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Comprehensive Review on Deep Learning for Neuronal Disorders:
Applications of Deep Learning

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ABSTRACT

In the last few years deep learning (DL) has gained a great attention in modern technology. By using a deep learning method, we can analyse different types of data in different domains which is near to the accuracy of humans. As DL is our upcoming technology and it is also under development, we can say DL is the successor of machine learning (ML) technique. In the present era, ML is used everywhere, wherever we need to analyse statistical data. As we can say DL is our future technology that going to cover every sector of our modern industry, one question always remains: why we are lagging? So, the simple answer in terms of analysing any algorithm is complexity, both time and space. DL needs a large artificial neural network (ANN) with hundreds of hidden layers trained with a huge amount of data. So, to performing these tasks we need high-performance computing device that is very expensive in nowadays. With the growing industries of semiconducting devices, we can easily say that the future of DL is about to come with developing artificial intelligence (AI). As an example, in 2009, the Google Brain, a deep learning artificial intelligence team of Google introduced a Nvidia GPU which increased the learning speed of DL system by 100 times. As of 2017, the intermediate connection of networks increases to a few million units from few thousand, this network can perform several tasks like object recognition, pattern recognition, speech recognition, and image restoration. It has a greater scope in bioengineering since each living organism contains a huge amount data; it can be used for disease diagnosis, rehabilitation, and treatment. It can also help by using data to find the different features and helps us to take several possible decisions in real time. In this review, we found that DL can be very helpful for diagnosing neurological disorders by its symptoms, because DL can be used to identify patterns for each disorder for identification. The benefit is learning how DL can be helpful identifying different neuronal disorders based on different neuropsychiatric symptoms.

KEYWORDS

Artificial Intelligence (AI), Deep Learning (DL), Machine Learning (ML), Neuronal Disorder, Physiological Signals

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1. INTRODUCTION

Deep Learning (DL) is an advance tool of Machine Learning (ML) System that is a part of Artificial Intelligence (AI) in the domain of Computer Science (Deng & Yu, 2014). Each and every algorithm has been designed to solve some specific types of problem. The required time to solve a particular problem is denoted by its Time Complexity or more specifically we can say according to the verse of computer science, the Time Complexity defined as the time to execute a particular programme to solve a specific type of problem This is denoted by "big O notation," (Gao & Xu, 2014). Analyzing the Time Complexity of problems we can classify all types of problems in two different categories, a polynomial time algorithm or P class problem that is denoted by $O(p(n))$ where $p(n)$ is a polynomial function and another is none-deterministic polynomial time algorithm or *NP class* problem which take exponential time format to solve it (Garey & Johnson, 1990). Here we can say that if we develop a machine or technique that is capable of solving the NP type problem that can also solve P type problem, so P is a proper subset of NP that is $P \subseteq NP$ (Meek, 2008). Now NP problems can also be converted into satisfiability problem that is solvable in polynomial time, this type of problem is called "hardest" problem in NP class, or we can say NP-Hard problem (Karp, 1972). Sometimes it is found that "hard" problem can also be solved as satisfiability problem, those are called NP-Complete problem. The Venn diagram of P, NP, NP-Complete and NP-Hard problem is shown in Figure 1.

Artificial Intelligence (AI) the intelligence of machine by which we try to solve the problem belongs to the NP-Complete problem using probabilistic solution, sometimes it is also called AI-Complete (Yampolskiy, 2012). AI is mainly based on human thoughts and assumption that is further mechanized or we can say artificially designed. But the idea of AI or the journey of AI started many centuries ego. In Greek mythology Hephaestus and Pygmalion incorporated the idea of intelligent robots (such as Talos) and artificial beings (McCorduck, 2004). Aristotle; 384–322 BC described the deductive reasoning to come with a conclusion using logical arguments popularly known as

Figure 1. P, NP, NP-Complete and NP-Hard problem