Machine Learning Real-World Applications and Learning Techniques

G.Srinivas

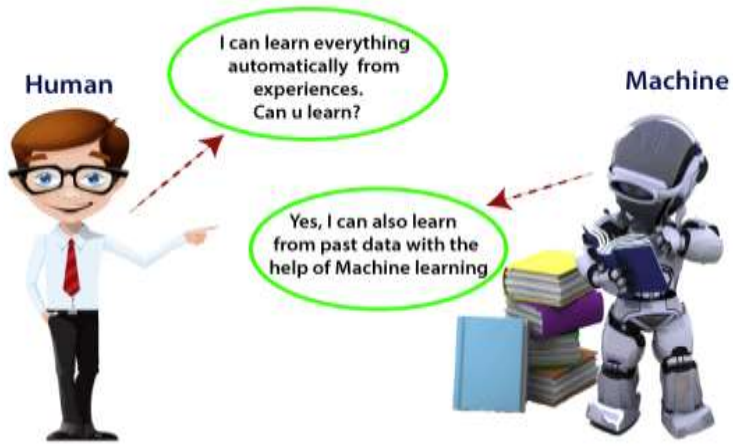
Associate Professor in Department of Computer Science

Nishitha Degree College (Autonomous), Accredited with "A" Grade by NAAC

Affliated to Telangana University, Nizamabad, Telangana State

Abstract:

Humans surround the real world, they can learn everything from their experiences with their learning capability and also we have computers, which work on our institutions, but can a computer also learn from experiences or past data like humans, so here comes the role of machine learning. Generally, the machines will not learn and think like humans i.e. they do not have IQ like the one we have; they just follow the instructions given by us. The Machine Learning is defined as enabling computers to learn things, which are not explicitly programmed to make successful predictions using previous experiences. It involves both mathematics and statistics to create models or algorithms. Many new high-impact applications of Machine Learning were discovered and brought to light, especially in healthcare, finance, speech recognition, autopilot cars, augmented reality, and more complex 3D and video applications. In this paper I have discussed what is machine learning and its types and how does machine learning works and the key elements of ML and I have also explained machine learning methods which are using today and its process, applications ,advantages, disadvantages. Overall, this paper aims to serve as a reference point for both academia and industry professionals as well as for decision-makers in various real-world situations and application areas, particularly from the technical point of view.



Keywords: Machine learning (ML), Types of Learning, Traditional Programming, ML models and algorithms.

Introduction to Machine Learning

In 1959, Arthur Samuel first used the term "Machine Learning". Machine learning is a field of computer science and subset of Artificial Intelligence that provides the systems the ability to learn and improve from experience without being explicitly programmed. Machine Learning focuses on the development of computer programs that can access data and use it learn for themselves. Machine Learning is the scientific study of algorithms and statistical models that computer systems use in order to perform a specific task efficiently without using explicit instructions, relays on patterns and inference instead. Machine learning algorithms build a mathematical model based on sample data, known as training data in order to make predictions or decisions without being explicitly programmed to perform the task. For 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. Machine learning and artificial intelligence share the same definition in the minds of many however; there are some distinct differences readers should recognize as well. In its application across business problems, machine learning is also referred to as predictive analytic.

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

It is currently being used for a variety of tasks, including auto-drive cars, speech recognition, email filtering, auto-tagging on Facebook, a recommended system, and image recognition.

Evolution of Machine Learning:

Today, machine learning is different from what it used to be in the past, due to the emergence of advanced computing technologies. Initially, it had gained momentum due to pattern recognition and the fact that computers did not have to be programmed to execute certain tasks to learn. Many researchers who were interested in Artificial Intelligence (AI) investigated this area further to find out whether computers could really learn from data or not. The focus here is on iterative learning. Machines begin to adapt to new data that they are exposed to, over a period. Based on the patterns and computations that are previously created, machines learn to repeat decisions made in the past, in similar situations. This aspect of machines ability to learn from the existing patterns, is now gaining huge momentum. Today, people are sitting up and taking notice of the fact that machines are now able to apply complicated mathematical calculations to areas, such as big data, at a much faster rate. Consider Google for instance, which is primarily built on the crux of machine learning. Another important use of machine learning can be found in regular recommendations that are rolled out by companies like Netflix and Amazon - an example of machine learning in everyday life. Next, ML can also be combined with linguistic rules creation.

Machine Learning is implemented by Twitter, where you will know what customers say about you and not to forget, machine learning is significantly being used to detect fraud in various industry sectors.

What is Machine Learning?

Machine learning (ML) is a branch of artificial intelligence (AI) focused on enabling computers and machines to imitate the way that humans learn, to perform tasks autonomously, and to improve their performance and accuracy through experience and exposure to more data.

Machine learning is the way to make programming scalable. The difference between Traditional Programming and Machine Learning is:

Traditional Programming: Data and program is run on the computer to produce the output.

Machine Learning: Data and output is run on the computer to create a program. This program can be used in traditional programming.

Machine learning is like farming or gardening. Seeds is the algorithms, nutrients is the data, the gardener is you and plants is the programs.

How does the machine learning works.

Machine Learning uses the model to train the computers how to learn from data and make predictions. Following steps explain how it works:

Relevant data is collected from various sources like databases, sensors and internet.

The data is cleaned and prepared for analysis

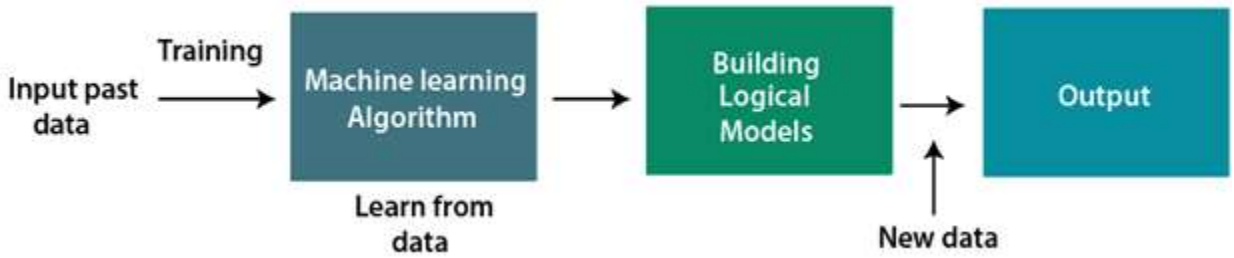
An algorithm or mathematical representation is trained to learn from the data and make predictions.

The model's performance is assessed to determine if it meets the desired criteria.

The model is put into use in real-world applications.

Machine learning models can use different algorithmic techniques and learning models, depending on the data and desired outcome.

The Machine Learning algorithm's operation is depicted in the following block diagram:



Why we need Machine Learning

The days are gone when programmers would tell a machine how to solve a problem at hand. We are in the era of machine learning where machines are left to solve problems, on their own, by identifying the patterns

in each data set. Analyzing hidden trends and patterns makes it easy to predict future problems and prevent them from occurring.

A machine learning algorithm usually follows a certain type of data and then uses the patterns hidden in that data to answer more questions. For example showing a computer a series of photographs, some of which say that "this is an apple" and some of which say, "This is not an apple." After this exercise, if we show some more photographs to the same computer, it will be on a mission to identify which of those photographs are of an apple and which of those are not that of a apple. Every correct and incorrect guess of the computer is added to its memory, which makes it smarter in the longer run and enriches its learning over a period

Machine Learning Methods, which we use today

Machine learning can be classified into three types:

1. Supervised learning
2. Un Supervised learning
3. Reinforcement learning

1. Supervised learning: It is defined as learning method which uses labeled datasets to train algorithms to classify data or predict outcomes accurately. Input data is fed into model, the model adjusts its weights until it has been fitted properly. It is nothing but a cross validation process to ensure that the model fits to well i.e. avoiding over fitting and under-fitting to predict well. Supervised learning helps many Organizations to solve Classification and Regression problems. Some methods used in supervised learning include neural networks, naive bays, linear regression, logistic regression, random forest, and support vector machine (SVM).

2. Unsupervised learning: It 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. We does not have a predetermined result. The machine tries to find useful insights from the huge amount of data. It can be further classifieds into two categories of algorithms:

1. Clustering
2. Association

Some methods used in Unsupervised learning include neural networks, k-means clustering, and probabilistic clustering methods.

3. Reinforcement learning

This is mainly used in navigation, robotics and gaming. Algorithms that use trial and error methods identify actions that yield the best rewards. There are three major components in reinforcement learning, namely, the agent, the actions and the environment.

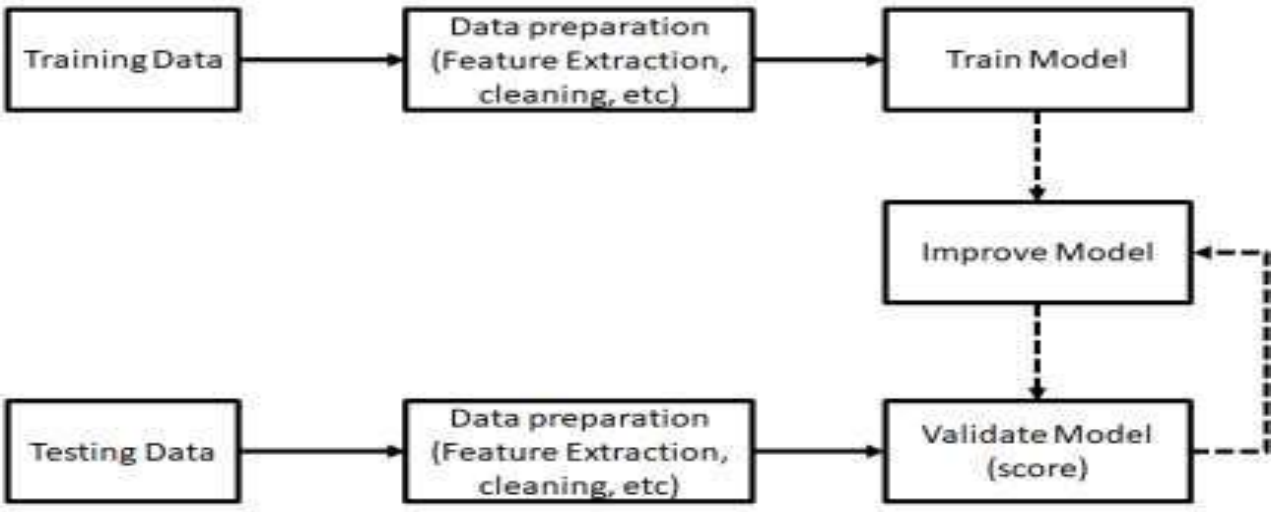
The agent in this case is the decision maker, the actions are what an agent does, and the environment is anything that an agent interacts with. The main aim in this kind of learning is to select the actions that maximize the reward, within a specified time. By following a good policy, the agent can achieve the goal faster. Hence, the primary idea of reinforcement learning is to identify the best policy or the method that helps businesses in achieving the goals faster. While humans can create a few good models in a week, machine learning is capable of developing thousands of such models in a week.

The Machine Learning process:

The machine learning process exist of a number of typical steps. These steps are:

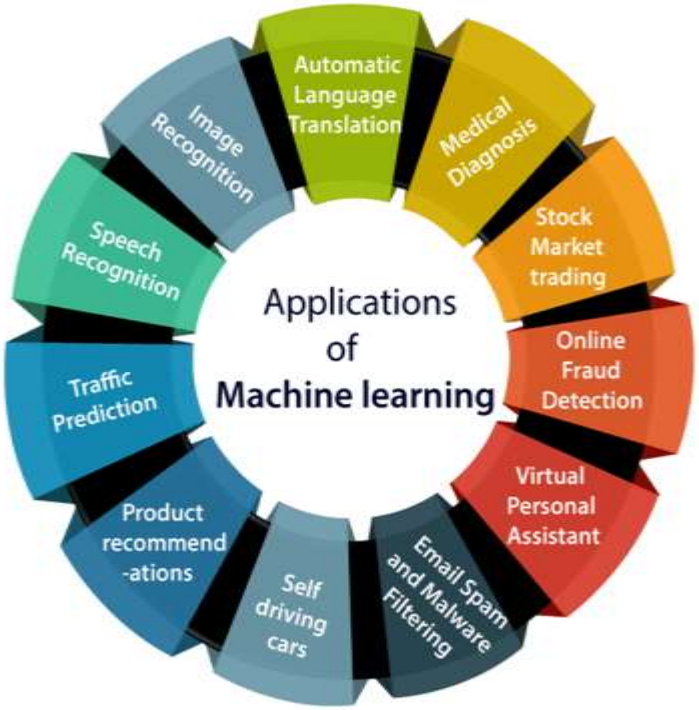
- We have to determine the problem we want to solve using machine learning technology
- Search and collect training data for our machine learning development process.
- Select a machine learning model
- Prepare the collected data to train the machine learning model
- We have to test our machine learning system using test data

Validate and improve the machine-learning model. Most of the time we will need to search for more training data within this iterative loop.



Applications of Machine Learning

We are using machine learning in our daily life even without knowing it such as Amazon, Google Maps, G mail, Google Assistant, Alexa etc. The most trending applications are shown in below figure:



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.

2. Speech Recognition

While using Google, we get an option of "Search by voice" it comes under speech recognition, and is a popular application of machine learning.

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 form Google Map app and sensor

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.

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. 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 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. Therefore, to detect this, Feed Forward Neural network helps us by checking whether it is a genuine transaction or a fraud transaction.

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 is 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.

The Best Machine Learning Language

To sum up, **Python** is arguably the best programming language for machine learning, as it is a general-purpose language that is suited for a variety of machine learning tasks. **R** is better suited for data analysis and statistical tasks as it is specifically designed for statistical computing.

Java and C are popular, established machine learning programming languages that are always good to know. **Mat lab** is great because it is rooted in mathematics. **SQL** is useful for querying large data sets. **Scala** is another general-purpose machine learning language that potentially has a lot to offer for aspiring machine learning engineers or anyone taking a machine-learning course.

Conclusion:

Machine Learning is a technique of training machines to perform the activities a human brain can do, a bit faster and better than an average human being is. Today we have seen that the machines can beat human champions in games such as Chess, Alpha GO, which are considered very complex. We have seen that machines can be trained to perform human activities in several areas and can aid humans in living better lives. Machine Learning

can be a Supervised or Unsupervised. If we have lesser amount of data and clearly labeled data for training, opt for Supervised Learning. Unsupervised Learning would generally give better performance and results for large data sets. If we have a huge data set easily available, go for deep learning techniques. We also have learned Reinforcement learning which helps to achieve the goals in business sector.

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