Chapter 7
Deep Learning of Data Analytics in Healthcare

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ABSTRACT

The importance of data as the fuel of artificial intelligence is self-evident. As the degree of informatization in various industries deepens, the amount of accumulated data continues to increase; however, data processing capability lags far behind the exponential growth of data volume. To gather accurate results, more and more data should be collected. However, the more data collected, the slower the processing and analyzing of that data. The emergence of deep learning solves the problem of how to process large amounts of data quickly and precisely. With the advancement of technology, the healthcare industry has achieved a promising level of needed data. Moreover, if deep learning can be used to aid disease diagnosis, patient data can be processed efficiently, useful information can be screened, valuable diagnostic rules can be mined, and disease diagnosis results can be better formulated and treated. It is foreseeable that deep learning has the potential to improve the effectiveness and the efficiency of healthcare and relevant industries.

DOI: 10.4018/978-1-7998-2310-0.ch007
DEVELOPMENT OF DEEP LEARNING

In 1986, while serving as a professor of the University of Toronto, the father of machine learning and the father of neural networks Geoffrey Hinton invented the BP (backpropagation) algorithm for the multilayer perceptron (MLP) and used Sigmoid for nonlinear mapping to effectively solve his linear classification and learning problems. However, in 1991, the BP algorithm was found to have an issue; there was a problem of gradient disappearance, which directly hindered the further development of deep learning. In addition, in the mid-1990s, the support vector machine (SVM) algorithm was created, and various shallow machine learning models were proposed. SVM is a supervised learning model for pattern recognition, classification, and regression analysis. Support vector machines are based on statistical data and are very different from neural networks. The implementation of algorithms such as support vector machines hinders the development of deep learning.

To this end, Hinton and his students published an article in Science that proposed a solution to the gradient disappearance problem in deep network training: unsupervised pre-training to initialize weights and supervised training to fine-tune. In terms of their in-depth research, Stanford University, New York University, and the University of Montreal in Canada attach great importance to this study for academic and industrial use.

In 2011, the ReLU activation function was proposed, to effectively suppress the gradient disappearance problem. Since then, Microsoft has used deep learning for speech recognition for the first time and has made a major breakthrough. The world’s top speech recognition researchers use DNN (deep neural network) to reduce speech recognition error rates by 20% to 30%, which is the biggest advancement in speech recognition for more than a decade. In 2012, DNN technology achieved remarkable results in the field of image recognition, reducing the error rate of ImageNet evaluation from 26% to 15%. In that same year, DNN was also applied to a pharmaceutical company’s drug activity forecast and achieved the best results in the world.

At the same time, in order to prove the potential of deep learning, in 2012, the Hinton team participated in the ImageNet Image Recognition Competition for the first time. The CNN (Conventional Neural Network) established by AlexNet won the championship and attracted a lot of attention. With the development of the deep learning, GPU hardware training methods and continuous improvement are also expanding in other fields. The detailed development of artificial intelligence and deep learning is described in the following table (Table 1).
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Payam Hanafizadeh and Ahmad Hashemi (2014). *International Journal of Business Intelligence Research* (pp. 44-57).

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