

# Review of Fuzzy logic and Neural network

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**Abstract**— There are many fields in scientific world which requires fast processing even in complex networks. Neural network is a powerful data modelling tool that is able to capture and represent complex input output relationships. Fuzzy logic is a mathematical representation for answering questions with imprecise information. In this paper we are going to discuss about the neural network and fuzzy logic and their difference.

**Index Terms**— neural network, fuzzy logic, back propagation

## I. INTRODUCTION

The main component of a neural network is neuron. Neurons are connected to each other through pathways with transmitted electrical signals. All the connections are parallel and complex. Each cell is considered as mathematical function. Each neuron has input and output when it receives electrical impulses from a cell associated with other cells connected. We have to put all the connections in order to get proper outputs.[4][1]

An artificial neural network is an interconnected group of nodes, akin to the vast network of neurons in a brain. Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one neuron to the input of another.

In machine learning and cognitive science, "artificial neural networks" ("ANNs") are a family of statistical learning models inspired by biological neural networks (the central nervous systems of animals, in particular the brain) and are used to estimate or Universal approximation theorem approximate. Function (mathematics) functions that can depend on a large number of Argument of a function inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected "artificial neurons" which send messages to each other. The connections have numeric weights that can be tuned based on experience, making neural nets adaptive to inputs and capable of learning.

For example, a neural network for handwriting recognition is defined by a set of input neurons which may be activated by the pixels of an input image. After being weighted and transformed by a Function (mathematics) function (determined by the network's designer), the activations of these neurons are then passed on to other neurons. This process is repeated until finally, an output neuron is activated. This determines which character was read.[4]

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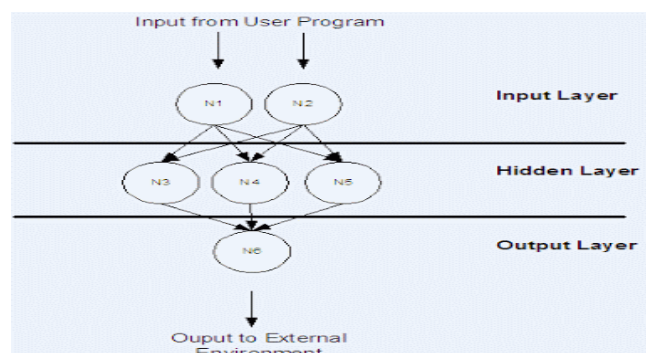
NNs have been applied in microwave engineering and applied in antenna and array analysis with encouraging results.

To do so we need to designate some cells as input and others as output cells to make things simpler.

Hence neural network is just a function that takes in a few input numbers and outputs a few numbers and in between it does some computation in hidden layer.

## II. CALCULATIONS:

All the arrows indicate strength of connections(weights): $m_1, m_2, m_3, m_4$  between input and hidden layer  $m_5, m_6, m_7$  between hidden and output layer.



$$N1=f(x1) \quad n3=f(m1 *n1) \\ N2=f(x2) \quad n4=f(m2* y1+m4*n2) \text{ and so on..}$$

Backpropagation is an important factor which decides the error( $\sim$ ).[4]it calculates the gradient of a loss function with respects to all the weights in the network. The gradient is fed to the error solving method which updates the weights in order to minimize the loss function.

$$\sim 3 = \sim *m6 \\ \sim 4 = \sim *m7 \text{ and so on....}$$

**Fuzzy logic** Fuzzy logic is a form of many-valued logic that deals with approximate, rather than fixed and exact reasoning. Compared to traditional binary logic where variables may take on two-valued logic true or false values, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false[3].

It uses fuzzy sets and fuzzy rules to model the world and make decisions.

**Fuzzy set** It allows us to do with the situations which are not precise. Real world decisions are reasoning and uncertain. Hence it is a collection of related items which belongs to set that are assigned to different degrees.

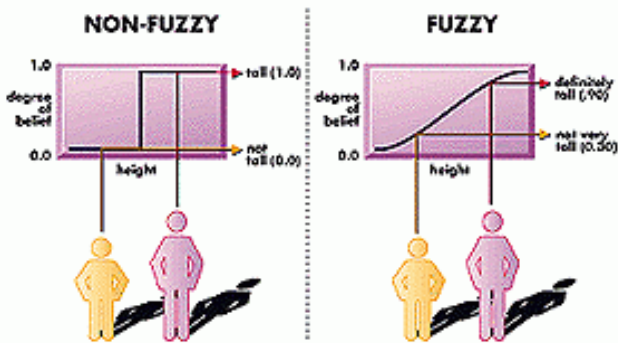
**Fuzzy rules** Rules take partially true facts and finds out to what degree they are true and then takes another fact making it true to that degree.

No. of such rules are combined and final decision is made. This whole process is called inference.

These are more likely common sense rules. We use words rather than numbers for final results. Fuzzy sets are the terms used in fuzzy rules.

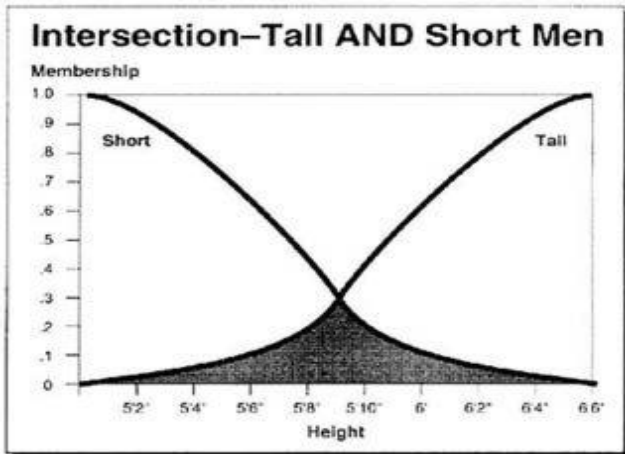
| Parameters | Fuzzy logic | Neural network  |
|------------|-------------|-----------------|
| Simplicity | Simple      | Complex         |
| Speed      | Slower      | Faster          |
| Accuracy   | Reasonable  | Better accuracy |

**Example**



Consider a basketball team. We divide the team in two categories: tall and not tall. The boundary is considered as crisp boundary which is not sufficient to tell the exact result. In a fuzzy network it will tell that all the team members are tall at certain degree.

Hence it will give more accurate analysis.



Uses of fuzzy logic:

- Digital cameras
- Cars
- Washing machine
- Networking devices[2]

III. CONCLUSIONS

Neural network learns through samples on a trial and error basis. The goal of this type of network is to create a model that correctly maps an input to the desired output using historical data.

Fuzzy logic deals with reasoning that is approximate rather than fixed and precise. They help decision makers to identify and solve problems by compiling useful information from data, personal knowledge and business models.

**Table: comparison between fuzzy logic and neural network**

**Limitations** They are limited by its environment as all the applications are done in open world and decisions change minute by minute.

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