DELIBERATION OF LOAD VS DEMAND USING BIOLOGICAL NEURAL NETWORKS TECHNIQUE

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ABSTRACT

Biological Neural Network (NN) Method is applied to computing the load in a particular time period for a large power system. The load has two distinct patterns: weekday and weekend-day patterns. The weekend-day pattern includes Saturdays, Sunday and Monday loads. A nonlinear load model is proposed and several structures of ANN for target time load are tested. Inputs to the ANN are past loads and the output of the ANN is the computing load for a given day. This project presents a study of computing a specified hourly load using Biological Neural Networks (NN).

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INTRODUCTION

Work on artificial neural network has been motivated right from its inception by the recognition that the human brain computes in an entirely different way from the conventional digital computer. The brain is a highly complex, nonlinear and parallel information processing system. It has the capability to organize its structural constituents, known as neurons, so as to perform certain computations many times faster than the fastest digital computer in existence today. The brain routinely accomplishes perceptual recognition tasks; it resembles the brain in two respects:

1. Knowledge is acquired by the network from its environment through a learning Process.
2. Interneuron connection strengths, known as synaptic weights, are used to store the acquired knowledge.

WHY DO WE USE NEURAL NETWORK*S?*

Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyses. This expert can then be used to provide projections given new situations of interest and answer "what if" questions.

BENEFITS OF ANN

1. They are extremely powerful computational devices.
2. Massive parallelism makes them very efficient.
3. They can learn and generalize from training data – so there is no need for enormous feats of programming.

BIOLOGICAL MODEL:

The human nervous system can be broken down into three stages that may be represented as follows:

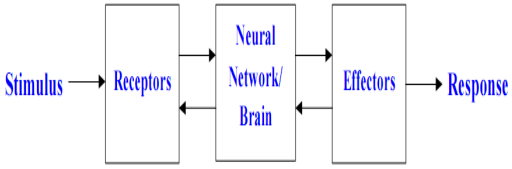


Fig: Block Diagram of a Human Nervous System.

The receptors collect information from the environment. The effectors generate interactions with the environment e.g. activate muscles. The flow of information/activation is represented by arrows. There is a hierarchy of interwoven levels of organization:

1. Molecules and Ions

2. Synapses

3. Neuronal microcircuits

4. Dendritic trees

5. Neurons

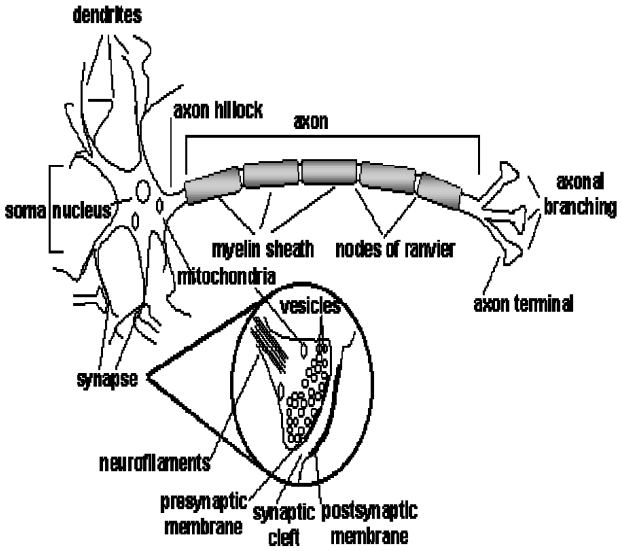
6. Local circuits

7. Inter-regional circuits

8. Central nervous system

There are approximately 10 billion neurons in the human cortex. Each biological neuron is connected to several thousands of other neurons. The typical operating speed of biological neurons is measured in milliseconds. The majority of neurons encode their activations or outputs as a series of brief electrical pulses. The neuron's cell body processes the incoming activations and converts

the into output activations. The neurons nucleus contains the genetic material in the form of DNA. This exists in most types of cells. Dendrites are fibers which emanate from the cell body and provide the receptive zones that receive activation from other neurons Axons are Fibers acting as transmission lines that send activation to other neurons. The junctions that allow signal transmission between axons and dendrites are called synapses. The process of transmission is by diffusion of chemicals called neurotransmitters across the synaptic cleft.



STRUCTURE OF NN

MATHEMATICAL MODEL OF A NEURON

A neuron is an information processing unit that is fundamental to the operation of a neural network.

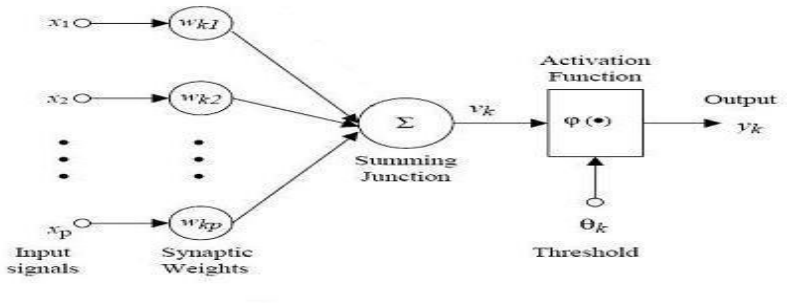


Fig: Model of an ANN

NETWORK ARCHITECTURES

There are three fundamental different classes of network architectures.

1 .**Single-layer Feed forward Networks**:

In single-layer network, there is only one input and one output layer. Input layer is not counted as a layer since no mathematical calculations take place at this layer.

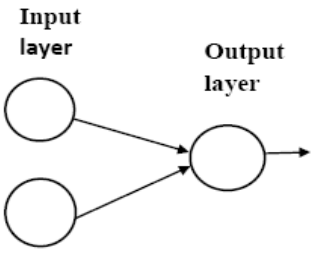
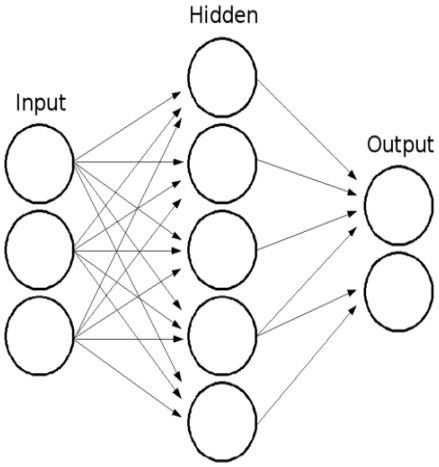


Fig 2.2 Single-layer Feedforward Network

2. **Multilayer Feed forward Networks** :

The second class of a Feed forward neural network distinguishes itself by the presence of one or more hidden layers, whose computational nodes are correspondingly called hidden neurons. The function of hidden neuron is to intervene between the external input and the network output in some useful manner.



3) **Recurrent networks**:

A recurrent neural network has at least one feedback loop. A recurrent network may consist of a single layer of neurons with each neuron feeding its output signal back to the inputs of all the other neurons. Self-feedback refers to a situation where the output of a neuron is fed back into its own input. The presence of feedback loops has a profound impact on the learning capability of the network and on its performance.

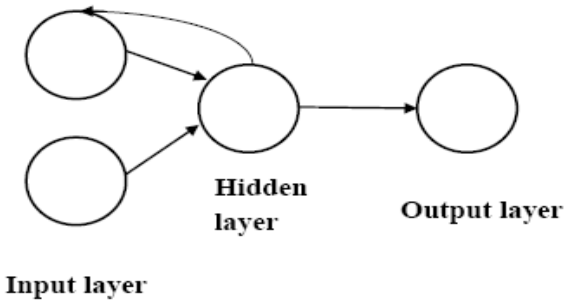


Fig 2.4 Recurrent Network

LEARNING PROCESSES

By learning rule we mean a procedure for modifying the weights and biases of a network. The purpose of learning rule is to train the network to perform some task. They fall in three broad categories:

1. **Supervised learning**:

The learning rule is provided with a set of training data of proper network behavior. As the inputs are applied to the network, the network outputs are compared to the targets. The learning rule is then used to adjust the weights and biases of the network in order to move the network outputs closer to the targets.

2. Reinforcement learning:

It is similar to supervised learning, except that, instead of being provided with the correct output for each network input, the algorithm is only given a grade. The grade is a measure of the network performance over some sequence of inputs.

3. Unsupervised learning:

The weights and biases are modified in response to network inputs only. There are no target outputs available. Most of these algorithms perform some kind of clustering operation. They learn to categorize the input patterns into a finite number of classes.

CONCLUSION

This project presents a study of computing a specified hourly load using Biological Neural Networks (NNs). To demonstrate the effectiveness of the proposed approach, publicly available data from the (NEMMCO) web site has been taken to computing the hourly load for the power system. A nonlinear load model is proposed and several structures of NN for computing loads are tested. Inputs to the NN are past loads and the output of the NN is the prediction load for a given

day. The network with one or two hidden layers is tested with various combinations of neurons, and the results are compared in terms of forecasting error. The neural network, when grouped into different load patterns, gives good load prediction.

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