

Types of Machine Learning

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1. Abstract

Machine Learning can be briefly explained as a field that is enabling the computers in making such useful predictions using past experiences which has shown a huge progress and development with the help of the ever advancing computer systems with new and powerful processors, storage capacities and fast Internet. In this paper, I am going to present the basic theories, information and concepts of Machine Learning such as it's history, application of machine learning in the modern world, its various types, advantages and disadvantages, as well as various techniques of machine learning. Machine learning has one purpose which is to take a set of data and make predictions based on various patterns in the datasets to answer different important questions related to businesses, detect and analyse various trends as well as solve big problems.

“The rapid increase of information and

accessibility in recent years has activated a paradigm shift in algorithm design for artificial intelligence.

Recently, Deep Learning (a surrogate of Machine Learning) have won several contests in pattern recognition and machine learning.”[1]

Machine learning is basically a method of data analysis to automate the process of building data models so that we could program computers to enable them to “learn” from input which is available. Basically, Learning is the process of using experiences and converting them into knowledge. There are learning algorithms used that take training data as input and give output in the form of expertise which generally work like a computer program and perform important tasks.

Keywords: Machine Learning, Supervised Learning, Unsupervised Learning, Artificial Intelligence, Computer Science, Automation.

2. Introduction

“Machine learning is one of the fields in the modern computing world. A lot of research has been undertaken to make machines intelligent. Learning is a natural human behavior which has been made an essential aspect of the machines as well. There are various techniques devised for the same. Traditional machine learning algorithms have been applied in many application areas. Researchers have put many efforts to improve the accuracy of that machine learning algorithm. Another dimension was given thought which leads to deep learning concepts.”[2] The main motive is to take a set of observable quantities which are the inputs and another set of variables that are related to them which are the outputs and model a relationship amongst them. Using that mathematical model, the value of the desired variable could be predicted by measuring the input observables. But the problem is that most of the phenomena are just so complex that it is not easy to model the input and output relationship directly. Machine learning is a very important subfield of computer science and is also often called predictive analytics/modeling.

There are a huge variety of applications of machine learning algorithms such as e-mail

filtering and computer vision where to perform the needed task is difficult as the development of conventional algorithms are infeasible. There are various fields of studies which are closely related to machine learning such as Data Mining which works on data analysis by using unsupervised learning. A vital part of machine learning involves the computers discovering how to complete any given task without the help of a user. Whenever any simple task is handed to the computer, the user easily programs an algorithm to execute all the steps needed to solve the problem without any learning. But, whenever any advanced task is given to the computer, the user can find it somewhat difficult to manually create the algorithm needed to solve the problem. So, the more effective solution is to enable the machine to learn and develop algorithms itself rather than taking help of a user everytime any task is handed over to the computer. Machine learning has a lot of methods which can help the computer to learn how to complete tasks without the requirement of a pre existing fully satisfactory algorithm. One of the methods is to create a training data that consists of a number of labelled correct answers which the machine can utilize and learn to improve its algorithms to determine correct ways to complete the given task and find the right answers by itself.

In today's world, machine learning is used in most sectors to gain intelligent insights as well as to automate time and energy consuming tasks. Most of the modern technology driven devices utilize the benefits of machine learning such as Fitbit fitness trackers, Google Home, Alexa etc. Few of the examples of areas where machine learning is used are mentioned and explained as follows:

- Prediction - There are many sectors which use machine learning and its applications to get useful predictions. For example, Banks often use it to classify the data available in certain groups.
- Image Recognition - There are several mobile phones, laptops, Tablets and various other electronic devices which use machine learning for face detection for security purposes.
- Speech Recognition - Machine learning is also used in speech recognition for voice searches, voice dialing, call routing as well as appliance control.
- Medical diagnosis - Machine learning is also being used to treat and recognize cancerous tissues.
- Financial Industries - Machine learning is used by various financial trading companies for fraud detection and credit checks.

2.1 History of Machine Learning

In 1943, a neurophysiologist named Warren McCulloch and a mathematician Walter Pitts together wrote about neurons and how they worked together in their paper. They also created a model of neural networks by using an electric circuit and that is how the idea of neural networks came to life.

Then in 1950, a mathematician named Alan Turing created the famous Turing Test. In this test the computer had to convince a human that it was not a computer but a human being to pass the given test.

In 1952, an American pioneer Arthur Samuel created the very first computer program which could learn and play a game of checkers.

In 1958, a psychologist named Frank Rosenblatt created the very first artificial neural network which he called the Perceptron which used to recognize shapes and patterns.

In 1959, Bernard Widrow and Marcian Hoff created two models of neural networks at Stanford University. The name of the first model was Adeline which could detect binary patterns in a stream of bits and could predict the next binary digit. The second model was called Madeline which could clear echoes present in phone lines which is still being used today.

In 1982, the Neural network started getting attention again when John Hopfield created a network with bidirectional lines, which had similarities with the actual neurons in the way it worked.

In 1986, three researchers from Stanford University were working on an algorithm created by Widrow and Hoff in 1962 which allowed the neural networks to use multiple layers which are known as 'slow learners'.

Then in 1997, a computer designed by the company IBM which was called Deep Blue defeated the World's Chess champion in the game of chess.

In 1998, AT&T Bell Laboratories presented research on digital recognition which resulted in having good accuracy in detecting handwritten postcodes by using back-propagation technique.

2.2 Machine Learning in the modern world

In the 21st Century, machine learning has gained a lot of popularity in the business world and many more researches are being done on the field by various big companies. Some of the most popular projects are mentioned as follows:

- GoogleBrain - In 2012, a deep neural network that focused on detecting patterns in videos as well as images was created by Jedd Dean of Google. It used Google's resources and

was later used for detection of objects in Youtube videos.

- AlexNet - In 2012, AlexNet won the ImageNet competition. It made way for machine learning to use GPUs and Neural Networks. They also created an activation function called ReLU.

- DeepFace - In 2014, Facebook created a deep Neural Network called DeepFace which could recognize people's faces as perfectly as a human being.

- DeepMind - In 2014, Google bought a company called DeepMind which created a software that could play basic video games like a human being. The software DeepMind defeated a professional human player in a game called game Co, which is the most difficult board game.

- OpenAI - In 2015, the CEO of SpaceX and Tesla created a non-profitable organization to work on a safe artificial intelligence.

- Amazon Machine Learning Platform - in 2015, Amazon created this machine learning platform which is used to drive their internal systems and is also used in Alexa, Prime Air and Amazon Go.

- U-net - In 2015, the company CNN created U-net biomedical image segmentation which introduced upsampling, downsampling and skip connections.

2.3 Types of Machine Learning

Before explaining the types of machine learning i should explain the types of data which are used in machine learning. There are two types of data which are labelled and unlabelled data.

Labelled data is a dataset which has been labelled by a human for the machine to understand which has input and output parameters in a machine-readable format/pattern. Whereas, the unlabelled data is a dataset which is not labelled by a human but only has either one or none of the parameters and also requires more complex solutions to be worked with.

Now coming to the types of machine learning, there are mainly three types of machine Learning which are mentioned as follows:

- **Supervised Machine Learning** - In supervised machine learning we divide the whole dataset in two parts of training dataset and testing dataset. The training dataset is just a small part of the whole dataset which is then labelled by the user so that the machine could get an idea of the problem it is working with. Then the machine designs an algorithm based on the knowledge gained from the training dataset which it then applies to the final dataset. Supervised machine learning keeps on improving itself by working on the data and finding new patterns and relationships.

- **Unsupervised Machine Learning** - In unsupervised learning there is no need for a human being to provide a labelled training dataset to the machine. Here, the machine figures out hidden structures, patterns and relationships between the data points in an abstract manner without any input from the user. Unsupervised learning algorithms adapt to the data by dynamically changing hidden structures.

- **Reinforcement Learning** - Reinforcement Learning enables the machine to work exactly the way the human brain works by featuring an ever improving algorithm that keeps on learning by using trial-and-error method. In reinforcement learning the machines apply the algorithms in a work environment with a reward system. Whenever the outcome is favourable the machine is rewarded by the interpreter and whenever the outcome is not favourable the machine has to reiterate forcefully until it finds the favourable outcome.

2.4 Advantages of Machine Learning

There are various advantages of Machine Learning and a few of them are mentioned as follows:-

- Machine Learning can easily identify

patterns and trends which are not apparent to humans.

- Machine Learning is used in Automation of tasks which are time and energy consuming such as spam filtering, identifying bugs and viruses in a software etc.
- Machine Learning uses algorithms which are ever improving and gets better as they gain experience and work on more data which makes it very good to be used in fields like weather forecasting.
- Machine Learning is gaining more and more popularity in a lot of sectors and fields such as Defence, GPS Tracking, Email spam filtering, spell check, future predictions, education etc.
- Machine learning uses a massive amount of information and data from unlimited sources to improve itself and gain more and more accuracy.

2.5 Disadvantages of Machine Learning

There a lot of disadvantages to machine learning as well and some of them are explained as follows:

- Machine learning uses a lot of unlabelled and uncleaned data from various known and unknown sources which might contain incorrect data which makes it difficult to maintain good accuracy of machine learning models.
- Machine learning is highly error-prone as it encounters a lot of garbage as well as improper

data while accessing data from various sources which might enable the machine to produce incorrect results.

- Machine Learning uses different algorithms for different problems. So, it gets very difficult for the user to run different models and algorithms and then identify the most accurate model based on the outcome.
- Machine learning can be very time consuming as it makes the machine process a massive amount of data and information which sometimes also leads to the requirement of additional resources for computation.
- Machine learning is an ever improving and evolving field which forces machine learning engineers to stay updated with the latest technological updates, researches etc.

3. Conclusion

“Machine learning is used to teach machines how to handle the data more efficiently. Sometimes after viewing the data, we cannot interpret the pattern or extract information from the data. In this case, we apply machine learning. With the abundance of datasets available, the demand for machine learning is in rise. Many industries from medicine to military apply machine learning to extract relevant information”[3]. Basically, Machine learning is a method of improving the

abilities of computers to learn faster and in a better way so that they could perform various tasks that a human being performs and also in a better and faster way. Today's computers are better than an average human being in a lot of fields which are very complex for an average human.

Machine Learning uses two types of data which are labelled and unlabelled data and it uses algorithms to figure out patterns and relationships amongst the data points in the datasets. There are three main types of machine learning which are Supervised machine learning, Unsupervised machine learning and Reinforcement machine learning. Machine learning is gaining popularity in many fields and is performing various tasks for us such as helping in taking business decisions, predicting future events, spam filtering, image and speech recognition etc.

4. Future Scope

In the 21st Century, Machine Learning is gaining a lot of popularity and is becoming one of the most viable career options for the students of computer science, mathematics and many others. Machine learning is also seeming to be making a big impact on the world of automation, computer

science, business etc.

When there was no machine learning, people had it very difficult in making important decisions in the business world. They used to spend a massive amount of energy and time on analysing the seasonality and trends in the markets. Machine learning has changed it all by making it accessible to every individual with the help of the latest electronic devices such as mobile phones, laptops etc.

Machine learning has also affected other sectors such as banking, information technology, media, entertainment, gaming, automotive etc. Specially in the automotive sector various big multinational companies such as Google, Tesla, Mercedes Benz, Nissan, etc are using machine learning to build cars with sensors, cameras, voice recognition systems and also cars which could drive on its own.

The field of Robotics has also gained a lot from the improvement of machine learning which has enabled them to create smarter and self learning robots such as the AI robot, Sophia. Machine Learning and Artificial intelligence together has helped change the world and has helped humanity in achieving great goals.

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