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Descriptive Analysis of Artificial Neural Network

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ABSTRACT: An Artificial Neural Network (ANN) is an information processing prototype that is stimulated by the way biological nervous systems, such as the process information, brain. The key element of this prototype is the original formation of the information processing system. It is composed of a huge number of extremely interrelated processing elements (neurons) working in unity to solve specific problems. ANNs, like group, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. This paper gives overview of Artificial Neural Network's methodology , working of ANN. It also explains the advantages of ANN.

KEYWORDS*:* ANN (Artificial Neural Network), Neurons, pattern recognition.

I.INTRODUCTION

The study of the human brain is thousands of years old. With the advent of modern electronics, it was ordinary to try to connect this thinking process. The initial step towards artificial neural networks came in 1943 when Warren McCulloch, a neurophysiologist, and a young mathematician, Walter Pitts, wrote a paper on how neurons might work. They modelled a simple neural network with electrical circuits. Neural networks, with their incredible capability to obtain meaning from convoluted data, can be used to extract patterns and perceive tendencies that are too composite to be observed 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 analyse. Other advantages include:

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
2. Self-Organisation: An ANN can create its own organisation or representation of the information it receives during learning time.
3. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
4. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

Neural networks take a different approach to problem solving than that of conventional computers. Conventional computers
use an algorithmic approach i.e. the computer follows a set of instructions in order to solve a problem. Unless the specific steps that the computer needs to follow are known the computer cannot solve the problem. That restricts the problem solving capability of conventional computers to problems that we already understand and know how to solve. But computers would be so much more useful if they could do things that we don't exactly know how to do. Neural networks process information in a similar way the human brain does. The network is composed of a large number of highly interconnected processing elements (neurons) working in parallel to solve a specific problem. Neural networks learn by example. They cannot be programmed to perform a specific task. The examples must be selected carefully otherwise useful time is wasted or even worse the network might be functioning incorrectly. The disadvantage is that

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because the network finds out how to solve the problem by itself, its operation can be unpredictable. On the other hand, conventional computers use a cognitive approach to problem solving; the way the problem is to solved must be known and stated in small unambiguous instructions.

II. METHODOLOGY

A. *Artificial Neural Network*

Artificial Neural Networks are comparatively basic electronic reproductions based on the neural structure of the brain. The brain essentially trained from practice. It is ordinary evidence that several problems that are ahead of the range of existing computers are certainly solvable by petite power competent packages. This brain reproduction also assures a fewer procedural way to expand machine resolutions.

These organically enthused techniques of computing are considered to be the next foremost expansion in the computing industry. Even simple animal brains are proficient of functions that are presently impracticable for computers. Computers do rote things well, like maintaining ledgers or executing composite mathematical problem. But computers have trouble identifying even though easy samples much less simplifying those samples of the past into proceedings of the futures.

B. *A simple neuron*

An artificial neuron is a machine with various inputs and single output. The neuron consist two methods of functions; the training method and the using method. In the training method, the neurons can be taught to fire (or not), for fastidious input sample. In the using method when a taught input sample is identified at the input, their related outputs become the existing output. If the input sample does not belong in the taught record of input sample, the firing rule is used to determine whether to fire or not.

Due to more resources of the human brain Neural Network, scientists seek to transmit the principal of synaptic advances to computer science and its functions. Hence, the principal of ANN is established.

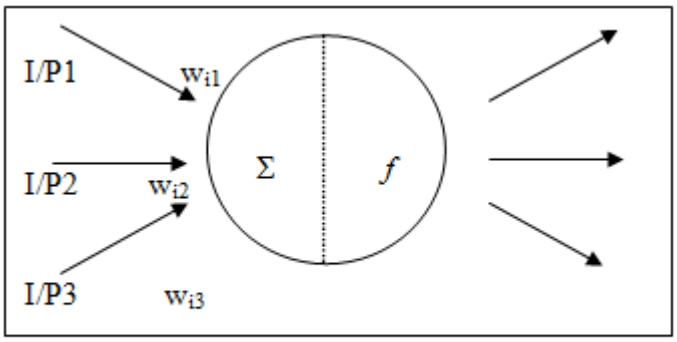

Figure 1. ANN basic building layout

The basic computational factor (neuron) is frequently known as a unit or node (Figure 1). It acknowledges input from other or from an outside basis. Each input has an associated weight w, which can be rehabilitated, so as to model synaptic edification. The node figure out some function f of the weighted sum of its inputs (Equation (1)):

$$Y_i = f(\Sigma_j \; w_{ij} \; y_j) \qquad (1)$$

Where

- The weighted sum $\Sigma_j \; w_{ij} \; y_j$ is known as the net input to node i, frequently written net_i.
- Note that w_{ij} refers to the weight from node j to node i.
- The function *f* is the node's activation function. In the simplest case, *f* is the unique function, and the node's output is just its net input. This is known as linear node.

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C. *Working of ANN*

The other components of ANN of using neural networks revolve around the numerous of ways these individual neurons can be clustered together. This clustering occur in the human being brain in such a way that information can be procedure in a dynamic, interactive, and self-organizing way. Biologically, neural networks are assembled in a three-dimensional world from atomic components. These neurons seem capable of almost unobstructed interconnections. That is not true of any proposed, or existing, man-made network. Integrated circuits, using current technology, are two-dimensional devices with a partial number of layers for interconnection. This physical reality restrains the types, and scope, of artificial neural networks that can be implemented in silicon. Currently, neural networks are the simple clustering of the primitive artificial neurons. This clustering occurs by creating layers which are then connected to one another. How these layers connect is the other part of the "art" of engineering networks to resolve real world problems.

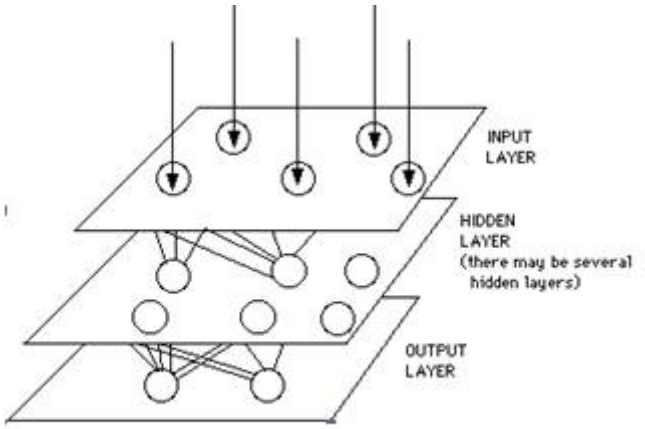

Figure 2. A Simple Neural Network Diagram.

Essentially, all artificial neural networks have a related composition or topology as shown in Figure2. In that structure some of the neurons interface to the real world to receive its inputs. Other neurons provide the real world with the network's outputs. This output might be the particular character that the network thinks that it has scanned or the particular image it thinks is being viewed. All the rest of the neurons are hidden from view. But a neural network is more than a bunch of neurons. Some early researchers tried to simply connect neurons in a random manner, without much success. Now, it is known that even the brains of snails are structured devices. One of the easiest ways to design a structure is to create layers of elements. It is the grouping of these neurons into layers, the connections between these layers, and the summation and transfer functions that comprises a functioning neural network. The general terms used to describe these characteristics are common to all networks. Although there are useful networks which contain only one layer, or even one element, most applications require networks that contain at least the three normal types of layers - input, hidden, and output. The layer of input neurons receives the data either from input files or directly from electronic sensors in real-time applications. The output layer sends information directly to the outside world, to a secondary computer process, or to other devices such as a mechanical control system. Between these two layers can be many hidden layers. These internal layers contain many of the neurons in various interconnected structures. The inputs and outputs of each of these hidden neurons simply go to other neurons. In most networks each neuron in a hidden layer receives the signals from all of the neurons in a layer above it, typically an input layer. After a neuron performs its function it passes its output to all of the neurons in the layer below it, providing a feed forward path to the output.

These lines of communication from one neuron to another are important aspects of neural networks. They are the glue to the system. They are the connections which provide a variable strength to an input. There are two types of these connections. One causes the summing mechanism of the next neuron to add while the other causes it to subtract. In more human terms one excites while the other inhibits. Some networks want a neuron to inhibit the other neurons in the same layer. This is called lateral inhibition. The most common use of this is in the output layer. For example in text recognition if the probability of a character being a "P" is .85 and the probability of the character being an "F" is .65,

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the network wants to choose the highest probability and inhibit all the others. It can do that with lateral inhibition. This concept is also called competition

III. ADVANTAGES

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
2. Self-Organisation: An ANN can create its own organisation or representation of the information it receives during learning time.
3. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
4. Pattern recognition is a powerful technique for harnessing the information in the data and generalizing about it. Neural nets learn to recognize the patterns which exist in the data set.
5. The system is developed through learning rather than programming.. Neural nets teach themselves the patterns in the data freeing the analyst for more interesting work.
6. Neural networks are flexible in a changing environment. Although neural networks may take some time to learn a sudden drastic change they are excellent at adapting to constantly changing information.
7. Neural networks can build informative models whenever conventional approaches fail. Because neural networks can handle very complex interactions they can easily model data which is too difficult to model with traditional approaches such as inferential statistics or programming logic.
8. Performance of neural networks is at least as good as classical statistical modelling, and better on most problems. The neural networks build models that are more reflective of the structure of the data in significantly less time.

IV. CONCLUSIONS

In this paper we discussed about the artificial neural network, working of ANN. There are a variety of advantages of ANN over conservative advances. Depending on the nature of the application and the power of the internal data patterns you can usually imagine a network to train quite well. This applies to problems where the interaction may be quite non-linear. ANNs provide a systematic substitute to conservative techniques which are often limited by severe hypothesis of normality, linearity, variable independence etc. Because an ANN can detain many kinds of relations it allows the user to quickly and moderately simply model experiences which otherwise may have been very complicated to enlighten otherwise. Today, neural networks consideration is taking place everywhere. Their promise seems very bright as nature itself is the proof that this kind of thing works. However, its future, definitely the very key to the whole technology, lies in hardware development. Currently most neural network development is simply proving that the principal works.

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