# A Review of Machine Learning Algorithms

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***Abstract*- Machine learning (ML) is a subset of artificial intelligence field. In this machine learning, computer algorithms are utilized to learn automatically from data and information. Basically, machine learning algorithms enable machines to learn from data or information, and improve themselves, without being explicitly programmed. Now-a-days, machine learning entered in variety of applications including science, engineering, technology and finance too. This paper focuses on survey of different machine learning algorithms. Basically this survey paper explains the main theme and motto of ML techniques.**

***Index Terms*- Artificial intelligence, Classification, Machine learning, Supervised learning, Unsupervised learning.**

## I. INTRODUCTION

Machine Learning (ML) is nothing but a prediction of future based on past experience. In many applications, at a particular point we are unable to write a code of programming for solving a problem and we require experience or past data. A real time example is a traffic scenario. We generally take a decision of changing a traveling route due to heavy traffic on a particular road and during specific time duration. How we decide and take a decision? Our decision is based on our past experience and changing conditions.

A human brain is very superior and learns from experience and accordingly reacts. Could a machine learn and act like a brain? Yes, now the machines are becoming intelligent. Now-a-days Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL) are highly researched topics in this cutting edge.

Artificial Intelligence is related to the theory and development of computers or machines to perform tasks like human. And such tasks require human intelligence. The tasks may be speech recognition, language interpretation, decision making, and visualization etc.

The machine learning is a way of achieving Artificial Intelligence. A system is said to be an intelligent when it learns in changing conditions and adapts to the new condition.

When we apply machine learning algorithms to large datasets then it is called as Data Mining [3].

The advantage of machine learning (ML) methods is that it uses mathematical models, heuristic learning, knowledge acquisitions and decision trees for decision making [9]. Hence, it provides controllability, observability and stability.

## II. CLASSIFICATION OF MACHINE LEARNING

The ML is considered as a subfield of Artificial Intelligence. It is related with the development of techniques and methods which enable the computer to learn [11]. Machine learning overlaps with statistics in many ways. Over the period of time many techniques and methodologies were developed for machine learning tasks [11]. ML algorithms are broadly classified into three divisions namely supervised learning, unsupervised learning and reinforcement learning [1]. The machine learning can be classified as below [1], [2], [3], [4] and [10].

*A. Supervised learning*
*B. Unsupervised learning*
*C. Reinforcement learning*
*D. Multitask learning*
*E. Ensemble learning*
*F. Neural network*
*G. Instance based learning*

The ML was the phenomenal outcome when Computer Science and Statistics joined forces [5].

The ML provides the required data to train for a machine and also it can modify accordingly whenever exposed to new data. This is termed as

training. It extracts information from largest of data. With the help of different statistical measures then it detects and identifies underlying patterns. This improves its ability to interpret new data and produce more effective results [5].

## III. MACHINE LEARNING METHODS

This section focuses on different machine learning methods.

### *A. Supervised Learning*

Supervised learning is the most common form of machine learning scheme used in solving the engineering problems [12]. In supervised learning, the aim is to learn a mapping from the input to an output whose correct values are provided by a supervisor [3].

The external assistance is required for the supervised machine learning algorithms. The input dataset is segmented into train and test dataset. The train dataset has output variable which needs to be classified or predicted. For the purpose of classification all algorithms learn some kind of patterns from the training dataset and apply them to the test dataset [13]. The supervised learning has popular algorithms as Decision Tree, Naive Bayes and SVM (Support Vector Machine).

### *I. Decision Tree*

For supervised learning, it is a hierarchical model. With the help of this model, the local region is identified in a sequence of recursive splits in a smaller number of steps [3].

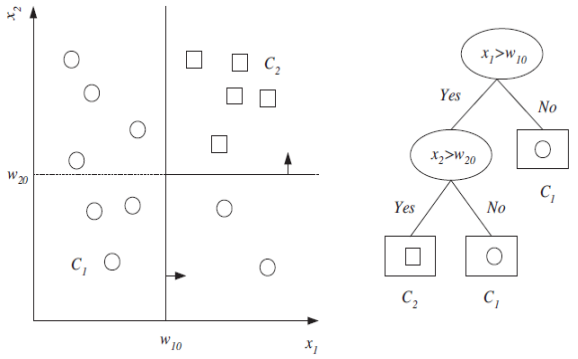


Fig. 1 A dataset and its decision tree [3]

The internal decision nodes and terminal leaves are the part of decision tree as shown in Fig. 1. A test function fm(x) is implemented by each decision node m with discrete outcomes labeling the branches. A test is applied with an input at each node, and depending on the outcome, one of the branches is taken. This phenomenon starts at the root. This process is repeated until a leaf node is hit, at which point the value written in the leaf constitutes the output [3]. Some of the recent issues related to Decision Tree are pointed out in [7] and [8]. Recently some authors published work in connection with Decision Tree as mentioned in [1].

The paper [18] claimed an example-reliant cost-sensitive decision tree algorithm.

The paper [19] proposed a predicting learning styles in conversational intelligent tutoring systems using fuzzy decision trees has been proposed.

### *II. SVM (Support Vector Machine)*

This model comes under Kernel machines category. Basically SVM is a classification tool. It is also a regression prediction tool. To increase predictive accuracy, this SVM tool exploits machine learning theory. While doing this, it automatically avoids over-fit to the data. The SVMs are the systems which use hypothesis space of linear functions in a high dimensional feature space, trained with a learning algorithm from optimization theory that implements a learning bias derived from statistical learning theory [11].

SVM can just be defined as a prediction tool wherein we search for a particular line or decision boundary termed as hyperplane which easily separates out the datasets or classes, hence it avoids the extra over fit to the data. It uses hypothesis space of a linear space into high dimensional feature space. It is also capable of classifying the nonlinear data where it uses kernel functions [4]. The recent work on SVM is surveyed in the paper [1]. Some of the techniques mentioned below.

The paper [14] proposed a novel K-nearest neighbor establish structural twin support vector machine (KNN-STSVM).

In paper [15], authors claimed a new SNSVM (structural nonparallel SVM). Each model of SNPSVM checks the concentration in both classes. It also checks the reparability between classes.

The authors of paper [16] claimed a linear kernel support vector machine (SVM) as a consistent least-squares (RLS) problem. The solution to the RLS problem is represented as an equation that describes the error vector to the indicator variables.

The paper [17] proposed a well-known OCC SVM (one-class classification support vector machine). It is relating with interval-valued or set-valued training data. Here every distance of training data is represented by a finite set of explicit data with imprecise weights.

*B. Unsupervised Learning*

As stated in supervised learning, there is a mapping from the input to an output whose correct values are provided by a supervisor. In unsupervised learning, there is no such supervisor and we only have input data. The objective is to find the regularities in the input. The input space has the structure in such a way that particular patterns appear many times than others. Generally we are interested to know what happens and what does not. This is called density estimation in the language of Statistics [3].

Basically unsupervised learning is a technique of ML in which it is studied that how systems can learn to represent particular input patterns. And such patterns reflect the statistical structure of the overall collection of input patterns [20].

Principal components analysis (PCA) is an unsupervised method in that it does not use the output information; the criterion to be maximized is the variance [3].

The survey paper [21] focused on different techniques and methodologies of Unsupervised Machine Learning. Such techniques are used to learn complex, highly non-linear models with millions parameters to use large amount of unlabeled data. The popular techniques of unsupervised learning models are sparse coding and Deep belief networks (DBNs).

*C. Reinforcement Learning*

In simple words, it is defined in [3] as "learning with a critic". In this RL, a decision-making agent is nothing but a learner. It tries to solve problem by taking actions in an environment and receives reward (or penalty) for its actions. It goes through such trial-and error runs and after a set of trial-and error runs, it should learn the best policy, which is the sequence of actions that maximize the total reward [3].

The RL is also called adaptive (or approximate) dynamic programming (ADP). It has emerged as a powerful tool for solving complex sequential decision-making problems [22].

The RL is also called as ADP (Adaptive Dynamic Programming). The RL is a powerful technique due to its ability to solve, near-optimally, complex and large-scale Morkov Decision Problems (MDPs) on which classical DP (Dynamic Programming) breaks down. The RL has evolved from four attractive demanding fields as classical DP, AI, stochastic approximation, and function approximation (regression, Bellman error, and neural networks) [22].

*D. Deep Learning Algorithms*

The Deep Learning (DL) is also a subpart of ML. The modern version of the ANN is a DL algorithm. The DL algorithms involve the utilization of larger neural networks to solve semi-supervised problems where major portion of data is unlabeled or not classified. Some popular and promising examples are Deep Boltzmann Machine (DBM), Deep Belief Networks (DBN), Convolutional Neural Network (CNN), and SAE (Stacked Auto-Encoders) [5].

## IV. CONCLUSION

As this Machine learning topic is very vast. This paper illustrates the survey of some of the main techniques by focusing on main theme and motto of the said techniques. There are numerous applications including Computer Vision, Biomedical processing, Speech processing, Robotics etc. to be implemented with ML techniques.

This paper explains about the concept of ML. Later it classifies ML domain. Then this paper reviews various papers published recently in the field of ML including Supervised Learning, Unsupervised Learning and Reinforcement Learning. Finally it adds a note about Deep Learning Algorithms. Deep learning is also a part of ML.

The future scope of this work is to implement an application (e.g. Computer Vision) using different ML techniques and compare the results.

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