

## Chapter 22

# Deep Learning and Biomedical Engineering

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### ABSTRACT

*Deep learning (DL) is a method of machine learning, as running over artificial neural networks, which has a structure above the standards to deal with large amounts of data. That is generally because of the increasing amount of data, input data sizes, and of course, greater complexity of objective real-world problems. Performed research studies in the associated literature show that the DL currently has a good performance among considered problems and it seems to be a strong solution for more advanced problems of the future. In this context, this chapter aims to provide some essential information about DL and its applications within the field of biomedical engineering. The chapter is organized as a reference source for enabling readers to have an idea about the relation between DL and biomedical engineering.*

### INTRODUCTION

It is clear that the World is currently in an age of intelligent innovations. These innovations are all cause of the field of Artificial Intelligence and the rise of this scientific field seems almost infinite. While all improvements – developments by intelligent systems are appeared rapidly, the importance of using the data and processing it becomes more visible. As a result of all technological developments and increasing interaction of the humankind with the data oriented machines – devices, it is now more important to have systems processing data in a fast way and of course accurately. Since its first appearance in the scientific arena, Artificial Intelligence seems the most powerful candidate for this task. Today, we cannot think about any field that is not associated with the approaches, methods, and techniques introduced by Artificial Intelligence. It is a clear situation that we hear news about an innovative intelligent system dealing with a particular real world in each day and it seems that this situation will continue as long as the humankind want to experience the life with a World in which intelligent machines – systems are living. But an important issue regarding to the mentioned reality has become always the amount of data. As the society and technologies rise, the amount of data and complexity of processing them to solve

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newly encountered real world problems has become a common research problem among scientists. But the most effective answer to that issue has give from the Artificial Intelligence side. ‘The science of the future’ now has a well-structured, effective approach, which is effective enough to deal with bigger data within complex problems. Called as Deep Learning, this approach of Artificial Intelligence and so Machine Learning has lots of application ways as it is seemed from the reported research results.

The Objective of this chapter is providing some essential information about DL and its applications within the field of Biomedical Engineering. The chapter was organized as a reference source for enabling readers to have idea about relation between DL and Biomedical Engineering. Research works considered – referred here are from the most recent literature to give well-enough information what is actually done in the intersection of Deep Learning and Biomedical Engineering.

Based on the subject of the chapter, the remaining sections are organized as follows: The next section is devoted to some essential information about Deep Learning and its general application types. Following to that, the third section draws the connection between Deep Learning and Biomedical Engineering, and gives information about some remarkable and recent works. Next, the fourth section provides some future ideas by the authors and finally, the chapter ends with the conclusion section.

## **DEEP LEARNING**

Before discussing about Deep Learning and Biomedical Engineering, it is a good idea to briefly introduce the concept of Deep Learning and take a look at to its application ways.

### **The Concept of Deep Learning**

In the past few years, Deep Learning (DL) has rapidly evolved into the de-facto approach, showing tremendous improvement in accuracy, robustness, and cross-language generalizability over conventional approaches (Deng & Yu, 2014). DL also termed as Hierarchical Learning or Deep Structured Learning in some of the literature work is a technique of Information Processing. It is a sub-set of machine learning methods. It is the process of training and learning from Artificial Neural Networks (ANNs) containing more than one hidden layer. DL allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction. These methods have dramatically improved the state-of-the-art in drug discovery and genomics. DL discovers intricate structure in large data sets by using the backpropagation algorithm to indicate how a machine should change its internal parameters that are used to compute the representation in each layer from the representation in the previous layer. Deep convolutional networks have brought about breakthroughs in processing bio medical images, video, speech and audio, whereas recurrent networks have shone light on sequential data such as text and speech (LeCun et al., 2015). To date, DL has emerged as the leading machine-learning tool in the general imaging and computer vision domains. DL is a growing trend in general data analysis and was termed as one of the 10 breakthrough technologies of 2013 (MIT Tech. Review, 2013). DL has improved day by time till nowadays as an important approach for the future of intelligent systems.

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