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Adaptive AI's Kept Promises to Neuroscience

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Introduction

A complex and Powerful organ has long been the subject of fascination and study. The journey to emulate the human brain is bridging the gap between artificial intelligence and Neuroscience, the intersection of AI and Neuroscience brings with it exciting possibilities as well as ethical challenges. There is immense progress made in this area and the challenges ahead we will look at, and a possible future of using artificial intelligence to mimic the human brain. Journey of understanding the human mind has come a long way AI and Neuroscience have often drawn inspiration from each other. Early AI research was based on mimicking human cognitive processes, while Neuroscience uses AI to analyse complex neural data.

This Synergy has led to the development of advanced neural network models, and machine learning algorithms that have pushed the boundaries of both fields. Deep learning is the most important factor that advances at the intersection of AI and Neuroscience, at the development of artificial neural networks and deep learning these models are inspired by the biological structure and functioning of the human brain. They are capable of processing large amounts of data learning patterns, and making predictions. Artificial neural networks are still not capable of simulating the full complexity of the human brain, however, they have provided valuable knowledge of the principles governing neural processing.

Computer interfaces and Neuroprosthetics are some another area where AI and Neuroscience intersect, it is in the development of brain computer interfaces and neuroprosthetics that enables direct communication between the brain and external devices. Whereas, neuroprosthetics involves replacing or enhancing damaged neural functions with electronic or mechanical

components. AI driven techniques can improve the treatment of various neurological disorders, and improve the quality of life for patients with sensory or motor impairments. Human Connectome Project, is a major effort to map the complex connections of the brain. It has greatly benefited from the data processing capabilities of AI, machine learning algorithms have been used to analyse the vast data sets generated by Advanced neuroimaging Techniques. It has provided researchers with detailed maps of neural connections, this information is important for understanding brain function. This brings us one step closer to mimicking the human brain.

Ethical Challenges - as we move towards replicating the human brain, the ethical implications of such an achievement must be considered. A strong ethical framework is essential to guide future developments in AI and Neuroscience. To conclude, although significant progress has been made in understanding the human brain, and in developing AI technologies replicating the brain in its entirety remains a distant goal. The complexity of the brain with its billions of neurons and trillions of connections presents considerable challenges, furthermore the human brain is not a static entity. The human brain constantly changes over time this adds another layer of complexity to the simulation process

AI is the study and development of computer systems able to perform tasks that are normally believed to require human intelligence, and if we look at the terminology that is commonly used in AI research, we can clearly see that this terminology and vocabulary is almost entirely imported from Psychology and Neuroscience. So, there is a very strong terminological overlap between the categories that are commonly used in neuroscience, and the categories that are commonly used in artificial intelligence.

And, this overlap of terminologies is not purely random, it actually has historical reasons. In fact, both modern cognitive neuroscience and artificial intelligence have a common origin which can be traced back to what historians of science tend to refer to as the cognitive revolution. Namely, the birth of the cognitive Sciences, which occurred in the 1950s and 1960s. Mostly, triggered by people such as Marvin Minsky Alan Newell Herbert, Simon uh Claude Shannon and many other people who gathered around Darth mood College in the summer of 1956.

The research line of all this very heterogeneous, spectrum of scientists was about basically highlighting the necessity of postulating mental systems to process sensory inputs, and this premise led to the application of the scientific method to the study of those mental systems which in turn led to the origin of modern Neuroscience. This was basically the study of the neurobiology of mental systems in humans and other animals, and simultaneously some researchers applied the same scientific method, not to the study of the neurobiology of mental systems in humans, but to the reproduction of mental systems in machines.

Topics such as the ethics of cognitive enhancement drugs, and related ethical implications in contrast AI ethics has focused primarily on issues such as Robert rights algorithmic explainabilities, fairness of AI algorithms as well as issues surrounding Black Box problems, transparency and accountability. Now despite this very strong overlap between these two disciplines. Only in recent years we are experiencing some greater communication and collaboration between neuroethics and AI ethics. However, the point that I would like is that, due to some developments at the interplay between AI and Neuroscience. We can no longer afford to have the ethics of Neuroscience decouple from the ethics of AI and vice versa. In contrast, we argue that we do need a unified ethical framework for the entire brain and AI continuum.

Applications of AI and Neuroscience, and Neuroscience in AI, we observed that the scientific literature on these

topics revolves around four main domains of application. So, one is prediction, AI algorithms especially are supervised learning models and convolutional neural networks have large application for predicting the onset of neurological and psychiatric disorders from brain data in particular. We looked at a high prominence of convolutional neural networks approaches for the prediction of the onset of Alzheimer's disease as well as the use of approaches to supervised learning to predict. For example, the onset of the epilepsy from intracranial EEG data.

The second domain of obligation is diagnosis so besides predicting disease from biomarkers some AI models are, holding potential for early diagnosis of neurological and psychotic conditions including Alzheimer's disease, mild cognitive impairment, ADHD, schizophrenia and many others and the third domain is brain modelling . And, here is about using AI models to simulate or model brain mechanisms and functions, and this is the primary target goal of the human brain project. So, it's a very pertinent topic today and then finally AI models have greater and greater obligation in the development and design of neural Technologies, especially brain computer Interfaces. Here, I think we can quite confidently say that AI is revolutionizing the design and development of BCI.

So, if we want to Cluster this Trends in the interplay between neuroscience and AI in a bit more metaphorical way but hopefully easier to grasp way we can say that there are three main socio-technical Trends. The first one is, what we can call the digital mind namely the fact that more and more activities and processes of the human mind are becoming inferentially analysable based on data from digital devices and AI algorithms.

The second trend is what we can call artificial mind so this precisely refers to modelling, so neuromorphic approaches to Computing are increasingly able to mimic the functioning of the human or other animal brains in data processing and use especially regarding certain cognitive tasks and the third Trend is what we can call the hybrid. Namely, the incorporation of AI features in brain computer interfaces, especially in closed-loop systems can lead to a greater degree of integration and mutual influence between the cognitive and effective processes of the human individual and AI systems.

The digital mind, as I said before is this increased availability of Digital Data about human mental functions and also the increase availability of brain related information. And, this is triggered not only by consumer neurotechnology which is of course the most obvious trend in this domain. But, also by other Trends, such as digital phenotyping social media and Effective computing and all those added friends they may not rely directly on brain data, but, they may be used to make inferences about mental States.

The artificial mind, in contrast concerns the obligation of artificial intelligence, to the study of Neuroscience and here I really would like to refer to a very nice review by Shimon Allman and science who studied the interaction between Ai and Neuroscience and observed how this is a bi-directional interaction. On the one end we are improving, our understanding of the human brain through artificial intelligence, but, on the other hand we are simultaneously improving AI through better understanding of the human brain. And, finally I mentioned the hybrid mind which is described as a biological system that involves a two-way a bi-directional exchange of information between a biological brain, and AI and in which there are processes of mutual adaptation between the human user and the artificial system.