Chapter 9
Deep Learning in Early Detection of Alzheimer's: A Study

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ABSTRACT

Advancement in technology has paved the way for the growth of big data. We are able to exploit this data to a great extent as the costs of collecting, storing, and analyzing a large volume of data have plummeted considerably. There is an exponential increase in the amount of health-related data being generated by smart devices. Requisite for proper mining of the data for knowledge discovery and therapeutic product development is very essential. The expanding field of big data analytics is playing a vital role in health-care practices and research. A large number of people are being affected by Alzheimer's Disease (AD), and as a result, it becomes very challenging for the family members to handle these individuals. The objective of this chapter is to highlight how deep learning can be used for the early diagnosis of AD and present the outcomes of research studies of both neurologists and computer scientists. The chapter gives introduction to big data, deep learning, AD, biomarkers, and brain images and concludes by suggesting blood biomarker as an ideal solution for early detection of AD.

INTRODUCTION

The huge amount of data being generated by healthcare industry has great future to support a variety of healthcare and medical functions. The digitization of this voluminous data generated by the healthcare industry is the Big Medical data. This data includes physicians' prescription, laboratory test data, X-ray, scan reports, pharmacy data, patient data in Electronic Health records, sensor data, social media posts

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which includes tweets, Facebook messages and status updates, news feeds, newspaper, magazines and medical journals.

The digitization of medical data, the field of genomics and use of wearable sensors to monitor patient health are some of the factors that have contributed to the growth of Big Data in Health Care/Biomedicine (Mathew & Pillai, 2016).

Big Medical Data can be used by researchers to identify patterns which can be used for predictions. For example, in the case of Alzheimer's, disease (AD) by analyzing the MRI images of the brain certain patterns can be identified. This knowledge can be used in identifying the ones who are at the greatest risk of getting this disease.

Big data analytics has helped in medical research as we have the necessary software and algorithms capable of analysing cognitive functions and help doctors to easily identify such patients. Lumosity is a brain game platform wherein user score data is used for early detection of Alzheimer's before a permanent neuronal loss occurs (Krishnan, 2018). High-dimensionality research in the future is likely to create intelligent analytical systems that are capable of generating effective disease diagnostic and drug development deliverables. Biomedical datasets are growing daily and a plethora of high-dimensionality datasets are now freely accessible for neurodegenerative diseases, such as AD (Maudsley, Devanarayan, Martin & Geerts, 2018). The convergence of advanced computing and numerous Big Data technological options has paved the way to attain high performance and scalability at a relatively low cost. Big data solutions usually come with a set of innovative data management solutions and analytical tools, and when effectively implemented can transform the healthcare outcomes (Mathew & Pillai, 2015).

Deep Learning

Deep learning is an artificial intelligence function in machine learning that enables computers to learn from experience and understand the world in terms of a hierarchy of concepts. Deep Learning (DL) is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks (Browniee, 2016). In Deep learning neural network composed of several layers are used. The node combines input from the data with an associated weight or coefficient. The product of input and weight are summed and sent to the activation function. Depending on the value of the summation, the signal progresses further through the network to identify the final outcome. The earlier versions of Neural Networks had one input, one output, and one hidden layer. In deep learning, there is more than one hidden layer and each layer of nodes is trained on a different set of features based on the previous layer's output. One main benefit of deep learning is as there are several layers, and as we go deep into the network, nodes will be capable of identifying complex features as they aggregate and recombine features from the previous layer.

Supervised learning algorithms used are:

- Logistic Regression
- Multilayer perceptron
- Deep Convolutional Network

Semi-Supervised / Unsupervised Learning algorithms are: