

Machine Learning Algorithms: Features and Applications

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INTRODUCTION

Human has developed machines to accomplish tasks that are not easily processed and analyzed by human brain. Intelligent tools and machines lead businesses to be more creative and productive through creating competitive advantage for businesses. The initial concept of intelligent machines was shaped in the mid-twentieth century when Alan Mathison Turing first thought about the possibility of employing machines to process data. Then, Artificial Intelligence that is considered as a branch of computer science was developed at a rapid pace. Machine Learning that its learning capacity is not dependent on programming was initially based on the simulation of human intelligence. Today, ML that is generally defined as learning from different levels and classes of data (Amornsamankul, Pimpunchat et al. 2019) through employing different algorithms to make accurate predictions (Das and Behera, 2017) is broadly used in various fields ranging from biomedical science and spacecraft to biological science (El Naqa and Murphy, 2015) aiming to solve problems that are mainly based on big datasets. ML can solve complex projects through processing complicated and big data inputs to predict potential threats and profitable opportunities for businesses that are widely reliant on data to proceed. This review discusses and compares popular and commonly used Supervised Learning, Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning, Neural Network Learning, and Instance-Based Learning methods and algorithms.

MACHINE LEARNING

Since ML employs different types of models and algorithms based on AI to proceed with the learning phase from data (Sze, Chen et al. 2017).

It is almost believed that the difference between ML and AI is very slight which leads to being used interchangeably in many cases. However, ML is mainly defined as one of the most important subsets of AI. On the other hand, AI has a close association with computers or machines to make decisions based on datasets (Osarogiagbon, Udeze et al. 2015). ML applies various types of algorithms or models based on an AI to proceed with the learning phase from data (Sze, Chen et al. 2017).

The modern definition of ML is incorporated with a psychologist scientist from Cornell University Frank Rosenblatt who created a procedure that was capable of recognizing the alphabet by inspiration from the human nervous system called “perception”. It becomes the prototype of a modern Artificial Neural Network (Fradkov, 2020). In 1967, the first algorithm Nearest Neighbor algorithm was first de-

DOI: 10.4018/978-1-7998-9220-5.ch054

veloped and became the basic pattern recognition (Cover and Hart, 1967). There are various algorithms and classes of Machine Learning, but no one is free from limitations and deficiencies. The main reason for many developments has been the necessity of providing a simple and clear equation or solution that is easy to understand and solve problems. Although researchers believe that the employment of ML for many real-life issues and challenges is difficult, many extraordinary developments have happened in this area. In this review, the most practical and popular algorithms of Machine Learning and modifications which happen to make them more reliable, accurate, and user-friendly have been studied.

MACHINE LEARNING ALGORITHMS

The development of a Machine Learning application relies on using an appropriate ML algorithm. Since the appealing concept of ML has been an interesting topic for researchers, they have categorized ML algorithms innovatively. ML algorithms are generally categorized into four main classes including Supervised, Unsupervised, Semi-supervised, and Reinforcement learning. However, in this chapter, algorithms are discussed in more detailed categories based on their specifications. An overview of the subjects covered in this review is shown in Figure. 1.

Supervised Learning

Supervised Learning is known as the subset of ML and AI. The procedure of this algorithm is based on learning from labeled data for predicting the result more accurately. This algorithm is called Supervised since its learning process takes place through observation of variables. The process of learning will be continued till an acceptable level of accuracy is achieved. This type of learning is based on training data to make decisions, minimizes errors, compares and calculates desired outcomes. However, labeling large amounts of input and output big data in the training and testing phases can be a laborious task that consumes a considerable amount of time (Lee & Shin, 2020).

This algorithm is mostly used in bioinformatics, database marketing, spam detection, speech recognition, and many other fields. Supervised Machine Learning algorithm refers to methods that need assistance to perform, and starts its operation by classifying input data into two classes: a) Train, and b) Test.

The output of the training class contains variables to be classified. This can happen by learning the pattern from training data and applying them for predicting or classifying (Kotsiantis, 2007).

Some of the most popular Supervised Machine Learning algorithms that are discussed here are Decision Tree, Naïve Bayes, Support Vector Machine (SVM), Logistic Regression, and Random Forest.

Decision Tree

Decision Tree was first developed in 1959, by William Belson, a British researcher (Belson, 1959). This algorithm is defined as an alternating result from different series of decisions. One of the most popular areas to employ decision trees are planning and defining strategies. One of the advantages of a decision tree that makes it preferable to employ is its simplicity. There are different types and modifications of Decision Trees. The main difference between these algorithms is the mathematical model chosen to split attributes in extracting the Decision Tree rules. Decision Tree employs different algorithms to classify input data. For instance, CART, ID3, and C4.5 are popular algorithms in this regard (Richter and Khoshgoftaar, 2018).

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