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A Compendium of Various Applications of Machine Learning

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Abstract - Machine learning, or ML, is a branch of study that largely focuses on computer programs that use data to "learn", that is, identify patterns and relations in data which is difficult to achieve using conventional programming, and methods to solve problems more accurately over time. Machine Learning was largely considered a subfield of Artificial Intelligence since its inception. It was only by 1990's when Machine Learning started to flourish as a separate field which caused Machine Learning to become widely known and widely used in various technologies. This paper aims to review various applications of Machine Learning.

Key Words: Machine Learning, Artificial Intelligence, Anomaly Detection, Algorithms, Deep Learning, Cancer Prediction

1. INTRODUCTION

The growing area of data science includes machine learning as a key element. Algorithms are trained to generate classifications or predictions using statistical techniques, revealing important insights in data mining operations. The decisions made as a result of these insights influence key growth indicators in applications and enterprises. Much of machine learning (ML) research is inspired by weighty problems from biology, medicine, finance, astronomy, etc[1]. The use of machine learning techniques in bioinformatics includes genomics, proteomics, microarrays, systems biology, evolution, and text mining. Two areas which may benefit from the application of ML techniques in the medical field are diagnosis and outcome prediction. This includes a possibility for the identification of high risk for medical emergencies such as relapse or transition into another disease state [2]. Machine learning algorithms are employed in the financial industry to spot fraud, automate trading, and offer investors financial advising services. Much of finance involves pattern recognition using data, where multifarious inputs are modeled to predict outputs. For example, stock market prediction may be based on many variables (streaming data on stock prices, interest rates, volatilities, etc.). Another case is in consumer banking, where customers are characterized by myriad variables to determine what products to offer them, or to compute their probabilities of retention [3]. In the field of astronomy, Machine Learning is applied for classification of galaxy type, classifying different types of stars, to predict the mass of a local group etc. In this paper, we will delve into some of the applications of Machine Learning in detail.

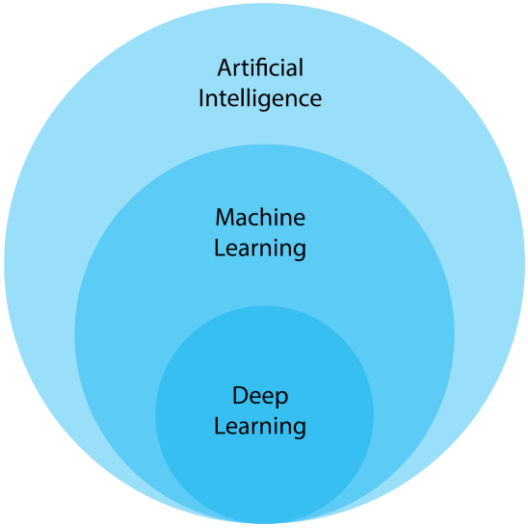

Fig-1: Venn diagram showing relationship between Artificial Intelligence, Machine Learning and Deep Learning

2. VARIOUS APPLICATIONS OF MACHINE LEARNING

2.1 Energy Efficiency in Industry

Large amounts of data are produced more frequently than not in the modern industrial environment, but most of it seems to go unused by most businesses. The topic of EM in industry received very little attention prior to the 1970s [5]. The oil crisis of the 1970s, which raised worries about energy security and actively promoted more energy-efficient technology and practices, was one of the turning moments. Because the scientific community has been actively involved in tackling these difficulties, there is a wealth of literature on the subject covering a wide range of industrial EE-related topics. Multiple contributions and a range of managerial tactics have been documented for promoting EE. The application and efficiency of energy audits in industry are topics that are covered in several contributions. The

possibility of modeling methodologies for EE objectives is investigated by Zhou et al. (2016) [6]. The development of optimization-based approaches or of prediction strategies is made possible by modeling. A wide variety of tools are included in ML for the extraction of knowledge from data. This comprises Principal Component Analysis (PCA), Support Vector Machines (SVM), Clustering techniques, Artificial Neural Networks (ANN), and many other methods. A variety of procedures must be used to systematically modify raw data to gain ever richer information because the problem of extracting insights from data is frequently not an easy one. A typical data process for insight generation is shown in Fig-2.

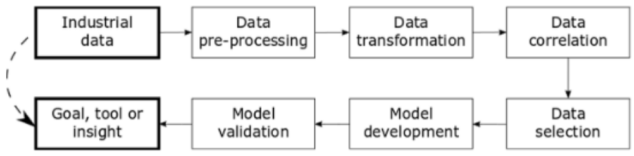

Fig-2: Typical procedures for using ML technologies to derive insight from data [6]

2.2 Approaches in Intrusion Detection System

One of the main issues of the modern day is network security. The vulnerabilities of network security have grown in importance as a result of the internet's rapid expansion and widespread use over the past ten years. Unauthorized access and unexpected attacks on secured networks are found using intrusion detection systems. Numerous studies on the intrusion detection system have been undertaken in recent years [7]. As a solitary classifier or single classifier, one machine learning method or technique can be applied to the development of an intrusion detection system. Decision Tree, Naive Bayes, K-nearest Neighbours, Artificial Neural Network, Support Vector Machines, and Fuzzy Logic are a few machine learning algorithms that have been discovered to be widely utilized single classifiers. The primary idea underlying SVM for intrusion detection is to assume that the remaining items are anomalies by just using the training data to describe the typical class of objects, or what is known as a non-attack in an intrusion detection system.

A hybrid classifier combines many machine learning methods or methodologies to significantly increase the performance of the intrusion detection system. Using pre-processing methods based on clustering to weed out non-representative training samples from the training data, followed by using the clustering results as training samples for pattern recognition to create a classifier. Weak learners are classifiers that perform only marginally better than a random classifier. Ensemble classifiers are used when several weak learners are merged with the goal of considerably increasing a classifier's performance.

2.3 Anomaly Detection

Since many years ago, anomaly detection has been utilized to locate and separate aberrant components from data. Anomalies have been found using a variety of ways. Machine Learning (ML), which is one of the increasingly important techniques, is crucial in this area. Finding patterns in data that do not match expected behaviour is known as anomaly detection [8].

In order to construct models that could detect anomalies when used, researchers used 28 ML approaches, as illustrated in Fig-3. Classification, ensemble, optimization, rule system, clustering, and regression are six categories into which these methods can be separated. Intrusion detection is a persistent issue in the realm of computer security. Anomaly detection is one of the many viable ways to intrusion detection that has attracted a lot of interest [9].

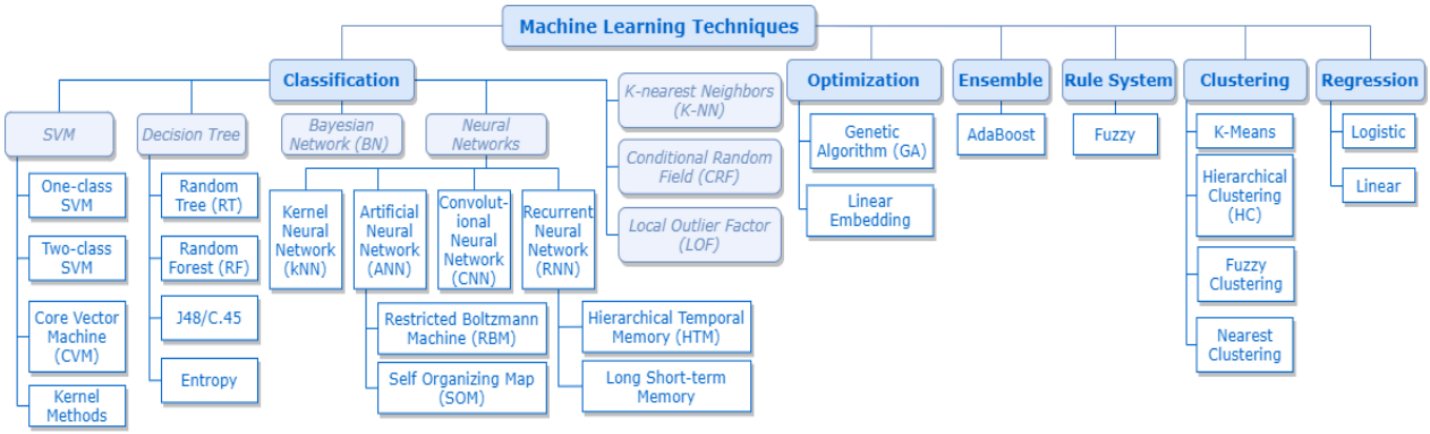

Fig-3: Different machine learning techniques used or anomaly detection [8]

2.4 Quantitative Finance

In a variety of sectors, such as fraud detection, payment processing, and regulation, ML is being used to enhance function throughout the financial sector. [10] Systems that mimic human thought processes include AI and ML. These days, a lot of these technologies are marketed as cognitive computing systems. Recent years have seen an increase in the use of machine learning (ML) techniques, as well as a rise in interest in their financial applications. These applications include sentiment analysis of news, trend analysis, portfolio optimization, and risk modelling, among many other use cases that support investment management.

With the development of computing technology, it became possible to gather and analyse massive volumes of market data, which led to the rise in popularity of a quantitative approach to market analysis. This led to tremendous advancements in our understanding of financial markets by enabling the development and verification of market models on a scale that was previously impractical.

Support vector machine (SVM) is a machine learning method for categorizing data. A decision function that maximizes the margin between classes is discovered by the SVM. [11] is a noteworthy SVM-based effort in which the authors sought to create a productive technique for making large gains by studying stock markets. The SVM model was specifically used by the authors to pick only equities that outperformed the market in terms of percentage return. The outcomes supported the success of the suggested SVM; in fact, the stocks chosen showed a total return of 208 percent over a 5-year period.

2.5 Cancer Prediction and Prognosis

A developing trend towards personalized, predictive medicine includes the use of computers (and machine learning) in disease prediction and prognosis. In more recent times, machine learning has been used to forecast and prognostic cancer. In the field of cancer research, machine learning is not new. For almost 20 years, cancer detection and diagnosis have relied on artificial neural networks (ANNs) and decision trees (DTs). Predictive medicine is a growing field, and it's crucial for patients, doctors, health economists, and policy makers as well (in implementing large scale cancer prevention or cancer treatment policies).

The use of machine learning techniques today spans a wide range of applications, from the detection and classification of tumors using X-ray and CRT images to the classification of malignancies from proteomic and genomic (microarray) studies. [12] The primary objectives of cancer prognosis and prediction are different from those of cancer diagnosis and detection. Three predictive foci are important in cancer prognosis and prediction: 1) cancer susceptibility prediction (risk assessment); 2) cancer recurrence prediction; and 3) cancer survival prediction. These kinds of molecular-scale details on patients or tumors can now be easily gathered thanks to the quick development of genomic, proteomic, and imaging technology.

3. CONCLUSIONS

Machine Learning provides a wide variety of helpful approaches to issues that might otherwise defy manual resolution. It allows computers to identify patterns and relations with minimal effort. It also improves the performance with "Experience" that is with every execution, the program optimizes its performance and gets more accurate. Machine learning has advanced recently as a result of the creation of new learning theories and algorithms as well as the continual explosion in the accessibility of online data and low-cost processing. Science, technology, and business have all adopted data-intensive machine-learning techniques, which has increased the use of evidence-based judgment in numerous fields such as marketing, manufacturing, health care, and financial modeling. Machine Learning can be adopted to solve problems or provide better insights for any industry or field, as clearly demonstrated in this paper. The applications discussed in this short paper encompass energy, security, finance and healthcare. The real-life applications of Machine Learning are endless and rapidly growing at a very steady pace. Today every person is using Machine Learning either with his or her knowledge or without. It is not far-fetched to say that in the near future Machine Learning will be impacting our lives directly, even in the aspects we cannot yet imagine.

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