

A Review: an analysis of Artificial Neural Network System

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ABSTRACT

An Artificial Neural Networks are comparatively basic electronic models that the based on the neural structure design of the human brain. The human brain basically learns from experience of human like nature and its working style. It is natural proof that some human problems and other problems that are beyond the scope of current computers system are indeed solvable by small power of efficient packages. These networks are the heart of artificial intelligence the root of which lies within the human nervous system.

Keywords: Artificial Neural, Network, Input, Output, Layer, learning, Feed forward, Feedback

INTRODUCTION:

Artificial Neural Network is an attempt to induce human-like intelligence in computers so that they simulate brain. These networks tend to process the information using the same approach which is used by the human brain to portray intelligence. However, much is still unknown about the approaches or methodologies adopted by the brain using which it is able to process imprecise data and are also successful in deriving conclusions from it[1] . These networks are the heart of artificial intelligence the root of which lies within the human nervous system. The term Artificial Neural Network is derived from the neural networks existing in the nervous system of human body which is comprised of millions of neurons working in unison in order to solve a specific problem. Collection of artificially created neurons working in a specific arrangement to estimate functions is referred as Artificial Neural Networks.

Human and Artificial Neurons

Human neurons are the basic inspiration of engineered neurons.

These are the nerve cells which transmit and receive the information in both electrical and chemical forms throughout the body. These are mainly responsible the information communication allowing different body parts to coordinate and behave in a more intelligent manner.

A typical neuron has three basic components cell body, dendrites and axon. The dendrites of the neurons collects the signals from the host and passes on to the cell body from where it travels across a thin long hair-like structure called the axon in the form of electrical signals [2]. Now, in order to achieve communication the information needs to be transmitted within the neurons as well as to other neurons, for which it needs to cross the synaptic gaps. In some cases, these signals are able to cross these gaps but if they are not able to bridge it then neurotransmitters, also known as, chemical messengers helps the signals to bridge the gaps. In this way the information is communicated from one neuron to another.

An Engineered Neuron

Artificial neurons process the input signals gathered from external sources using some function and generate a single output signal. An artificial neuron can take one or more than one input signals. These are weighted inputs with each input a specific weight is associated. A function is applied to the dot product of the signal inputs and the weight vector to produce a single output which can again act as inputs to other neurons for information transmission.

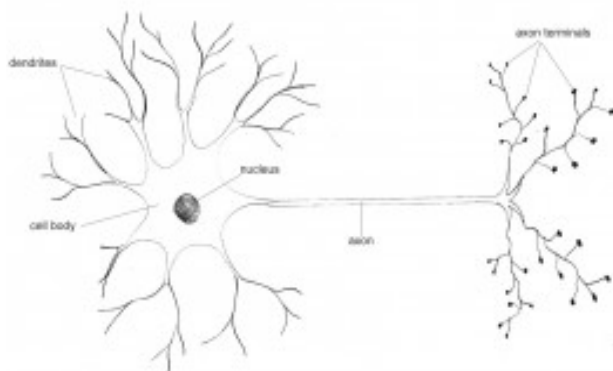


Figure 1: Structure of a biological neuron

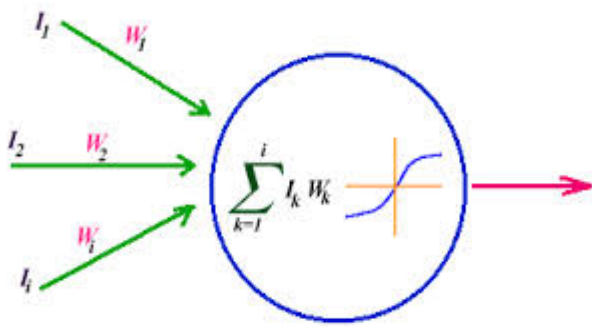


Figure 2: Structure of an artificial neuron

An artificial neuron can typically operate in either training mode or using mode. In training mode, a neuron is trained to produce output for specific input patterns whereas in using mode whenever an already taught input pattern is fed to the neuron, the associated output to that input pattern is generated [3]. Firing rules determine whether neuron should fire for any input pattern or not. If the detected input pattern is unknown to the neuron then firing rules determines whether or not the neuron should fire.

Artificial Neural Networks

An artificial neural network consists of numerous artificially engineered neurons collaborated in a specific configuration. Each neuron has its own functionality and it is also independent of other neurons but when they work in collaboration they can estimate or compute any function. These networks adopt parallel processing approach in computing any function and also have a memory associated with them [4]. Knowledge is stored in this memory which is used in future by artificial neural networks to produce desired outputs this knowledge is called numeric data. Neurons transfer this numeric data through weights. The output from every individual neuron has some weight associated with it which is actually a local representation of memory in which the knowledge is stored. Learning process of artificial neural networks involves training i.e. these are trained networks. These networks are trained by introducing the input patterns repeatedly to ANN and adjusting the associated weights each time until it reaches an optimum value whether it either tends to minimize or maximize. After such repeated inputs ANN learns to compute the desired function [5].

Input to a neuron

The inputs to an ANN like colors, symbols or parameters must be assigned numeric values and these inputs are called patterns which can be a single numeric value or it could also be a vector. Net input to a neuron can be linear basis or radial basis.

Linear basis input: - Linear basis input is calculated by summing up the dot products of the input vectors and their

associated weights. The result of the summation is the net input to the neuron.

Radial basis input:-This is a hyper spherical function in which the distance between input vectors and weight vectors.

Output of a neuron

An output is produced by applying an activation function to the net inputs which is non-linear in nature. The output so produced is called the response of the neuron and this activation function is simply called neuron function.

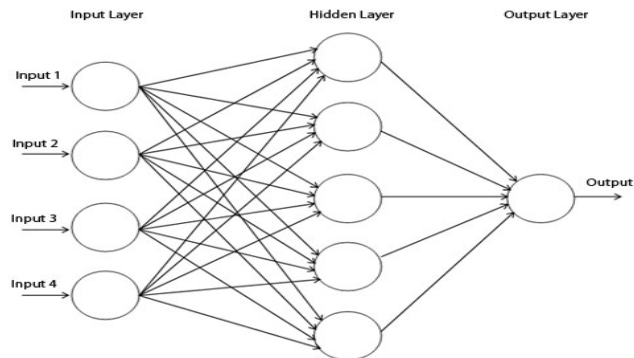


Figure 3: Artificial Neural Networks with input and output Layers

The Learning Process

The process of learning in ANNs involves the memorization of input patterns and their respective responses. All the learning methods of adaptive neural networks can be broadly classified as:

Supervised Learning

Under supervised learning an external supervisor or teacher is the one who trains the neural network. ANNs are taught the desired responses to specific input patterns. Information is already fed into the network to estimate or compute desired function. An input pattern is introduced at the input unit and then response produced is compared with the desired response taught by the human . The teacher then informs whether output produced is correct or incorrect .If the output is correct then no changes are made, but if it is incorrect then an error difference between the actual and desired response is provided by the teacher so that the weights can be adjusted accordingly and the network will be trained with successive input patterns [7]. Supervised learning also involves error correction learning and stochastic learning. Error correction is a more concerning paradigm because it becomes difficult to calculate the weight vectors which will minimize the error. We tend to minimize the error between actual and computed responses.

Unsupervised Learning

Unsupervised learning does not involve any external trainer. Only the input patterns are fed at the input unit and no desired output is provided to the network. System

itself determines the features which it will use while grouping of input data. These networks don't have any target output and are often referred as adaptive or competitive learning networks. Such networks are based on clustering techniques and helps in grouping of similar patterns [7]. Hidden layer of neurons extract the statistical features from the input data set and compete with each other. The neuron which is closest to the input data is the winning neuron which is updated and it comes closer to the input data point. Whenever an output is produced under this kind of learning, it is evaluated using a cost function and weights are updated according to the total cost. This process iterates until an output with minimal cost is generated. These kinds of networks have more significance because there are many situations where exact training sets cannot be determined. Unsupervised networks allow us to get the most optimal output from any given input data set.

Architecture of ANNs

Neural network architecture defines its structure including:

Feed-forward network

Feed-forward networks allow only one-way propagation i.e. from input to output. Perceptrons are arranged in layers. Feed-forward networks can be single layer or multilayer as well. The first layer receives the inputs while the last layer produces the output. The middle layers are referred as hidden layers because they are localized in the network and have no association with external environment [8]. Perceptrons of each layer is connected to perceptrons of another layer, however, no such connections exist between the perceptrons of the same layer. So, when the input layer receives the information, and it is propagated forward to the next layer of perceptrons in an iterative fashion until the output layer is reached.

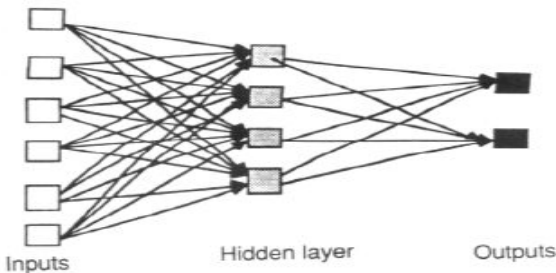


Figure 4: Feed-forward network

Feedback Networks

Feedback networks allow the signals to propagate in both the directions and so it contains loops within it. Two kinds of feedbacks which exist in these networks are local

feedbacks and global feedbacks. Local feedbacks are the links which pass the output of a neuron to itself while global feedbacks are the links which pass the output of a neuron to other neurons of the same or lower layers in multilayer feedback architecture [8]. These networks are more complicated and possess dynamic nature which means they keep on changing until a stable state is reached. They remain at equilibrium until the input remains the same. As soon as the input changes the equilibrium is disturbed and new equilibrium is to be achieved. These are also referred as recurrent networks.

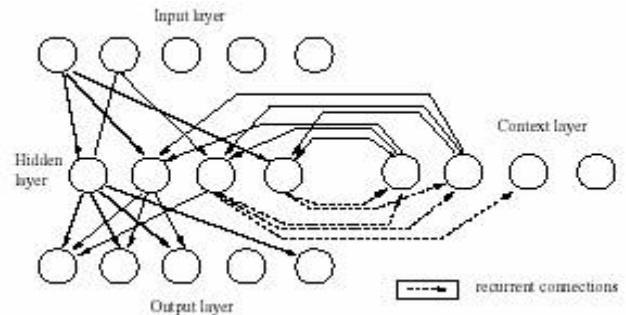


Figure 5: Feedback Networks

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