ORIGINAL RESEARCH PAPER

Computer Science

A RESEARCH ON MACHINE LEARNING METHODS AND ITS APPLICATIONS

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ABSTRACT

Machine learning is a science which was found and developed as a subfield of artificial intelligence in the 1950s. The first steps of machine learning goes back to the 1950s but there were no significant researches and developments on this science. However, in the 1990s, the researches on this field restarted, developed and have reached to this day. It is a science that will improve more in the future. The reason behind this development is the difficulty of analysing and processing the rapidly increasing data. Machine learning is based on the principle of finding the best model for the new data among the previous data thanks to this increasing data. Therefore, machine learning researches will go on in parallel with the increasing data. This research includes the history of machine learning, the methods used in machine learning, its application fields, and the researches on this field. The aim of this study is to transmit the knowledge on machine learning, which has become very popular nowadays, and its applications to the researchers.

1. INTRODUCTION

Learning is defined as **"the process of a change and enhancement in the behaviours through exploring new information in time"** by Simon. When the "learning" in this definition is performed by the machines, it is called machine learning. The term enhancement is creating the best solution based on the existing experiences and samples during machine learning process (Sırmaçek, 2007). As a result of the developments in information technologies, the term 'big data' has emerged. The term 'big data' is not a new concept and can be defined as enormous and accumulating raw data sets which have no limits and cannot be analyzed by the traditional database techniques (Altunı ık, 2015). Enormous data are collected from the Internet applications, ATMs, credit card swiping machines and etc. The information collected by this way is waiting to be analyzed. The aim of analyzing the data collected in different fields change in accordance with the business sector. Machine learning applications are used in some fields like natural language processing, image processing and computer vision, speech and handwriting recognition, automotive, aviation, production, generation of energy, calculated finance and biology. However, the aim is based on the principle of analyzing and interpretation of the previous data. As it is impossible to analyze and interpret by human, machine learning methods and algorithms have been developed to do this (Amasyalı, 2008).

In this study, the concept of machine learning, which has become very popular recently, is examined in detail. The study includes information about the history of machine learning, the methods and algorithms used and its application areas. The final part is a conclusion which consists of the results of the previous studies.

2. Machine Learning

There is no error margin in the operations carried out by computers based an algorithm and the operation follows certain steps. Different from the commands which are written to have an output based on an input, there are some situations when the computers make decisions based upon the present sample data. In those situations, computers may make mistakes just like people in the decision-making process. That is, machine learning is the process of equipping the computers with the ability to learn by using the data and experience like a human brain (Gör, 2014).

History

In 1940s, based on the studies on the electrical crashes of the neurons, the scientists explained the decision-making mechanism of human by cannon and fire. In this way, the researches of the artificial intelligence started in the 1950s (Erdem, 2014). In those years, Alan Turin executed the Turing Test in order to test the ability of a machine to imitate a human. The aim of the Turing Test was to measure the ability of the machine to make a contact with a human during an interview. If the machine performed worse than a human, it was successful. In 1956, the term 'artificial intelligence' was first used in a summer school held by Marvin Minsky from Massachusetts Institute of Technology, John McCarthy from Stanford University and Allen Newell and Herbert Simon from Carnegie-Mellon University. Until that time, Alan Turing's term, 'machine intelligence', had been used.

Machine Learning Methods

Machine Learning can be examined in four parts as follows;
* Supervised learning
* Unsupervised learning
* Semi-supervised learning
* Reinforced learning

Supervised Learning:

It is a method in which the present input data is used to reach the result set. There are two types of supervised learning: classification and regression supervised learning.
* Classification: Distributing the data into the categories defined on the data set according to their specific features.
* Regression: Predicting or concluding the other features of the data based on its some available features.

Unsupervised Learning:

The difference between the supervised and unsupervised learning is that in unsupervised learning the output data is not given. The learning process occurs by using the relations and connections between the data. Also, unsupervised learning doesn't have a training data.

There are also two types of unsupervised learning: clustering and association.
* Clustering: Finding the groupings of data which are similar to each other when inherent groupings in the data is not known.
* Association: Determining the relations and connections among the data in the same data set.

Semi-supervised Learning:

supervised and unsupervised learning is inadequate when the labeled data are less than unlabelled data. In such cases, the unlabelled data, which are very inadequate, is used to deduce information about them. And, this method is called semi- supervised learning. The difference between the semi-supervised learning and the supervised learning is the labeled data set. In supervised learning, the labelled data are more than the data to be predicted. In contrast, in semi-

supervised learning, the labelled data are less than the data to be predicted (Kızılkaya ve O   uzlar, 2018).

Reinforcement Learning:
This is a kind of learning in which the agents learn via reward system. Although there is a start and finish points, the aim of the agent is to use the shortest and the correct ways to reach the goal. When the agent goes through the correct ways, s/he is given positive rewards. But the going through wrong ways means negative rewards. Learning occurs on the way to the goal (Sırmaçek, 2007).

Machine Learning Algorithms : Artificial Neural Networks
Artificial neural network is a data processing system which is developed based on the biological neural networks in the human brain to function like human brain neural networks (Kocadayı, Erkaymaz, ve Uzun, 2017).

Neurons (process elements) are the basics of artificial neural networks. Neurons have 5 basic functions: inputs, weights, summation function, activation function and output.

Inputs (x_1, x_2, …, x_n): It is the layer created by the user with the samples in the data set. **Weight (w_1, w_2, …, w_n):** It shows how much of the input data would reach the output. For example; $w1$ weight shows how much the $x1$ input would affect the output. The values of the weights can be changeable, which doesn't mean that the inputs are important or unimportant.

Summation Function:
This is the function which is used to calculate the total input in a cell.

Activation Function:
This function is used to calculate the output value which corresponds the input value. In some neural network models, it is must for the activation function to be derivable. Calculating the derivative is important for the learning process of the network. Thus, the derivation of the sigmoid function is the most commonly used function because it can be written in the function itself. It is not compulsory to use the same activation function in all the cells. They can have different activation functions. Activation functions are as follows: linear function, sigmoid function, hyperbolic tangent function, sine function, digit function.

Output:
This is the value which is determined by the activation value. The last output produced can both be sent to the other cells or to the outer world. If there is a feedback, the cell may use the output as an input by this feedback (Haciefendio   lu, 2012).

3. Machine Learning Application Areas
The previous section includes the theoretical background of the machine learning algorithms. In this section, information about the areas and studies in which the machine learning are used nowadays will be given.

1. Education:
One of the most important application fields is education in which there have been some studies in order to identify and increase success recently. Despite the projects made in the field of education in recent years, the desired success has not been achieved.

There are a lot of factors that influence this failure. However, it has not been determined which factor has more influence on this failure. In this context, by a questionnaire applied to secondary school students, the successes of the students in the lessons were predicted by machine learning models, which resulted with success

2. Image processing:

In this method, it is aimed to process and improve recorded images. Some application areas where the image processor is used are as follows:
- Security systems
- Face detection
- Medicine (to diagnose diseased tissues and organs)
- Military (to process underwater and satellite images)
- Motion detection
- Object detection

3. Computational biology:
- DNA sequencing
- Finding a tumor
- Drug discovery

4. Natural language processing:
It is aimed to investigate and analyse the structures of natural languages. It is possible to perform many applications with natural language processing:
- Automatic translation of written texts
- Question-answer machines
- Automatic summarization of text
- Understanding speech and command

5. Automotive, aviation and production:
- Detecting malfunctions before they occur
- Producing autonomous vehicles

6. Retail:
- Customized shelf analysis for persons
- Recommendation engines
- Material and stock estimates
- Purchasing - demand trends

7. Finance:
- Credit controls and risk assessments
- Algorithmic trading

8. Agriculture:
- Predicting yields or deficiencies by analysing satellite images

9. Human Resources:
- Selecting the most successful candidate among a lot of applicants.

10. Energy:
- Calculating the heating and cooling loads for building designs
- Power usage analysis
- Smart network managements

11. Cyber security:
- Detecting the harmful network traffic
- Finding out address fraud

CONCLUSION
Along with the developments in the technology in recent years, machines have a big role in our lives. There are a lot of data gathered in every part of our lives and these data are increasing day by day. Thanks to the machines, these data are used very efficiently. Although these machines are thought to be used only in the fields of engineering and computer science, they are encountered at every part of human life.

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