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MACHINE LEARNING USING ITS CONCEPT, ALGORITHMS AND APPLICATIONS

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ABSTRACT

Machine Learning (ML) is a branch of mathematics that goes beyond the purview of a small number of computer organizations. It uses statistical inference to estimate the likelihood that mainframes will learn through game play. The idea and development of machine learning, some of its more sophisticated algorithms, and a comparison of the three most sophisticated and well-liked algorithms based on some fundamental usage and each algorithm's performance in terms of estimate accuracy, prediction time, and training time have all been identified and linked. The field of machine learning, which may be briefly defined as enabling computers to generate accurate predictions by leveraging historical data, has seen rapid growth in recent years because to the rapid advancements in computer processing power and storage. Numerous industries, including agriculture, medicine, and weather forecasting, use machine learning. In recent years, machine learning (ML) has been increasingly popular as a learning methodology for several categorization methods, including vector machines and ML-based OCR recognition algorithms. ML is utilized in the medical industry to identify diseases and diagnoses, as well as to manage health records (smart health records. Other machine learning techniques, such MATLAB's and Google's cloud vision API, were employed in the past and sometimes. For this application field, more sophisticated machine learning techniques have been developed as a result of the challenges and expense of biological analyses. These basic machine learning topics include feature evaluation, supervised vs unsupervised learning, and categorization types. Next, we highlight the key concerns with creating machine learning experiments and assessing their effectiveness. A few supervised and unsupervised learning techniques are presented.

KEYWORDS: Machine Learning, Algorithm, Data, Training,

1. INTRODUCTION

One technique that could compensate for learning from previous experience to enhance performance in the future is machine learning. This field's primary focus is on automatic learning techniques. The primary component of learning is the automatic modification or improvement of an algorithm based on prior "experiences" without the need for outside human assistance. When developing a software system, a programmer always has a precise goal in mind, unlike when designing a machine [2]. Within the science of artificial intelligence, machine learning focuses on creating statistical models and algorithms that allow computers to become more proficient at tasks over time. Without explicit guidance, these algorithms and models are intended to learn from data and generate predictions or judgments. supervised learning, unsupervised learning, and reinforcement learning are among the various forms of machine learning. In supervised learning, a model is trained on labelled data [1], whereas in unsupervised learning, a model is trained on unlabelled data. Using trial and error, a model is trained in reinforcement learning. Deep learning, natural language processing, recommender systems, and picture and speech recognition are just a few of the many uses for machine learning.

2. MACHINE LEARNING

The astounding outcome of combining computer science and statistics was machine learning.The structure of machines that solve particular problems is the primary emphasis of computer science [5], which also attempts to determine if the issues can be solved at all. In statistics, data inference, hypothesis modeling, and conclusion reliability measurement are the primary methods used. Even though the fundamental concept of machine learning is slightly different, it nevertheless depends on both. While computer science focuses on manually programming computers [3], machine learning (ML) tackles the issue of enabling computers to automatically re-program themselves in response to

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fresh input by utilizing pre-existing learning methodologies. While Machine Learning incorporates extra considerations regarding the viability [7] and efficacy of architectures and algorithms to process the data, Statistics concentrates on data conclusion and probability, while Machine Learning combines multiple learning tasks into a single, compact one and performance metrics. The development of techniques that allow a computer to independently learn from data and past experiences is the main goal of machine learning, a subset of artificial intelligence. The phrase "machine learning" was originally coined in 1959 by Arthur [9] Samuel. This is how it may be summed up: Machine learning lets a machine learn automatically from data, get better at something by learning from past experiences, and make predictions without having to be openly coded. With the use of training data—sample historical data—machine learning algorithms develop a mathematical model that, without being publicly programmed, assists in making predictions or judgments. Machine learning is the process of combining computer science and statistics to create prediction models. In machine learning, algorithms that learn from past data are either created or used.

3. MACHINE LEARNING AND HUMAN LEARNING

The study of the human and animal brains in the domains of neuroscience, psychology, and allied sciences is called machine learning. Theoretically, a machine's capacity for experience-based learning would most likely not differ appreciably from the ways in which the minds of animals and humans develop through time and experience [7]. Nevertheless, research focused on applying human brain learning techniques to machine learning challenges has not produced as promising results as research utilizing a statistical-computational approach. This may be because the psychology of humans and other animals is still not completely understood. Notwithstanding these challenges, there is a growing link between human and machine learning since many learning strategies observed in humans and animals are explained by machine learning. To explain brain signals in animal learning, for instance, the temporal difference machine learning approach was proposed. It is reasonable to assume that this partnership will expand greatly in the upcoming years.

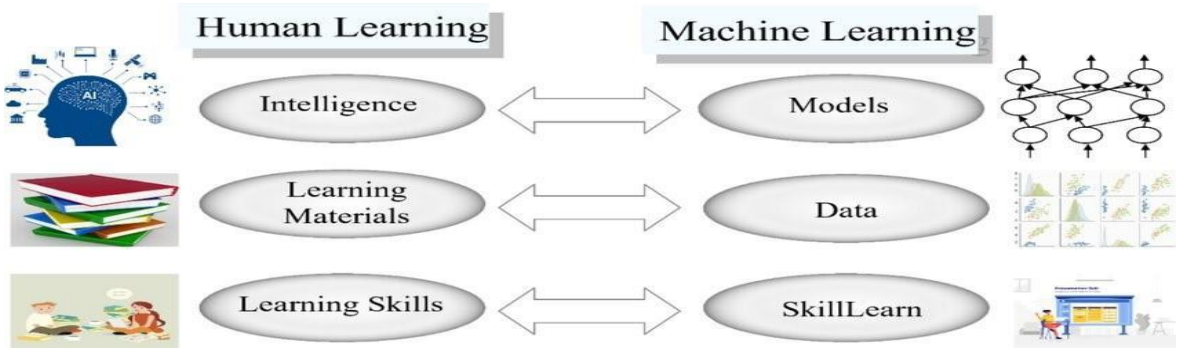

Fig: 1**Relationship b/w human learning and machine learning**

4. DATA MINING, ARTIFICIAL INTELLIGENCE AND MACHINELEARNING

In essence, data mining is the interpretation of any type of data, but it also establishes the groundwork for machine learning and artificial intelligence. As a result, data mining is a technique for formulating pertinent hypotheses rather than just proving them. The data that has been mined, along with the associated patterns and theories, can serve as a foundation for artificial intelligence and machine learning [11]. Machine learning, such as ANN, neural networks, and other learning techniques, uses deep learning. Image processing is utilized in digital image processing, such as the machine learning component of color image processing. The term artificial intelligence refers to machines that possess the capacity to independently solve problems without the need for human intervention. The relevant data and the AI's interpretation of that data enable the system to generate a solution on its own without the need for direct programming of the solutions. All that's below is a data mining algorithm, nothing more. By giving a machine the data it needs to appropriately train and adapt to new data, machine learning[5] advances the strategy to a higher level. We call this "training." In order to enhance its capacity to analyze fresh data and generate more useful outcomes, it concentrates on extracting information from incredibly vast sets of data. It then employs different statistical measures to find and

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identify underlying patterns.The core component of artificial intelligence is machine learning. The primary goal is for any machine with intelligence-related capabilities—such as language or vision—to arrive instantly. Advanced technology, machine learning is frequently combined with deep learning and artificial intelligence.

5. ML ALGORITHMS

An overwhelming number of ML algorithms have been designed and introduced over past years. Not every one of them is widely known. Some of them did not satisfy or solve the problem, so another was presented in its place [11]. Here the algorithms are broadly grouped into two category and those two groups are further sub-divided. This section try to name most popular ML algorithms and the next section compares three most widely used ML algorithms.

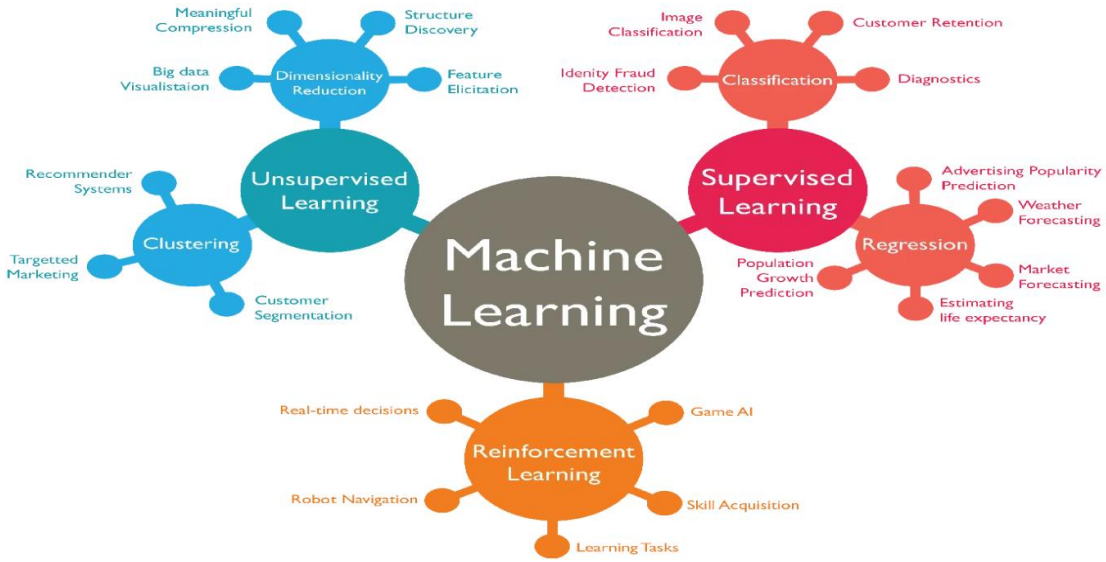

Fig: 2 ML and its Algorithms

5.1 GROUP BY LEARNING ML ALGORITHMS

i) **Supervised learning:** Input data or training data has a pre-determined label for ex: True/False, Positive/Negative, Spam/Not Spam etc. A function or a classifier is built and trained to predict the label of test data. The classifier is properly tuned (parameter values are adjusted)to achieve a suitable level of accuracy.

ii) **Unsupervised learning:** In the unsupervised learning the Input data or training [15] data is not labelled. A classifier is designed by deducing existing patterns or cluster in the training datasets.

iii) **Semi-supervised learning:** Training dataset contains both labelled and unlabelled data. The classifiers train to learn the patterns to classify and label the data as well as to predict.

iv) **Reinforcement learning:** The algorithm is trained to map action to situation so that the reward or feedback signal is maximised. The classifier is not automatic directly to choose the action, but instead trained to find the most rewarding actions by trial and error.

v) **Transduction:** Though it shares similar traits with supervise learning, but it does not develop a explicit classifier. It attempts[13] to predict the output based on training data, training label, and test data.

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vi) **Learning to learn:** The classifier is trained to learn from the bias it induced during previous stages.

5.2 ALGORITHMS GROUPED BY SIMILARITY

i) Regression Algorithms: Regression analysis is part of predictive analytics and exploits the co-relation between dependent(target) and independent variables. The notable regression models are: Linear Regression, Logistic Regression, Stepwise Regression, Ordinary Least Squares Regression (OLSR), Multivariate Adaptive Regression Splines (MARS), and Locally Estimated Scatter plot Smoothing (LOESS) etc.

ii) Instance-based Algorithms: Instance-based or memory-based learning model stores instances of training data instead of developing a precise definition of target function. Whenever a new problem or example is run into,[10] it is studied in accordance with the stored instances in order to determine or predict the target function value. It can simply replace a stored instance by a new one if that is a better fit than the former. Due to this, they are also known as winner-take-all method. Examples: K-Nearest Neighbour (KNN), Learning Vector Quantisation (LVQ), Self-Organising Map (SOM), Locally Weighted Learning (LWL) etc.

iii) Regularisation Algorithm: Regularisation is simply the process of stabilizing overfitting or abates the outliers. Regularisation[16] is just a simple yet powerful modification that is augmented with other existing ML models typically Regressive Models. It smoothes up the regression line by castigating any bent of the curve that tries to match the outliers. Examples: Ridge Regression, Least Absolute Shrinkage and Selection Operator (LASSO) Elastic Net, Least-Angle Regression (LARS) etc.

iv) Decision Tree Algorithms: A decision tree constructs a tree like structure involving of possible solutions to a problem based on certain constraints. It is so named for it begins with a single simple decision or root, which then forks off into a number of branches until a decision or prediction is made, forming a tree. They are favoured for its ability to the problem helps identifying potential solutions faster and more accurately than others. Examples: Classification and Regression Tree (CART), Decision Stump, M5, Conditional Decision Trees etc.

v) Bayesian Algorithms: A group of ML algorithms employ Bayes' Theorem to solve classification and regression problems.[17]Examples: Naive Bayes, Gaussian Naive Bayes, Multinomial Naive Bayes, Averaged One-Dependence Estimators (AODE), Bayesian Belief Network (BBN), Bayesian Network (BN) etc.

vi) Support Vector Machine (SVM):SVM is so popular a ML technique that it can be a group of its own. It uses a separating hyperplane or a decision plane to demarcate decision boundaries among a set of data points classified with different labels. It is a strictly supervised classification algorithm. In other words, the algorithm develops an optimal hyperplane utilising input data or training data and this decision plane in turns categories new examples. Based on the kernel in use, SVM can perform both linear and nonlinear classification.

vii) Clustering Algorithms: Clustering is concerned with using in-built pattern in datasets to classify and label the data accordingly. Examples: K-Means, K-Medians, Affinity Propagation, Spectral Clustering, Ward hierarchical clustering,

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Agglomerative clustering. DBSCAN, Gaussian Mixtures, Birch, Mean Shift, Expectation Maximisation (EM) etc.

viii) **Association Rule Learning Algorithms:** Association rules help discover correlation between apparently associated data[14]. They are widely used by ecommerce websites to predict customer behaviours and future needs to promote certain appealing products to him. Examples: Apriori algorithm etc.

ix) **Artificial Neural Network (ANN) Algorithms:** A model based on the built and operations of actual neural networks of humans or animals. ANNs are regarded as non-linear models it tries to discover complex associations between input and output data. But it draws sample from data rather than considering the entire set and thereby reducing cost and time. Examples: Perceptron, Back- Propagation, Hop-field Network, Radial Basis Function Network (RBFN) etc.

x) **Deep Learning Algorithms:** These are more reorganized versions of ANNs that capitalise on the profuse supply of data today. They are utilises larger neural networks to solve semi-supervised problems where major portion of an abound data is unlabelled or not classified. Examples: Deep Boltzmann Machine (DBM), Deep Belief Networks (DBN),Convolutional Neural Network (CNN), Stacked Auto-Encoders etc.

6. APPLICATIONS

6.1 SPEECH RECOGNITION

Speech recognition is technology that can be recognizing spoken words, which can be converted to text. Most of the system implements[18] learning in two different phases: first pre-shipping speaker independent training and secondly post-shipping speaker-dependent training.

6.2 COMPUTER VISION

Widely held of recent vision systems, like facial recognition software, systems capable of automatic classification microscopic images of cells employ machine learning approaches for better accuracy. For example, computer vision can help recognize faces of people or animals from image or videos etc. Other best example of recognize traffic signs from videos, track movements of people or vehicles and provide by summaries from videos.

6.3 BIO-SURVEILLANCE

Several government initiatives to track[17] probable outbreaks of diseases uses ML algorithms. Consider the RODS project in western Pennsylvania. This project collects admissions reports to emergency rooms in the hospitals there, and the ML software system is trained using the profiles of admitted patients in order to detect aberrant symptoms, their patterns and areal distribution.

6.4 ROBOT OR AUTOMATION CONTROL

ML methods are largely used in robot and automated systems. For example, consider the use of ML to obtain control procedures for stable flight and aerobatics of helicopter. The self-driving cars developed by Google use ML to train from collected terrain data.

6.5 EMPIRICAL SCIENCE EXPERIMENTS

A large group data-intensive science disciplines use ML methods in several of it researches. For example, ML is being implemented in genetics, to identify unusual celestial objects in

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astronomy, and in Neuroscience and psychological analysis. The other small scale yet important application of ML involves spam filtering, fraud detection, topic identification and

Predictive analytics (e.g., weather forecast, stock market prediction, market survey etc.).

7. FUTURE SCOPE

Machine learning is research area that has attracted a lot of brilliant minds and it has the potential to divulge further. But the three most important future sub-problems are chosen to be discussed here.

7.1 EXPLAINING HUMAN LEARNING

As previously indicated, ideas of machine learning are thought to be appropriate for understanding aspects of animal and human learning. Remarkably accurate estimations of the dopaminergic neurone-induced activity in animals during reward-based learning are made by reinforcement learning algorithms [15]. Visual characteristics found in animals' early visual cortex are predicted by machine learning techniques that identify irregular boundaries of naturally occurring images. However, ML algorithms currently do not account for the key factors that influence learning in humans or animals, such as excitement, terror, urgency, hunger, instinctual behavior, and trial-and-error learning across several time scales.

7.2 PROGRAMMING LANGUAGES CONTAINING MACHINE LEARNING PRIMITIVES

ML algorithms are integrated into manually programmed programs as part of application software in the majority of applications. the requirement for a new programming language that can handle both manually written and "to be learned" subroutines. The programmer may be able to specify a set of inputs and outputs for each algorithm in a "to be learned" program by selecting one of the nine fundamental learning techniques that have already been taught in the language. Programming languages like R, Python (Sckit-learn), and others already employ this idea, albeit in a more limited way. The development of a model to specify the pertinent learning experience for each subroutine marked as "to be learned," timing, and security in the event that the program's functionality is altered, however, raises an intriguing new topic.

7.3 PERCEPTION

A broader definition of computer perception that can connect machine learning techniques, which are employed in many different types of computer perception nowadays [4], including but not restricted to extremely sophisticated vision, speech recognition, etc., One issue is integrating various senses—such as sight, hearing, touch, etc.—to create a system that uses self-supervised learning to estimate one sense's knowledge based on the others.

8. CONCLUSION

The primary goal of machine learning researchers is to create practical, time- and space-efficient general purpose learning techniques that can outperform others across a wide range of domains. A key performance indicator in machine learning (ML) is a method's ability to efficiently use data resources, in addition to time and space complexity. An advantage of machine learning (ML) algorithms over manual or direct programming is that they are entirely data-driven and can analyze enormous amounts of data in shorter turnaround times. They are frequently more accurate as well. Think about the following situations: software development to address sensor-based perception tasks such as computer vision, speech recognition, etc. Anyone can easily identify a letter image by the alphabet it represents, but creating an algorithm to do this is a challenging task. Think about speech recognition software that needs to be tailored to the specific requirements of the user. Similar to e-commerce websites that adjust product displays based on user preferences or email readers that allow spam detection based on user settings. When needed, ML gives software the adaptability and flexibility it needs. Writing matrix multiplication algorithms in certain applications where machine learning could lead to an increase in data resources and a rise in the need for individualized, customizable software In addition

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to software development, "How to empower it to program itself" replaces "how to program a computer" as the central query. ML, the development of devices that are self- monitoring, self-diagnosing and self-repairing, and the utilizes of the data flow accessible within the program rather than merely processing it. Naturally, as computer science and statistics evolve and offer more sophisticated theories to change how people learn, they will also enhance machine learning.

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