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Neural Network, Artificial Neural Network (ANN) and Biological Neural Network (BNN) in Soft Computing

Dr. G.P.Rameshkumar[*1], S.Samundeswari[2]
[*1]Professor and Head, S.N.R. SONS College, Coimbatore, India
[4] M.Phil Scholar, S.N.R. SONS College, Coimbatore, India
gpr.snr@gmail.com

Abstract

This paper presents basics and brief about neural network, artificial neural network (ANN), biological neural network (BNN) in soft computing. Neural network are of interest to quite a lot of people from different fields. The environmental nature and related functioning, marketing business as well as designing of any such systems can be implemented via neural network; NNs are useful for mapping problems.

Keywords: Neural Network, Artificial Neural Network (ANN) and Biological Neural Network (BNN).

Introduction

Neural Network

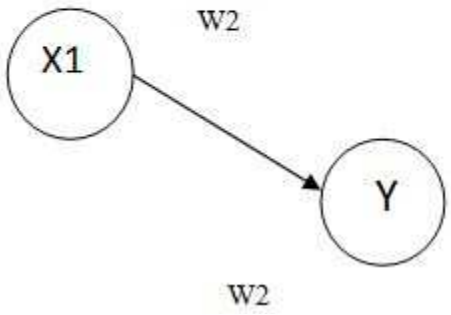
Neural network (NNs) represents a meaningfully different approach to using computers in the work place. A neural network is used to learn patterns and relationship in data, Neural networks do not require explicit coding of the problems for example, to generate a model that performs a sales forecast, a neural network needs to be given only raw data related to the problem. The raw data might consist of history of past sales, prices, competitor's prices and other economic variables, the NNs sorts through this information and produces an understanding of the factors impacting sales. The model can be called upon the to provide a prediction of future sales given a forecast of the key factors. These advancements are due to the creation of neural network learning rules, which are the algorithms used to learn the relationships in the data.

Computer Scientist, Engineers, Cognitive Scientist, Neuro -physiologists, physicists, biologists and philosophers uses neural networks for their own purposes. The aim of neural network is to mimic the human ability to adapt to changing circumstances and the current environment. This depends heavily on being able to learn from events that happened in the past and to be able to apply this to future situations.

Artificial Neural Network (ANN)

Artificial Neural Networks is information – processing system. In this information-processing system, the elements called **neurons,** process the information**.** The signal is transmitted by means of connection links. The links posses associated Weights, Which is multiplied along with the incoming signal (net input) for any typical neural net. The output signal is obtained by applying activation to the net input. The simple neural net with two input neuron (x1, x2) and one output neuron (y).The inter-connected weights are given by w1 and w2.In a single layer net there is a single layer of weighted interconnections.

A simple artificial Neural Net fig 1.1



The neural net can generally be a single layer or a multilayer net A typical multi-layer artificial neural network consists of three layers they are input layer, hidden layer and output layer.

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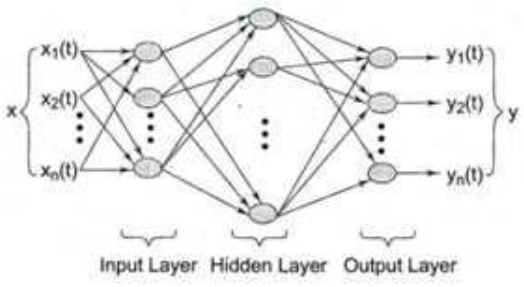


Density interconnected three layered static Neural Network. The circle represents an artificial neuron fig 1.2

As shown in the fig 1.2,The activity of neurons in the input layer represents the raw information that is fed into the network. The activity of Neuron in the hidden layer is determined by the activities of the input neuron and the connecting weight between the input and hidden units. The behavior of the output units depends on the activity of the neuron in the hidden layer and the connecting weights between the hidden layer and the output layer. Among the most popular hardware implementation are Hopfield, multilayer perceptron, self –organizing feature map, learning vector quantization, radial basis function, cellular neural and adaptive resonance theory (ART) network, and counter propagation network, back propagation network etc

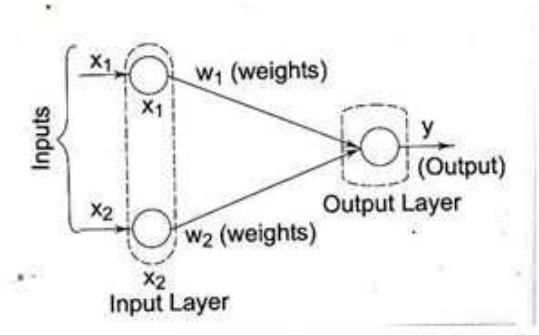
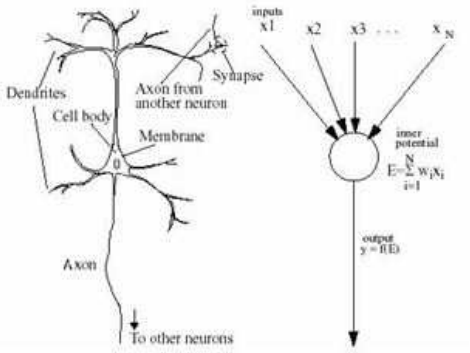


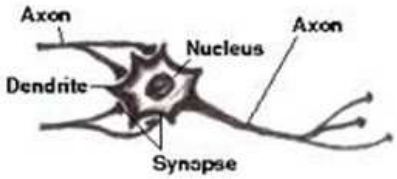
Fig 1.3 A Simple Artificial Neural Net

Shows a simple artificial neural network with two input neurons (x_1,x_2) an done output neuron (y). The inter connected weights are given by w_1 and w_2 An artificial neuron is ap input single output signal processing element, which can be though of as a simple model of a non-branching biological neuron. In Fig 1.3.various inputs to the network are represented by the mathematical symbol, x(n). Each of these inputs are multiplied by a connection weight. These weights are represented by w(n). In the simplest case, these products are simply summed, fed through a transfer function to generate a result, and then delivered as output. This process lends itself to physical implementation on a large scale in a small package. This electronic implementation is still possible with other network structures, which utilize different summing functions as well as different transfer functions.

Biological Neural Network

A biological neuron or a nerve cell consists of synapses, dendrites, the cell body (or hillock) and the axon.





- The synapses are elementary signal processing devices.
- A synapse is a biochemical device, which converts a pre-synaptic electrical signal into chemical signal and then back into a post-synaptic electrical signal.
- The input pulse train has its amplitude modified by parameter stored in the synapse. the nature of this modification depends on the type of the synapse, which can either inhibitory or excitatory.
- The post synaptic signals are aggregated and transferred along the dendrites to the nerve cell body.
- The cell body generates the output neuronal signal, a spike, which is transferred along the axon to the synaptic terminal of other neurons.
- The frequency of firing of a neuron is proportional to the total synaptic activities and is controlled by the synaptic parameters (weight).
- The pyramidal cell can receive 104

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Synaptic inputs and it can fan-out the output signal to thousands of target cells--connectivity difficult to achieve in the artificial neural networks.

In general the function of the main elements can be given as

Dendrite- Receives signals from other neurons.
Soma - Sums all the incoming signals.
Axon - When a particular amount of input is received, then the cell fires. It transmits signal through axon to other cells.

The fundamental processing of a network is a neuron. This building block of human awareness encompasses a few general capabilities. Basically, a biological neuron receives inputs from other sources, combines them in some way, performs a generally nonlinear operation on the result, and then outputs the final result.

The properties of the biological neuron pose some features on the artificial neuron, they are:

1. Signals are received by the processing elements, this elements sums the weighted inputs.
2. The weight at the receiving ends has the capability to modify the incoming signal.
3. The neuron fires (transmits output), when sufficient input is obtained.
4. The output produced from one neuron may be transmitted to other neurons.
5. The processing of information is found to be local.
6. The weights can be modified by experience.
7. Neurotransmitter for the synapse may be excitatory or inhibitory.
8. Both artificial and biological neurons have inbuilt fault tolerance.

Comparison between ANN and BNN

Artificial Neural Network:

SPEED: Neural networks are faster in processing information.

PROCESSING: Many programs have number of instructions, and they operate in the sequential mode one instruction after another.

STORAGE: In computer, the information is stored in the memory, which is addressed by its location. Any new information in the same location destroys the old information. Hence here it is strictly replaceable.

FAULT TOLERANCE: The information corrupted in the memory cannot be retrieved.

CONTROL MECHANISM: There is a control unit, which monitors all the activities of computing.

Biological Neural Network

SPEED: Biological neurons are slow in processing information.

PROCESSING: Biological neural networks can perform massively parallel operation.

STORAGE: Neural networks store information in the strengths of the interconnections. Information in the brain is adaptable, because new information is added by adjusting the interconnection strenght, without destroying the old information.

FAULT TOLERANCE: They exhibit fault tolerance since information is distributed in the connection throughout the network. Even though if few connections are not working the information is still preserved due to the distributed nature of the encoded information.

CONTROL MECHANISM: There is no central for processing information in the brain. The neuron acts based on the information locally available, and transmit its output to the neurons connected to it. There is no specific control mechanism external to the computing task.

Conclusion

The aim of neural networks is it mimics the human ability to adapt to changing circumstances and the current environment. Artificial neural network are faster in processing information then the biological neural network. Thus the ANN‘s are a type of artificial intelligence that attempts to imitate the way of human brain works.

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