ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 10, October 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)

DOI: 10.5958/2249-7137.2021.02089.9

AN OVERVIEW OF DEEP LEARNING

Dr. Ajay Rana*; Dr. Mamta Bansal**

*Shobhit Institute of Engineering and Technology,
(Deemed to be University), Meerut, INDIA
Email id: ajay.rana@shobhituniversity.ac.in,

**School of Computer Science and Engineering,
Faculty of Engineering and Technology,
Shobhit Institute of Engineering and Technology,
(Deemed to be University), Meerut, INDIA
Email id: mamta.bansal@shobhituniversity.ac.in

ABSTRACT

Deep learning technologies has been a significant study area in the field of machine learning with the advent of big data, and it has been extensively used in image processing, natural language processing, voice recognition, and online advertising, among other applications. This paper covers various aspects of deep learning techniques, such as common deep learning models and optimization methods, commonly used open source frameworks, existing problems, and future research directions. To begin, we'll go through some of the applications of deep learning; Second, we go through several popular deep learning models and optimization techniques. Finally, we go through several popular deep learning frameworks and platforms. Finally, we emphasize deep learning's future development by introducing the most recent deep learning acceleration technology.

KEYWORDS: *Deep Learning ,Data Corporation, Image Processing , Natural Language Processing Recognition Of Speech*

1. INTRODUCTION

The rise of different applications in the Internet area has led to the exponential expansion of data scale, owing to the fast development of technologies such as cloud computing, Big data, and Internet of things. According to the International Data Center's study, According to the International Data Corporation (IDC), worldwide total data would be 22 times more in 2012 than it was in 2011[1]. By 2020, the amount of ZB will have increased to 35.2. Big data has a lot of promise and has a lot of value. Human civilization is undergoing change and growth, but it is also encountering severe issues[2]. "Overload" is a term used to describe a situation where How can I get useful information from a website fast and efficiently. Managing a wide range of complicated data has become a significant problem. Deep learning has made significant progress in recent years. advances in image processing, voice recognition, and natural language comprehension Deep learning can map because of the fast advancement of deep learning technologies. by automatically learning features from diverse data in the same hidden space. Obtains a consistent data representation from multi-source heterogeneous data[3]. This document was written by examines many elements of deep learning methods, such as typical deep learning models. learning and optimization techniques, widely used frameworks, actual issues, and so on. path of future research The rest of this document is laid out as follows: The second section delves further into the topic. Deep learning has many uses. The typical models of deep learning.The optimization techniques. We introduce frequently.

Deep learning systems and frameworks that are open source were utilized. The sixth section contains information on Deep learning acceleration technology The difficulties and possibilities are discussed. learning to the depths Section 8 brings our study to a close and suggests areas for further research[4].Deep learning is a form of machine learning that is entirely based on artificial neural networks. Because neural networks are designed to imitate the human brain, deep learning is likewise a human brain mimic[5]. We don't have to explicitly program anything in deep learning. Deep learning is not a new idea. It has been around for quite some time. It's all the rage these days since we don't have nearly as much processing power or as much data as we have today[6]. As processing power has increased rapidly over the past 20 years, deep learning and machine learning have entered the scene. This is a depiction of a solitary neuron in the human brain, which has about 100 billion neurons[7]. Each neuron is linked to thousands of its neighbors. The issue is, how can these neurons be recreated in a computer. As a result, we construct an artificial neural network, which consists of nodes or neurons[8]. We have neurons for input and output values, and in the hidden layer, there may be a large number of neurons linked.

1.1 Application of Deep Learning:

- Image Processing: Deep learning's first use was image recognition. Using deep convolutional neural networks to learn the end-to-end mapping connection between low-resolution and high-resolution pictures for image identification for the first time in 2014. DenKer.obtained the greatest results at the time by using a convolutional neural network to identify handwritten digital. Using a deep convolutional neural network, developed the Faster R-CNN object identification technique. For image identification, incorporated sparse priors into deep convolutional neural networks in 2015. Autoencoder to categorize pictures, and support vector machines were trained for image classification. In the 2016 ImageNet Competition, deep learning accuracy surpassed 97 percentfor image recognition, developed CNNH (Convolutional Neural Network Hashing), a supervised depth hashing method.

- Recognition of Speech:Deep learning technology has been used in voice recognition in recent years. At the end of 2016, Baidu, HKUST, and SOGOU all claimed that their accuracy of Chinese voice recognition based on deep learning had surpassed 97 percent.Microsoft's research on deep neural network-based voice recognition has totally altered the basic technological foundation of speech recognition. The deep neural network model has resulted in significant improvements in speech recognition accuracy.Deep neural network models are being utilized in voice recognition algorithms used by well-known Internet businesses (Baidu, HKUST, and SOGOU). They used a convolutional neural network (CNN) to extract voice features in [12]. developed a multilayer perceptron-based voice synthesis model for speech recognition. They utilized the LSTM technique to extract voice characteristics , which significantly increases feature efficiency. G. E. Hinton replaced the Gaussian mixture model (GMM) in the conventional model with DBN in 2012, and the findings indicated that the error rate on the TIMIT core test set fell to 20.7 percent, a considerable improvement.Recently, Google developed a speech recognition system based on the feedforward sequential memory network, which employs a high number of convolutional layers to directly model the whole sentence speech signal and better convey long-term speech relevance. Baidu used deep convolutional neural networks to improve speech recognition by combining visual geometry group networks with deep convolutional neural networks. As a result, the recognition error rate has decreased significantly[9].

- Natural Language Processing (NLP): Deep learning is also used for natural language processing. Recurrent neural network (RNN)-based vector constant length representation model for machine translation. In natural language processing, artificial neural networks have gotten a lot of attention. Similar models were employed in statistical machine translation tasks, who assessed them using the bilingual assessment understudy rating method[10]. For common natural language processing problems like semantic role labeling, Karlenused embedding and multi-layered one-dimensional convolutional architectures. Investigated the neural network model further and discovered that adding many recursive layers improves performance. Using embedding techniques to map words into a vector representation space, and then representing the language model using nonlinear neural networks. A RNN search model for Machine Translation. Part-of-speech tagging, dependency grammar analysis , naming body identification , semantic role tagging , and Twitter sentiment analysis are just a few of the tasks that deep learning methods have been applied to in the area of natural language processing. Sentiment analysis of Chinese microblogs, machine translation , question answering , dialogue system , and so forth.

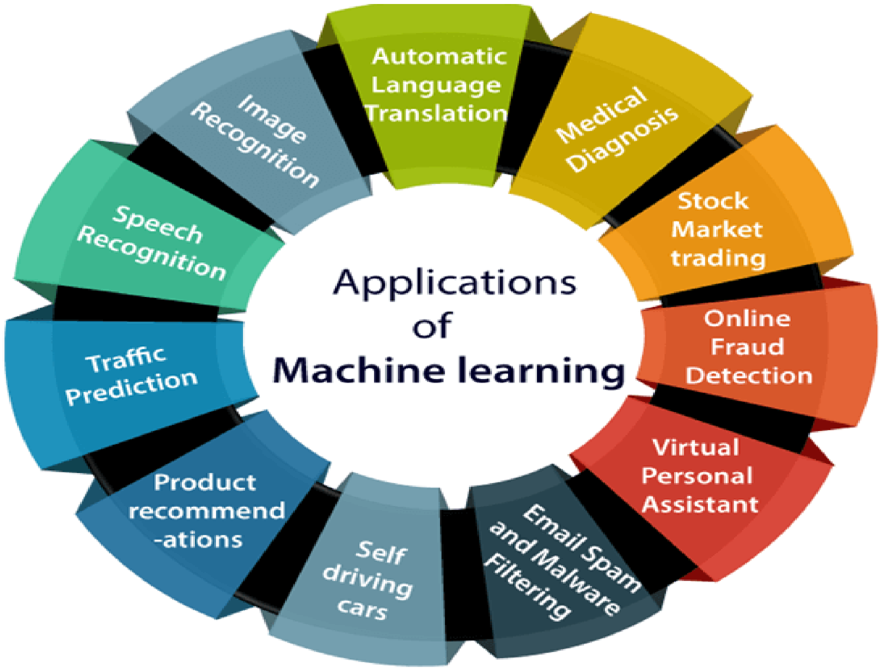

Figure 1: Diagrammatic Representation of Application Deep Learning [JAVATPOINT]

1.2 Model ofDeep Learning:

- Auto encoder: Auto encoder is a backpropagation-based unsupervised learning method that sets the target values to be identical to the inputs. The auto encoder (AE) concept in 1986 and used it to process high-dimensional complex data. By rebuilding the input data to create the output data, the auto encoder may extract the hidden feature. The fundamental construction of an auto encoder is a three-layer neural network, with input layer x, hidden layer h, and output layer y, with the output layer and input layer having the same size, as. The input and output layers of auto encoders contain the same neurons, while the intermediate layer has more than the input layer. The output layer reconstructs the input data by training the network, then maximizing the similarity between the input and output data. The similarity is represented by the training error. Assuming that the input signal is x, the signal transforms to z when it reaches the hidden layer, which can be represented using the following formula:

$$z = g(Wx + b)$$

The sigmoid function and the rectified linear unit function, which are also known as active functions, are frequently employed when g() is a nonlinear function. W is the input layer's link weight to the hidden layer, and b is the hidden layer's bias. The decoding layer decodes the signal y and sends it to the output layer, where it is converted to z:

$$y = f(W' z + b')$$

Where W′ is the hidden layer's link weight to the output layer, and b' is the output layer's bias. y is regarded as an x prediction. The weight matrix W′ is, in general, restricted to the transpose of the weight matrix W: W′ = WT. The reconstruction error is typically described as mean square error or cross entropy, depending on the kind of data.

- Boltzmann Machine with Restrictions: In 1986, Hinton and Sejnowski proposed the Boltzmann Machine (BM). The Boltzmann Machine is a kind of feedback neural network that is made up of random neural networks. The Boltzmann Machine is made up of visible units (visible variables, i.e. data samples) and hidden units (hidden variables), with each visible unit connected to all hidden units. The visible variables and hidden variables are binary variables with states of 0 or 1, with 0 representing a suppressed neuron and 1 representing an active neuron. In addition, Boltzmann machine (RBM). The visible layer V and the hidden layer H are shown in Fig. 2, which is a schematic representation of RBM. Input the training data to the visible layer, then the hidden layer identifies the input data's characteristics; the neurons are disconnected within the same layer but completely linked between the two layers. The combined probability distribution of two layers is represented by equation.Restricted Boltzmann machine training is quicker than Autoencoder training. Using the stochastic gradient descent technique, presented a more efficient optimization algorithm in. RBM's conventional training technique requires a large number of sample steps, resulting in a low training efficiency. Hinton's suggested contrastive divergence addressed the issue. Deep deconvolution network to learn hierarchical structural characteristics from the bottom layer to the top layer directly from the global picture by concatenating several convolutional sparse Autoencoder and maximum pooling layers.

Many expansion models based on the limited Boltzmann machine have been proposed by certain academics. suggested incorporating discriminative learning into the RBM's generative learning algorithm so that it could be better used to discriminative tasks like categorization. The RBM model is immediately cascaded into a multi-layer structure in, which is referred to as a deep Boltzmann machine. For learning the latent characteristics of picture pixel blocks Deep SparseAuto encoder model. The restricted Boltzmann machine may be cascaded to create a deep neural network, which can be optimized using the layer-by-layer training technique used convolution operations to expand the deep belief network, allowing the model to learn possible feature representations straight from the initial 2D picture.

There are various hierarchical generation models than the RBM-based deep structure. To create a deep belief network, a multi-layered directed sigmoid belief network was cascaded with RBM in. By adding a Gaussian kernel in, Restricted As input signals, the Boltzmann machine accepts continuous variables. By changing the structure of the RBM or probability distribution, the restricted Boltzmann machine may be expanded to tackle increasingly complicated problems. In these models, a more complicated energy function is typically specified, which reduces the efficiency of learning and inference.

- Deep Neural Network: The input and output layers, as well as numerous hidden layers, make up deep neural networks (DNN).DNNs can solve linear and non-linear problems by calculating the probability of each output layer by layer using an activation function that is suitable for the issue. DNNs are often used in image interpretation and voice recognition, among other applications. DNNs are full-connected neural networks in essence. Multi-layer perceptron is another name for a deep neural network (MLP). The hidden layer transforms the input feature vectors, which subsequently reach the output layer, where the classification result is obtained. It was a two-category linear classification model that was primarily used for linear classification and had poor classification performance. Because early discrete transfer functions have some limitations for multiplayer perceptrons, we may overcome this issue by using continuous functions like the tanh or sigmoid functions.The number of neurons and hidden layers may be increased to create DNNs.

- Convolutional Neural Networks (CNNs): Except for the input and output layers, Convolutional Neural Networks (CNNs) include convolutional, pooling, and fully-connected layers. CNNs may decrease complexity and parameters by sharing weights, which improves the generalization ability of the neural network, and by pooling neurons to make the network more resilient. CNNs have been used to analyze multi-dimensional data for picture comprehension in recent years. When using a CNN to analyze a multi-dimensional picture, the image is immediately fed into the network, bypassing the time-consuming feature extraction and data reconstruction procedure that conventional image processing methods need. To generate two-dimensional feature maps, a convolutional neural network must learn a collection of two-dimensional filtering templates and perform a convolution operation with the feature map x. The previous layer's feature map is convoluted with a convolution kernel in the convolutional layer, and the output of the convolution result after the activation function forms the neurons of the next layer of the feature map, resulting in the next layer corresponding to a specific feature map of the features. Convolution, nonlinear activation function, and maximum pooling are the three processes in each convolutional layer. Various convolution kernels may be used to extract different characteristics from the preceding layer of feature maps using convolution.

2. DISCUSSION

Deep learning (also known as deep structured learning) is a kind of machine learning technique that uses artificial neural networks to learn representations. There are three types of learning: supervised, semi-supervised, and unsupervised. Deep-learning architectures like deep neural networks, deep belief networks, deep reinforcement learning, recurrent neural networks, and convolutional neural networks have been used in areas like computer vision, speech recognition, natural language processing, machine translation, bioinformatics, drug design, medical image analysis, material inspection, and board game programs.Information processing and dispersed communication nodes in biological systems inspired artificial neural networks (ANNs). ANNs vary from biological brains in a number of ways. In particular, neural networks are static and symbolic, while most live creatures' organic brains are dynamic (plastic) and analogue. In deep learning, the term "deep" refers to the usage of many layers in the network. A linear perceptron cannot be a universal classifier, but a network with a no polynomial activation function and one hidden layer of unlimited width may, according to early research. Deep learning is a more recent version that has an unlimited number of layers of bounded size, allowing for practical application and optimization while maintaining theoretical universality under moderate circumstances. For the purposes of efficiency, trainability, and understandability, deep learning layers are also allowed to be heterogeneous and vary significantly from physiologically informed connectionist models, thus the "structured" component.

3. CONCLUSION

Deep learning, as a major machine learning research path, heralds the beginning of artificial intelligence research. We carefully presented the current advances in deep learning due to the fast changes in the field. To begin, we presented many widely used deep learning neural network models, evaluated two widely used parallel deep learning training models, and compared the benefits and drawbacks of the two models' training techniques. Then we looked at some of the most popular deep learning open source frameworks, compared their application capabilities, and looked at a few industrial research platforms. Finally, we focused on current neural network hardware accelerator research. Deep learning technology's future growth is still full with possibilities and difficulties, yet it is very promising. Deep learning models such as Deep Feedforward Neural Networks (D-FFNN), Convolutional Neural Networks (CNNs), Deep Belief Networks (DBNs), Auto encoders (AE), and Long Short-Term Memory networks are all examples of deep learning models (LSTMs). These models may be thought of as the basic architectures of deep learning today. We also spoke about related ideas like Restricted Boltzmann Machines and robust back propagation, which are important for a technical grasp of these models. Given the versatility of network topologies, which allows for "Lego-like" model creation, an infinite number of neural network models may be built using the basic architectural building blocks described in this study. As a result, a fundamental knowledge of these components is essential for being prepared for future AI advancements.

REFERENCES

1. S. Min, B. Lee, and S. Yoon, "Deep learning in bioinformatics," *Briefings in bioinformatics*. 2017, doi: 10.1093/bib/bbw068.

2. G. Litjens *et al.*, "A survey on deep learning in medical image analysis," *Medical Image Analysis*. 2017, doi: 10.1016/j.media.2017.07.005.

3. R. Miotto, F. Wang, S. Wang, X. Jiang, and J. T. Dudley, "Deep learning for healthcare: Review, opportunities and challenges," *Brief. Bioinform.*, 2017, doi: 10.1093/bib/bbx044.

4. M. M. Najafabadi, F. Villanustre, T. M. Khoshgoftaar, N. Seliya, R. Wald, and E. Muharemagic, "Deep learning applications and challenges in big data analytics," *J. Big Data*, 2015, doi: 10.1186/s40537-014-0007-7.

5. J. Ker, L. Wang, J. Rao, and T. Lim, "Deep Learning Applications in Medical Image Analysis," *IEEE Access*, 2017, doi: 10.1109/ACCESS.2017.2788044.

6. L. Deng and D. Yu, "Deep learning: Methods and applications," *Foundations and Trends in Signal Processing*. 2013, doi: 10.1561/2000000039.

7. Y. Guo, Y. Liu, A. Oerlemans, S. Lao, S. Wu, and M. S. Lew, "Deep learning for visual understanding: A review," *Neurocomputing*, 2016, doi: 10.1016/j.neucom.2015.09.116.

8. Y. Lecun, Y. Bengio, and G. Hinton, "Deep learning," *Nature*. 2015, doi: 10.1038/nature14539.

9. A. Karatzoglou and B. Hidasi, "Deep learning for recommender systems," 2017, doi: 10.1145/3109859.3109933.

10. D. Ravi *et al.*, "Deep Learning for Health Informatics," *IEEE J. Biomed. Heal. Informatics*, 2017, doi: 10.1109/JBHI.2016.2636665.