iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** IV **Month of publication:** April 2021

DOI: https://doi.org/10.22214/ijraset.2021.33605

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue IV Apr 2021- Available at www.ijraset.com

Machine Learning with Applications

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Abstract: Thinking is the process of keeping in mind or reasoning about something. The ability of computers to think itself without being programmed in detailed way known as Machine Learning. Humans have brain which are capable of thinking or we can commonly say brain is fastest machine learning algorithm. In this journal we will see applications, challenges and techniques of Machine Learning or automated thoughts in Computers.
Keywords: Applications, Machine Learning, IBMer, Hurricane detector.

I. INTRODUCTION

Machine Learning is an application of Artificial intelligence. Generally, Machine Learning is a technique of feeding machine with necessary data to make it learn. It focuses on the development of computer programs which can access data from different sources and use it to learn themselves. The term Machine learning was introduced by Arthur Samuel in 1959.

Machine learning totally concentrates on two interlinked questions: How computer systems are constructed which can automatically improve through experience and What are the fundamental, statistical, computational information and theoretic laws which govern all learning systems, including computers, humans and organizations? Its important to study machine learning both for addressing these fundamental scientific and engineering questions and for the highly practical computer software it has produced and putup across many applications.

The problem of improving a amount of performance when executing some piece of work through some kind of training experience is known as Learning problem. For example, In credit-card fraud detection learning, the task is assigned a label of fraud or not fraud to any given credit-card transaction. The performance metric which has to be improved might be the precision of this fraud classifier, and the training event consists of a collection of historical credit-card transactions each labeled in survey as fraudulent or not. On the other hand one might define a different performance metric that assigns a higher disadvantage when fraud is labeled not fraud than when not fraud is incorrectly labeled fraud.

Many algorithms focuses on function approximation problems, where the task is embodied in a function for example given an input transaction output a fraud or not fraud label and the learning problem is to improve the precision of that function, with experience consisting of a sample of known input-output pairs of the function. In some cases, the function is represented explicitly as a parameterized functional form. In other cases the function is indirect and obtained via a search process, a factorization, an optimization procedure, or a simulation-based procedure. Even when indirect, the function generally depends on values or other adapt degrees of freedom and training corresponds to finding values for these values that optimize the performance metric.

II. TECHNIQUES USED IN MACHINE LEARNING.

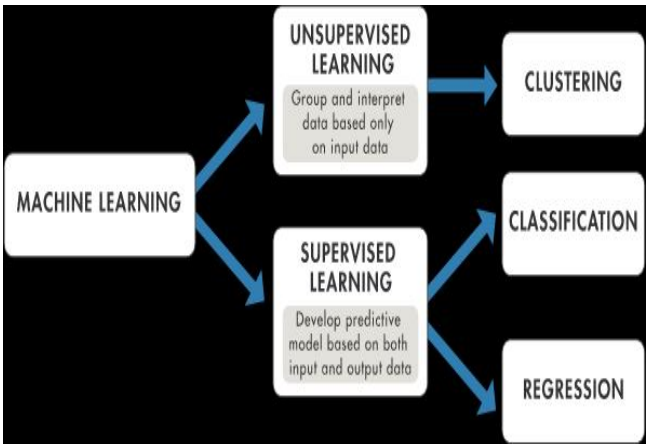

Figure 1 : Classification of Machine Learning.

Machine Learning is classified into two techniques.

1) *Unsupervised Learning:* A machine learning algorithm used to draw conclusion from datasets consisting of input data without labeled responses is known as Unsupervised Machine Learning. One of the most common unsupervised learning method is cluster analysis, which is used for searching data analysis to find grouping or hidden patterns in data. As a example of this type of algorithm we may take a collection of 1000 essays, and find the way to group those essays into small groups, that are some how similar or selected to each other based on feature like word frequency, page content, page count etc. This type of problem comes under clustering problem. As another example, clustering is the problem of finding a partition of the observed data (and a rule for predicting future data) in the absence of explicit labels indicating a desired partition. A wide range of clustering procedures has been developed, all based on specific assumptions regarding the nature of a "cluster."
2) *Supervised Learning:* It is type of Machine Learning algorithms in which training data sets consists of lebel data i.e. data with input values and responses value. It is also known as learning with examples. Algorithm here tries to find out the relationship between input values and output values. Basically supervised learning is a learning in which we teach or train the machine using data which is well labeled that means some data is already tagged with the correct answer.

Representation of data in Supervised Learning.

$$X = \begin{bmatrix} x\hat{}1 \\ x\hat{}2 \\ \vdots \\ x\hat{}m \end{bmatrix} = \begin{bmatrix} x(1)\hat{}1 & x(2)\hat{}1 & \cdots & x(n)\hat{}1 \\ \vdots & \cdots & \cdots & \cdots \\ \vdots & x(j)\hat{}i & \cdots & \cdots \\ x(1)\hat{}m & x(2)\hat{}m & \cdots & x(n)\hat{}m \end{bmatrix}$$

Here, X is input matrix, x(j)^I is value of j^{th} feature of i^{th} example.

$$Y = \begin{bmatrix} \vdots \\ \vdots \\ y\hat{}i \\ \vdots \end{bmatrix}$$

Here, y^i is outcome of i^{th} example.

3) *In Regression*

f(x) : X -> Y

X ϵ R^n

Y ϵ R^1(because Y is singal dimensional)

4) *In Classification*

f(x) : X -> Y

X ϵ R^n

Y ϵ { 1……k }

III. APPLICATIONS OF MACHINE LEARNING

1) *Image Recognition:* Image recognition is the most common application in Machine Learning. We use this application to recognize objects, digital images, persons, places and many more things.
2) *Speech Recognition:* Voice instructions are converted into text using the process of Speech Recognition. It is the most liked application of machine learning.
3) *Traffic Prediction:* We use google map daily in our life as a assistant which tells us about the traffic in a specific area which is a best example of Traffic Prediction. Google map is designed in such a way that who is using it can also help it to improve. It gathers the information from the user and sends back to the database for improving the performance.
4) *Product Recommendations:* Netflix and Amazon are some of the major example of e-commerce and entertainment companies which uses Machine learning for product the product recommendations. The application's algorithm is designed in such a way that when some product is searched on these sites we get recommended with the products of similar types.
5) *Self-driving Cars:* The cars which uses automatic driving assistant is the most exciting applications of machine learning. Elon Musk's company Tesla makes self driving car made using algorithms of machine learning. It is uses the unsupervised learning method which trains the car model for detecting people and objects while driving.
6) *Email Spam & Malware Filtering:* When we receive a mail it gets filtered automatically as a important or spam. The important mail which is received by us in our inbox is automatically categorised using machine learning algorithm into important and spam symbol.

7) *Virtual Personal Assistant:* There are various Virtual Personal Assistants used in our day to day life which uses machine learning algorithms to work. The voice instructions are recorded and sent over the server cloud and the recorded instructions are decoded using machine learning algorithm. Ex- Google assistant, Alexa, Siri, Cortana, Bixby.
8) *Online Fraud Detection:* Presently online Transactions are very common, even in rural areas online transactions are preferred but with high demand there comes some drawback. There is drawback using online transactions of being frauded online. Online transactions can be made more safe and sound to use, using Machine Learning algorithm.
9) *Medical Diagnosis:* Medical Science is one of the most essential need in one's life, by using Machine Learning we can diagnose the diseases which makes more easy to save anyone's life. Eg : Brain tumors and any other brain related diseases can be easily diagnosed.
10) *Automatic Language Translation:* When we are travelling to some destination language can be a major problem, one can know the language of that destination or not but with the help of machine learning we can translate that place's language easily. Google's GNMT is one of the various translators available that uses machine learning.

A. Latest Applications

1) *Automated Theorem Proving:* Development of modern logic and formalised mathematics was seen in end of the 19th and early 20th centuries. The modern predicate logic and complete propositional calculus both was intorduced by Frege's Begriffsschrift in 1879. His Foundations of Arithmetic published in 1884 expressed mathematics in formal logic. Russell and Whitehead continued this approach in Principia Mathematica[5][6], first published from 1910–1913, and with a revised second edition in 1927. Both thought they could derive all mathematical truth using axioms and inference rules of formal logic, in principle opening up the process to automatisation. Thoralf Skolem in 1920 cleared up a previous result by Leopold Löwenheim, leading to the Löwenheim–Skolem theorem and the notion of a Herbrand universe and a Herbrand interpretation that allowed satisfying of first-order formulas in 1930 and the legality of a theorem to be reduced to possibly infinitely many consisting satisfying problems. Resting upon the fundamental logic, the problem of deciding the legality of a formula varies from unimportant to impossible. For the ordinary case of propositional logic, the problem is decidable but co-NP-complete and hence for general proof tasks only exponential-time algorithms are believed. For given unbounded resources any valid formula can eventually be proven. However invalid formulas are those that are not required by a given theory cannot always be recognized. First order theory may describe a specific model in which some statements may be true but undecidable in the theory used to describe the model. For example, Gödel's incompleteness theorem explains that any theory whose proper axioms are true for the natural numbers cannot prove all first order statements true for the natural numbers even if the list of proper axioms is allowed to be infinite countable. An automated theorem prover fails to terminate while searching of a proof precisely when a statement is being investigated is undecidable in the theory being used even if it is true in the model of interest. Many hard problems can be solved by the theorem provers despite the theorectical limit even in models which are not fully described by any first order theory such as the integers.
2) *Precision Agriculture [11]:* Precision agriculture is a concept for managing farming in a non-premitive way. It is based on observing, measuring and responding to inter and intra-field changes in crops. Precision agriculture research has a goal to define a decision support system for whole farm management with the goal of improving returns on inputs while taking care of resources. Satellite and aerial imagery were in the first wave of the precision agricultural revolution. Weather prediction, variable rate fertilizer application, and crop health indicators also helped in managing farms. The second wave combined the machine data for even more precise planting, topographical mapping, and soil data. Precision agriculture is usually done as a four-stage process to observe non-linear variability: Various toools are used in Precision agriculture some of the basic tools are: tractors, combines, sprayers, planters, diggers, which are all are entertained with auto-guidance systems. The small devices on the equipment that uses geographic information system are what makes precision agriculture what it is. Geographical information system are the brain. To use precision agriculture the equipment needs to be wired with the right technology and data systems. More tools may include Variable rate technology, Global positioning system and Geographical information system, Grid sampling and remote sensors. Machine learning is commonly used in partnership with robots, drones and IOT devices. All these sourses are allowed to input the data. Information gained is processed by the computer and appropriate actions are sent back to these devices. This allows robots to deliver the perfect amount of fertilizer or IoT devices to provide the perfect quantity of water directly to the soil[36]. Every year the future of agriculture is moving more towards machine learning architecture. It has made more efficient and precise farming with less manpower.

IV. CHALLENGES FACED IN MACHINE LEARNING.

While machine learning is on its peak within cyber security and autonomous cars, but it hasn't been able to overcome a number of challenges that still comes in the way some of them are described as follows.

1) *Memory Networks:* We may require large working memory to store data for neural networks. This is a major challenge that machine learning needs to overcome.
2) *Natural Language Processing:* Natural language processing and understanding of language is a massive challenge for Machine learning to achieve. At present computers are taught to represent languages and simulate reasoning based on it.
3) *Object Detection:* Image classification in Machine learning is lacking therefore it is still hard for algorithms to correctly Detect Objects. To solve this type of challenge we have to invest more time and resources.

V. TOOL OF IMPLEMENTATION

Scikit-learn also known as sklearn is a free software Machine learning library for the Python programming language. This library consists of various classification, regression and clustering algorithms including vector machines, random forests, gradient boosting, *k*-means and DBSCAN.

In 2007 David Cournapeau intially developed Scikit learn as a Google Summer Code Project. Scikit Learn came in a specific use when Matthieu Brucher joined the project and used this library for his thesis work. The French Istitute of Research in Computer Science and Automation commonly known as INRIA got involved in this project in 2010 and released the first public version in late January 2010.

Other developers also rewritten the original codebase latter. Fabian Pedregosa, Gael Varoquaux, Alexandre Gramfort and Vincent Michel from the French Institute for Research in Computer Science and Automation in Rocquencourt, France, took contol of the project and made the first public release on 1st of February 2010. Scikit-learn is one of the most popular machine learning libraries on GitHub.

Scikit-learn uses numpy widely for high-performance linear algebra and array operations. Some core algorithms of this tool is written in Cython to improve performance. Scikit-learn is written in Python and it integrates well with some of Python libraries, such as matplotlib and plotly for plotting, numpy for array vectorization, pandas dataframes, scipy.

VI. SUMMARY

Talking about Machine Learning it is a subtopic of Artificial Intelligence. Systems are made such that they can train themselves from large data sets and use them in facial recognition, speech recognition, object recognition, translation, and many other tasks. Machine learning shares large boundries from government to education to health care. Businesses focused on marketing, social media, customer service, driverless cars uses Machine Learning sysytem extensively. For decision making it is now regarded as a core tool. There are two techniques used Unsupervised and Supervised Learning. Some of the various applications are Image recognition, Speech Recognition, Traffic Prediction, Product Recommendation, Hurricane Detector, Material Discovery etc. In coming future Machine Learning will be familiar to everyone but with familiarity there will be more challenges which have to be countered.

VII. CONCLUSION

In the above article we came to know about what is Machine Learning, Methods used in Machine Learning such as Supervised and Unsupervised Machine Learning. We came to see that what are the challenges we face during the implementation work. We have undergone through the applications of Machine Learning which had been discovered or are in working phase such as Material Discovery and Nasa's Hurricane Detector. We came to know about the Software Technique through which we can create a Machine Learning Algorithm i.e Scikit Learn which is a Python Library from Google.

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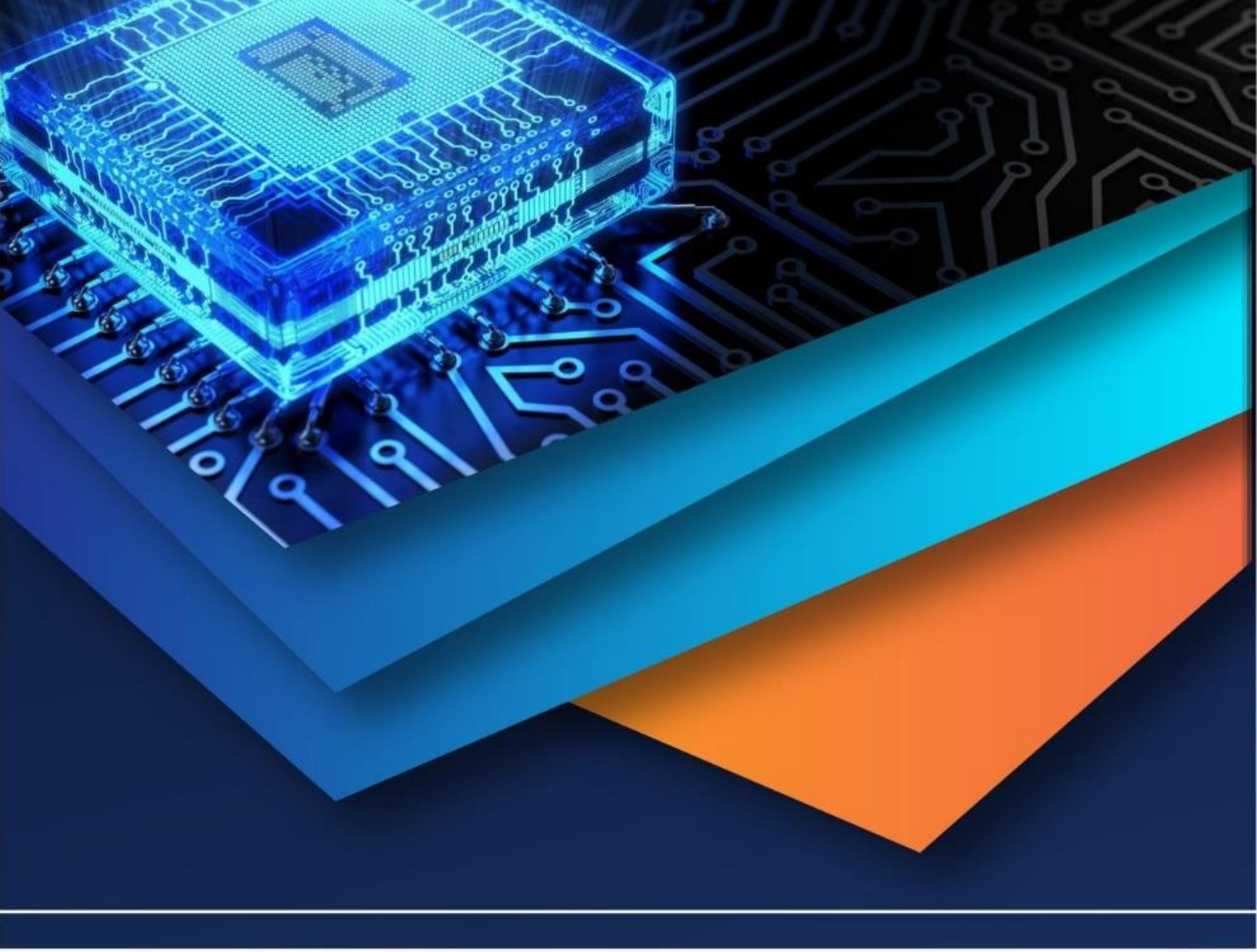

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