

Chapter 69

Overview of Machine Learning Approaches for Wireless Communication

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ABSTRACT

Machine learning is one of the most popular research areas, and it is commonly used in wireless communications and networks. Security and fast communication are among of the key requirements for next generation wireless networks. Machine learning techniques are getting more important day-by-day since the types, amount, and structure of data is continuously changing. Recent developments in smart phones and other devices like drones, wearable devices, machines with sensors need reliable communication within internet of things (IoT) systems. For this purpose, artificial intelligence can increase the security and reliability and manage the data that is generated by the wireless systems. In this chapter, the authors investigate several machine learning techniques for wireless communications including deep learning, which represents a branch of artificial neural networks.

INTRODUCTION

Convolutional neural networks and deep learning is very popular not only for wireless communication but also other areas. Deep learning is a type of machine learning that researchers have shown interested in recent years because of its recognition performance. Nowadays, it is mostly preferable by the scientists for improving the performance of learning techniques and building intelligent systems to help people. Intelligent systems on speech recognition, pattern recognition, image identification, robotics, bioinformatics, and others are used for different areas like computer vision, computer games, robots, cars, medical systems, financial forecasting, information retrievals, medical diagnosis, natural language processing, and online advertising. Recent developments in technology and human requirements need more intelligent systems. Therefore, the importance of artificial intelligence is getting more important.

In our technologically based daily life, we generate and record data. This data continues to accumulate and grow, whether we like it or not. This is called ‘Big Data’ as a reference to its size. Although big data is constantly growing, it is not possible to make sense of this data as long as we do not implement the necessary methods. Many studies proposed by scientists to manipulate the data are being studied for their proper processing tools or methods.

In this chapter, we will investigate several machine learning techniques for wireless communications including deep learning (Brunato & Battiti 2005; Callado et al., 2009; Demestichas & Dimitrakopoulos 2006; Haykin 2005; Hussain et al., 2009; Pinto & Montez 2010; Wang 2007; Zhang et al., 2009; Zhang et al. 2013). Deep learning is a branch of artificial neural networks. Machine learning algorithms are divided into two parts as supervised learning and unsupervised learning according to their learning strategies. Linear regression, logistic regression, decision trees, k-nearest neighbors, Naïve Bayes, random forest and support vector machines algorithms are the examples for the supervised machine learning techniques. K-means clustering, hierarchical clustering, singular value decomposition, nonnegative matrix factorization and hidden markov models are some example algorithms for unsupervised learning. For most of the algorithms, before starting to execute learning algorithms, data preprocessing is taking an important place and has a big influence on the success of the accuracy of the method. The preprocessing part consists of feature extraction, data conversion, and feature selection.

Scientists and developers started to work on artificial neural networks many years ago. It is improved by analyzing the working principle of human brain. To make it clear we need to understand the terms about neural networks. Number of connections between neurons and speed of the data transmit are the reasons for why human brain was taken as inspiration source for learning. Biological neuron has dendrites, cell body and axon. Dendrites take signals, forward it to cell body to process it and send the processed data to axon to transmit it to other neurons. Similarly, artificial neurons get inputs with weight value that is generated particularly for each input. Inside the neuron, inputs and weights are multiplied and summed. The main point of the learning is about the determining and updating of the weights. Therefore, multilayer perceptrons and artificial neural networks with more layers created the deep learning concepts. Deep learning has the model that provides hierarchical learning. Each layer represents a different level of learning. If readers are interested in not only artificial neural networks and deep learning but also in other machine learning algorithms, they should know basic knowledge about calculus, linear algebra, probability theory, numerical computation, and optimization theory.

Rest of this chapter was organized as following. In section 2, some machine learning and big data processing methods, that used to solve necessary issue in wireless communication, have been categorized to reader for general overview. Some of methods that mentioned in section 2, has been explained briefly

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