Machine Learning

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Abstract— . This paper is aim to convey the basic idea about 'what is machine learning'. Machine learning is a branch of study now a days. But the fact is still it is difficult to understand the students We know humans learns from their past experiences and machines follow instructions given by humans. But what if humans can train the machines to learn from the past data, that's called machine learning. Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically 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. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly. Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.

This paper give the basic concept of machine learning, how ML is working, different methods of machine learning, Applications of machine learning and how it can be related to our day to day life.

Keywords-Machine learning(ML),data,Artificial Intelligence(AI), cognitive technologies,

INTRODUCTION

Machine learning is one of the most exciting technologies that one would have ever come across. As it is evident from the name, it gives the computer that which makes it more similar to humans: The ability to learn. Machine learning is actively being used today, perhaps in many more places than one would expect[4]. We probably use a learning algorithm dozens of time without even knowing it. Arthur Samuel, a pioneer in the field of artificial intelligence and computer gaming, coined the term "Machine Learning". He defined machine learning as –"Field of study that gives computers the capability to learn without being explicitly programmed". In a very layman manner, Machine Learning(ML) can be explained as automating and improving the learning process of computers based on their experiences without being actually programmed i.e. without any human assistance. The process starts with feeding good quality data and then training our machines(computers) by building machine learning models using the data and different algorithms. The choice of algorithms depends on what type of data do we have and what kind of task we are trying to automate.

Today, companies are using Machine Learning to improve business decisions,increase productivity, detect disease, forecast weather, and do many more things[1]. With the exponential growth of technology, we not only need better tools to understand the data we currently have, but we also need to prepare ourselves for the data we will have. To achieve this goal we need to build intelligent machines. We can write a program to do simple things. But for most of times Hardwiring Intelligence in it is difficult. Best way to do it is to have some way for machines to learn things themselves. A mechanism for learning – if a machine can learn from input then it does the hard work for us., although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

Key Elements of Machine Learning

There are tens of thousands of machine learning algorithms and hundreds of new algorithms are developed every year. Every machine learning algorithm has three components are(*figure1*) reprentation,evalution,optimisation.

figure1:key elements of ML

- ***Representation****:* how to represent knowledge. Examples include decision trees, sets of rules, instances, graphical models, neural networks, support vector machines, model ensembles and others.
- ***Evaluation****:* the way to evaluate candidate programs (hypotheses). Examples include accuracy, prediction and recall, squared error, likelihood, posterior probability, cost, margin, entropy k-L divergence and others.
- ***Optimization****:* the way candidate programs are generated known as the search process. For example combinatorial optimization, convex optimization, constrained optimization.

All machine learning algorithms are combinations of these three components. A framework for understanding all algorithms.

Basic Difference in ML and Traditional Programming

- **Traditional Programming :** We feed in DATA (Input) + PROGRAM (logic), run it on machine and get output.
- **Machine Learning :** We feed in DATA(Input) + Output, run it on machine during training and the machine creates its own program(logic), which can be evaluated while testing

figure 2:difference between traditional programming &ML

What does exactly learning means for a computer

A computer is said to be learning from **Experiences** with respect to some class of **Tasks**, if its performance in a given Task improves with the Experience.

A computer program is said to learn from experience **E** with respect to some class of tasks **T** and performance measure **P**, if its performance at tasks in **T**, as measured by **P**, improves with experience **E**

Example: playing checkers.
E = the experience of playing many games of checkers
T = the task of playing checkers.
P = the probability that the program will win the next game

In general, any machine learning problem can be assigned to one of two broad classifications: Supervised learning and Unsupervised learning.

How things work in reality:-

Talking about online shopping, there are millions of users with an unlimited range of interests with respect to brands, colors, price range and many more[3]. While online shopping, buyers tend to search for a number of products. Now, searching a product frequently will make buyer's Facebook, web pages, search engine or that online store start recommending or showing offers on that particular product. There is no one sitting over there to code such task for each and every user, all this task is completely automatic.

Here, ML plays its role. Researchers, data scientists, machine learners build models on the machine using good quality and a huge amount of data and now their machine is automatically performing and even improving with more and

more experience and time. Traditionally, the advertisement was only done using newspapers, magazines and radio but now technology has made us smart enough to do **Targeted advertisement** (online ad system) which is a way more efficient method to target most receptive audience.

Even in health care also, ML is doing a fabulous job. Researchers and scientists have prepared models to train machines for detecting cancer just by looking at slide – cell images[3].

For humans to perform this task it would have taken a lot of time. But now, no more delay, machines predict the chances of having or not having cancer with some accuracy and doctors just have to give an assurance call, that's it.

The answer to – how is this possible is very simple - all that is required, is, high computation machine, a large amount of good quality image data, ML model with good algorithms to achieve state-of-the-art results.

Doctors are using ML even to diagnose patients based on different parameters under consideration.

You all might have use **IMDB ratings**, **Google Photos** where it recognizes faces, **Google Lens** where the ML image-text recognition model can extract text from the images you feed in, **Gmail** which categories E-mail as social,promotion, updates or forum using text classification,which is a part of ML.
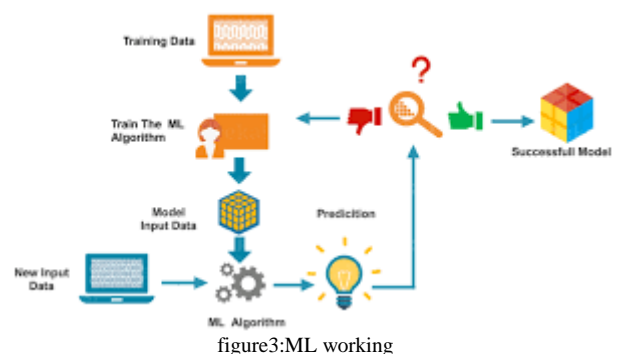
HOW ML WORKS:

figure3:ML working

- Gathering past data in any form suitable for processing.The better the quality of data, the more suitable it will be for modeling
- Data Processing –(*figure4*) Sometimes, the data collected is in the raw form and it needs to be pre-processed.
  Example: Some tuples may have missing values for certain attributes, an, in this case, it has to be filled with suitable values in order to perform machine learning or any form of data mining. Missing values for numerical attributes such as the price of the house may be replaced with the mean value of the attribute whereas missing values for categorical attributes may be replaced with the attribute with the highest mode.
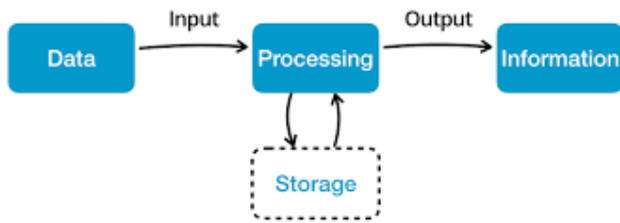
figure4:data processing

- This invariably depends on the types of filters we use. If data is in the form of text or images then converting it to numerical form will be required, be it a list or array or matrix. Simply, Data is to be made

  relevant and consistent. It is to be converted into a format understandable by the machine
- Divide the input data into training,cross-validation and test sets. The ratio between the respective sets must be 6:2:2
- Building models with suitable algorithms and techniques on the training set.
- Testing our conceptualized model with data which was not fed to the model at the time of training and evaluating its performance using metrics such as F1 score, precision and recall.

MACHINE LEARNING METHODS
Machine learning algorithms are often categorized as supervised or unsupervised.

- **Supervised machine learning algorithms** can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.
- In contrast, **unsupervised machine learning algorithms** are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data.
- **Semi-supervised machine learning algorithms** fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to

considerably improve learning accuracy. Usually, semi-supervised learning is chosen when the acquired labeled data requires skilled and relevant resources in order to train it / learn from it. Otherwise, acquiringunlabeled data generally doesn't require additional resources.

- **Reinforcement machine learning algorithms** is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is required for the agent to learn which action is best; this is known as the reinforcement signal.

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly[2]. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.

I. APPLICATIONS OF MACHINE LEARNING

- *Web Search Engine:* One of the reasons why search engines like google, bing etc work so well is because the system has learnt how to rank pages through a complex learning algorithm.
- *Photo tagging Applications:* Be it facebook or any other photo tagging application, the ability to tag friends makes it even more happening. It is all possible because of a face recognition algorithm that runs behind the application.
- *Spam Detector:* Our mail agent like Gmail or Hotmail does a lot of hard work for us in classifying 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.
- *Database Mining for growth of automation:* Typical applications include Web-click data for better UX(User eXperience), Medical records for better automation in healthcare, biological data and many more.
- *Applications that cannot be programmed:* There are some tasks that cannot be programmed as the computers we use are not modelled that way. Examples include Autonomous Driving, Recognition tasks from unordered data (Face Recognition/

Handwriting Recognition), Natural language Processing, computer Vision etc.

- ***Understanding Human Learning:*** This is the closest we have understood and mimicked the human brain. It is the start of a new revolution, The real AI. Now, After a brief insight lets come to a more formal definition of Machine Learning

Advantages of Machine Learning

Supplementing Data Mining

Data mining is the process of examining a database. Also, several databases to process or analyze data and generate informationData mining means to discover properties of datasets. While Machine Learning is about learning from and making predictions on the data.

Automation of Tasks

It involves the development of autonomous computers, software programs. Autonomous driving technologies, face recognition are other examples of automated tasks.

Limitations of Machine Learning

Problems With Verification

Another limitation is the lack of verification. It's difficult to prove that the predictions made by a Machine Learning system are suitable for all scenarios.

Time Constraint in Learning

It is impossible to make immediate accurate predictions. Also, remember one thing that it learns through historical data. Although, it's noted that the bigger the data and the longer it is exposed to these data, the better it will perform.

CONCLUSION

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.

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