Introduction to Artificial Neural Networks

Article · February 2015

CITATIONS
0

READS
2,663

1 author:

Nouman Nazir
University of Gujrat
1 PUBLICATION **0** CITATIONS

SEE PROFILE

Introduction to Artificial Neural Networks & Hidden Layer

Nouman Nazir
nouman103@yahoo.com
University Of Gujrat

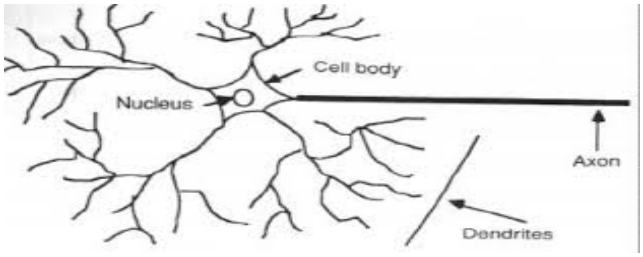
SUPERVISED BY
Zahid Iqbal

Abstract: This document is written for new-comers in the field of artificial neural networks. This paper gives brief introduction to biological and artificial neural networks, their basic functions & working, their architecture and types of artificial neural networks. It also covers three basic learning techniques and their comparison.
Steps to implement an artificial neural network are also mentioned here. Hidden layers are also discussed but how to select input parameters & details of network architecture are not covered in this paper.

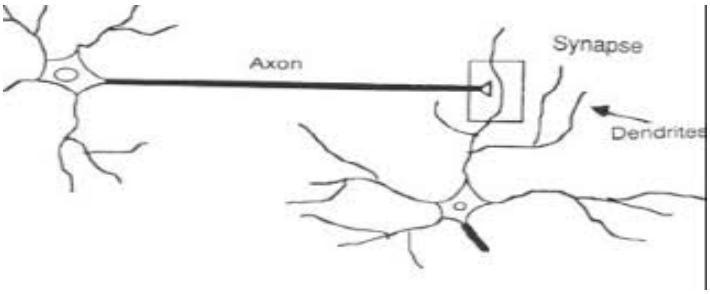
Introduction: Artificial Neural Networks are computational models inspired by human brain,used to solve complex problems.This paper is written to introduce artificial neural networks with new comers from computers science researchers and developers.This paper covers only those concepts from Biological Neural Network which are compulsory for computer science field.BNN have many other parts which are not covered here because of unnecessity.To understand ANN,basics of BNN(nervous system) should be clear.

Biological Neural Network/Animal Nervous System:

The basic unit of human nervous system is neuron.Neurons connect with eachother for processing data.A neuron is consists of three main parts;dendrites which accept input,soma which is central processing part and axon which forwards output of neuron to other nerons.This output may be input to other neurons or may be final output.Generally, a neuron is connected with 10,000 other neurons in nervous system.



Single neuron



Neurons with input/output.

Neurons are connected with each other. connection between neurons have numerical values which show the strength of connection between them. When multiple inputs are feed in a neuron, first of all, it performs summing function on the product of input values(I1,I2,I3……..In) and their respective weights(w1,w2,w3……..wn) then compare this value with threshold value(T) which is defined before. If the summing value is equal or greater than threshold value the output of neuron is 1 otherwise 0. Weights are modified according to output value. If the output is 1, weight value will increase otherwise decrease. Values of weight can be negative but maximum 1. Output of a neuron can be calculated as :

Sum=I1*w1+I2*w2+I3*w3+…….+In*wn

If sum >= T

Output = 1

Else

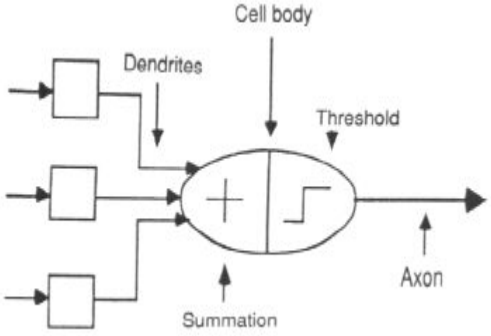
Output = 0

Threshold value for different neurons can be different.

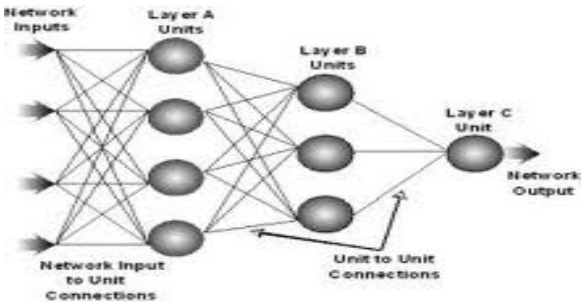
Artificial neural networks:

Artificial neural networks are computational models inspired by biological neural models used for processing large no. of inputs. Nodes are used as neurons work in biological neural networks.

Hypothetical node with basic parts is shown



Architecture: Artificial neural networks consists of three types of layers;input layers,hidden layers and output layers.Hidden layers are optional.Input layers receive inputs and forward these inputs to others layers without any processing. The next layer receive that input and perform processing(summing & comparison with T) on it and forward its results to next layers for further processing.Note that one node in a is connected with all nodes in next layer.



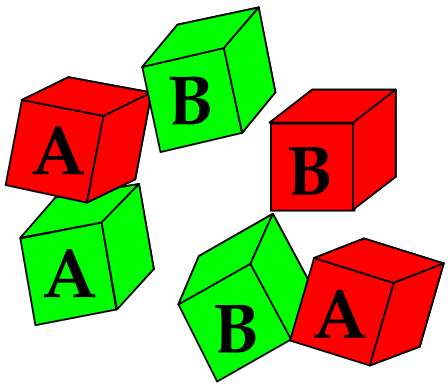
First of all,network is trained then tested and finaly implemented.During training,weights are assigned random values.These values change during training according to the output.There are some steps which are followed for implementing neural network:

1) *Data collection*
2) *Training and testing data separation*
3) *Select Network architecture*
4) *Parameter tuning and weight initialization*

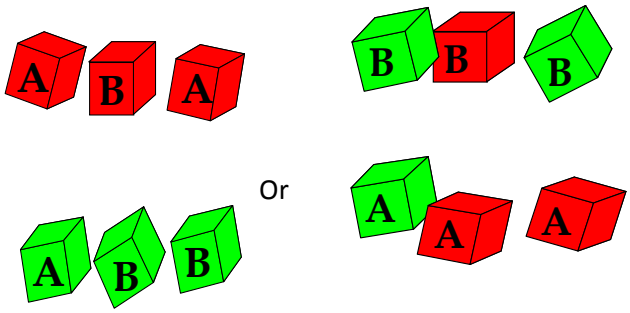
5) *Data transformation*
6) *Training*
7) *Testing*
8) *Implementation*

Learning Techniques: We are interested to develop such systems which learn from their experience because idea behind Neural Networks is learning.There are three types of learning in ANN;supervised,unsupervised & reinforced. Before implementing,we train the network,test it and finaly implement.
In supervised learning, input as well as output is provided to the network. By comparing inputs and output, network learn the required pattern and change the weights.
In unsupervised learning, only input is given to the network and it understand the pattern from given data.
In reinforced learning, input is given to the network and only indications are provided that either its output is correct or not.

Comparison of techniques: Supervised learning technique is better than unsupervised & reinforced because during this technique,network understand our required pattern from inputs provided. Different patterns exist in same data, so in unsupervised technique,we may want result from a particular perspective but network is solving problem from other perspective. For example, given data is



Its output may be



Output 1 Output 2

During unsupervised learning, network will provide any one of above mentioned outputs and result is ambiguous. If it is trained under supervised learning, we will teach the network about output therefore will get correct output. If we train the network to give output on the basis of color then output will be output 1 & if we train the network to give output on the basis of content then output will be output 2 and result is not ambiguous.Reinforced technique is better than unsupervised because if output is not provided in this technique but indication is given that either its result is correct or not. In reinforced technique, network learn through indications.

Hidden layers & no. of nodes : The main issue in neural networks is the no. of hidden layers & no. of nodes in input and hidden layers used.It is not clear yet that how many hidden layers should use and how many no. of nodes should use in input and hidden layers. The purpose of using hidden layers is parallel processing.According to some researchers, three hidden layers are enough to solve any problem. But these depends on the nature of the problem.No.of hidden layers & nodes also depends on no.of input parameters & type of architecture selected. How to select input

parameters & details of network architecture are not covered here.

Refrences:

1) S.N Sivanandam, M.Paul Raj, Introduction to artificial neural networks
2) Stuart Russel, Peter Norvig, Artificial Intelligence
3) http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/report.html
4) http://cs.stanford.edu/people/eroberts/courses/soco/projects/neural-networks/Architecture/usage.html
5) http://pages.cs.wisc.edu/~bolo/shipyard/neural/local.html