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RESEARCH PAPER ON OVERVIEW OF ARTIFICIAL NEURAL NETWORK

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ABSTRACT: An Artificial Neural Network (ANN) is an information processing model that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this model is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, 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 paper gives overview of Artificial Neural Network, working & training of ANN. It also explain the application, advantages and limitations of ANN.

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

INTRODUCTION

The study of the human brain is thousands of years old. With the beginning of modern electronics, it was only natural to try to couple this thinking process. The first step toward 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.Neural networks, with their remarkable ability to derive meaning from complicated 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 analyze. Several key terms involved in ANNs are:

1. *Adaptive learning:* An ability to learn how to do tasks based on the data given for training or initial experience.
2. *Self-Organization:* An ANN can create its own organization 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.

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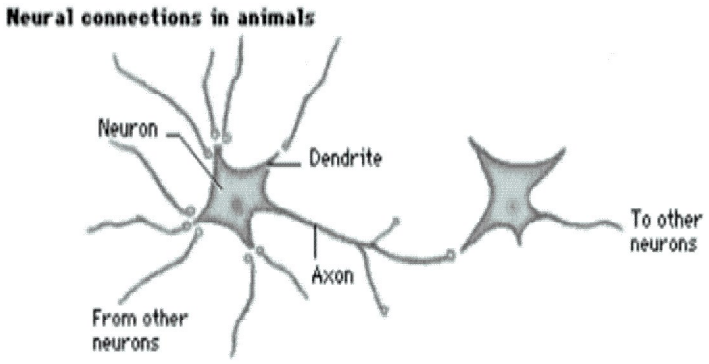
4. *Fault Tolerance via Redundant Information Coding:* Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.



Description about Artificial Neural Network

Artificial Neural Networks are relatively crude electronic models based on the neural structure of the brain. The brain basically learns from experience. This brain forming also promises a less technical way to develop machine solutions. These biologically inspired methods of computing are thought to be the next major advancement in the computing industry. Computers do various things well, like keeping ledgers or performing complex math. But computers have trouble recognizing even simple generalize. Now, advances in biological research promise an initial understanding of the natural thinking mechanism. This paper shows that brains store information as patterns. Some of these patterns are very complicated and allow us the ability to recognize individual faces from many different angles. This field also utilizes words very different from traditional computing, words like behave, react, self-organize, learn, generalize, and forget.

Whenever we talk about a neural network, we should more popularly say ¯Artificial Neural Network are computers whose architecture is modelled after the brain. They typically consist of hundreds of simple processing units which are wired together in a complex communication network. Each unit or node is a simplified model of real neuron which sends off a new signal or fires if it receives a sufficiently strong Input signal from the other nodes to which it is connected.

Traditionally neural network was used to refer as network or circuit of biological neurons, but modern usage of the term often refers to ANN. ANN is made up of interconnecting artificial neurons which are programmed like to imitator the properties of n biological neurons. These neurons working in unanimity to solve specific problems. ANN is configured for solving artificial intelligence problems without creating a model of real biological system. ANN is used for speech recognition, image analysis, adaptive control etc. These applications

are done through a learning process, like learning in biological system, which involves the adjustment between neurons through synaptic connection. Same happen in the ANN.

Working of ANN

There are various individual neurons can be clustered together in ANNs. This clustering occurs in the human mind in such a way that information can be processed in a dynamic, interactive, and self-organizing way. These neurons seem capable of nearly unrestricted interconnections. That is not true of any proposed, or existing, man-made network. Integrated circuits, using current technology, are twodimensional devices with a limited 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.

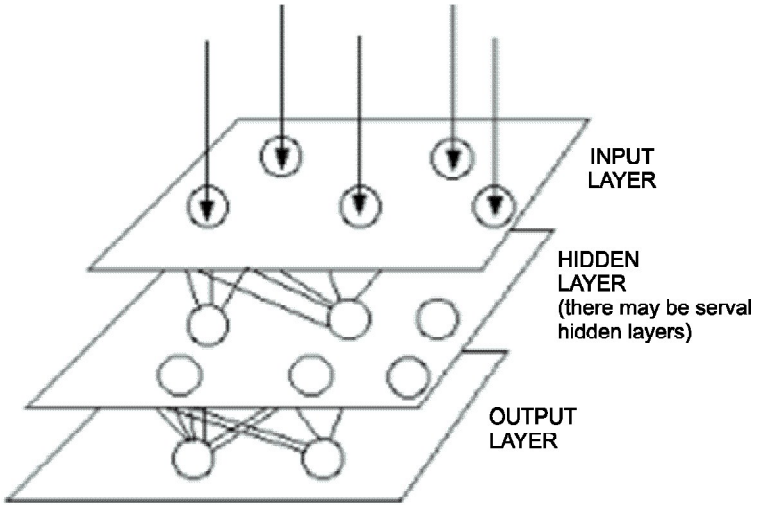


Figure 1: Simple neural network

Basically, all artificial neural networks have a similar structure or topology as shown in Figure1. In that structure some of the neurons interfaces 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.

Neural Network Topologies

1. *Feed forward neural network:* In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and

to the output nodes. There are no cycles or loops in the network. The data processing can extend over multiple (layers of) units, but no feedback connections are present, that is, connections extending from outputs of units to inputs of units in the same layer or previous layers.

2. *Recurrent network:* Recurrent neural networks that do contain feedback connections. Contrary to feed forward networks, recurrent neural networks (RNs) are models with bi-directional data flow. While a feed forward network propagates data linearly from input to output, RNs also propagate data from later processing stages to earlier stages.

Training of Artificial Neural Networks

A neural network has to be configured such that the application of a set of inputs produces the desired set of outputs. Various methods to set the strengths of the connections exist. One way is to set the weights explicitly, using a priori knowledge. Another way is to 'train' the neural network by feeding it teaching patterns and letting it change its weights according to some learning rule.

We can classify the learning conditions as follows:

Supervised learning or Associative learning in which the network is trained by providing it with input and matching output patterns. These input-output pairs can be provided by an external teacher, or by the system which contains the neural network (self-supervised).

Unsupervised learning or Self-organization in which an (output) unit is trained to respond to clusters of pattern within the input. In this learning the system is supposed to discover statistically relevant features of the input population. Unlike the supervised learning there is no a priori set of categories into which the patterns are to be classified; rather the system must develop its own representation of the input stimuli.

Reinforcement learning this type of learning may be considered as an intermediate form of the above two types of learning. Here the learning machine does some action on the environment and gets a feedback response from the environment. The learning system grades its action good or bad based on the environmental response and accordingly adjusts its parameters.

1. High Accuracy: Neural networks are able to approximate complex non-linear mappings.
2. Noise Tolerance: Neural networks are very flexible with respect to incomplete, missing and noisy data.
3. Independence from prior assumptions: Neural networks do not make a priori assumptions about the distribution of the data, or the form of interactions between factors.

4. Ease of maintenance: Neural networks can be updated with fresh data, making them useful for dynamic environments.
5. Neural networks can be implemented in parallel hardware
6. When an element of the neural network fails, it can continue without any problem by their parallel nature.

LIMITATIONS OF NEURAL NETWORKS

When the conditions are right artificial neural networks can perform quite a lot better than other techniques. This out-weighs there are following seemingly long list of disadvantages-

1. Hard to interpret the model. Neural networks are a black box once they are trained.
2. Don't perform as well on small data sets. The Bayesian approaches do have an advantage here.
3. Learning algorithm is a bit ad hoc when compared to ML or Bayesian approaches like EM or variational EM. OTOH I can't say I'm a huge fan of Gibbs sampling so maybe that's a draw.

CONCLUSION

In this paper we discussed about the artificial neural network, working of ANN. Also training phases of an ANN. There are various advantages of ANN. Depending on the nature of the application and the strength of the internal data patterns you can generally expect a network to train quite well. ANNs provide an analytical alternative to conventional techniques which are often limited by strict assumptions of normality, linearity, variable independence etc.

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