Chapter 6
Deep Learning

ABSTRACT

Neural network and deep learning techniques are essential tools for data scientists when analyzing big data for forecasting and classification. In supervised learning, data sets are divided into training sets and test sets, and neural network repeatedly adjusts the weight of data to better represent the actual data. This book offers a practical guide to performing a neural network experiment with RapidMiner, which readers can follow step-by-step. For big data, especially non-linear data, deep learning can be employed. This chapter introduces two types of deep learning: convolutional neural networks (CNN) for picture analysis and recurrent neural networks (RNN) for sequential or time series data. The book provides a demonstration of both techniques using RapidMiner, making it accessible to readers who wish to deepen their understanding of these powerful tools.

INTRODUCTION

In the early days when people first mentioned artificial intelligence, there was a lot of motivation to develop artificial intelligence capable of human-like responses. However, the challenge for the era was that artificial intelligence computing required high-performance computing technology and large volumes of experimental data, resulting in the gradual advancement of artificial intelligence. Now in the era of high-performance computing technologies such as GPUs with a high-speed network (Telikani, Shahbahrami, & Gandomi, 2021), data scientists are able to use data mining techniques to operate on high-performance computing technologies and collect big data for experimentation using techniques that are suitable for such processing. Deep learning technique is used to analyze unstructured data consisting of images, sounds, and text (Fernando et al., 2021: Hongyi Zhu, Samtani, Brown, & Hsinchun Chen, 2021). There are two types of deep learning: Convolutional Neural Networks and Recurrent Neural Networks (Lakshmi Devi & Samundeeswari V, 2021: Snineh et al., 2021). The deep learning model modulates the pre-configuration of data for processing in conjunction with neural network techniques. Artificial Neural Networks (ANNs) is a data mining technique that offers both classification and numerical predictions, which is considered supervised learning (Thankachan, Prakash & Jothi, 2021). Data scientists must first teach machines to learn before testing the data. In the case data scientists classify data with

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other data mining techniques, the data are classified by a linear plane. On the contrary, using neural networks, data scientists can classify data that are closely attached to facts with a Non-Linear Function. The neural network is, therefore, used in 2 ways: first, Pattern Recognition, such as user face recognition for identification or authentication for accessing the phone (Ghorpade & Koneru, 2021), and finally Forecasting such as forecasting the trend of stock prices (Chinnarasri, Nonsawang & Supharatid, 2012).

This book discusses the principles of artificial neural network and deep learning in both CNN and RNN formats as follows:

ARTIFICIAL NEURAL NETWORK: ANN

Conceptual Work of Artificial Neural Network: ANN

Artificial Neural Networks simulate human brain activities by having each node represent a brain cell, and connect each node to form a network which will then be used for processing (Chow and Cho, 2007: Aggarwal, 2018). The neural network therefore consists of 4 parts. 1. Input Neural is used to support the data which will be analyzed with the model. The number of input nodes depends on the number of variables or features used to analyze the data. 2. Output Neural is the result obtained from processing. It can have one or more results depending on data analysis questions. 3. Hidden Layer is each layer of nodes that enhance the processing efficiency of the neural network, and 4. Links is the connection of each node. Each Link calculates Weights, which must be passed on to the next node. Therefore, the neural network optimizes the nodes, so that the scientists can analyze the responses from the dataset imported into the model. The primary model of the neural network is Perceptron. The model is designed to analyze data with input neural and output neural without creating hidden layers to predict numbers. To teach machines learning and to test data with a neural network both focus on adjusting the weights of each link, known as the Back Propagation Artificial Neural Network (BP-ANN) (Ramirez-Hernandez et al., 2020: Guo, Zhang and Chen, 2021) with the process as follows.

1. Artificial Neural Network model estimates the analysis results.
2. The results are compared to the actual results that the scientists have taught to the machine learning in order to analyze Error.
3. The model takes the error to adjust the Weights in each layer in order to achieve a tightness between the analyzed value and the actual data. This process is repeated until the error values reach the acceptable level.

Iterating to adjust such Weights is to teach machine learning and increase the accuracy of data analysis. Iterating each time is called Epochs. Data scientists put 1,000 records into a neural network model, and the number of Epochs is 500, there will be 500,000 times of iteration to teach the machine learning. Therefore, the greater the number of data and the number of nodes within the model is, the more time and digital processing the data scientists need. From the working process that requires computation to analyze all the data, the neural network model is suitable for numerical data. Therefore, if data scientists need to analyze text data in the data preparation process, it is necessary to convert letters into numbers before entering the data into the model.