# A SURVEY AND ANALYSIS OF THE ARTIFICIAL NEURAL NETWORK AND THE BIOLOGICAL NEURAL NETWORK

***Ishwar verma[1], Kamal Sahu[2], Palak Keshwani[3]***

*[1][2]B.E. Student CSE Dept Kruti Inst. of Tech & Engg Raipur (C.G)*

*[3]Asst Prof. CSE Dept, Kruti Inst. of Tech & Engg Raipur (C.G)*

E-mail: - *vermaishwar888@gmail.com, kamalmsahu13@gmail.com, palakeshwani@gmail.com*

## ABSTRACT

***Artificial Neural Network (ANN) is modeled on the brain where neurons are connected in complex patterns to process data from the senses, establish memories and control the body. An Artificial Neural Network (ANN) is a system based on the operation of biological neural networks or it is also defined as an emulation of a biological neural system. An ANN is configured for a specific application, such as pattern recognition or data types, through a learning process. Artificial Neural Networks (ANN) is a part of Artificial Intelligence (AI) and this is the area of computer science which is related in making computers behave more intelligently. This paper gives overview of Artificial Neural Network, applications and advantages of ANN and the types of ANN. Artificial neural networks (ANNs)are computing systems inspired by the biological neural networks that constitute animal brains.***

**Keywords:** *Artificial Neural Network, Biological Neural Network.*

## 1. Introduction

The main stage toward an artificial neural networks originated in 1943 after Warren McCulloch, a neurophysiologist, and a new mathematician, Walter Pitts, created a paper on in what way neurons might work. They modeled a modest neural network through electrical circuits. A computing system is created up to a number of simple, highly interconnected processing elements and they process information to external inputs with their dynamic state response. A neuron has the power to produce a linear or a non-linear response. A non-linear artificial network is made by the interconnection of non-linear neurons. Non-linear systems have inputs which will not be proportional to outputs. The biological brain memories are also represented by patterns of activation amongst populations of neurons.

### 1.1 Artificial Neural Network

The location of the key neuro computer, Dr. Robert Hecht-Nielsen, defines a neural network as "...a calculating system extensive up of an amount of simple, very interconnected processing collection, which process report by their dynamic public answer to exterior inputs."An artificial neuron network (ANN) is a computational characteristic based agreed the building and role of biological neural networks. Information that activities done the network moves the structure of the ANN for a neural network changes - or learns, in a sense - based on that input and output.

### 1.2 Basic Structure of ANNs

The idea of ANNs is based on the belief that working of human brain by making the right connections, can be imitated using silicon and wires as living **neurons** and **dendrites**.The human brain is composed of 86 billion nerve cells called **neurons.** They are connected to other thousand cells by **Axons.** Stimuli from external environment or inputs from sensory organs are accepted by dendrites. These inputs create electric impulses, which quickly travel through the neural network. A neuron contains then send the message to other neuron to handle the issue or does not send it forward.

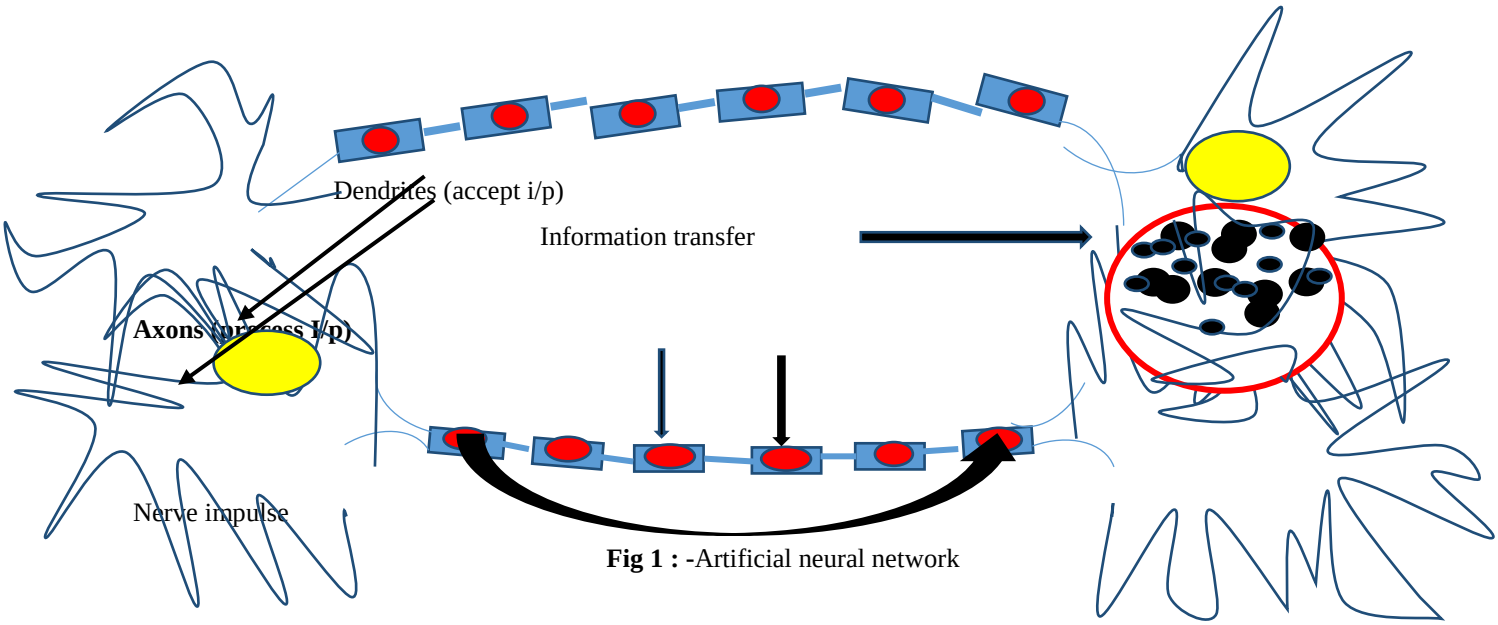



**Fig 1 : -**Artificial neural network

ANNs remain collected of many **nodes**, which emulate biological **neurons** of human brain. The neurons are connected by relatives and they interact with each other. The nodes can take input data and perform simple operations on the files. The result of these process is passed to other neurons. The production on all node is called its **activation** or **node value.** Each relatives is associated through **weight.** ANNs are capable of knowledge, which takes place through altering weight values. The following illustration shows a simple ANN

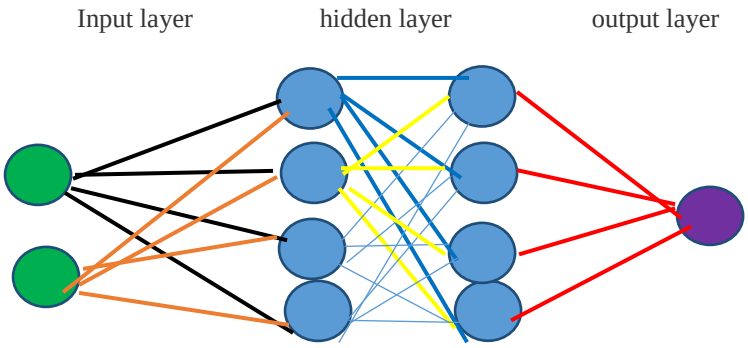



**Fig 2-**Neural Networks

### 1.3 Applications of Artificial Neural Networks

- Artificial neural network submissions have been used in the ground of solar energy for modeling and design of a solar steam generating plant.
- They are beneficial in system modeling, such as in applying multifaceted mapping and system identification.
- ANN are used for the estimation of heating-loads of buildings, parabolic-trough collector's intercept issue and native concentration ratio.

- ANN are used in diverse requests 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 movements 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 organizations, refrigeration, modeling, heating, load-forecasting, control of power-generation systems and solar radiation.

### 1.4 Advantages

- A neural network container perform tasks in which a inlines program cannot perform.
- When a group of the neural network fails, it can remain without any problem by their parallel nature.
- A neural network does not need to be reprogrammed as it learns itself.
- It can be applied in an easy way without some problem.
- As adaptive, intelligent schemes, neural networks are healthy and excel at solving complex problems. Neural networks are effectual in their programming and the scientists decide that the advantages of using ANNs outweigh the risks.
- It can be implemented in some application.

### 1.5 Disadvantages

- The neural network needs training to work.
- Needs high processing time for big neural networks.

- The construction of a neural network is different from the architecture and history of microprocessors so they consume to be emulated.

### 1.6 Types of Artificial Neural Networks

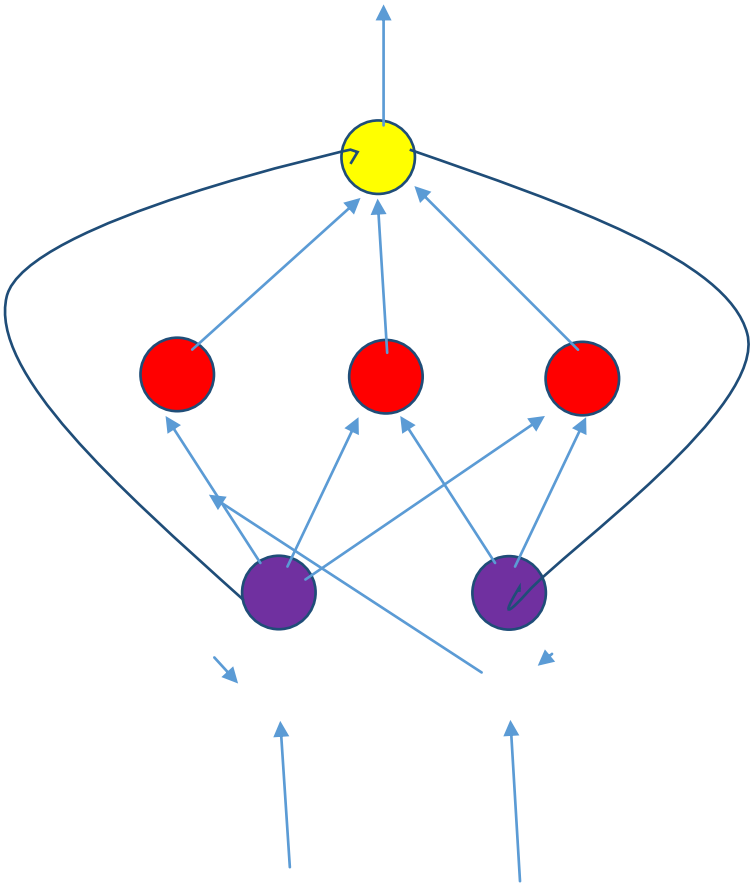
There are different types of Artificial Neural Networks (ANN) – Depending upon the human brain neuron and network functions, an artificial neural network or ANN performs tasks in a similar manner. Most of the artificial neural networks will have some resemblance with more complex biological counterparts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

1. **Feedback ANN**
2. **Feed forward ANN**

#### 1.6.1 Feedback ANN

In these type of ANN, the output goes back bone into the network to attain the best-evolved results internally. The feedback network feeds information back into itself and is well matched to solve optimization problems, according to the University of Massachusetts, Lowell Center for Atmospheric Research. Feedback ANNs are used by the inner system fault modifications.



**1.6.2 Feed Forward ANN**

A feed-forward network is a simple neural network containing of an input layer, an output layer and one or additional layers of neurons. Through evaluation of its output by studying input, the command of the network can be noticed base on group performance of the connected neurons and the output is decided. The main benefit of this network is that it studies to evaluate and recognize input patterns. The material movement is unidirectional. A unit sends information to other unit from which it does not accept some information. There are no feedback loops. They are used in pattern generation/recognition/classification. They have fixed inputs and outputs.

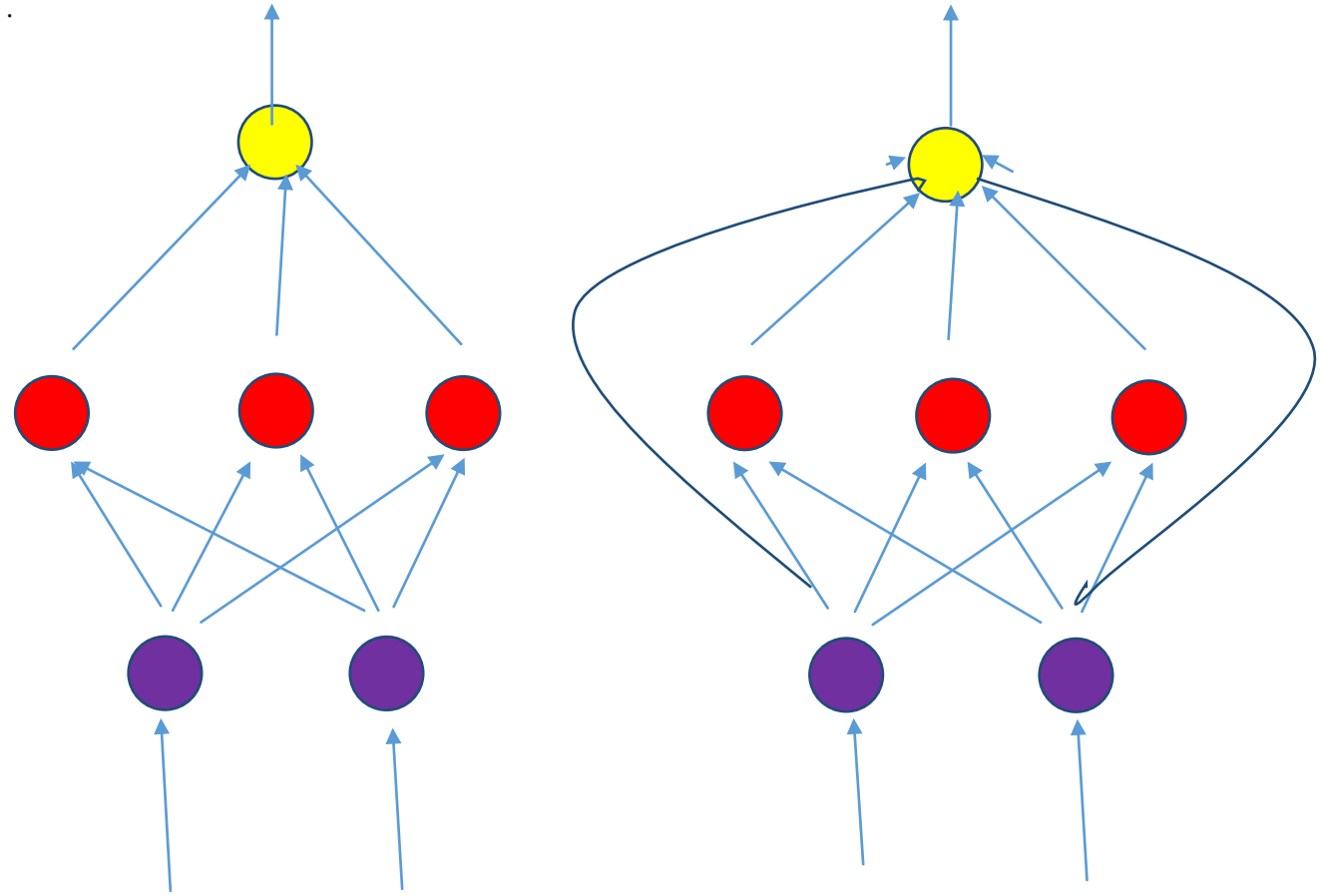


**Fig 3: Feed Forward ANN**

### 1.7 Biological Neural Network

Neural networks are moved by our mind. The human mind has about 1011 neurons and 1014 synapses. A neuron contains of a soma (cell body), axons (sends signals), and dendrites (receives signals).A synapse connects an axon to a dendrite. Assumed a signal, a synapse strength increase (excite) or decrease (inhibit) electrical potential. A neuron fires when it's electrical potential extents a threshold. Learning might happen by changes to synapses. The neural system of the human frame consists of three stages: receptors, a neural network, and effectors. The receptors receive the stimuli either inside or from the outside world, then permit the info into the neurons in a form of electrical impulses. The neural network then procedures the inputs then kinds proper decision of outputs. Finally, the effectors translate electrical impulses from the neural network into responses to the outside environment. Figure - shows the bidirectional communication between stages for feedback

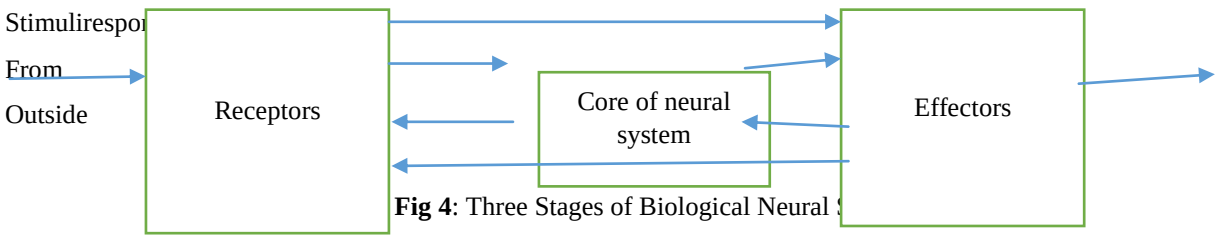



**Fig 4**: Three Stages of Biological Neural S

The fundamental part of the neural network is called a neuron. As shown in figure, a neuron mostly contains of three portions: dendrites, soma, and axon. Dendrites are the tree-like structure that accepts the signal from surrounding neurons, where a line is connected to one neuron. Axon is a tiny cylinder that transfers the signal from one neuron to all. At the end of axon, the connection to the dendrites is completed through a synapse. The inter-neuronal signal at the synapse is commonly chemical diffusion but occasionally electrical impulses. A neuron fires an electrical impulse only if confident condition is met.

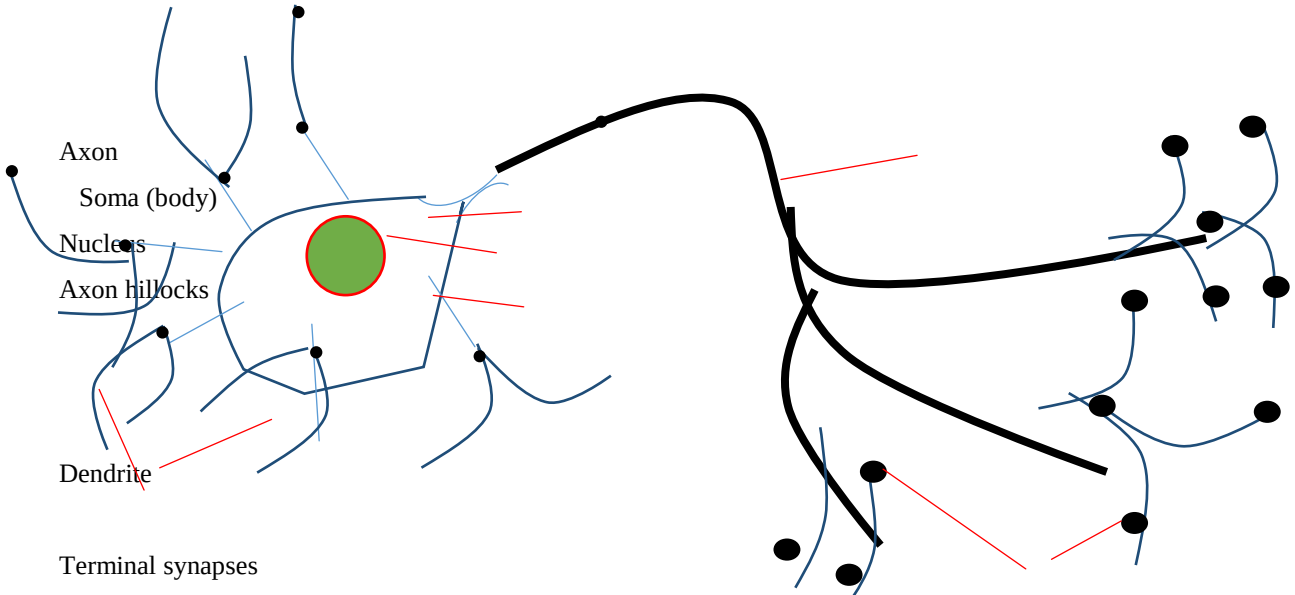



**Fig 5:** A biological neuron

The received impulse signal from all synapse to the neuron is either excitatory or inhibitory, which means selection or obstructing firing. The condition of producing firing is that the excitatory signal must exceed the inhibitory signal by a certain quantity in a short period of time, called the period of latent summation. As we allocate a weight to each received impulse signal, the excitatory signal has positive weight and the inhibitory signal has negative weight. This technique, we can say, ``A neuron fires first if the full weight of the synapses that accept impulses in the passé of covert summation exceeds the threshold."

### 1.7.1 Basic Components of Biological Neurons

1. The popular of neurons encode their activations or productions a series of brief electrical pulses.
2. The neuron's cell body (soma) develops the incoming activations and alters them into output activations.
3. The neuron's nucleus contains the genetic material in the form of DNA. This exists now greatest kinds of cells, not impartial neurons.
4. Dendrites are fibres which arise from the cell body and offer the receptive parts that receive activation from extra neurons.
5. Axons remain fibres temporary as transmission lines that show activation nearby extra neurons.
6. The links that certification pointer transmission among the axons and dendrites are called synapses. The procedure of transmission is by diffusion of chemicals called neurotransmitters diagonally the synaptic cleft**.**

## 2. Comparison between Biological Neural Network and Artificial Neural Network

**Table-1:** Artificial neural network and biological neural network

| **Biological Neural Network** | **Artificial Neural Network** |
|---|---|
| Soma | Unit |
| Axon, dendrite | Connection |
| Synapse | Weight |
| Potential | weighted sum |
| Signal | activation |
| Threshold | Bias weight |

## 3. Conclusion

In this paper, we have studied the artificial neural network and biological neural network. The thoughtful of biological nervous systems enthused the concept of Artificial Neural Networks, a structure of information processing. Just as a biological nervous system is a enormous interconnection of nodes called neurons, located within the brain, Artificial Neural Network consists of many interrelated processing elements which at the same time work to solve precise problems. Typically created for precise applications, neural networks are perfect for data classification and also for pattern recognition problems. Mankind, having learned the brain for many years, it was only normal that go forward in electronics would entice man to try and recognize and imitate its processes of problem solving, understanding, memorizing, and so on.

## 4.Acknowledgement

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