Chapter 12
Mind Uploading in Artificial Intelligence

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ABSTRACT

Mind uploading is the futurist idea of emulating all brain processes of an individual on a computer. Progress towards achieving this technology is currently limited by society's capability to study the human brain and the development of complex artificial neural networks capable of emulating the brain's architecture. The goal of this chapter is to provide a brief history of both categories, discuss the progress made, and note the roadblocks hindering future research. Then, by examining the roadblocks of neuroscience and artificial intelligence together, this chapter will outline a way to overcome their respective limitations by using the other field's strengths.

INTRODUCTION

The concept of mind uploading has been explored in science fiction for over fifty years, however, we are only scratching the surface of how to bring this technology into existence. Humanity's current trajectory towards discovery is vastly disagreed upon. Famous computer science theorists the world over have differing opinions on when mind uploading will be recognized. In an interview with IEEE Spectrum, a few of these theorists were asked to predict when machines would surpass the computational limitations of the human brain. Ray Kurzweil, cofounder of Singularity University and author of countless books dedicated to this very subject, predicts that, "computers will match and then quickly exceed human capabilities in the areas where humans are still superior today by 2029" (IEEE Spectrum, 2023). Meanwhile, Robin Hanson, author of *The Age of Em: Work, Love, and Life When Robots Rule the Earth* and Chairman and CTO of Rethink Robotics, Rodney Brooks, both believe it to be centuries away (2023). Despite the wide range of singularity projections, most theorists believe the key to unlocking a computer's emula-

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tive potential is brain scans. Additionally, most of these predictions hinge on the creation of nanobots, capable of being injected into the bloodstream to travel to the brain and transmit a full scan. This paper will propose a different method, a new path towards whole brain emulation. Taking current neurological findings and pairing it with recent progress in the development of complex machine learning models could be the best way to shave decades, and possibly centuries, off the mind uploading development timeline.

The rest of the chapter is organized as follows. An overview of the background of mind uploading technologies is given in section 2. Section 3 examines major approaches of artificial intelligence. Section 4 proposes how neuroscience and meta-learning could be united to finally reach the goal of mind uploading. Current limitations, challenges, and ethical issues in mind uploading are discussed at the end.

BACKGROUND

To develop technology that emulates brain function, we must first have a way to measure and record brain function. The ability to analyze brain waves and electrical impulses was, and still is, fundamental for all experiments to follow. In this section, this paper will discuss three of the most important developments towards understanding the human brain and how it relates to mind uploading: Brain Computer Interfacing, the Blue Brain Project, and nanobots. The main issues in mind uploading, from a neurological standpoint, are addressed at the end of the section.

BCI Technology

BCI stands for Brain Computer Interfacing. An organization known as the BCI Society categorizes a BCI system based on its functionality, which could be any of the following: replacement, restoration, enhancement, supplementation, or improvement (Welikala & Karunananda, 2017). The first recorded advancement in understanding brain function was discovered by a British physician, Richard Caton, in 1875 (Welikala & Karunananda, 2017). He was the first to note electrical impulses due to brain activity. This discovery was humanity's first step towards harnessing the power of BCI technology. Then, in 1929, a German Psychiatrist, Hans Berger, recorded these same signals using a device with small discs covering the scalp. Now, the process of using this type of gadget to measure and record brain activity is called Electroencephalography (EEG). Despite the impact this discovery has on neuroscience today, his work was originally dismissed and abruptly brought to a halt by the Nazi regime and his eventual suicide. When Berger's work was replicated by two British physiologists in 1934, EEG was finally accepted as functional and effective (Biasiucci et al., 2019).

When Brain Computer Interfacing technology was first introduced in the 1970s, it was frequently set aside due to the costliness of the equipment and the logistics of human testing (Welikala & Karunananda, 2017). During this era, several distinguished computer scientists tried to layout a reasonable path to mind uploading. The first was Hans Moravec in 1988, when he published a technical explanation on the mind uploading method of replacing each individual brain cell with software until the whole brain is emulated. The next was Ralph Merkle in 1989, where he used automated analyses to test the possibility of reestablishing the brain through this method. With the success of his tests, he reported that we should see the emergence of this technology in a few decades (Welikala & Karunananda, 2017). This revelation sparked an onslaught of projects that attempted to scan and reconstruct the human brain, one of which was mildly successful.