1.ARTIFICIAl Neural Networks

Artificial Neural networks are the simplified models of biological Neural networks (ANN).

The ANN's are used to mimic the characteristics of biological neural networks or human brain.

The fundamental element in the biological neural network is the biological neuron and in the ANN is artificial neuron.

Artificial neuron is represented graphically or mathematically by different scientists,but the following models are popular:

1.Mc-culloch & pitts model

2.Perceptron model

3.ADALINE model (Adaptive Linear element model)

Out of 3 models perception model is mostly used in practical cases because of it can be applied to complex problems also.

The Artificial brain or neuron network is designed by interconnecting different Artificial neurons in the layer format.

The different architechtures of Artificial Neural networks are as given below:

1.Single layer feed forward Neural Network.

2.Multi layer feed forward Neural Network.

3.Multi layer feed back Network

Or

Recurrent Neural Network.

The Artificial Neural networks are trained using 3 basic learning methods :

1.Supervisory learning

2.Unsupervisory learning

3.Reinforced learning.

Based on the algorithm used for training purpose, the following popular Neural networks are used for various applications .

1.Back propagation Neural networks.

2.Radial function Neural networks.

3.Kohenen’s Neural networks.

4.Hopfield Neural networks.

5.ADALINE Neural Network.

6.MADALINE Neural Network.(multi-ADALINE)

7.Convolution Neural Network.

8.Deep learning Neural Network.

Different applications of the Artificial Neural networks are :

1.Pattern recognition.

2.Pattern processing.

3.Image processing.

4.Data compression.

5.Forecasting applications.

6.Optimization applications .

2.FUZZY LOGIC

Fuzzy logic is developed by scientist called lotfi a zadeh.

Fuzzy means uncertain or vagueness or incompleteness.

Fuzzy logic is extended from the classical set theory.

Classical set theory is developed using crisp logic or boolean logic.

Fuzzy set theory is developed using Fuzzy logic.

In classical set theory , a set is defined as collection of elements.

Ex:- a={1,2,3,4}

b={a,b,c,d}

In the classical set theory , for every question , the answer will be either (true/false) , (1 or 0).

Fuzzy set theory also collection of elements but each element is attached with degree of truth or membership value.

Membership value or degree of truth represents how much strong the element is belongs to set.

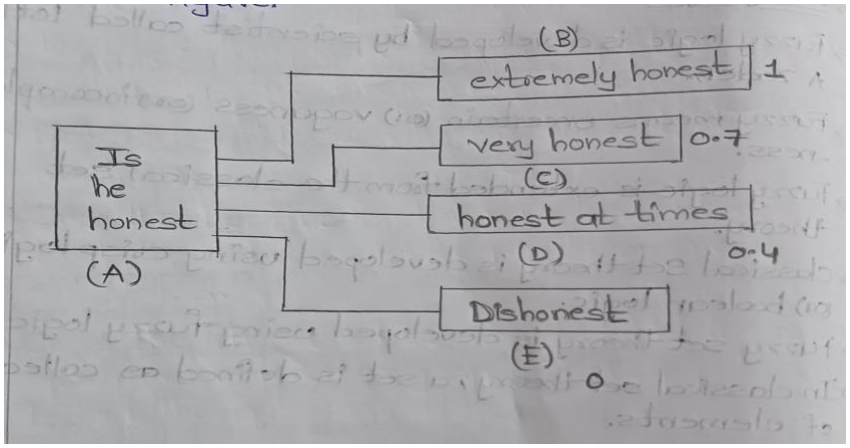
Let us consider an example question,

Is he honest ?

We may have different answers like

extremely honest , very honest , honest at time , dishonest.

The truth are membership values are as given in the figure :



A^ = [(B,1) , (C,0.7) , (D,0.4) , (E,0)]

Different fuzzy set operations are :

1.union.

2.intersection .

3.complement.

4.equality.

5.product.

6.difference.

7.power of fuzzy set.

8.conjuctive sum.

The seven different fuzzy variables are given below which will be only understand by the fuzzy logic controller.

1.PB → positive big.

2.PM → positive medium.

3.PS →positive small.

4.ZE →Zero.

5.NS → negative small.

6.NM → negative medium.

7.NB → negative big.

The fuzzy logic controller is designed using the following 3 steps .

1.Fuzzification.

2.Fuzzy Inference.

3.Defuzzification.

Fuzzification is nothing but conversion of crisp or linguistic variables into fuzzy variables.

Fuzzy inference is nothing but implying inputs to produce outputs based on rules from rulebase.

Defuzzification methods is defined as conversion of fuzzy variables into crisp or linguistic variables.

Applications of fuzzy logic are:

1.Control system.

2.Image recognition.

3.Decision making.

3.Genetic Algorithms

Genetic Algorithms are used to find the optimum solution for the given problem.

It follows the natural evolution (human genetics).

The basic principle of genetic algorithm is Darwinion's theory of "Survival of fittest" .

The basic thing in the genetic algorithm is identifying objective function or fitness function .

Different problems will have different objective functions.

Once the objective function is finalised, fitness values to all the solutions in the population are calculated .

Once the fitness values are calculated the following operators repetitively apply on the population to get the optimum solution.

The first genetic operator is selection / reproduction.

1.Selection / reproduction ::

The first genetic operator is selection or reproduction.

This is the first operator applied on the population to get the next fittest population .

Different selection operators are :

1.roulette wheel selection.

2.Rank ordering.

3.Boltzman selection.

4.Tournament selection.

5.Steady state selection.

2.Cross – Over ::

This is the second operator applied on the population .

The purpose of cross-over operator is to improve the fitness value of the population.

Different types of cross-over operator are:

1.single site cross-over.

2.two site cross-over.

3.multi site cross-over.

4.uniform cross-over.

5.matrix cross-over.

3.Mutation ::

The last operator applied on the population is mutation.

Mutation is nothing but flipping 0 to 1 or 1 to 0.

Applications of genetic algorithms are:

1.optimization.

2.scheduling (Travelling salesperson problem).

3.machine learning.

4.Back-Propagation Algorithm

Back-Propagation algorithm provides step by step procedure to train multi-layer artificial Neural Network (ANN).

It is also called as generalised data learning rule.

It uses gradient descent method to minimise the squared error.

It is a supervisory learning algorithm.

X1,X2,....Xi,...,Xn are the inputs.

Y1,Y2,....Yk .....,Ym are the outputs.

V11 to Vnp are the weights between input layer and hidden layer .

Vo1.....,Vop are the bias between the input layer and the output layer

W11 to Wpm are the weights between the hidden layer and the output layer.

Wo1 to Wom are the bias weights between the hidden layer and the output layer.

Since the back propagation Neural Network is having more than one computational layer , it is called as multi layered network.

While calculating the output the signal flows in feed forward direction.

So the network is also called as feed forward multi layer Neural Network.

Once the outputs calculated the outputs of Neural Network compare with the target outputs to find the error (absolute or squared error).

To minimise the error , weights are updated / changed.

Training ::

Updation or the changing of the weights until the error decreases below a tolerance value usually 0.001.

First the weights between input layer and hidden layer will be changed , later the weights between hidden layer and output layer will be changed.

Since while updating the weights , signal is processed / propagated in backward direction, this algorithm is also called as back propagation algorithm and network is called as back propagation multi layer feed forward Neural Network.

The activation values at each and every neuron in the hidden layer is calculated as :

hj = Voj + € XiVij

The outputs of the jth neuron in the hidden layer will be obtained by processing activation value (hj) through sigmoidal activation function.

Hj= 1 / 1 + e^-hj

The activation value of kth neuron in the output layer is calculated as :

OK = Wok + € HjWjk

The output of the kth neuron in the output layer is calculated by processing activation value OK through the sigmoidal activation function.

Yk = 1 / 1 + e^ -OK

The actual output of the Neural Network is compared with the target value and the error is calculated as :

E = (tk- Yk) → absolute error

E = ½ (tk – Yk)^2 → squared error.

To minimise the error, weights are adjusted as :

Wnew = Wold + (delta)W

W0 new = W0 old + (delta)W0

Vnew = Vold + (delta)V

V0 new = V0 old + (delta)V0