

Artificial intelligence (AI) is the ability of a computer or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence and discernment.

What is artificial intelligence examples and explain?



A virtual assistant like Siri is an example of an AI that will access your contacts, identify the word “Mom,” and call the number. These assistants use NLP, ML, statistical analysis, and algorithmic execution to decide what you are asking for and try to get it for you.

Who is the father of AI?



John McCarthy

Unit – I Introduction to machine learning

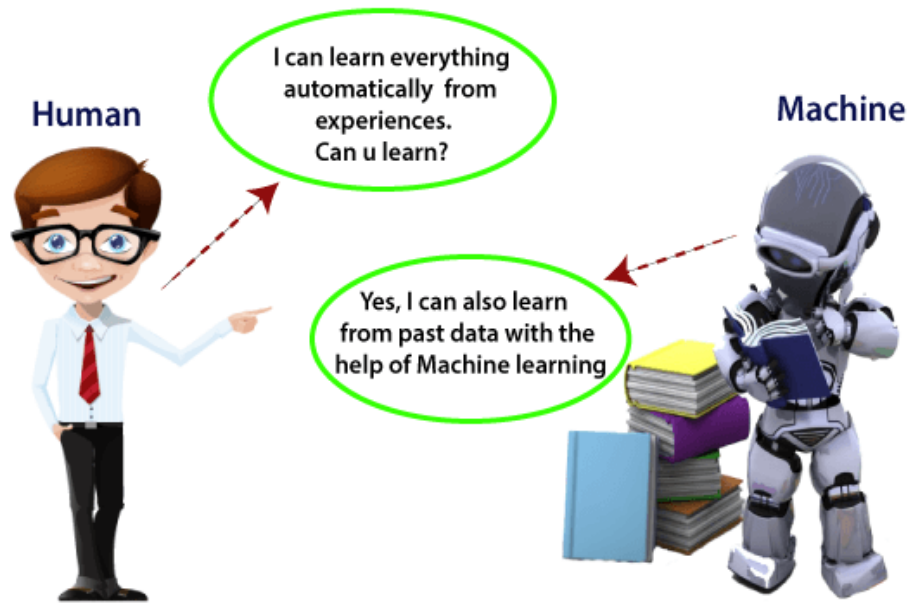
1.1 Describe basic concept of machine learning and its applications

Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for **building mathematical models and making predictions using historical data or information**. Currently, it is being used for various tasks such as **image recognition, speech recognition, email filtering, Facebook auto-tagging, recommender system**, and many more.

1.1.1 Overview of Human Learning and 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**.

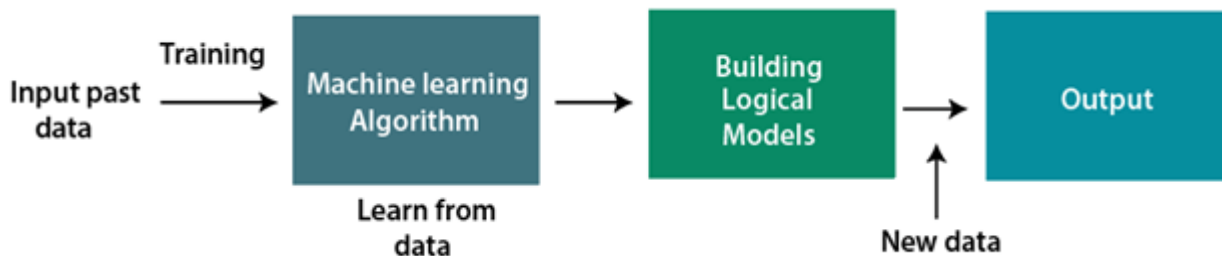
Machine Learning is said as a subset of **artificial intelligence** that is mainly concerned with the development of algorithms which allow a computer to learn from the data and past experiences on their own. The term machine learning was first introduced by **Arthur Samuel** in **1959**. We can define it in a summarized way as:



Definition:

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

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.



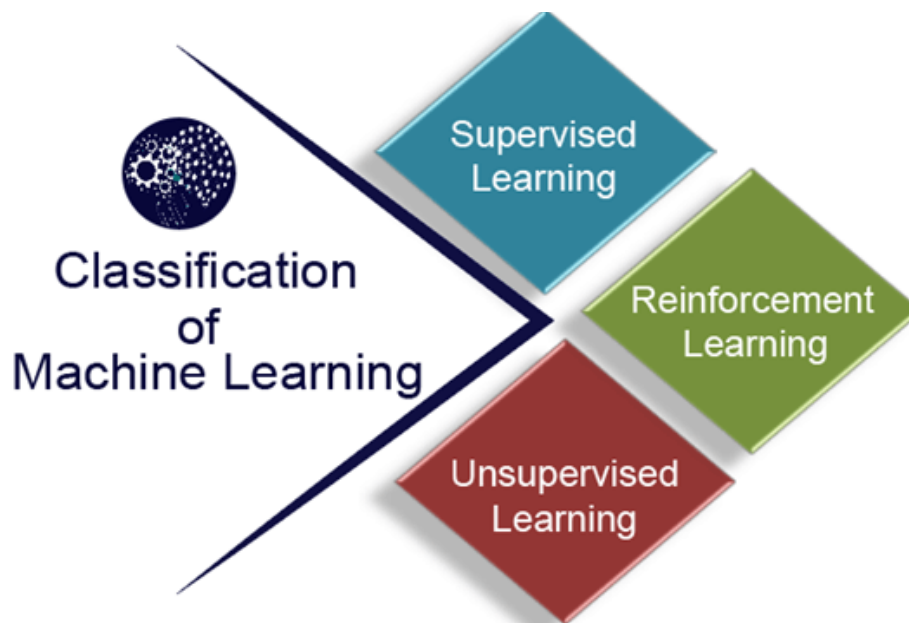
1.1.2 Types of Machine Learning

- Supervised Machine Learning
- Unsupervised Machine Learning
- Reinforcement Learning.

Classification of Machine Learning

At a broad level, machine learning can be classified into three types:

1. **Supervised learning**
2. **Unsupervised learning**
3. **Reinforcement learning**



Supervised learning is a type of machine learning method in which we provide sample labeled data to the machine learning system in order to train it, and on that basis, it predicts the output.

The system creates a model using labeled data to understand the datasets and learn about each data, once the training and processing are done then we test the model by providing a sample data to check whether it is predicting the exact output or not.

The goal of supervised learning is to map input data with the output data. The supervised learning is based on supervision, and it is the same as when a student learns things in the supervision of the teacher. The example of supervised learning is **spam filtering**.

Supervised learning can be grouped further in two categories of algorithms:

- **Classification**
- **Regression**

Unsupervised learning is a learning method in which a machine learns without any supervision.

The training is provided to the machine with the set of data that has not been labeled, classified, or categorized, and the algorithm needs to act on that data without any supervision. The goal of unsupervised learning is to restructure the input data into new features or a group of objects with similar patterns.

In unsupervised learning, we don't have a predetermined result. The machine tries to find useful insights from the huge amount of data. It can be further classified into two categories of algorithms:

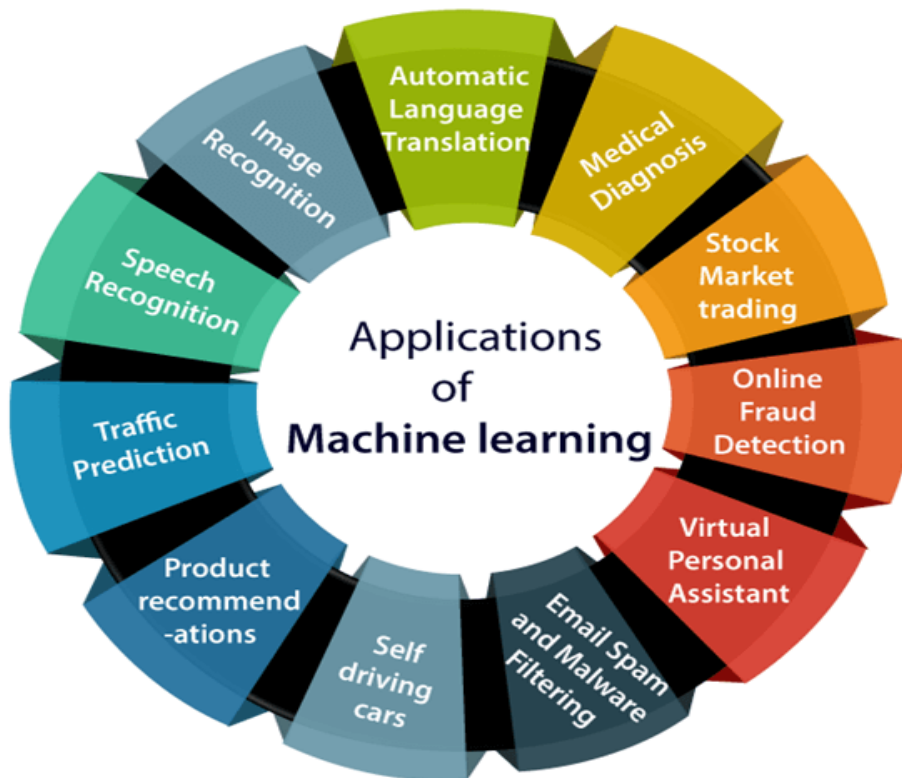
- **Clustering**
- **Association**

Reinforcement learning is a feedback-based learning method, in which a learning agent gets a reward for each right action and gets a penalty for each wrong action. The agent learns automatically with these feedbacks and improves its performance. In reinforcement learning, the agent interacts with the environment and explores it. The goal of an agent is to get the most reward points, and hence, it improves its performance.

The robotic dog, which automatically learns the movement of his arms, is an example of Reinforcement learning.

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



1. 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 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.

2. 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.

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.

Everyone who is using Google Map is helping this app to make it better. It takes information from the user and sends back to its database to improve the performance.

4. Product recommendations:

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.

As similar, when we use Netflix, we find some recommendations for entertainment series, movies, etc., and this is also done with the help of machine learning.

5. 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.

6. 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

Some machine learning algorithms such as **Multi-Layer Perceptron**, **Decision tree**, and **Naïve 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 instructions 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 assistant record our voice instructions, send it over the server on a cloud, and decode it using ML algorithms and act accordingly.

8. 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.

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 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.

11. 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.

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.

1.1.4 Tools and Technology for Machine Learning

Machine learning is one of the most revolutionary technologies that is making lives simpler. ***It is a subfield of Artificial Intelligence, which analyses the data, build the model, and make predictions.*** Due to its popularity and great applications, every tech enthusiast wants to learn and build new machine learning Apps. However, to build ML models, it is important to master machine learning tools. Mastering machine learning tools will enable you to play with the data, train your models, discover new methods, and create algorithms.

There are different tools, software, and platform available for machine learning, and also new software and tools are evolving day by day. Although there are many options and availability of Machine learning tools, choosing the best tool per your model is a challenging task. If you choose the right tool for your model, you can make it faster and more efficient. In this topic, we will discuss some popular and commonly used Machine learning tools and their features.



1. TensorFlow



TensorFlow is one of the most popular open-source libraries used to train and build both machine learning and deep learning models. It provides a JS library and was developed by **Google Brain Team**. It is much popular among machine learning enthusiasts, and they use it for building different ML applications. It offers a powerful library, tools, and resources for numerical computation, specifically for large scale machine learning and deep learning projects. It enables data scientists/ML developers to build and deploy machine learning applications efficiently. For training and building the ML models, TensorFlow provides a high-level Keras API, which lets users easily start with TensorFlow and machine learning.

Features:

Below are some top features:

- TensorFlow enables us to build and train our ML models easily.
- It also enables you to run the existing models using **the TensorFlow.js**
- It provides multiple abstraction levels that allow the user to select the correct resource as per the requirement.
- It helps in building a neural network.
- Provides support of distributed computing.
- While building a model, for more need of flexibility, it provides eager execution that enables immediate iteration and intuitive debugging.
- This is open-source software and highly flexible.
- It also enables the developers to perform numerical computations using data flow graphs.
- Run-on GPUs and CPUs, and also on various mobile computing platforms.
- It provides a functionality of auto diff (Automatically computing gradients is called automatic differentiation or auto diff).
- It enables to easily deploy and training the model in the cloud.
- It can be used in two ways, i.e., by installing through NPM or by script tags.
- It is free to use.

2. PyTorch



PyTorch is an open-source machine learning framework, which is based on **the Torch** library. This framework is free and open-source and developed by **FAIR(Facebook's AI Research lab)**. It is one of the popular ML frameworks, which can be used for various applications, including computer vision and natural language processing. PyTorch has Python and C++ interfaces; however, the Python interface is more interactive. Different deep learning software is made up on top of PyTorch, such as PyTorch Lightning, Hugging Face's Transformers, Tesla autopilot, etc.

It specifies a Tensor class containing an n-dimensional array that can perform tensor computations along with GPU support.

Features:

Below are some top features:

- It enables the developers to create neural networks using Autograd Module.
- It is more suitable for deep learning researches with good speed and flexibility.
- It can also be used on cloud platforms.
- It includes tutorial courses, various tools, and libraries.
- It also provides a dynamic computational graph that makes this library more popular.
- It allows changing the network behaviour randomly without any lag.
- It is easy to use due to its hybrid front-end.
- It is freely available.

3. Google Cloud ML Engine



While training a classifier with a huge amount of data, a computer system might not perform well. However, various machine learning or deep learning projects requires millions or billions of training datasets. Or the algorithm that is being used is taking a long time for execution. In such a case, one should go for the Google Cloud ML Engine. It is a

hosted platform where ML developers and data scientists build and run optimum quality machine, learning models. It provides a managed service that allows developers to easily create ML models with any type of data and of any size.

Features:

Below are the top features:

- Provides machine learning model training, building, deep learning and predictive modelling.
- The two services, namely, prediction and training, can be used independently or combinedly.
- It can be used by enterprises, i.e., for identifying clouds in a satellite image, responding faster to emails of customers.
- It can be widely used to train a complex model.

4. Amazon Machine Learning (AML)



Amazon provides a great number of machine learning tools, and one of them is **Amazon Machine Learning** or AML. Amazon Machine Learning (AML) is a cloud-based and robust machine learning software application, which is widely used for building machine learning models and making predictions. Moreover, it integrates data from multiple sources, including **Redshift, Amazon S3, or RDS**.

Features

Below are some top features:

- AML offers visualization tools and wizards.
- Enables the users to identify the patterns, build mathematical models, and make predictions.
- It provides support for three types of models, which are multi-class classification, binary classification, and regression.
- It permits users to import the model into or export the model out from Amazon Machine Learning.
- It also provides core concepts of machine learning, including ML models, Data sources, Evaluations, Real-time predictions and Batch predictions.
- It enables the user to retrieve predictions with the help of batch APIs for bulk requests or real-time APIs for individual requests.

5. NET



Accord.Net is .Net based Machine Learning framework, which is used for scientific computing. It is combined with audio and image processing libraries that are written in C#. This framework provides different libraries for various applications in ML, such as **Pattern Recognition, linear algebra, Statistical Data processing**. One popular package of the Accord.Net framework is **Accord. Statistics, Accord.Math, and Accord.MachineLearning**.

Features

Below are some top features:

- It contains 38+ kernel Functions.
- Consists of more than 40 non-parametric and parametric estimation of statistical distributions.
- Used for creating production-grade computer audition, computer vision, signal processing, and statistics apps.
- Contains more than 35 hypothesis tests that include two-way and one way ANOVA tests, non-parametric tests such as the Kolmogorov-Smirnov test and many more.

6. Apache Mahout

Apache Mahout is an open-source project of Apache Software Foundation, which is used for developing machine learning applications mainly focused on Linear Algebra. It is a distributed linear algebra framework and mathematically expressive Scala DSL, which enable the developers to promptly implement their own algorithms. It also provides Java/Scala libraries to perform Mathematical operations mainly based on linear algebra and statistics.

Features:

Below are some top features:

- It enables developers to implement machine learning techniques, including recommendation, clustering, and classification.
- It is an efficient framework for implementing scalable algorithms.
- It consists of matrix and vector libraries.
- It provides support for multiple distributed backends(including Apache Spark)
- It runs on top of Apache Hadoop using the MapReduce paradigm.

7. Shogun



Shogun is a free and open-source machine learning software library, which was created by **Gunnar Raetsch and Soeren Sonnenburg** in the year **1999**. This software library is written in C++ and supports interfaces for different languages such as Python, R, Scala, C#, Ruby, etc., using **SWIG**(Simplified Wrapper and Interface Generator). The main aim of Shogun is on different kernel-based algorithms such as Support Vector Machine (SVM), K-Means Clustering, etc., for regression and classification problems. It also provides the complete implementation of Hidden Markov Models.

Features:

Below are some top features:

- The main aim of Shogun is on different kernel-based algorithms such as Support Vector Machine (SVM), K-Means Clustering, etc., for regression and classification problems.
- It provides support for the use of pre-calculated kernels.
- It also offers to use a combined kernel using Multiple kernel Learning Functionality.
- This was initially designed for processing a huge dataset that consists of up to 10 million samples.
- It also enables users to work on interfaces on different programming languages such as Lua, Python, Java, C#, Octave, Ruby, MATLAB, and R.

8. Oryx2



It is a realization of the lambda architecture and built on **Apache Kafka** and **Apache Spark**. It is widely used for real-time large-scale machine learning projects. It is a framework for building apps, including end-to-end applications for filtering, packaged, regression, classification, and clustering. It is written in Java languages, including Apache Spark, Hadoop, Tomcat, Kafka, etc. The latest version of Oryx2 is Oryx 2.8.0.

Features:

Below are some top features:

- It has three tiers: specialization on top providing ML abstractions, generic lambda architecture tier, end-to-end implementation of the same standard ML algorithms.
- The original project of Oryx2 was Oryx1, and after some upgrades, Oryx2 was launched.
- It is well suited for large-scale real-time machine learning projects.
- It contains three layers which are arranged side-by-side, and these are named as Speed layer, batch layer, and serving layer.
- It also has a data transport layer that transfer data between different layers and receives input from external sources.

9. Apache Spark MLlib



Apache Spark MLlib is a scalable machine learning library that runs on Apache Mesos, Hadoop, Kubernetes, standalone, or in the cloud. Moreover, it can access data from different data sources. It is an open-source cluster-computing framework that offers an interface for complete clusters along with data parallelism and fault tolerance.

For optimized numerical processing of data, MLlib provides linear algebra packages such as Breeze and netlib-Java. It uses a query optimizer and physical execution engine for achieving high performance with both batch and streaming data.

Features

Below are some top features:

- MLlib contains various algorithms, including Classification, Regression, Clustering, recommendations, association rules, etc.
- It runs different platforms such as Hadoop, Apache Mesos, Kubernetes, standalone, or in the cloud against diverse data sources.
- It contains high-quality algorithms that provide great results and performance.
- It is easy to use as it provides interfaces in Java, Python, Scala, R, and SQL.

10. Google ML kit for Mobile



For Mobile app developers, Google brings ML Kit, which is packaged with the expertise of machine learning and technology to create more robust, optimized, and personalized apps. This tools kit can be used for face detection, text recognition, landmark detection, image labelling, and barcode scanning applications. One can also use it for working offline.

Features:

Below are some top features:

- The ML kit is optimized for mobile.
- It includes the advantages of different machine learning technologies.
- It provides easy-to-use APIs that enables powerful use cases in your mobile apps.
- It includes Vision API and Natural Language APIS to detect faces, text, and objects, and identify different languages & provide reply suggestions.

Features of Machine Learning:

- Machine learning uses data to detect various patterns in a given dataset.
- It can learn from past data and improve automatically.
- It is a data-driven technology.
- Machine learning is much similar to data mining as it also deals with the huge amount of the data.

Following are some key points which show the importance of Machine Learning:

- Rapid increment in the production of data
- Solving complex problems, which are difficult for a human
- Decision making in various sector including finance
- Finding hidden patterns and extracting useful information from data.

Key differences between Artificial Intelligence (AI) and Machine learning (ML):

Artificial Intelligence	Machine learning
Artificial intelligence is a technology which enables a machine to simulate human behavior.	Machine learning is a subset of AI which allows a machine to automatically learn from past data without programming explicitly.
The goal of AI is to make a smart computer system like humans to solve complex problems.	The goal of ML is to allow machines to learn from data so that they can give accurate output.
In AI, we make intelligent systems to perform any task like a human.	In ML, we teach machines with data to perform a particular task and give an accurate result.
Machine learning and deep learning are the two main subsets of AI.	Deep learning is a main subset of machine learning.
AI has a very wide range of scope.	Machine learning has a limited scope.
AI is working to create an intelligent system which can perform various complex tasks.	Machine learning is working to create machines that can perform only those specific tasks for which they are trained.
AI system is concerned about maximizing the chances of success.	Machine learning is mainly concerned about accuracy and patterns.
The main applications of AI are Siri, customer support using catboats , Expert System, Online game playing, intelligent humanoid robot, etc.	The main applications of machine learning are Online recommender system, Google search algorithms, Facebook auto friend tagging suggestions , etc.
On the basis of capabilities, AI can be divided into three types, which are, Weak AI, General AI , and Strong AI .	Machine learning can also be divided into mainly three types that are Supervised learning, Unsupervised learning , and Reinforcement learning .
It includes learning, reasoning, and self-correction.	It includes learning and self-correction when introduced with new data.
AI completely deals with Structured, semi-structured, and unstructured data.	Machine learning deals with Structured and semi-structured data.

	SUPERVISED LEARNING	UNSUPERVISED LEARNING
Input Data	Uses Known and Labeled Data as input	Uses Unknown Data as input
Computational Complexity	Less Computational Complexity	More Computational Complex
Real Time	Uses off-line analysis	Uses Real Time Analysis of Data
Number of Classes	Number of Classes are known	Number of Classes are not known
Accuracy of Results	Accurate and Reliable Results	Moderate Accurate and Reliable Results
Output data	Desired output is given.	Desired output is not given.
Model	In supervised learning it is not possible to learn larger and more complex models than with supervised learning	In unsupervised learning it is possible to learn larger and more complex models than with unsupervised learning
Training data	In supervised learning training data is used to infer model	In unsupervised learning training data is not used.
Another name	Supervised learning is also called classification.	Unsupervised learning is also called clustering.
Test of model	We can test our model.	We can not test our model.
Example	Optical Character Recognition	Find a face in an image.