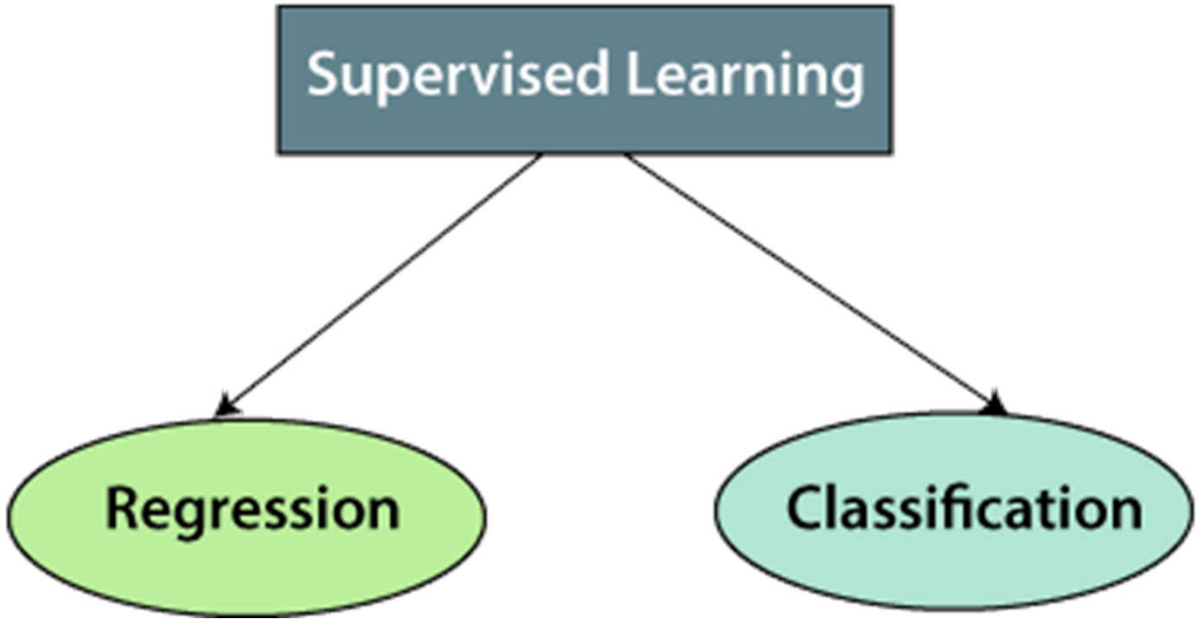
# Supervised machine learning

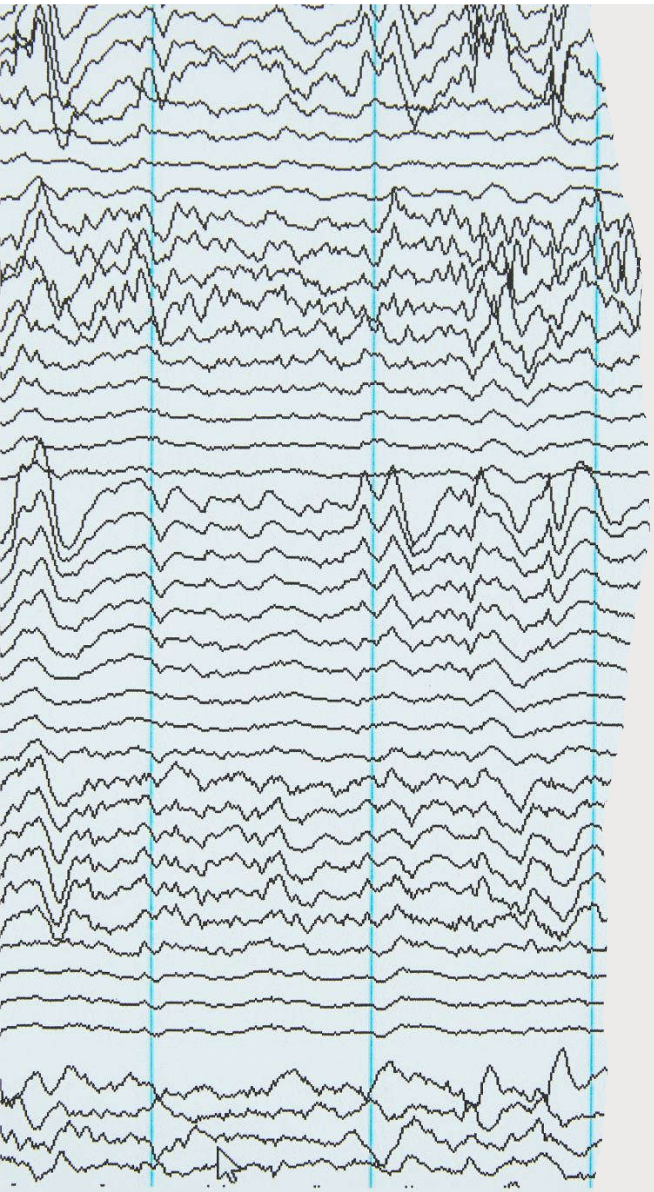


# Steps Involved in Supervised Learning:



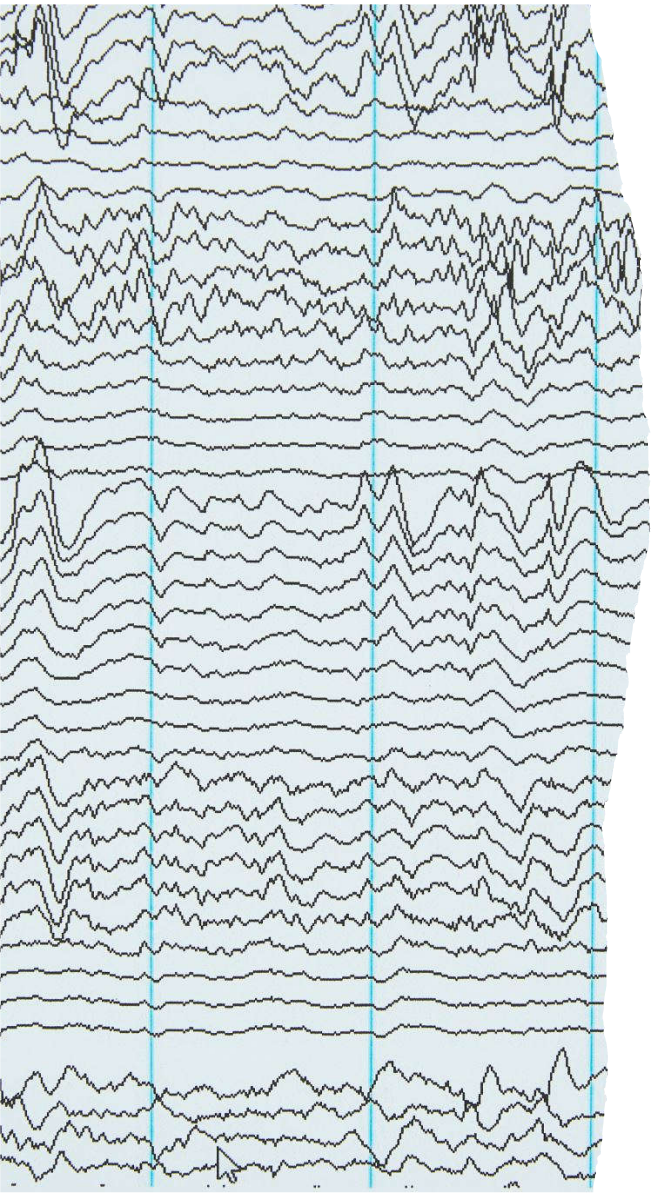
Types of supervised Machine learning Algorithms:





# 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 that come under supervised learning:
- Linear Regression
- Regression Trees
- Non-Linear Regression
- Bayesian Linear Regression
- Polynomial Regression

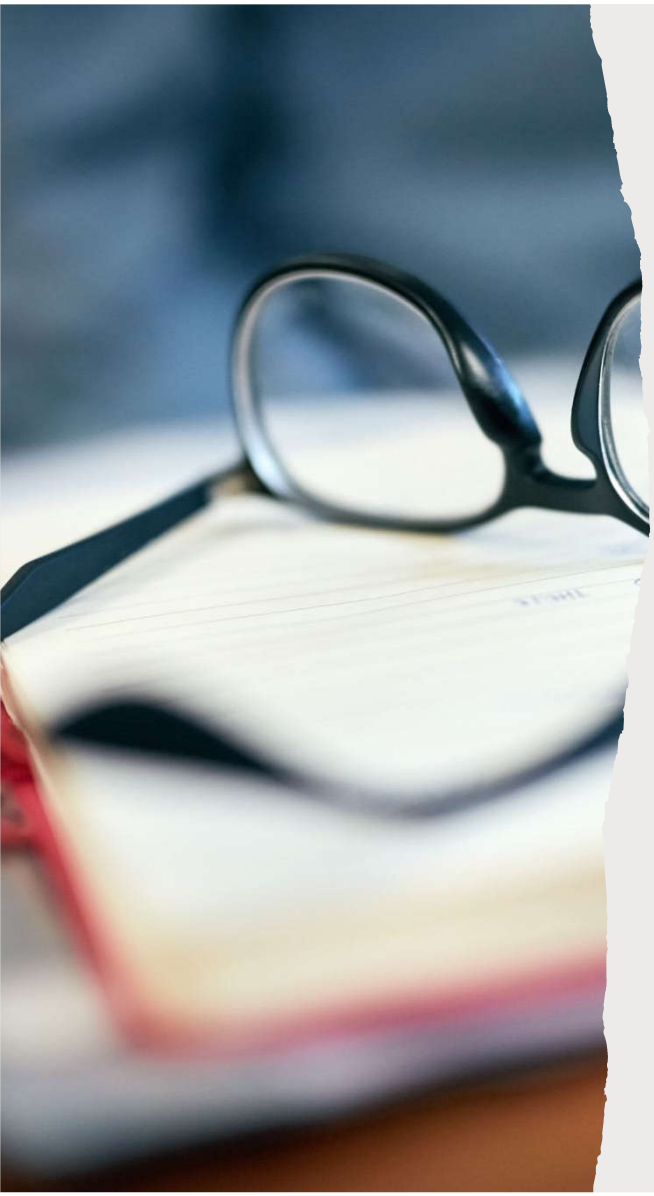


# Classification

- Classification algorithms are used when the output variable is categorical, which means there are two classes as Yes-No, Male-Female, True-false, etc.
- Random Forest
- Decision Trees
- Logistic Regression
- Support vector Machines

# Advantages of Supervised learning:

- 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.



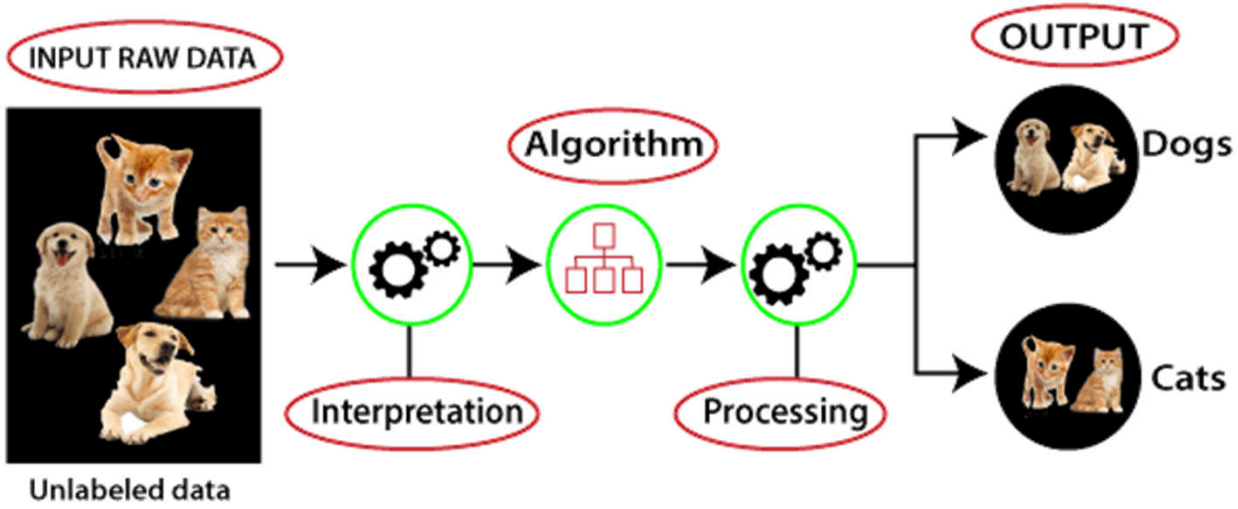
# Disadvantages of supervised learning:

- 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.

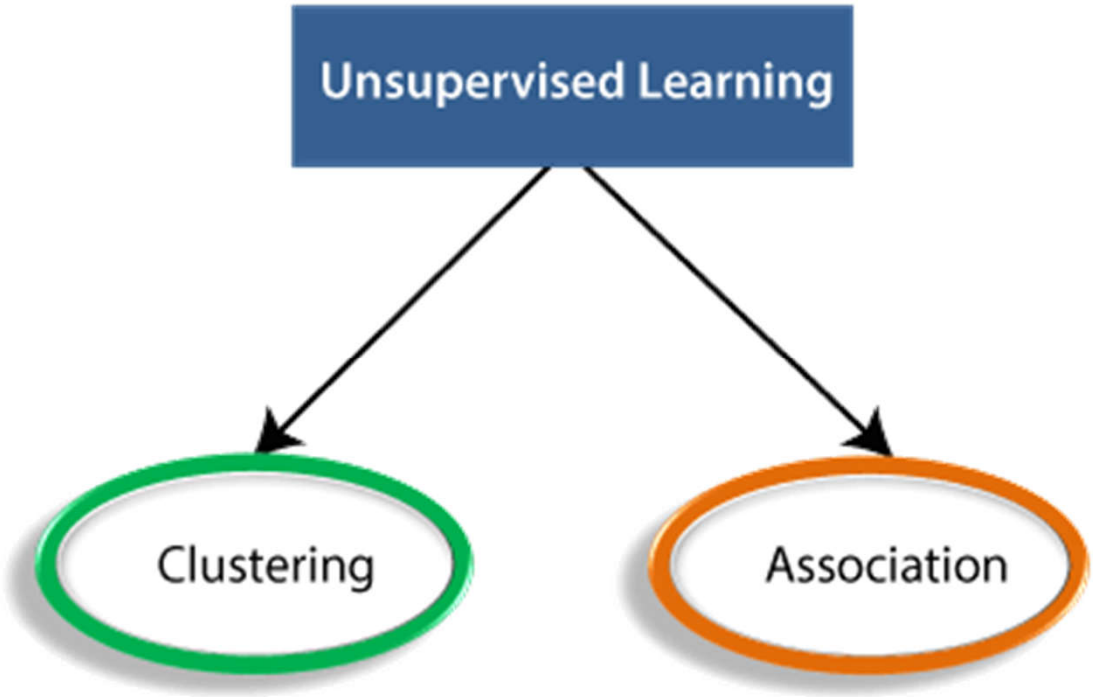
# Unsupervised Machine Learning

- In the previous topic, we learned supervised machine learning in which models are trained using labeled data under the supervision of training data. However, there may be many cases in which we do not have labeled data and need to find the hidden patterns from the given dataset. So, to solve such types of cases in machine learning, we need unsupervised learning techniques.
- As the name suggests, unsupervised learning is a machine learning technique in which models are not supervised using a training dataset. Instead, the models themselves 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.

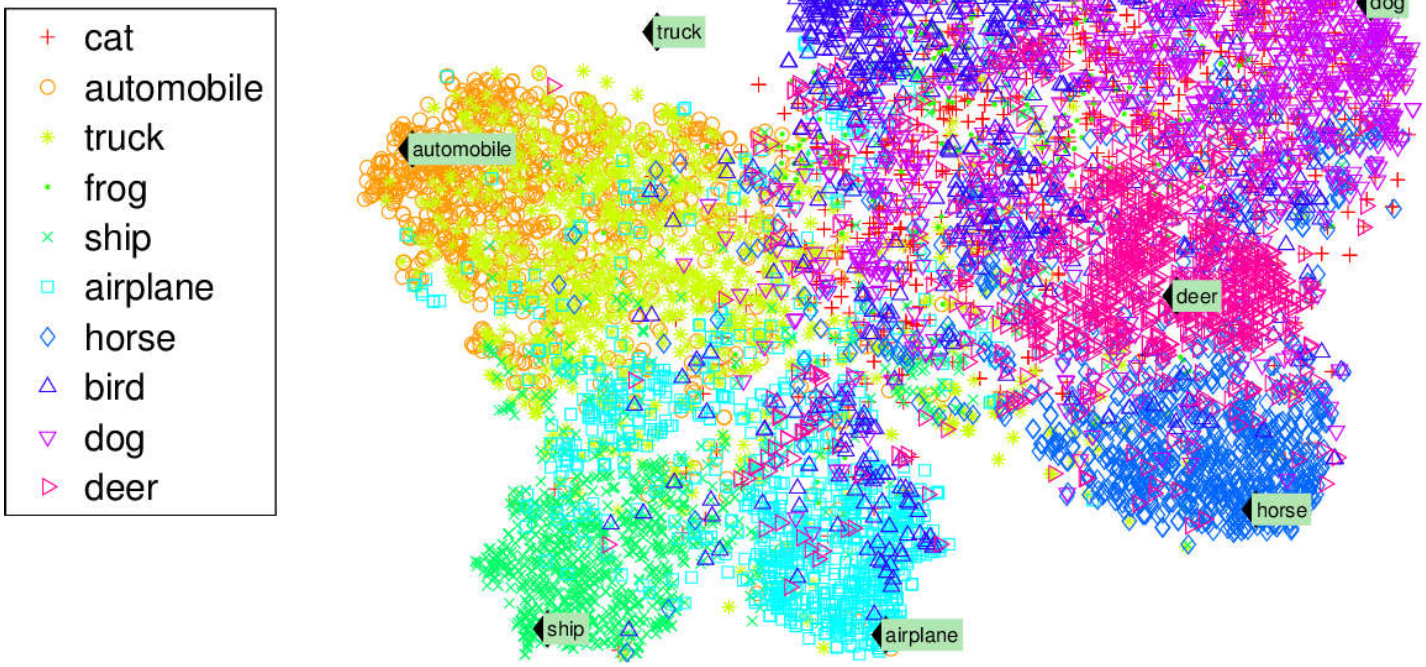
# Unsupervised learning



Types of Unsupervised Learning Algorithm:



# Unsupervised Learning

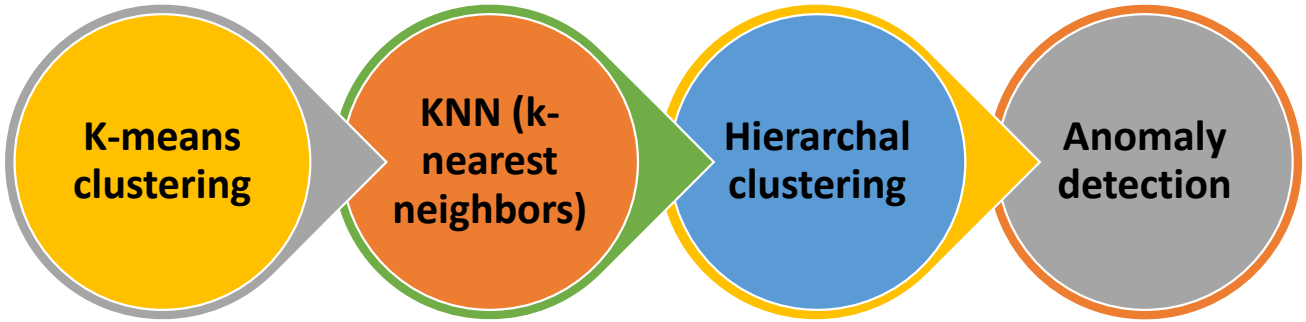


# Types of Unsupervised Learning Algorithm:

**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**: 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.

# Popular Unsupervised Algorithms



# Advantages of Unsupervised Learning

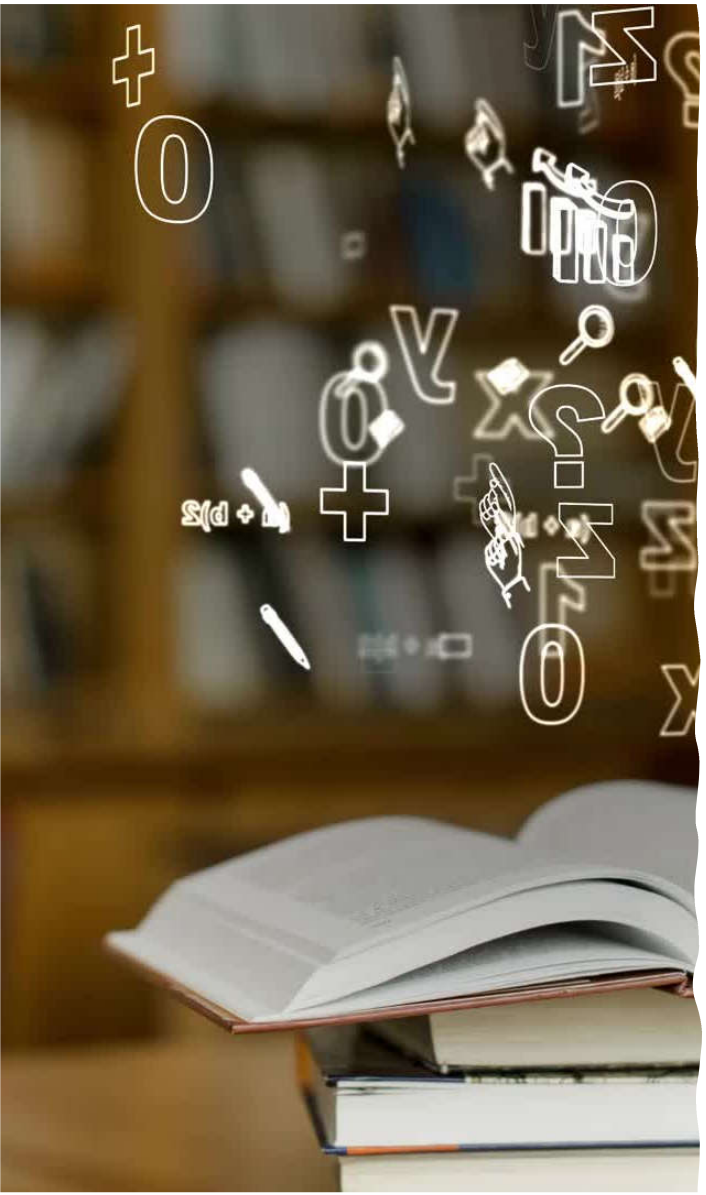
Unsupervised learning is used for more complex tasks as compared to supervised learning because, in unsupervised learning, we don't have labeled input data.

Unsupervised learning is preferable as it is easy to get unlabeled data in comparison to labeled data.

# Disadvantages of Unsupervised Learning

Unsupervised learning is intrinsically more difficult than supervised learning as it does not have corresponding output.

The result of the unsupervised learning algorithm might be less accurate as input data is not labeled, and algorithms do not know the exact output in advance.



# Learning, training

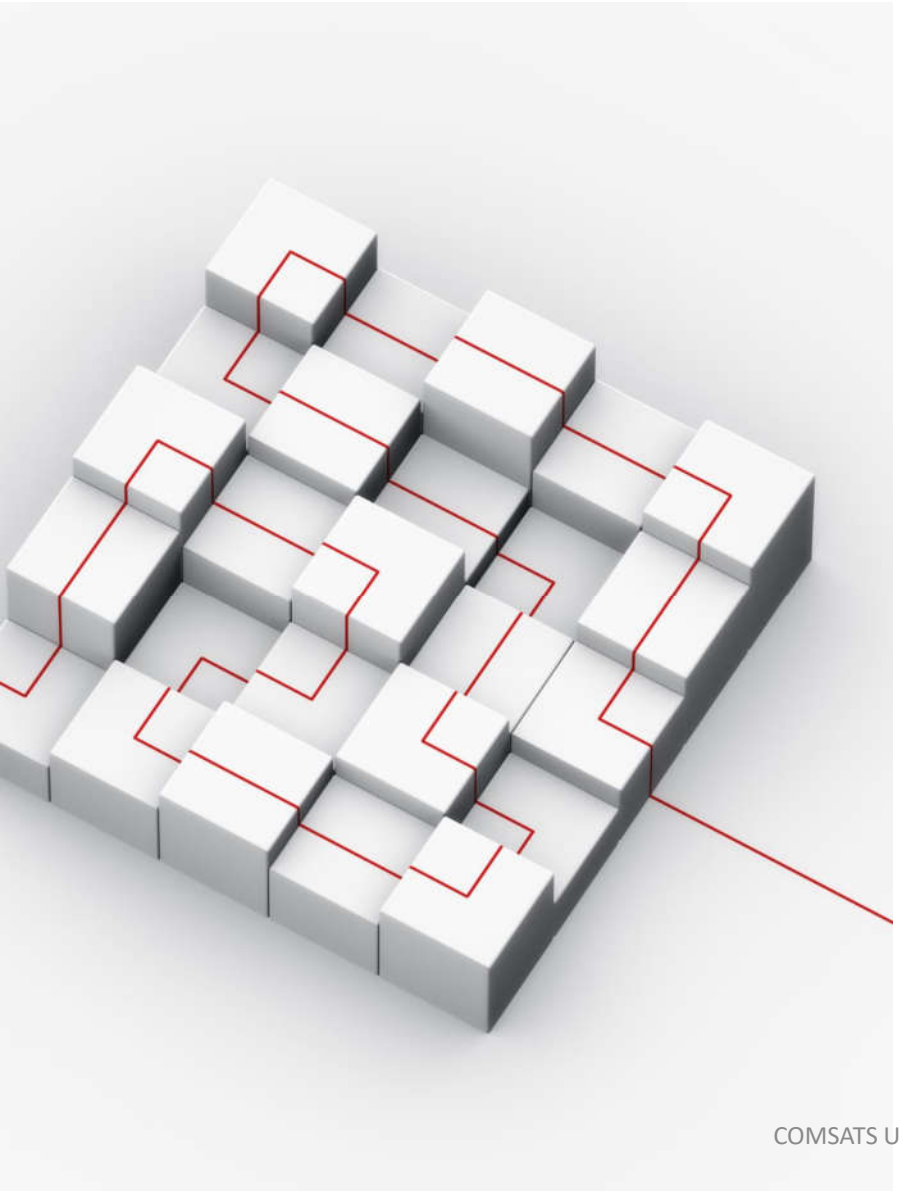
- It is the process in which the patterns of a data set are detected, that is the heart of machine learning. Once patterns are identified, predictions can be made with new data entered into the system.
- For example, historical data from book purchases on an online website can be used to analyze customer behavior in their purchasing processes (titles visited, categories, purchase history…), group them into behavioral patterns, and make purchase recommendations to new customers who follow known or learned patterns.

# Dataset

- It is the raw material of the prediction system. This is the historical data used to train the system that detects patterns. The dataset is composed of instances, and instances of factors, characteristics, or properties.

# Features

- In machine learning, features are individual independent variables that act like input in your system. Actually, while making the predictions, models use such features to make the predictions. Using the feature engineering process, new features can also be obtained from old features in machine learning.
- To understand in more simple way, lets take an example, where you can consider one column of your data set to be one feature which is also know as “variables or attributes” and the more number of features are known as dimensions. And depending on what you are trying to analyze the features you include in your dataset can vary widely.



# Model

- After training the system (that is, after detecting patterns in the data), a model is created to make predictions. We can assimilate a model to a filter in which new data are entered and whose output is the classification of that data according to the patterns that have been detected in training. For example, if a model with historical data is trained to detect the risk of credit card cancellation, the model will classify new customers based on their behavior to predict the cancellation.

# Reinforcement Learning

- *Reinforcement Learning* is a very different beast. The learning system, called an *agent* in this context, can observe the environment, select and perform actions, and get *rewards* in return (or *penalties* in the form of negative rewards. It must then learn by itself what is the best strategy, called a *policy*, to get the most reward over time. A policy defines what action the agent should choose when it is in a given situation.