

Neural Network

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Abstract—In recent years, scientists have learned about how the brain functions. The brain is composed of nerve cells, which are connected to other nerve cells by synapses to form networks. A system of interconnected neurons forms neural networks which are of two types: Biological Neural Network (interconnected nerve cells), Artificial Neural Network (ANNs). The concept of biological neural system of the human body consists of three stages: receptors, a neural network, and effectors. The receptors receive the stimuli either internally or from the external world, then pass the information into the neurons in a form of electrical impulses. The neural network then processes the inputs then makes proper decision of outputs. Finally, the effectors translate electrical impulses from the neural network into responses to the outside environment. The ANNs are computational tools inspired by neurons in the brain, and are used to model a biological brain. The concept of ANNs can be applied in pattern recognition, anomaly detection, electronic noses, and instant physician and in diagnosing the cardiovascular system via neural modeling. Scientist are looking at the development of artificial intelligence using the understanding of the architecture of the human brains research into potential systems of artificial intelligence. Computation in the brain brings together computational concepts and behavioral data within a neurobiological framework.

Index Terms—Neural network

I. INTRODUCTION

The human brain has been undergoing serious investigations by many researchers in the field of neuroscience. In time past, there have been considerable investigations of the structure of the brain (anatomy of the brain), but studies on the functional operation of its complex neural network, paraded all sorts of fantasies as knowledge for many centuries (Sundal et al., 2014).

Around the middle of the 18th century, a functional understanding of the human brain began to take shape. At that time, studies on the brain revealed that nerve signals formerly thought of as “animal spirits” are actually electric signals not very different from the currents that flow in an electrical circuit (Sundal et al., 2014). Not only that, advancements in microscope and neuroscience revealed the morphology of neurons, and presented a vision of the brain as a network of neurons; unraveling how neurons interact among themselves using chemical signals.

An Artificial Neural Network (ANN) is a computational model that is inspired by the way biological neural networks in the human brain process information. Artificial Neural Networks have generated a lot of excitement in Machine Learning research and industry, thanks to many breakthrough results in speech recognition, computer vision and text

processing. In this, we will try to develop an understanding of a particular type of Artificial Neural Network called the Multi-Layer Perceptron.

II. BACKGROUND

The examination of the central nervous system of human brain was the inspiration of neural networks. In an Artificial Neural Network, simple artificial nodes, known as “neurons”, “processing elements” or units”, are connected together to form a network which is called a biological neural network.

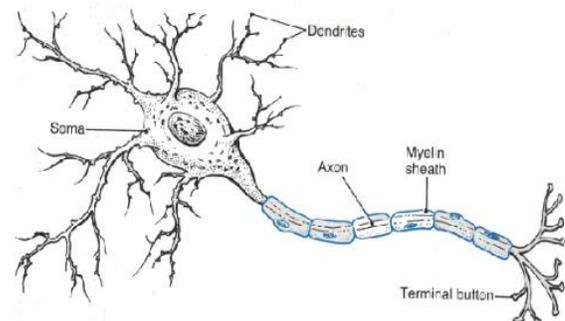


Fig. 1. Genetic neuron

There is no single formal definition of an artificial neural network. However, a class of statistical or mathematical or computational models may commonly be called “Neural Networks” if they possess the following characteristics:

- 1) Consist of sets of adaptive weights, i.e. numerical parameters that are tuned by a learning algorithms
- 2) Capable of approximating non-linear functions of their inputs

The adaptive weights are conceptually connection strengths between neurons, which are activated during training and prediction. Neural networks are similar to biological neural networks in performing functions collectively and in parallel by the units, rather than there being a clear delineation of subtasks to which various units are assigned. The term “neural network” usually refers to models employed in statistics, cognitive psychology and artificial intelligence. Neural network models which emulate the central nervous system are part of theoretical neuroscience and computational neuroscience.

III. WORKING OF NEURAL NETWORK

The working of neural networks revolves around the myriad of ways these individual neurons can be clustered together. This

clustering occurs in the human mind in such a way that information can be processed in a dynamic, interactive, and self-organizing way. Biologically, neural networks are constructed in a three-dimensional world from microscopic components. These neurons seem capable of nearly unrestricted interconnections. That is not true of in the case of any proposed, or existing, man-made network. Integrated circuits, using current technology, are two-dimensional devices with a limited number of layers for interconnection. This physical reality restrains the types, and scope, of artificial neural networks that can be implemented in silicon. Currently, neural networks are the simple clustering of the primitive artificial neurons. This clustering occurs by creating layers which are then connected to one another. How these layers connect is the other part of the "art" of engineering networks to resolve real world problems.

IV. TYPES OF ARTIFICIAL NEURAL NETWORKS

There are different types of Artificial Neural Networks (ANN) – Depending upon the human brain neuron and network functions, an artificial neural network or ANN performs tasks in a similar manner. Most of the artificial neural networks will have some resemblance with more complex biological counterparts and are very effective at their intended tasks like for e.g. segmentation or classification. Types of Artificial Neural Networks

- 1) *Feedback ANN*: In these type of ANN, the output goes back into the network to achieve the best-evolved results internally. The feedback network feeds information back into itself and is well suited to solve optimization problems, according to the University of Massachusetts, Lowell Center for Atmospheric Research. Feedback ANNs are used by the internal system error corrections.
- 2) *Feed Forward ANN*: A feed-forward network is a simple neural network consisting of an input layer, an output layer and one or more layers of neurons. Through evaluation of its output by reviewing its input, the power of the network can be noticed base on group behavior of the connected neurons and the output is decided. The main advantage of this network is that it learns to evaluate and recognize input patterns.
- 3) *Classification-Prediction ANN*: It is the subset of feed-forward ANN and the classification-prediction ANN is applied to data-mining scenarios. The network is trained to identify particular patterns and classify them into specific groups and then further classify them into "novel patterns" which are new to the network.

An artificial neural network is a computational simulation of a biological neural network. These possess the behavior of neurons and the electrical signals in which they communicate between input such as from the eyes or nerve endings in the hand to the output of the brain such as reacting to light, touch or heat.

Scientists were researching in the designing of artificial neural networks and the creation of artificial intelligence about

the way neurons semantically communicate.

V. APPLICATIONS OF ARTIFICIAL NEURAL NETWORKS

- Artificial neural network applications have been used in the field of solar energy for modeling and design of a solar steam generating plant.
- They are useful in system modeling, such as in implementing complex mapping and system identification.
- ANN are used for the estimation of heating-loads of buildings, parabolic-trough collectors intercept factor and local concentration ratio.
- ANN are used in diverse applications in control, robotics, pattern recognition, forecasting, medicine, power systems, manufacturing, optimization, signal processing, and social/psychological sciences.
- They have also been used for the prediction of air flows in a naturally ventilated test room and for the prediction of the energy consumption of solar buildings.
- They are able to handle noisy and incomplete data and also able to deal with non-linear problems.
- The use of artificial neural-networks in ventilating and air-conditioning systems, refrigeration, modeling, heating, load-forecasting, control of power-generation systems and solar radiation.

An Artificial Neural Network Application provides an alternative way to tackle complex problems as they are among the newest signal processing technologies. Artificial neural networks offer real solutions which are difficult to match with other technologies. Neural network based solution is very efficient in terms of development, time and resources.

VI. BENEFITS OF ARTIFICIAL NEURAL NETWORKS

- Artificial neural networks are flexible and adaptive.
- Artificial neural networks are used in sequence and pattern recognition systems, data processing, robotics, modeling, etc.
- ANN acquires knowledge from their surroundings by adapting to internal and external parameters and they solve complex problems which are difficult to manage.
- It generalizes knowledge to produce adequate responses to unknown situations.
- Flexibility-Artificial neural networks are flexible and have the ability to learn, generalize and adapts to situations based on its findings.
- Non-Linearity-This function allows the network to efficiently acquire knowledge by learning. This is a distinct advantage over a traditionally linear network that is inadequate when it comes to modelling non-linear data.
- An artificial neuron network is capable of greater fault tolerance than a traditional network. Without the loss of stored data, the network is able to regenerate a fault in any of its components.
- An artificial neuron network is based on Adaptive

Learning.

VII. CONCLUSION

In this paper we discussed about the artificial neural network, working of neural networks, characteristics of ANN, its advantages, limitations and applications of ANN. There are various advantages of ANN over conventional approaches. Depending on the nature of the application and strength of the internal data patterns you can generally expect a network to train quite well. This applies to problems where the relationships may be quite dynamic or nonlinear. By studying Artificial Neural Network we had concluded that as the technology is increasing the need of Artificial Intelligence is also increasing because of parallel processing, because by using parallel processing we can do more than one task at a time. So Parallel Processing is needed in this present time because with the help of parallel processing we can save more and more time and money in any task related to electronics, computers and robotics. If we talk about the Future work we can say that we have to develop more algorithms and programs so that we can remove the limitations of the Artificial Neural Network and can make it more and more useful for the various kinds of applications. If the Artificial Neural Network concept is combined with the Computational Automata, FPGA and Fuzzy

Logic we will definitely solve some of the limitations of neural network technology.

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