Chapter 9
Neural Network and Neural Computing

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ABSTRACT

Deep learning, a subset of AI, has gained popularity in various fields, including computer vision and NLP. It is based on artificial neural networks, which process multiple layers of data and extract high-level features automatically. Unlike traditional ML algorithms, deep learning can process large unstructured data and complex algorithms better than traditional methods. The human brain inspires neural networks, which contain artificial neurons similar to biological neurons. These networks are made up of three layers: input, hidden, and output. Deep learning maps inputs to outputs and finds correlations, making it a "universal approximator." It can be combined with other AI methods to perform more complex tasks, such as deep reinforcement learning. Top companies using ANN include Nvidia Corp., Alphabet, Salesforce.com, Amazon.com, Microsoft Corp., Twilio, IBM, and Facebook. Deep learning uses ANN to analyze data and make predictions and has found applications in almost every business sector.

INTRODUCTION

The progress in Machine Learning has facilitated the advancement of Artificial Intelligence. Many people consider deep learning to be the most advanced technique available for resolving complex problems requiring large amounts of data. In this part, we will examine what a neural network is and how it may solve challenging data-driven problems.

A neural network was created to mimic and imitate the functioning of the human brain. An artificial neural network (ANN) is made up of many perceptrons, as explained below, whereas the human brain is a neural network made up of many neurons.

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A node's or neuron's activation function for a particular input or set of inputs determines the node's or neuron's output in artificial neural networks (ANNs). Artificial intelligence has come a long way, bridging the gap between humans and machines. Enabling and programming machines to view their surroundings in the same manner that humans do is the aim of the field of computer vision. This knowledge is applied to computer vision applications such as picture analysis, classification, and recognition. In computer vision, deep learning has shown to be effective, especially when using the convolutional neural network approach.

Historical Perspective of Neural Networks

Neural networks have a long history, dating back to the 1940s when McCulloch and Pitts proposed the first mathematical model of artificial neurons. In the 1950s, Rosenblatt developed the perceptron, an algorithm for pattern recognition based on a single-layer network. However, the perceptron had limitations in solving non-linearly separable problems, leading to a decline in neural network research in the 1960s and 1970s. The 1980s saw the invention of the backpropagation algorithm, enabling the training of multi-layer networks.

Since then, neural networks have evolved into deep learning, which uses multiple layers of neurons to learn complex features from data. Deep learning has shown remarkable performance in various domains, including image recognition, natural language processing, speech synthesis, and self-driving cars. Neural networks are the backbone of the future of AI, allowing us to classify and cluster data at high velocity.

What Is Machine Learning?

"Machine learning" is a branch of artificial intelligence and computer science that uses data and algorithms to simulate human learning processes. Just two examples of the innovative products it has enabled are Netflix's recommendation engine and self-driving cars. Machine learning is an essential part of the quickly growing field of data science. Data science classifies data, predicts outcomes, and uncovers important insights using statistical approaches. As big data grows and becomes more prevalent, the industry will need more data scientists (Zhou, 2021).

What Is Deep Learning?

The goal of deep learning, a subfield of machine learning, is to better oneself by analyzing computer algorithms. Artificial neural networks, designed to imitate human thought and learning, are used in its operation. Advances in big data analytics have made it feasible to create larger, more complex neural networks. As a result, computers are able to observe, comprehend, and react to complicated situations faster than humans. Deep learning has shown useful in speech recognition, picture classification, and language translation. It may also be used to automatically handle any pattern identification problem (Heaton, 2018).

Example of Deep Learning at Work

The goal of a neural network is to recognize photos that feature dogs. To do this, one has to assemble a training set of images that includes pictures of objects that aren't dogs and several depictions of dog faces.