Chapter 17

Introducing the Deep Learning for Digital Age

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ABSTRACT

Deep learning is playing vital role with greater success in various applications, such as digital image processing, human-computer interaction, computer vision and natural language processing, robotics, biological applications, etc. Unlike traditional machine learning approaches, deep learning has effective ability of learning and makes better use of data set for feature extraction. Because of its repetitive learning ability, deep learning has become more popular in the present-day research works.

INTRODUCTION

Deep Learning is a subset of Machine learning in Artificial Intelligence that simulates with the working nature of human brain in processing the unstructured or unlabeled data using unsupervised method and creating patterns which will be used further for decision making. Deep Learning also called Deep Neural Network uses neural networks. Deep Learning became popular in digital era because of an explosion of data from various parts of the world from various sources such as social media, internet search engines, e-commerce platforms, etc. And we simply call this data as Big Data which is unstructured in nature. Manual process of retrieving the relevant information from the Big Data takes decades. Hence it became necessary to develop automated models that adapt techniques of Machine Learning in Artificial Intelligence to retrieve wealthy information hidden in the Big Data. Thus, Deep Learning became popular nowadays as it learns the system in repetitive process deeply and supports in building automated models.

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Artificial Neural Networks (ANN) is employed by Deep learning to assists the process of machine learning. The ANN in structure simulates the human brain with neuron nodes connected like a web. ANN is a multi layered network, input of the one layer is the output of the preceding layer in such way information is passed through each layer in the network. The initial layer of the network is the input layer and the layer at the end of the network is called an output layer. There are many layer called hidden layers between input and output layers consisting of neurons and they are connected to each other. Deep Learning operates on the data using nonlinear approach because of its hierarchical function the computers. The hierarchy of knowledge in deep learning for each layer represents a deeper level of knowledge. Hence, with increasing number of layers in neural network it will learn more complex features than a few layers of neural network. Learning occurs in two phases in Deep Learning. First phase consists creating a statistical model as output by applying a non linear transformation of the input. Second phase focus at improving the model with a mathematical method known as Derivative. These two phases are repeated hundreds to thousands of time until it has achieved decent level of accuracy. For example, Deep Learning nonlinear technique will adapt present or instance time, current position, IP address, and other attributes for detecting and identifying illegal activity. In Deep Learning, the first layer of the neural network processes takes raw data as input and passes through the second layer as output. The second layer will pass its output to the next layer along with the previous layer’s output. The third layer takes the second layer’s information and adds additional information and produces data patterns. The series of constructing data patterns continues through all levels of the neuron network.

Deep learning is making major advances in solving problems of the artificial intelligence community that have resisted the best, attempts for many years. It has turned out that in high-dimensional data deep learning is very good at finding complex structures and is therefore applicable to many domains of business, science and government. In addition it has done far more better in at predicting the activity of potential drug molecules, analyzing particle accelerator data, reconstructing brain circuits, and predicting the effects of mutations in non-coding DNA on gene expression and disease compared to other machine-learning techniques. It has produced extremely favorable results for various tasks in natural language understanding, classification of particularly topic, analysis of person sentiment, answering questions and language translation.

Background

Deep learning was first emerged in 1940s with the development of Artificial Neural Network (ANN). McCulloch and Pitts (1943) by analyzing and summarizing the characteristics of neurons proposed the model of ANN named as McCulloch-Pitts (MP) model. Hebb (1949) in their work, proposed a cell assembly theory for describing cerebral neuron adaptation process during its learning, explaining the development of neural networks. To imitate the thought process of the cerebral neuron process they used a combination of algorithms and mathematics called “threshold logic”. Deep Learning has been steadily evolving since then, with only two significant breaks in its development. Later, Rosenblatt (1958) developed an important concept of ANN called the perceptron algorithm. The author explains the perceptron algorithm as a binary classifier that adapts supervised learning. Widrow (1990), an author based on the MP model proposed a single layer artificial neural network which has the property of the adaptive linear element. Kunihiko Fukushima first used “convolutional neural networks”. Neural networks with multiple pooling and convolutional layers was designed by Fukushima. In 1979, he developed an artificial neural network which used a hierarchical, multilayered design, called Neocognitro. It permitted the computer