Recent Applications of Machine Learning: A Survey

Sujatha Kamepalli, Bandaru Srinivasa Rao

ABSTRACT--- Machine Learning is an interesting research area in computer science which changes the thoughts of human to machines. It is mainly used for data analysis that plays a vital role in many application areas where more data is generated and need to turn that data into useful information. This paper focuses on different application domains of machine learning algorithms. The paper explains use of ML algorithms in various domains such as medical context, manufacturing, text processing in information retrieval, big data analytics, Internet of Things and in research etc. The paper focusses on different application domains where machine learning recently used for analyzing the data and for producing different patterns which are very useful in making decisions. In medical field the patterns are used for better diagnosis, in manufacturing they can be used for verifying the machine condition and also used for fault diagnosis. Big data analysis is the thrust research area where usage of machine learning models increases the performance. The machine learning algorithms not only used in these application areas they can also be used in different domains such as marketing, in financial sectors and other areas where we have more data and immediate need of turning that data into useful information. By using machine learning algorithms in these domains, we can do 100% accurate predictions.

Keywords: Artificial Intelligence, Machine Learning, IoT, Manufacturing, Big Data Processing, Medical Diagnosis.

1. INTRODUCTION

The term Artificial Intelligence is a popular word used in computer science. It is not a single word, it encompasses many different technologies such as intelligent automation, video analytics, **machine learning** etc [6]. Machine Learning (ML) is an interesting research area that focus attention on different parameters such as presentation, efficiency of learning models, concept etc. These methods are very useful in different areas in which the data plays a vital role. Human brain can be capable of processing some amounts data but the machine learning models are capable of processing and computing vast amounts of data for which human brain is incapable. If we fed more data to a machine learning model, the model produces more complex and accurate results [7]. Machine Learning is the combination of computer science, engineering and statistics [11].
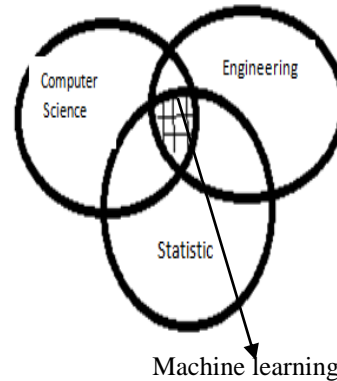

Figure 1: Formation of Machine Learning

Machine learning simply can be defined as the computational models used by machines for data processing and analysis. Machine learning, by using different procedures it constantly learns from data and allows computing machines to identify invisible patterns without much intervention of programmer.

Technically it is defined as "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".

"A more formal definition was given as a computer program is said to learn from experience (E) with respect to some task (T) and some performance measure (P), if its performance on T, as measured by P, improves with experience E then the program is called a machine learning program."[17].

2. ORGANIZATION

The organization of remaining paper is as follows. In session three the objectives of studying the paper are clearly mentioned. In session four it explains different application domains where machine learning can be applied. In fourth session the concluded remarks and future scope is given. Finally, the references and author affiliation are provided.

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3. OBJECTIVES

The main objectives of this survey are

i. To understand the concept of machine learning.
ii. To know the application domains of machine learning.
iii. To know the use of ML algorithms in order to find the hidden and interesting patterns in different application domains.
iv. To know the use of these data patterns in making decisions and predictions in real world.

The concept of machine learning can be clearly understood by studying its definition. If (performance of (T)) is increased with respect to a factor P by its past experience E, then we can say that the machine learns something by experience, and then the machine is thinking with intelligence as human being. Machine learning can be used in many application domains such as medical, data analysis, internet of things etc. ML algorithms can be used to find the hidden interesting patterns in different application domains and these patterns can be used to make decisions and predictions in corresponding fields. The architecture of machine learning system is working in the following manner.

4. APPLICATION DOMAINS

4.1. ML Methods in Medical Domain

In now a day as the technology is growing up almost all the clinics or hospitals are having the automatic machines for testing and scanning etc. these machines are producing large amounts of data, this data is used by the doctors to take the required steps among the patients. In current scenario, the medical supervisor or doctor is taking reports that are obtained from laboratories and considering the symptoms of the patients and by observing these things he will give medicines to patients. With this type of process, large amount of time is wasted. ML algorithms can be used to analyze medical diagnosis data and these produces number of hidden but interesting patterns that are used in making decisions on various specialized diagnostic problems.

The medical data like symptoms of a disease, laboratory test data can be taken as input by the systems and by using machine learning approaches generates some results. Based on the accuracy of the result, the system decides on training and testing data.

By using some ML algorithms such as classification, prediction and association algorithms, for any particular disease, the accuracy, speed, reliability and performance of the diagnostic can be improved [5]. But main problems with medical data are that the data bases are having more number of dimensions and these dimensions are continuously changing. There also may some human errors that are generated due to entering data manually. Machine Learning incorporates different tools and techniques for solving a number of diagnostic problems in different medical domains. These tools or techniques are used for analyzing different clinical parameters [8].

In [5] the scientists proposed a new algorithm based on the ANN with feed-forward network that can predict the swine flu even in early stages of flu.

The most common cancer disease among the woman throughout the world is breast cancer. According to the global statistics it is a severe public health hazard in today's society. The early diagnosis of breast cancer changes the survival of woman significantly. The authors in paper [19] reviews machine learning tools and its applications in diagnosis of breast cancer. A healthcare system model that implements ML models is also shown as given below.
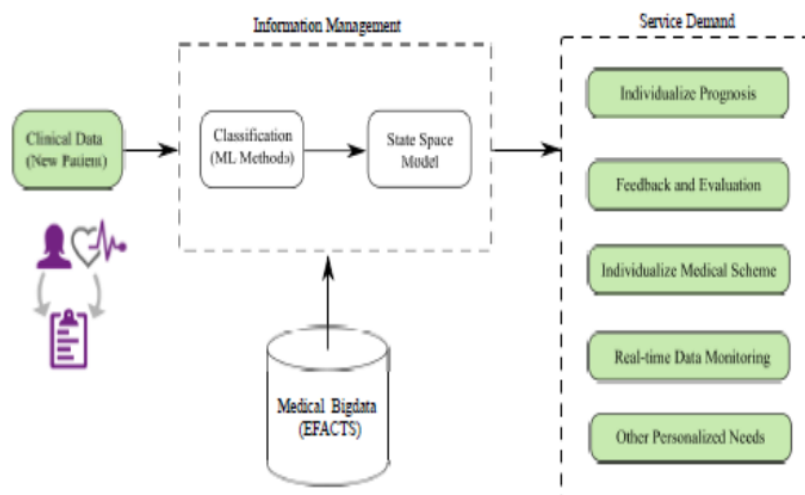

Fig 3: Healthcare System Model

4.2. Machine Learning (ML) Methods in Big Data Analysis(BDA)

Both ML and BDAs are emerging areas of computer science research. The author in [15] provides the review of latest developments in Machine Learning algorithms used for big data analysis and processing. This paper also discussed on the challenges that are with the application of ML based approaches [21]. The future trends of machine learning should concentrate on veracity and value aspects.
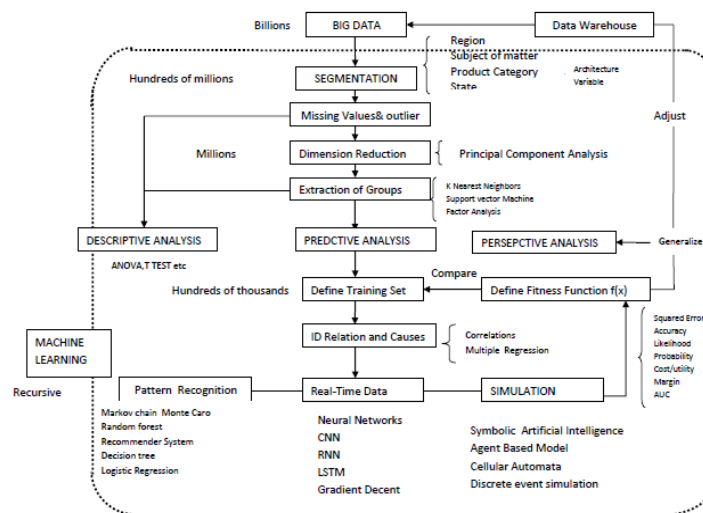
Fig 4: Role of Machine Learning in Big Data

There are a number of tools available in machine learning for processing big data such as map reduce frame work, apache spark, apache mahout etc[11].

4.3. Machine Learning in Manufacturing

Manufacturing industry has to satisfy the demand for high-quality products in an efficient manner; one area that shows developments in terms of not only results but also usability is machine learning. In [18], the authors Thorsten Wuest etal explained the challenges in manufacturing domain and also the paper explores on suitability of ML algorithms to today's manufacturing challenges. This paper also discusses on pros and cons of ML algorithms in manufacturing. This paper explains the use of supervised ML algorithms in manufacturing industry. The application area of SVM in manufacturing in monitoring. It can be used to monitor the machine condition and also used for fault diagnosis. SVM can also be used for image recognition through which the damaged can easily be identified.

Statistical Learning Theory (SLT) focuses on the generalization of the functionality and estimation of outputs for unknown inputs.

It also proposes that in future there is a necessity of using unsupervised ML techniques in manufacturing industry.

4.4. ML Techniques in IoT

The significance of IOT is that it is used to develop smarter environment. The process of IoT can be defined as follows:

First, sensors and IoT devices collect raw data from the environment.

Next, this raw data is analyzed and useful knowledge is extracted.

Then, this knowledge is ready for using in different application areas and also machine learning uses this as training data and make predictions in various applications.

Internet of Things growing rapidly, number of applications developed by academia and industry. Because of these applications large amount of data is generated.ML techniques are vitally used in order to process these large amounts of data. Using machine learning with Internet of Things provides a brain to the machine in order to think, which is called Embedded Intelligence" [2].
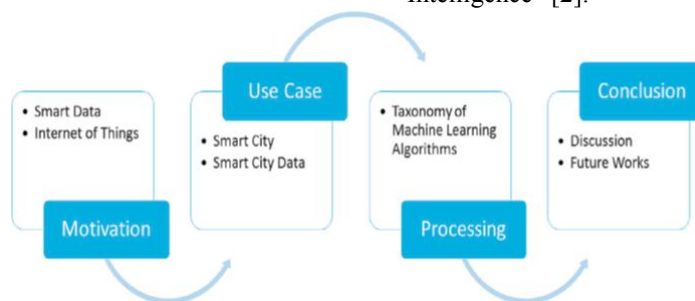

Fig 5: frame work ML in IOT

The paper in [20] focuses on intelligent machine learning applications. It also discusses the application of machine learning in industry. It also details the application deep learning.

4.5. Machine Learning in Information Retrieval

Information retrieval system creates larger volumes of data and text that is available to the people for their information needs. The information retrieval can be considered as a part of research in text mining. The text

mining can be performed on structured data as well as unstructured data.

For text mining classification and clustering algorithms are used. Different social web sites can also be analyzed using text mining. The following is an instance of text mining where sentiment analysis is carried out on twitter data using SVM classifier. Information retrieval is automated for decades. The paper in [16] provides different text representation models. The paper also explains how machine learning can be used for the above phases of information retrieval.
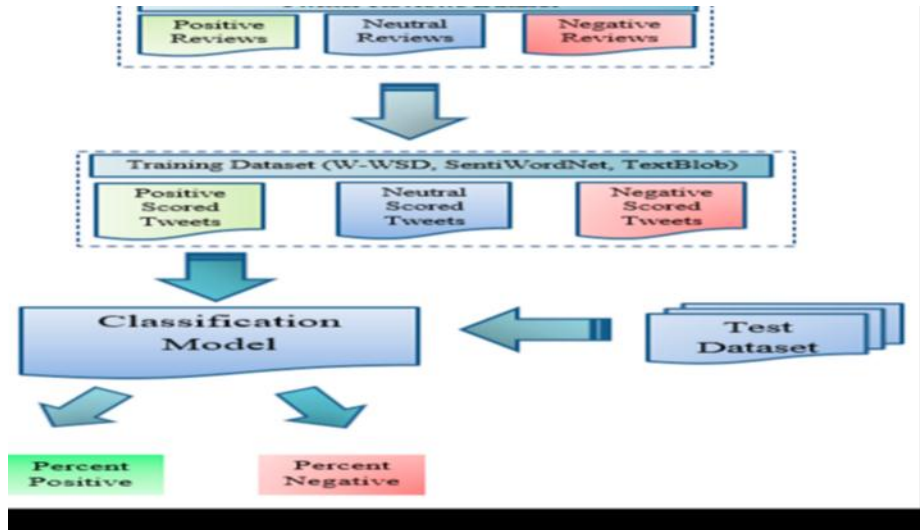

Fig 6: Frame work of tweet classification and sentiment analysis

4.6. Machine Learning in Research

The paper in [13] explains different scientific research applications of machine learning. The following are some of the scientific research areas where machine learning can be effectively used to continue the research.

i. New insights in neurosciences
ii. Detecting new particles in physics
iii. Finding patterns in astronomical data
iv. making predictions on weather changes etc.

Machine Learning ca also be used in Biotechnology Research. Prediction is the most commonly used technology of machine learning which predicts future values. The paper in [4] provides the machine learning applications in bio technology. This mainly explains about the classification and regression, which are very important in prediction of different parameters in bio technology research. This paper proposes an application

"Decision tree supported substructure prediction of metabolites from GC-MS profiles".

4.7. Machine Learning in Computer Security

Machine Learning can be in different fields and shows its effectiveness in all those fields over traditional rule-based methods. These ML methods also incorporated in cyber security system. There are mainly three where ML algorithms can be used to detect intrusions, for malware analysis and also for spam detection. Conventional security methods are not efficiently working for cyber security where more human intervention is required in order to identify threats. This conventional process can be improved by considering the Machine Learning algorithms [14].

Kolter and Maloof in [10] presented N-gram analysis which can be used to distinguish different types of viruses. C.Wright et al. [3] uses k-nearest neighbours' method in order to identify the protocols in data.
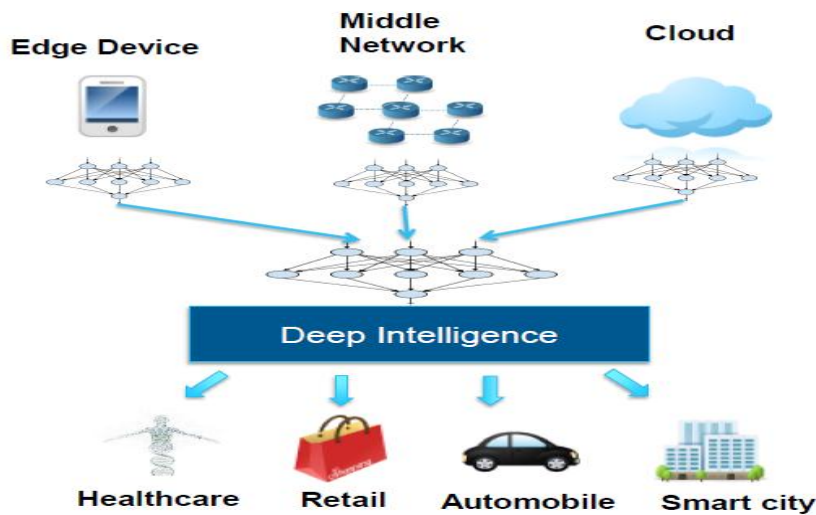
Fig 7: Application of ML in medicine, retail, auto, and smart city

5. CONCLUSION

This paper focuses on applications of machine learning in different domains. The paper focusses on different application domains where machine learning recently used for analyzing the data and for producing different patterns which are very useful in making decisions. In medical field the patterns are used for better diagnosis, in manufacturing they can be used for verifying the machine condition and also used for fault diagnosis. Big data analysis is the thrust research area where usage of machine learning models increases the performance. The machine learning algorithms not only used in these application areas they can also be used in different domains such as marketing, in financial sectors and other areas where we have more data and immediate need of turning that data into useful information. By using machine learning algorithms in these domains, we can do 100% accurate predictions.

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