


# Chapter 18

## What Is Deep Learning and How Has It Helped the COVID–19 Pandemic?

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### **ABSTRACT**

*Since the beginning of the COVID-19 pandemic, researchers have been trying to find solutions through international collaborations and interdisciplinary studies. This chapter aims to present how deep learning is used for the COVID-19 pandemic. Within this scope, this chapter covers the fundamentals of deep learning in terms of definitions, key concepts, popular network types, and application areas. Then it gives a summary of the most recent studies in which deep learning models are used for COVID-19. The authors believe this chapter is a good start for researchers who want to study deep learning. In addition, the literature review section of this chapter, which was prepared by considering the COVID-19 pandemic, is expected to shed light on a broad range of health studies within the pandemic process and to provide better solutions to similar problems encountered in different sectors.*

### **INTRODUCTION**

COVID-19 caused by SARS-CoV-2 first appeared in the Wuhan province of China at the end of 2019. It spread very quickly across the world and in March 2020 was declared as a pandemic by the World Health Organization. As of the beginning of March 2021, there are approximately 112 million COVID-19 cases in the world. Nearly 91 million people recovered and approximately 2.6 million people died due to the virus. Since there was no approved drug or vaccine to be used in treatment at the beginning of the pandemic, healthcare professionals in hospitals encountered a burden of patients over their service

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capacity. The virus became a serious threat to human life. Governments tried to prevent the rapid spread of the virus by making a quarantine decision. Individuals also tried to protect themselves from the virus by paying attention to the use of masks, hygiene, and social distancing. Besides individual losses, almost every sector such as health, finance, economy, education, transportation, and tourism has been adversely affected by the pandemic.

Unlike past pandemics in history, such as the black death, smallpox, and HIV/AIDS, today we have more powerful technological and computational advances which offer undeniable contributions to the diagnosis, treatment, and prevention of COVID-19. As the amount of data on COVID-19 patients (such as symptoms, X-ray images, CT scans, results of Reverse Transcription-Polymerase Chain Reaction (RT-PCR), antigen and antibody tests) increased, the role of interdisciplinary studies in medicine and computer science gained importance in the process. In recent years, progress in artificial intelligence, and particularly in machine learning and deep learning, has impacted a host of fields, including medicine. Deep learning is one of the sub-fields of machine learning and can also be seen as the re-rise of Artificial Neural Networks.

Deep learning models enable researchers to deal with a huge amount of data due to increased inexpensive data storage capacities, the emergence of computers with powerful processors, and other computational advances. Deep learning has achieved high performance on tasks that are considered easy for humans, but in the past were considered difficult for machines/computers, such as object recognition, natural language processing, and speech recognition. Deep learning learns patterns in the data, rather than the development of rule-based systems in the early years of artificial intelligence. An important source of inspiration for deep learning models has been the structure and functioning of the brain. For instance, the visual system in the brain learns complex structures such as visual objects, by first learning simpler features such as edges, and then across multiple stages (i.e., deeply) learning textures and shapes, and finally learning to recognize whole objects. Recent studies show that deep learning models have already been used for classification, prediction, identification, and diagnosis of COVID-19, with the help of medical imaging (such as X-ray images and CT scans) (Cohen, Morrison, & Dao, 2020; Wang & Wong, 2020; Zhao et al., 2020). Deep learning has also contributed to drug and vaccine discovery (sometimes considering mutations/variants), forecasting and tracking the spread of the disease, and social distance monitoring.

This book chapter aims to present how deep learning is used for the COVID-19 pandemic. Within this scope, this chapter covers the fundamentals of deep learning in terms of definitions, key concepts, popular network types, and application areas. Then it gives a summary of the most recent studies in which deep learning models are used for COVID-19. The authors believe this chapter is a good start for researchers who want to study deep learning. In addition, the literature review section of this chapter, which was prepared by considering the COVID-19 pandemic, is expected to shed light on a broad range of health studies within the pandemic process and to provide better solutions to similar problems encountered in different sectors.

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