

Q. What is ANN (Artificial neural network) write its characteristic & application of ANN.

ANN:- (Artificial Neural Network)

The term of ANN is derived from Biological neural network that develop the structure of a human brain. It is similar to the human brain that has neuron interconnected to one another. Artificial neural network also have neuron that are interconnected various layer of other networks. These neuron are known as node. Artificial neural network is based on the feed forward strategy.

Characteristic of ANN:-

- it is neurally implemented mathematical model
- it contains huge number of interconnected processing element called neuron to do all operation
- Information stored in the neuron are basically the weighted linkage of neuron.
- the input signal arrive at the processing element through connection & connecting weights
- it has the ability to learn, recall and generalize from the given data by suitable assignment & adjustment of weight
- the collective behavior of the neurons describes the computational power & no single neuron carries specific information.

→ Applications

1) Pattern Recognition:- Ann are used in image & speech recognition system.

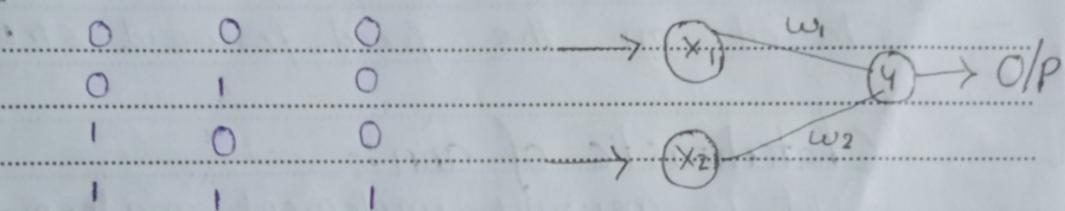
2) Robotics:- they enable robots to learn & adapt to their environment.

3) NLP:- Ann power language translation, sentiment analysis & chat bots.

4) Gaming:- Ann are used to develop intelligent agent in game.

Q.2 Implement AND function using McCulloch Pitts neuron

AND x_1 x_2 Output



Assume $w_1, w_2 = 1$

$$\text{formula} = x_1 w_1 + x_2 w_2$$

$$1. (0,0) = 0 \times 1 + 0 \times 1 = 0$$

$$2. (0,1) = 0 \times 1 + 1 \times 1 = 1$$

$$3. (1,0) = 1 \times 1 + 0 \times 1 = 1$$

$$4. (1,1) = 1 \times 1 + 1 \times 1 = 2$$

$$y_{\text{out}} = 0 \text{ if } y_{\text{in}} < 2$$

$$1 \text{ if } y_{\text{in}} \geq 2$$

$$\Theta \geq n w - p$$

$$\Theta \geq 2(1) - 1$$

$$\Theta \geq 2$$

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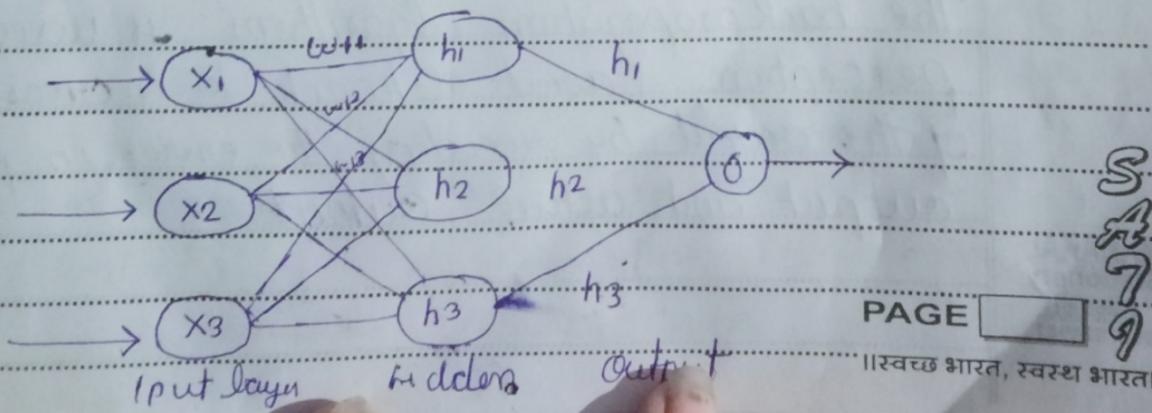
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QUESTION PAPERS

Q What is multilayer perceptron (MLP). Write the back propagation algorithm.

- A multilayer perceptron (MLP) Neural Network belongs to the feed forward neural network.
- it is an artificial neural network in which all nodes are interconnected to each other with nodes of different layers.
- Frank Rosenbatt first define the word perceptron in his perceptron g Program
- It is a Supervised learning algorithm containing nodes value, activation function, inputs, & weight to calculate the output
- Each nodes passes its value to the comming nodes only in the forward direction.
- MLP the neural network uses a Backpropagation algorithm to increase the accuracy of the training model
- Multilayer Perception Neural Network is a neural network with multiple layer
- Multilayer perceptron is a class of Deep learning also known as MLP



Advantage :- Multiplayer perceptron Neural network can easily work with non-linear problem.

- it can handle complex problem while dealing with large dataset
 - Developers use this model to deal with the fitness problem of Neural Network
 - it has a higher accuracy rate & reduces prediction error by using backpropagation
 - After training the model, the multilayer perceptron neural network quickly predicts the output

Disadvantages:- this neural network consists of large computation which sometimes increase the overall cost of model.

- overall cost of model

 - the model will perform well only when it is trained perfectly
 - Due to this model's tight connection the no of parameters & modes gradually increases.

Back propagation Algorithm.

The back propagation algorithm is used in a multilayer perceptron neural network to increase the accuracy of the output by recording the error in predicted output and actual output.

According to algo.

- Calculate the error after calculating the output from the multilayer perceptron neural network
- This error is the difference b/w output generated by neural network & actual output the error is feed back to the network from the output layer to the hidden layer
- Now the output become the input to the n/w
- The model reduce error by adjusting the weight in the hidden layer
- Calculate the predicted output & adjusted weight & check the error the process is recursively used till there is minimum or no error
- this algorithm help in increasing the accuracy of the neural network.

Q.3. What is adaption Resonance Theory write about ART-1

- Adaptive Resonance Theory :- it is a type of neural network
- it developed by Stephen Grossberg & Gaval Carpenter in 1987
- the basic ART use Unsupervised learning technology
- the term "adaptive" & resonance used in this suggests that are open to new learning (i.e. adaptive) without discarding the previous or old information (i.e. resonance)

- the ART network known to solve the stability plasticity dilemma ie stability refer to their nature of memorizing the learning & plasticity refers to fact that they are flexible to gain new information.
 - Due to the nature of ART they are always able to learn new input without forgetting the past
 - ART m/w implement a clustering along input is presented to the m/w & the algo checks whether it fits into one of the already stored clusters. if its is fits then S/P as added to the cluster that matches the most else a new cluster is formed.

ART-1:- it is designed for binary input vectors

- it consists of two field of unit - input unit (F_1 unit) & output unit (F_2 unit) along with reset control unit for controlling the degree of similarity of pattern placed on the same cluster unit.
 - there exist two set of weighted interconnection path b/w F_1 & F_2 layer.
 - In ART m/w input pattern can be presented in any order.
 - ART 1 m/w can be implemented by an logic circuit. Governing the differential equation
 - It is trained using fast learning.



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- the n/w perform well perfect binary input pattern but it is sensitive to noise in the i/p data
Should be handle carefully.

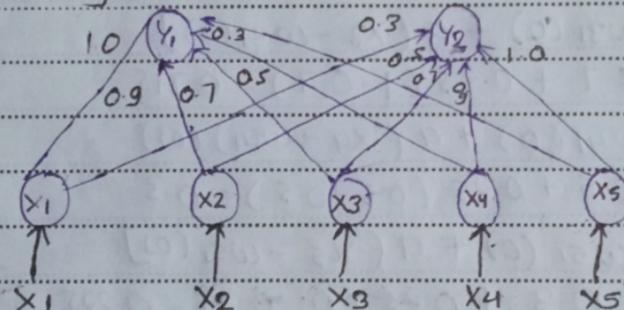
Q Consider a Kohonen Self Organizing net with two cluster unit & five input unit. the weight vectors for cluster unit are.

$$W_1 = [1.0, 0.9, 0.7, 0.5, 0.3]$$

$$W_2 = [0.3, 0.5, 0.7, 0.9, 1.0]$$

$$\text{input vector} = [0.0, 0.5, 1.0, 0.5, 0.0]$$

$$\text{learning rate} = \alpha = 0.25$$



Sol. the net can be forward as for input vector

$x = [0.0, 0.5, 1.0, 0.5, 0.0]$ & the learning rate $\alpha = 0.25$ the weight vector W is given by

$$W_{ij} = \begin{bmatrix} 1.0 & 0.3 \\ 0.9 & 0.5 \\ 0.7 & 0.7 \\ 0.5 & 0.9 \\ 0.3 & 1.0 \end{bmatrix}$$

- Euclidean Distance $D(j) = \sum (w_{ij} - x_i)^2$

for $i = 1 \text{ to } 5$, & $j = 1 \text{ to } 2$

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$$D(1) = (1-0)^2 + (0.3-0.5)^2 + (0.7-1)^2 + (0.9-0.5)^2 + (0.3-0)^2$$

$$D(1) = 1 + 0.16 + 0.09 + 0 + 0.08 = 1.34$$

$$D(2) = (0.3-0)^2 + (0.5-0.5)^2 + (0.7-1)^2 + (0.9-0.5)^2 + (1-0)^2$$

$$= 0.09 + 0.09 + 0.16 + 1 = 1.34$$

• Update weight $w_{ij}(\text{new}) = w_{ij}(\text{old}) + \alpha [x_i - w_{ij}(\text{old})]$

$$w_{11}(n) = w_{11}(0) + \alpha [x_1 - w_{11}(0)]$$

$$= 1 + 0.25(0-1) = 0.75$$

$$w_{21}(n) = w_{21}(0) + \alpha [x_2 - w_{21}(0)]$$

$$= 0.9 + 0.25(0.5 - 0.9) = 0.8$$

$$w_{31}(n) = w_{31}(0) + \alpha [x_3 - w_{31}(0)]$$

$$= 0.7 + 0.25(1 - 0.7) = 0.775$$

$$w_{41}(n) = w_{41}(0) + \alpha [x_4 - w_{41}(0)]$$

$$= 0.5 + 0.25(0.5 - 0.5) = 0.5$$

$$w_{51}(n) = w_{51}(0) + \alpha [x_5 - w_{51}(0)]$$

$$= 0.3 + 0.25(0 - 0.3) = 0.225$$

the update weight matrix for the winning unit is given by

$$\omega = \begin{bmatrix} 0.75 & 0.3 \\ 0.8 & 0.5 \\ 0.775 & 0.7 \\ 0.5 & 0.9 \\ 0.225 & 1.0 \end{bmatrix}$$

PAPERS
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Q. Describe the components of a fuzzy rule base system, including fuzzification, formation, decomposition and aggregation of fuzzy set

A fuzzy rule based system is a rule based system where fuzzy sets and fuzzy logic are used as tools for representing different form of knowledge about the problem at hand as well as for modelling the interaction & relationship existing between its variable

→ Components:

Fuzzification:- This is the initial step where crisp (exact) input values are converted into fuzzy membership values

- fuzzy sets are defined for each input variable & membership function determine the degree of an input belonging to those sets

- Imagine a temperature sensor reading 25 degrees Celsius. In a system for thermostat control, a membership function might assign a value of 0.8 (high belonging) to the set "cold" and 0.2 (some belonging) to the set "cool".

2 Rule formation:- this is where the heart of the fuzzy system lies - the fuzzy rules

- the rule express relationship b/w the fuzzy inputs & the desired fuzzy output

- they are typically written in an if-then format using linguistic terms derived from the fuzzy sets

for example:- "If temperature is cold THEN Heating power is high."

3. Rule decomposition:- Once fuzzified inputs match multiple rules, this stage determines the contribution of each rule to the final output
- Decomposition involves evaluating the fuzzy antecedents (IF parts) of each rule based on the fuzzified inputs
 - This might involve using operators like AND (minimum), OR (maximum) to combine the membership values of multiple input variables in a single rule

4. Rule Aggregation After evaluating each rule's contribution, this stage combines the results from all application rules to get single fuzzy output

- Aggregation method like sum or weighted average are used, considering the contribution level determined in decomposition
- the aggregated fuzzy output represents the overall system decision based on the combined influences of the rules.



SESSIONAL PAPERS

Q. Explain the fundamental concept of fuzzy logic & focusing on fuzzy Set theory & its distinction from Crisp Set. Provide example to illustrate the difference b/w Crisp & fuzzy set.

fuzzy logic:- the word 'fuzzy' means 'vague' or 'not well defined'. Fuzziness occurs when the boundary of a piece of information is not clear cut.

- it is an approach to variable processing that allow for multiple possible truth value to be processed through the some variable.
- fuzzy logic is a heuristic approach that allow for more advanced decision - tree processing & better integration with rule based programming
- it was first proposed by Lotfi Zadeh in 1965 paper for the journal Information & control
- it is used in a wide range of application such as control system, Image processing, nlp, medical diagnoses & ai

fuzzy Set theory:-

- it allow that the object belong to a set or couples of object belong to a relation to a given degree
- it allow partial membership of an object to different classes & also take into account the relative importance of each

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SESSIONAL PAPERS

- neighbor with respect to the test instance
- it may be viewed as a extension & generalization of the basic concept of crisp set
 - Important property of fuzzy set is that allow partial membership. A fuzzy set having degree of membership b/w 1 & 0

Crisps Set:- Crisp sets provide a clear cut definition of membership. An element either belong to a set (membership value of 1) or doesn't (membership value of 0)

- the binary nature serves as a reference point for fuzzy set which are a core concept in soft computing.
- fuzzy sets introduce degree of membership allowing element to partially belong to a set with value b/w 0 & 1

Difference b/w fuzzy set & crisp set.

Fuzzy Set

- it is prescribed by vague or ambiguous properties
- it is a set of component with different membership degree in the set.
- it shows incomplete membership

Crisp Set

- it is defined by precise & specific characteristics
- It is a set of object that have same functioning & fitness qualities

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QUESTION PAPERS

• it follows the infinite valued logic

• it follows the bivalued logic

• it specifies a number 0 & 1 which include both 0 & 1

• it specifies the values either as 0 & 1

Ex she is about 18 years old

she is 18 years.

Q- Explain the concept of genetic algorithm (GAs) and discuss their working principles, including encoding, fitness, function reproduction & genetic operators.

Genetic Algorithm :- are defined as a type of computational optimization technique inspired by the principle of natural selection & genetics

- they are used to solve complex problems by mimicking the process of evolution to improve a population of potential solution iteratively.
- GAs are adaptive heuristic search algorithms that belong to the large part of evolutionary algorithms
- it is based on the idea of natural selection & genetics
- they are commonly used to generate high quality solution for optimization problem & search problem



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Encoding:- Solution to the problem are encoded in chromosomes, typically represented as binary strings, where each gene corresponds to a decision variable.

Fitness function:- the fitness function evaluate the quality of each solution (chromosome) in the population based on how well it perform with respect to the problem objective.

Reproduction:- Individuals in the population are selected for reproduction based on their fitness. Higher fitness individuals have a higher probability of being selected.

Genetic Operations:- Crossover & mutation are genetic operations used to create new offspring. Crossover involves exchanging genetic information b/w parent chromosomes while mutation introduces random changes to maintain diversity in the population.