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Overview of Neural Network

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Abstract: *Neural network is a machine learning method evolved from the idea of having look of the human brain, a data processing system which includes large number of simple, highly interconnected processing elements in an architecture inspired by the structure of the cerebral cortex portion of the brain. Hence, neural networks are often capable of doing things which humans or animals do well but which conventional computers often do poorly. Neural networks have emerged in the past few years as an area of unusual opportunity for research, development and application to a variety of real world problems. Indeed, neural networks exhibit characteristics and capabilities not provided by any other technology. Here are some of the examples human handwriting, reading typewritten text, compensating for alignment errors in robots, modeling complex systems that cannot be modelled mathematically, and predicting whether proposed loans will be good or fail. This paper presents a brief tutorial on neural networks and briefly describes several applications.*

Keywords: Neural network

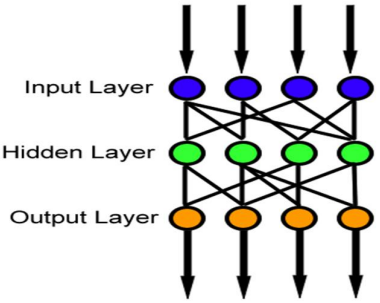
I. INTRODUCTION

An Artificial Neuron Network (ANN), popularly known as Neural Network is a computational model based on the structure and functions of biological neural networks. It is like an artificial human nervous system for receiving, processing, and transmitting information in terms of Computer Science.

Basically, there are 3 different layers in a neural network :-

1. Input Layer (All the inputs are fed in the model through this layer)
2. Hidden Layers (There can be more than one hidden layers which are used for processing the inputs received from the input layers)
3. Output Layer (The data after processing is made available at the output layer)

The given figure shows the three layer of Neural Network:



II. SCOPE OF NEURAL NETWORK

It has a wide and bright scope in the future. Researchers are constantly working on new technologies based on neural networks. Everything is converting into automation; hence they are very much efficient in dealing with changes and can adapt accordingly. Due to an increase in new technologies, there are many job openings for engineers and neural network experts. Hence in the future also neural networks will prove to be a major job provider.

2.1 How Does Neural Network Works

Neural networks are comprised of layers of neurons.

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These layers consist of the following:

1. Input layer
2. Multiple hidden layers
3. Output layer

The input layer receives data represented by a numeric value. Hidden layers perform the most computations required by the network. Finally, the output layer predicts the output.

In a neural network, neurons dominate one another. Each layer is made of neurons. Once the input layer receives data, it is redirected to the hidden layer. Each input is assigned with weights.

The weight is a value in a neural network that converts input data within the network's hidden layers. Weights work by input layer, taking input data, and multiplying it by the weight value.

It then initiates a value for the first hidden layer. The hidden layers transform the input data and pass it to the other layer. The output layer produces the desired output.

The inputs and weights are multiplied, and their sum is sent to neurons in the hidden layer. Bias is applied to each neuron. Each neuron adds the inputs it receives to get the sum. This value then transits through the activation function.

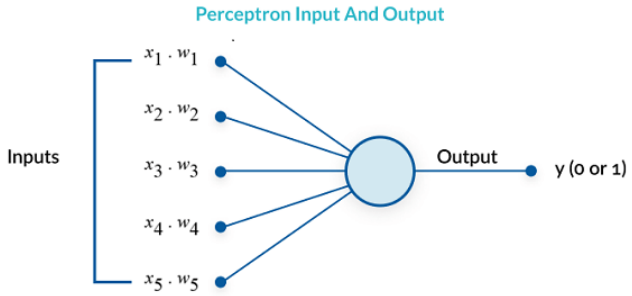
2.2 Types of Neural Network

There are different types of Neural Network based on their performance and principles to determine the output. Some different types of neural networks are listed below.

A. Perceptron

It is one of the simplest models that can learn and solve complex data problems using neural networks. Perceptron is also called an artificial neuron. A perceptron network is comprised of two layers:

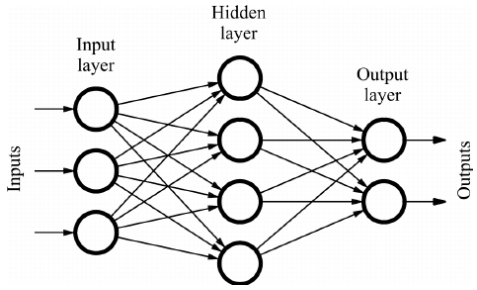
1. Input Layer
2. Output Layer



B. Feed Forward Neural Network

In a feed-forward network, data moves in a single direction. It enters via the input nodes and leaves through output nodes. By moving data in one direction, there is no back propagation. The back propagation algorithm calculates the gradient of the loss function with consideration to weights in the network. A couple of feed-forward neural networks applications are:

1. Speech Recognition
2. Facial Recognition



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C. Radial Basis Function Neural Network

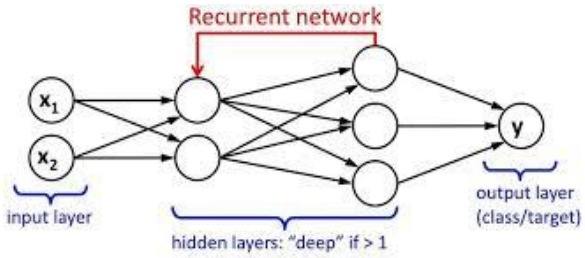
It are comprised of three layers:

1. Input Layer
2. Hidden Layer
3. Output Layer

RBF networks classify data based on the distance of any centered point and interpolation.
Interpolation resizes images. Classification is executed by estimating the input data where each neuron reserves the data. RBF networks look for similar data points and groups them.

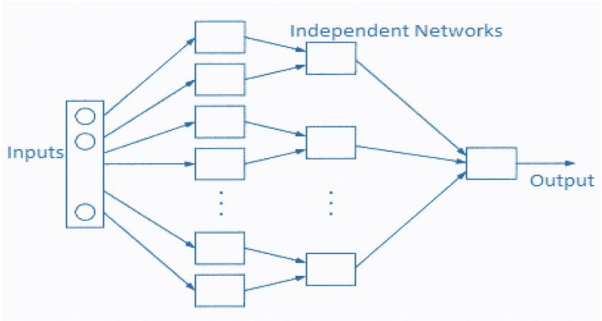
D. Recurrent Neural Network

A Recurrent Neural Network is a network good at modeling sequential data. Sequential data means data that follow a particular order in that a thing follows another



E. Modular Neural Network

A Modular Neural Network (MNN) is composed of unassociated networks working individually to get the output. The various neural networks do not interact with each other. Each network has a unique set of inputs compared to other networks.



III. NEURAL NETWORK CHALLENGES

The most complex artificial neural networks are often referred to as deep neural networks, referencing the multi-layered network architecture. Deep learning models are usually trained using labelled training data, which is data with a defined input and output. This is known as supervised machine learning, unlike unsupervised machine learning which uses unlabelled, raw training data. The model will learn the features and patterns within the labelled training data, and learn to perform an intended task through the examples in the training data. Artificial neural networks need a huge amount of training data, more so then more traditional machine learning algorithms. This is in the realm of big data, so many millions of data points may be required.

The need for such a large array of labelled, quality data is a limiting factor to being able to develop artificial neural network models. Organisations are therefore limited to those that have access to the required big data. The most powerful artificial neural network models have complex, multi-layered architecture.

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IV. HISTORY OF NEURAL NETWORK

The idea of neural networks began unsurprisingly as a model of how neurons in the brain function, termed 'connectionism' and used connected circuits to simulate intelligent behaviour .In 1943, portrayed with a simple electrical circuit by neurophysiologist Warren McCulloch and mathematician Walter Pitts. Donald Hebb took the idea further in his book, The Organization of Behaviour (1949), proposing that neural pathways strengthen over each successive use, especially between neurons that tend to fire at the same time thus beginning the long journey towards quantifying the complex processes of the brain.

The model paved the way for research to split into two approaches. One approach focused on biological processes while the other focused on the application of neural networks to artificial intelligence. This work led to work on nerve networks and their link to finite automata.[2]

V. CONCLUSION

Neural network is a vast subject. Many data scientists solely focus only on Neural network techniques .In this session, we practiced the introductory concepts only. Neural Networks has much more advanced techniques. There are many algorithms other than backpropagation .Neural networks particularly work well on some particular class of problems like image recognition .The neural network algorithms are very calculation intensive. They require highly efficient computing machines. Large datasets take a significant amount of runtime on R. We need to try different types of options and packages .Currently there is a lot of exciting research going on, around neural networks .After gaining sufficient knowledge in this basic session, you may want to explore reinforced learning, deep learning

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