**Imperial Journal of Interdisciplinary Research (IJIR)**
**Vol-2, Issue-10, 2016**
**ISSN: 2454-1362,** http://www.onlinejournal.in

# Artificial Neural Networks and Human Learning

Purushottam Lal Bhari
Research Scholar under Guidance Of Dr. Ashok Jetawat.
Dept. of Computer Science and System Studies, Mewar University, Chittorgarh

***Abstract:*** *This paper describes about working of neurons in a neural network system. We can find out the learning process by study of human brain and artificial brain. In this survey paper, we are explaining Artificial Neural Network, its various characteristics and applications. In this paper we also show that "what are neurons" and "How today's Artificial Intelligence System has need of neurons?" because many advances Intelligent Systems have been developed, some inspired by biological neural networks from them. Artificial Neural Network provides a very exciting alternative techniques and other application which can play important role in today's computer science.*

***Keywords****:- Artificial Neural Networks, Human Brain, Artificial Brain, Artificial Neuron. Characteristics and Applications*

## 1. Introduction

Artificial neural networks are computational systems which are increasingly common and sophisticated for learning. Computational scientists, who work with such systems, often assume that they are simplistic versions of the neural systems within our brains. It has the concept of human learning takes place through the self-organization of such systems according to the stimuli they receive. This continues to describe the human brain and its processes by the using metaphors to machinery in order. Artificial neural networks were originally maintained of in relation as well as biological neurons function. This metaphor allows us to accurately understand brain function. A complex neural network may be just like a series of interconnected nodes and they are connected by neurons. The meaning of the term complex, each node is only responding to signals from the neurons it is directly connected to each other, yet the system is able to respond to its environment.

A neural network is a computational device, its functions in certain ways similarly to the human brain. A mathematical function is modeled as a set of connected nodes in a computerized neural network. Each input node is connected to a certain number of internal nodes, these connections having defined weights. The weight provides a constant by which the input is multiplied. The internal nodes perform given mathematical manipulations upon the sum of the getting inputs, thus providing an output, which in turn goes to other nodes as input. In a neural network structure can be one level or more than one level of internal nodes, they connected similarly and eventually the final level of internal nodes is always connected to an output node or nodes. The neural network is mainly giving flexibility in the term weight; it can be adjusted to optimize the function to fit a set of data. In the brain, neurons work as nodes. The sum of neuron's inputs is known as fire based upon and information is stored by changing the strength of connections between all neurons available in network, which is the brain's analog of changing the weights of connections in neural network. Neural network algorithms may be at work without our conscious knowledge in the brain. This would be a good way of explaining the human learning process by using neural network

In practical applications neural networks have been found very useful. When we test some of these applications, it is clear that the hardware in the brain is more than sufficient for performing those operations that we would normally classify as "computations". Computational power of neural networks raises the question of why the brain is so inadequate at performing complex mathematical problems.

A neural network can helps to classify events as signal and background by providing a function. The provided function takes an input of a number of variables dealing with the energy deposits event and it gives an output estimating the probability that the event is signal as opposed to background. To evaluate this function, the network undergoes from a particular training period, in this period one feeds in a sample of background events and a sample of signal events. The neural network adjusts the weights of its various connections using the training samples and trying to find the weights that correspond to the best fit between the function and the data. The data consists for signal events are

ones and for background events zeros and the neural net output consists of numbers between zero and one depicting the likelihood that an event with the given parameters is a signal event.

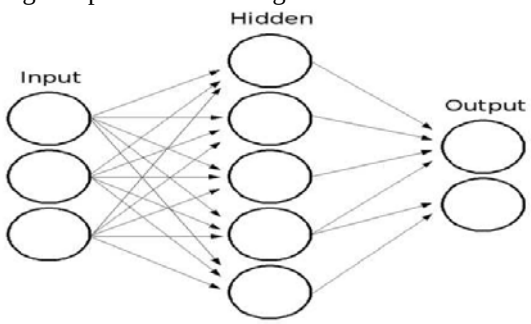


**Figure 1 – A simple neural network**

Artificial neural networks completely alter the progression of human thought. Artificial Neural Networks (ANNs) represent models of information processors that resemble biological neural networks. While ANNs provide more efficient ways of processing data, adverse results occur if machines interact with human cognition. Artificial neural network development has remains a fascinating element of scientific discovery. Neural networks consists number of cells known as neurons. The neurons transmit electrical impulses throughout the central nervous system. Each neuron consists of dendrites, axons, soma and myelin sheath. Where dendrites receive signals from other neurons, soma represents the cell body and protecting the neuron nucleus, axons work as terminals for electrical impulses and myelin sheath acting as an insulator.

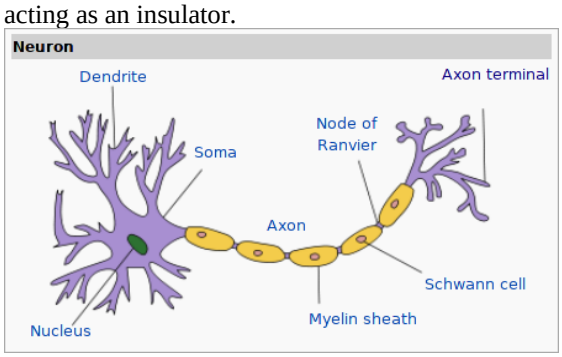


**Figure 2 – Components of a neuron**

Certain neurons perform specific tasks in network system, such as transmitting signals from sensory or motor organs to the brain. A neural network has multiple neurons; they transmit data for a specific purpose. ANN models continue to improve on creating by modern scientists that duplicate the phenomena of biological neurons, enabling inventors for create machines that perform human like tasks.

### 1.1. Artificial Neural networking as parallel processing

The concept of Artificial Neural Network is mainly introduced from the subject of biology where neural network plays an important role in human body as a nervous system. In human body work is done by the using neural network. Neural Network is just a structure of interconnected neurons which are millions and millions in number. All the parallel processing is done with the help of interconnected neurons in human body and the human body is the great example of Parallel Processing. A neuron is a special biological cell that A neuron process information from one neuron to another neuron with the help of some electrical and chemical change, there a neuron is a special biological cell. It is composed of a cell body or soma and two types the axon and the dendrites tree like branches. The cell body has a nucleus that contains information about hereditary traits and plasma. Nucleus holds the molecular equipments or producing material required by the neurons. A neuron receives signals from other neuron through dendrites, in that manner whole process of receiving and sending signals is done. The Neuron send signals at spikes of electrical activity by the using a long thin stand known as an axon and an axon splits this signals by the using synapse and send it to the other neurons in system.

### 1.2. Why Artificial Neural Network?

The long evolution in artificial intelligence has given many best and excellent characteristics to brain of human being which are not properly present in modern computers which are Massive Parallelism, Distributed representation and computation, Adaptability, Learning Ability, Generalization Ability, Inherent Contextual Information Processing, Fault Tolerance and Love Energy Consumption etc.

## 2. Artificial Neural Networks & the Human Brain related to each other

Neural networks are conceptually modeled on the basics on human brain metaphor. The human brain consists of, among other things, a highly interconnected system of neurons. The neuron is the basic building block of the brain and the nervous system. Signals are passed between neurons by means of electrochemical pulses. A neural net is an artificial representation of the human brain that tries to simulate its learning process. On the issues of memory, there is no comparison between them. Neural networks are much better and faster than humans.

## 2.1 The Human Brain

The neuron is the basic entity of the brain and the nervous system.

- The human brain has neurons between 10 and 500 billion (around $10^{11}$ neurons )
- In a human brain each neuron is connected to a large number of other neurons (about 1000 on average).

Each neuron is connected to other neurons by the using axons which end in synapses. These synapses are responsible for sending signals along dendrites into the neuron. The dendrites can be regarded as the inputs to the neuron and the axon can be regarded as the neuron's output.

In the brain axons (outputs) from many neurons will connect to the dendrites (inputs) of many other neurons. The strength of a signal can be easily modified by the strength of the synapse or connection between one neuron's axon (output) and another neuron's dendrite (input). The chemical equivalent of an electrical variable resistor can be regarded by the synapse. The brain learns by modifying the strength of its synapses. All neurons are arranged in a rough layer-like structure. In this structure early layers receive input from the sense organs and the final layers produce motor outputs.

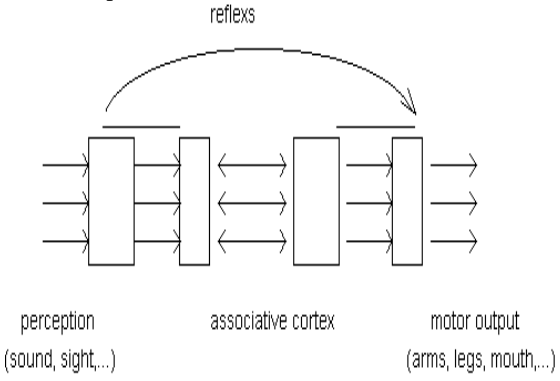


**Figure 3 – Levels of neural network system**

The middle layers form the associative cortex. This part of the brain is little understood, but is almost certainly the most important part of the brain in humans.

### 2.1.1. How the Human Brain Learns?

Much is still unknown about how the brain trains itself to process information. In dendrites a typical neuron collects signals from others through a host of fine structures in the human brain. The neuron is known as axon and it sends out spikes of electrical activity through a long, thin stand, which divide into numbers (thousands) of branches. At the ending point of each branch, a structure called a synapse, and it converts the activity from the axon into electrical effects that inhibit or excite activity from the axon into electrical effects that inhibit or excite activity in the connected neurons in the human brain. When a neuron receives excitatory input that is sufficiently large compared with its inhibitory input, then it sends a spike of electrical activity down its axon. Changing the effectiveness of the synapses occurs learning, so that the influence of one neuron on another changes in a human brain.

### 2.1.2. By the Human Neurons to Artificial Neurons

We have first trying to deduce the essential features of neurons and their interconnections for conducting neural networks. After that we typically program a computer to simulate these features because our knowledge of neurons is not complete and our computing power is also limited, our models are necessarily gross idealizations of real networks of neurons.

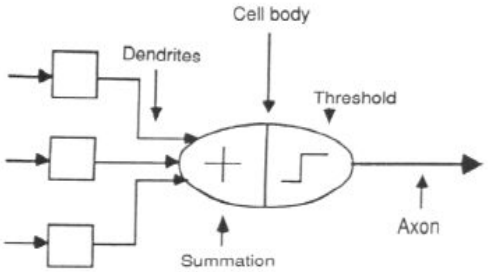


**Figure 4 – The neuron model**

## 2.2. An Artificial Brain

A collection of a number of simple and highly connected neurons is called an artificial neural network. Neurons are connected by weighted links passing signals from one neuron to another neuron. The first model of an artificial neuron designed in 1942 by McCulloch and Pitts. It is still the basis for most neural networks today.

It consisted of:

A set of inputs - (dendrites)
A set of variable resistances - (synapses)
A processing element - (neuron)
A single output - (axon)
A set of inputs - (I1, I2, In)
A set of variable resistances - (W1, W2, Wn)
A processing element - (summation and activation)
A single output - (Oj)

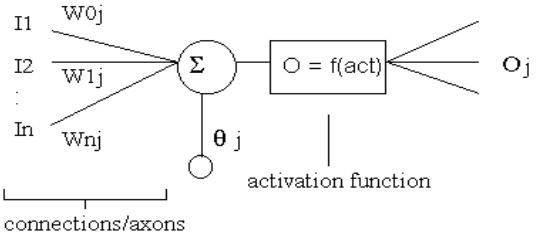

**Figure 5 – Model of an artificial brain**

The main cell body consists of:

- all of the input signals to the neuron adds together by a summation component
- a transfer function (activation function) modifies the results of the summation before sending it to the single output.

Basic transfer or activation functions used in processing elements can vary.

Only a few are found of practical use. If think of the transfer function as an electronic gate.

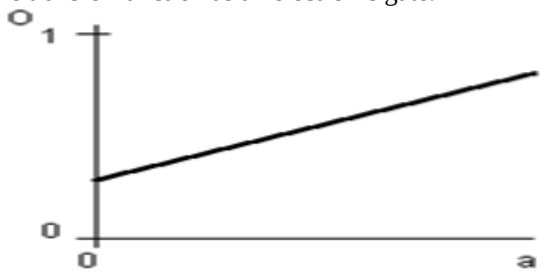


**Figure 6 – Linear function**

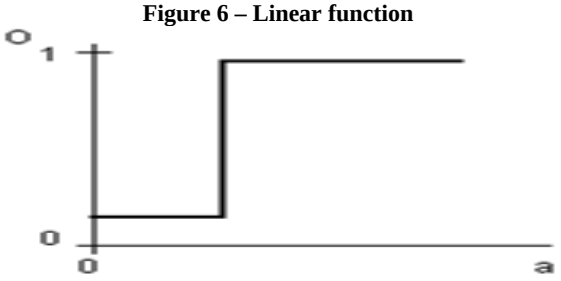


**Figure 7 – Nonlinear function**

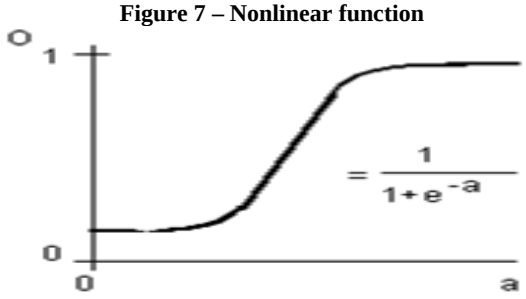


**Figure 8 – Semi-linear function**

Characteristics are common to both biological neural networks and most of the advanced neural networks.

- Massively parallel computation.
- Adaptation to changing environment and in response to data the emergence of "intelligent" information processing functions by self-organization.

**2.2.1. How Neural Networks Learn?**

Artificial neural networks are typically composed of interconnected neurons. A modifiable weight is useful for define the function of the synapse and this weight is associated with each connection of neurons in neural network. Each unit (neuron) converts the pattern of incoming activities that it receives into a single outgoing activity that it broadcasts to all other units. It performs this task of conversion in two stages:

1. First it multiplies each incoming activity by the weight on the connection and then adds together all these weighted inputs to get a quantity called the *total input*.
2. An input-output function used by a unit transforms the total input into the outgoing activity.

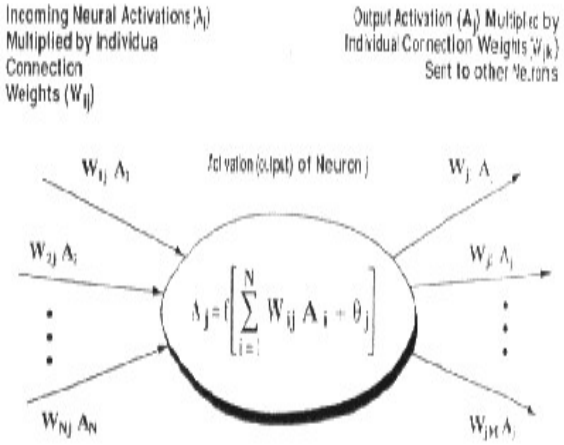


**Figure 9 – Computation Function**

Weights and the input-output function (transfer function) that is specified for the units play an important role in the behavior of an ANN (Artificial Neural Network) depends on both the. This function usually falls into one of three categories:

- linear
- threshold
- sigmoid

For **linear units**, the output activity of neurons is proportional to the total weighted output.

For **threshold units**, first the output is set at one of two levels, depending on comprising the total input is greater than or less than some threshold value.

For **sigmoid units**, the output arises continuously but not linearly as the input changes. A greater resemblance to real neurons handled by sigmoid units than do linear or threshold units, but all three units must be considered rough approximations.

To make a neural network need to perform some specific tasks, we must properly choose how the units are connected to one another because it is much important for design a network, and we must set the weights on the connections appropriately for calculating outputs. The connections determine whether it is possible for one unit to influence

another. The weights specify depend on the strength of the influence.

**2.2.2. Feed forward network with a single layer**

Single layer neurons are the simplest networks. Multiple input sources will be fed into the group of neurons, which provide the outputs to the neural network; these can only represent linearly-separable functions. We can make the system represent more complex functions by adding more layers.

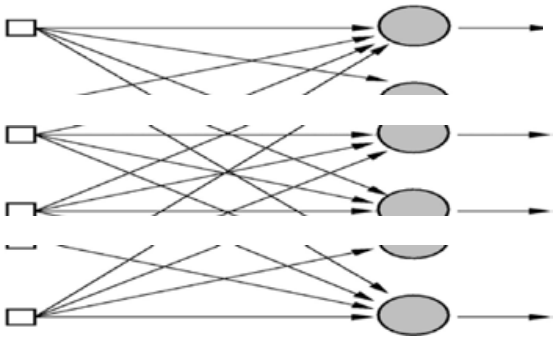

**Figure 10 – A single layer network model**

**2.2.3. Multilayer feed forward network**

The artificial neural network mainly consists of a three group's structure, or layers, of units: First layer of "**input**" units is connected to a layer of "**hidden**" units, which is connected to a final layer of "**output**" units.

- The raw information represented by the activity of the input units that is fed into the network.
- The all actions of the input units and the weights on the connections between the input and the hidden units are determining the activity of each hidden unit.
- The all actions of the hidden units and the weights between the hidden and output units decide the behavior of the output units.

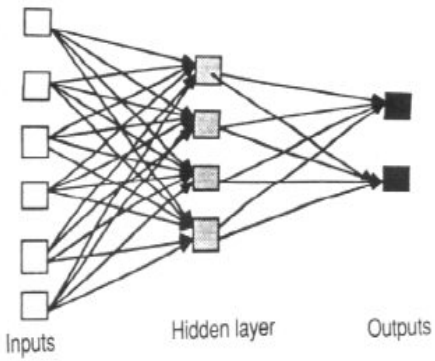


**Figure 11 – Multilevel network model**

This simple type of network system is interesting because the hidden units are free to construct their own representations of the input. The weights between the both input and hidden units determine when each hidden unit is active, and so a hidden unit can choose what it represents by modifying these weights.

We can use a three-layer network to perform a particular task by using the following procedure:

1. We present the neural network with training examples, which consist of a pattern of actions for the input units together with the desired pattern of actions for the output units.
2. We determine the network matches for find out how closely the actual output of the desired output.
3. The network produces a better approximation of the desired output is possible by the changing weight of each connection.

## 3. Perception Learning Algorithm

The step-by-step learning algorithm

**Step 1:**

Create a perceptron with a number of input neurons (n+1),

Neurons are A0, A1, An

Where A0 = 1 is the base input

Let O be the output neuron.

**Step 2:**

Input the weight W= (W0, W1, Wn) to each connection.

**Step 3:**

Repeat through the input patterns Aj of the training set using the weight set;

Calculate the weighted sum of inputs

$$\text{Net j} = \sum_{i=1}^{n} Ai\ Wi$$

For each input pattern j.

**Step 4:**

Calculate the output Yj using the step function

$$Yj = f(net) = \begin{cases} 1 & if\ net\ j \geq 0 \\ 0 & if\ net\ j < 0 \end{cases}$$

$$where\ net\ j = \sum_{i=1}^{n} Ai\ Wij$$

**Step 5:**

Compare the calculated output Yj with the target output Yj for each input pattern j.

If all the input patterns have been properly classified, then output the weights and then exit.

**Step 6:**

Otherwise, update the weights as given bellow:

If the calculated outputs Yj is 1 but should have been 0,

Then Wi = Wi – α Ai, I = 0,1,2,……, n
If the calculated outputs Yj is 0 but should have been 1,
Then Wi = Wi + α Ai, i=0, 1, 2, n
Where α is constant and also a learning parameter
**Step 7:**
Goto step 3
**Step 8:** Exit/End

## 4. Adaptive LINear Element (ALINE)

An ALINE consists of a single neuron of the McCulloch-Pitts type, where its weights are resolved by the normalized Least Mean Square (LMS) learning Rule. The LMS learning rule is also used as alpha rule. It is a well defined supervised training method that has been used over a wide range of diverse applications.

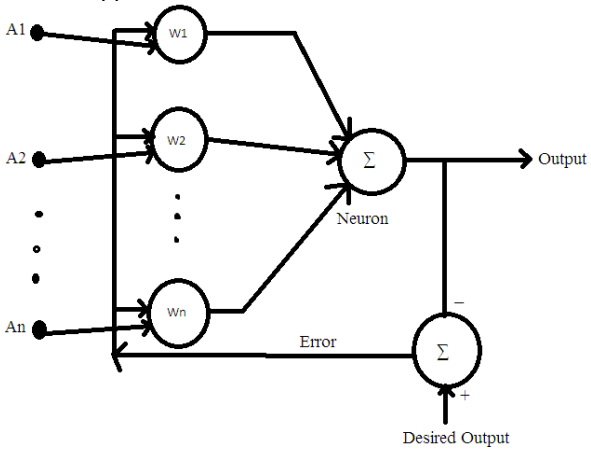


**Figure 12 – Information processing for output**

The basic format of an ALINE is similar to a neuron with a linear activation function and a feedback loop. During the learning phase of ALINE, the input vector as well as the desired output are presented to the network.

## 5. ALINE Learning Method

The basic format of an ALINE is similar to a linear neuron with an extra feedback loop.

- During the learning phase of ALINE, the input vector

  $A = [A1, A2, \ldots, An]^T$ as well as required output are presented to the network.
- The weights are adaptively adjusted based on alpha rule.
- After the ALINE is trained, an input vector presented to the network with fixed weights will result in a scalar output.
- After that, the network performs an n dimensional mapping to a scalar value.

The activation function is not used during the learning phase. Once the weights are properly adjusted, the response of the trained unit can be tested by applying various inputs, which are not in the learning set. If the network produces consistent responses to a high degree with the test inputs, it is said that the network could generalize. The process of learning and generalization are two important attributes of this network.

## 6. Usage of ALINE

In practice, an ALINE is used to make binary decisions; the output is sent through a binary threshold.

- Realizations of AND, NOT and OR logic gates.
- Only linearly separable logic functions that are realized.

## 7. Conclusion

In this paper we have tried to survey most important concepts handled by neurons in a Neural Network. A human brain is also an impotent fact in learning systems and designing an artificial brain, how it is work in processing information for learning. Mainly in a Neural Networking a neuron play an important role for learning by the using input and weight of connections between neurons. Although still regarded as a novel methodology, the neural network systems are shown to have matured to the point of offering real practical benefits in many of their applications because today's Artificial Intelligence systems mostly work as many learning systems. But there is a clear deficit of more complete work describing neural net processing; in particular nearly all quoted papers lack documentation of the applied Artificial Neural Networks. Replication of these studies under varied conditions, in order to validate them, must be encouraged and the application of new "generations" of neural network models is set to provide a sound statistical background to reinforce their performance and overcome some of their disadvantages.

## 8. References

### 8.1. Papers and Publications:

Chakraborty, R. (2010), 'Fundamentals of Neural Networks' Soft Computing Course Lecture 7 – 14, notes, slides, Aug. 10, 2010.

Hardman, M. (2010), 'Complex Neural Networks – A Useful Model of Human Learning?', British Educational Research Association Annual

conference University of Warwick 2nd September, 2010, pp. 1-6

Eluyode, O. and Akomolafe, D. (2013), 'Comparative study of biological and artificial neural networks', Scholars Research Library European Journal of Applied Engineering and Scientific Research, 2013, 2 (1):36-46

Elman, L. (1993), 'Learning and development in neural
networks: the importance of starting small', Departments of Cognitive Science and Linguistics, University of California, San Diego, La Jolla, CA 92093-0526, USA. Cognition, 48 (1993), pp. 71-99

Abidi, R. (1997), 'USING NEURAL NETWORKS TO EXPLICATE HUMAN CATEGORY LEARNING: A SIMULATION OF CONCEPT LEARNING AND LEXICALISATION', In Malaysian Journal of Computer Science, Vol. 10(2), 1997

Sharma, V., Rai, S. and Dev, A. (2012), 'A Comprehensive Study of Artificial Neural Networks', International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 10, October 2012

### 8.2. Web Sites:

[1]http://ijarcsse.com
[2]http://scholarsresearchlibrary.com/archive.html
[3]http://scholarsresearchlibrary.com/archive.html
[4]http://www.cs.nott.ac.uk/~rxq/files/2FAIANNa.pdf
[5]http://web.cs.dal.ca/~sraza/papers/Malay_journal.pdf
[6]http://www.ijarcsse.com/docs/papers/10_October2012/Volume_2_issue_10_October2012/V2I10-0117.pdf
[7]http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol2/cs11/article2.html
[8]http://www.learnartificialneuralnetworks.com/articles/artificial-neural-networks-and-their-role-in-our-lives/