An overview of Machine Learning

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Abstract— **Machine learning is one of the applications of artificial intelligence which is aimed at giving the capability of think and learn to machines just like human beings. Machines learning include various types of computer programs and algorithms which help machines to understand the surrounding environment by capturing data through sensors. Computer algorithms decipher the data captured by sensors and convert them into relevant information. Machine learning is aimed at minimizing human intervention. It is also focused on making the computer programs to understand the data and use the information to learn and improvise on their own to take decisions. Machine Learning is the term refers to the ability of IT systems to independently find solutions to problems by recognizing patterns in databases. In other words: Machine Learning enables IT systems to recognize patterns on the basis of existing algorithms and data sets and to develop adequate solution concepts. Therefore, in Machine Learning, artificial knowledge is generated on the basis of experience.**
This paper gives an overview of Machine Learning, types of machine learning, how ML works, and its applications.
Keywords— **Machine learning, IT system, Artificial Intelligence, computer programs.**

I. INTRODUCTION

Consider a scenario for online shopping, while checking for a product, did you notice when it recommends for a product similar to what you are looking for? or did you noticed "the person bought this product also bought this" combination of products. How are they doing this recommendation? This is machine learning. Consider another scenario of that we get a call from any bank or finance company asking to take a loan or an insurance policy. What do you think, do they call everyone? No, they call only a few selected customers who they think will purchase their product. How do they select? This is target marketing and can be applied using Clustering. This is machine learning. Machine Learning is a subset of artificial intelligence which focuses mainly on machine learning from their experience and making predictions based on its experience.[3]

Machines calculate and produce output results based on input data entered mostly through manual interventions. Researchers and scientists are working towards machine learning and developing the capability of artificial intelligence which includes decision making through prescriptive and predictive data analytics and also human like learning capability through vision, feel, bimetallism (i.e., ability to balance and walk on two legs just like humans), understand the surrounding environment and make decisions on their own. Machine Learning works in a similar way to human learning. For example, if a child is shown images with specific objects on them, they can learn to identify and differentiate between them. Machine learning works in the same way: Through data input and certain commands, the computer is enabled to "learn" to identify certain objects (persons, objects, etc.) and to distinguish between them. For this purpose, the software is supplied with data and trained. For instance, the programmer can tell the system that a particular object is an apple i.e. ="apple" and another object is not an apple i.e. ="no apple". The software receives continuous feedback from the programmer. These feedback signals

are used by the algorithm to adapt and optimize the model. With each new data set fed into the system, the model is further optimized so that it can clearly distinguish between "apple" and "non-apple" in the end.[2]

II. TYPES OF MACHINE LEARNING

Basically, machine learning algorithms play an important role. These algorithms are responsible for recognizing patterns and they can generate solutions. Algorithms can be divided into different categories as follows:
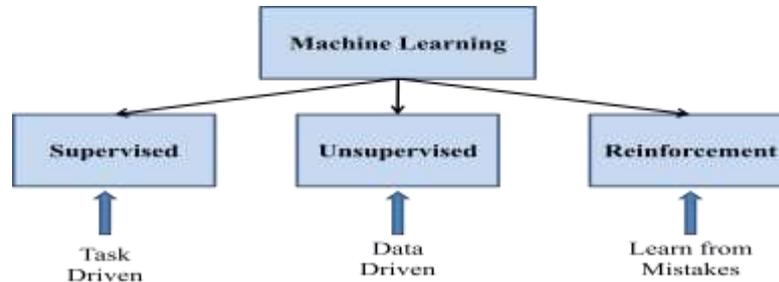

Figure1. Types of Machine Learning

A)   Supervised learning: Supervised learning is task driven activity. It predicts the next value. The system learns on the basis of given input and output pairs. Supervised learning is the most popular paradigm for machine learning. It is the easiest to understand and the simplest to implement. It is very similar to teaching a child with the use of flash cards. Given data is in the form of labelled data. Supervised learning is often described as task-oriented. It is highly focused on a singular task, feeding more and more examples to the algorithm until it can accurately perform on that task. This is the learning type that we will most likely encounter, as it is exhibited in many applications. Most common example is using Facebook. Machine learning model is   trained to recognize persons face. Having a system that takes a photo, finds faces, and guesses who that is in the photo (suggesting a tag) is a supervised process. It has multiple layers to it, finding faces and then identifying them.[4]

B)   Unsupervised learning: Unsupervised learning is exactly opposite to supervised learning. IT identifies the clusters. Unsupervised learning is based upon the data and its properties hence called data driven activity. It does not provide the labels. Instead, lot of data are given to algorithm and the tools are provided to understand the properties of the data. Algorithm itself can learn to group, cluster, and/or organize the data in a way such that a human can come in and make sense of the newly organized data. In unsupervised learning, artificial intelligence learns without predefined target values and without rewards. It is mainly used for learning segmentation i.e. clustering. The machine tries to structure and sort the data entered according to certain characteristics. For example, a machine could learn that coins of different colours can be sorted according to the characteristic "colour" in order to structure them.[4]

C)   Reinforcement learning: Reinforcement learning is quite deferent than supervised and unsupervised learning. It is known as behaviour driven activity. Reinforcement learning means learning from mistakes. It is employed by various software and machines to find the best possible behaviour or path it should take in a specific situation. In reinforcement learning, there is no answer but the reinforcement agent decides what to do to perform the given task. In the absence of training dataset, it is bound to learn from its experience. Some important points in Reinforcement learning are input, output, and training, learning continuously, and finding best solution. Model starts with initial input state. Output is depends on variety of solution. The training is based upon the input. The model will return a state and the user will decide to reward or punish the model based on its output. The model keeps continues to learn. The best solution is decided based on the maximum reward. Reinforcement learning is making decisions sequentially. That means the output depends on the state of the current input and the next input depends on the output of the previous input. i.e. decision is dependent, So labels are given to sequences of dependent decisions. In any reinforcement learning problem, there is a need of an agent and an environment as well as a way to connect the two through a feedback loop. To connect the agent to the environment, we need to give it a set of actions. To connect the environment to the agent, two signals are required to the agent: an updated state and a reward (our reinforcement signal for behaviour). It is used in robotics for industrial automation, machine learning and data processing, to create training systems that provide custom instruction and materials according to the requirement of students.[4]

III. HOW MACHINE LEARNING WORKS?

Let's see how machine learning works, the goal of machine learning is to create model and model is created by process called training. The goal of training is to create accurate model to answer the questions correctly. In order to train the data we need to collect the data and so many steps are required. In this section we learn how machine learning works using 7 steps. Following are the 7 steps of ML:

A)   *Data gathering:* This step is very important. Quality and quantity of data directly determine how predictive model can be?

B)   *Data preparation:* In next step all collected data is loaded and prepare to use for machine learning training. For data preparation we need to put all data together and then need to randomize the ordering. Data is splits into two parts, first part is use in training model and second part is use for evaluation. Different data is us for training and evaluation. Sometimes data we collected need other form of manipulations like normalization, error correction etc. This is all about data preparation.

C)   *Choosing a Model:* Researchers and data scientist has created many models. These models works on image data, sequence data, numerical data, and text data.

D)   *Training:* In this step data is used to incrementally improve the model ability to predict result. For example car driver at first time he doesn't know how to drive a car? Also don't know how clutch, breaks, switches works? But after lots of practice and mistakes he learn properly an after a years of driving he become a perfect driver. Machine learning model also train the model.

E)   *Evaluation:* Once the training complete we need to check model is good. So next step is evaluation. Evaluation allows test the model against data that are never being used.

F)   *Parameter Tuning:* once the evaluation is done we need to check further improvement in model hence parameter tuning is required. This is done by tuning some of the parameters. How many times we tune the training set from this we got higher accuracy.

G)   *Prediction:* Once we done with tunning next step is prediction. In prediction after so many iteration models predict proper result.[1]

From above steps it is clear that Machine learning utilizes a variety of techniques to intelligently handle large and complex amounts of information to make decisions and predictions. Following figure explain the working of machine learning.

Figure2. Working of Machine Learning

Machine Learning algorithm is trained using a training data set to create a model. When new input data is introduced to the ML algorithm, it makes a prediction on the basis of the model. The prediction is evaluated for accuracy and if the accuracy is acceptable, the Machine Learning algorithm is deployed. If the accuracy is not

acceptable, the Machine Learning algorithm is trained again and again with an augmented training data set. Many factors and steps are involved in ML process.

IV. MACHINE LEARNING APPLICATIONS

Machine Learning use in many domains. It is use as Virtual personal assistant, Image recognition, Email spam filtering, video recommendation system, Traffic prediction, Advertise recommendation, Online fraud detection, Stock marketing, Healthcare, Language translation and many more. Today, many companies are using Machine Learning to improve business decisions, increase productivity, detect disease, forecast weather, and do many more things. Let's see use of ML in above area.

A)   Virtual personal assistant: The popular examples of virtual personal assistants are Siri, Alexa, Google. They assist in finding information, when asked by anyone. Only we need to activate them and ask various questions. Machine learning is an important part of these personal assistants as they collect and refine the information on the basis of previous/past data. Later, this set of data is utilized to render results that are tailored to your preferences. Virtual Assistants are integrated to a variety of platforms. For example Smart Speakers like Amazon Echo and Google Home, Smartphones like Samsung Bixby on Samsung S8, and Mobile Apps like Google Allo.[5]

B)   Email spam filtering: Gmail or Hotmail classify the mails and moving the spam mails to spam folder. This is again achieved by a spam classifier running in the back end of mail application. Email spam filtering is one of the important applications of ML.

C)   Healthcare: ML is becoming a fast-growing trend in healthcare. Now a day's wearable sensors and devices are use to access health of a patient in real time. Sensors provide real-time patient information, such as overall health condition, heartbeat, blood pressure and other vital parameters. Doctors and medical experts can use this information to analyze the health condition of an individual, draw a pattern from the patient history, and predict the occurrence of any decease in the future. The technology also empowers medical experts to analyze data to identify trends that facilitate better diagnoses and treatment.

D)   IoT APPLICATIONS USING ML: Mohamed I. AlHajri, Nazar T. Ali, and Raed M. Shubair developed a machine learning approach for indoor environment classification based on real-time measurements of the RF signal. Several machine learning classification methods were studied including Decision Tree, Support Vector Machine, and k-Nearest Neighbour using different RF features. Results show that a machine learning approach using weighted k-NN method, utilizing CTF and FCF, outperforms the other methods in identifying the type of the indoor environment with a classification accuracy of 99.3%. The predication time was found to be below10μs, which verifies that the adopted algorithm is a successful candidate for real-time deployment scenarios. The results facilitate an efficient deployment of IoT applications in dynamic channels. Authors presents the methodology and highlight the benefits of using machine learning as a novel approach and a versatile tool for indoor environment classification.[7]

E)   Product recommendation: we all purchase items from Amazon. Suppose you check an item on Amazon, but you do not buy it. But the on next day, you're watching videos on YouTube and suddenly you see an advertisement for the same item. If you switch to Facebook, there also you see the same advertisement. This is happens because Google tracks your search history, and recommends ads based on your search history. This is one of the coolest applications of Machine Learning. In fact, 35% of Amazon's revenue is generated by Product Recommendations.

V. CONCLUSION

ML is a buzzword in the technology world right now and for good reason, it represents a major step forward in how computers can learn. Machines calculate and produce output results based on input data entered mostly through manual interventions. Researchers and data scientists are working towards machine learning and developing the capability of artificial intelligence which includes decision making through prescriptive and predictive data analytics and also human like learning capability through vision, feel, bimetallism, understand the surrounding environment and make decisions on their own. Machine Learning works in a similar way to human learning. In this review paper we have explain importance of Machine learning, types of machine learning like supervised, unsupervised and reinforcement. This paper shoes how ML works and applications of ML in various fields.

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