END TERM EXAMINATION [MAY-JUNE 2017]
EIGHTH SEMESTER [B.TECH]
SOFT COMPUTING [ETIT-410]

Time: 3 Hrs. **Max. Marks: 75**

Note: Attempt any five questions including Q. no. 1 which is compulsory.

Q.1. (a) Differentiate between feed forward and feedback neural network. (5)

Ans.

Architecture	Feed-forward neural network	Feed-back neural network
Layout	Multiple layers of nodes including convolutional layers.	Information flows in different directions, simulating a memory effect.
Data type	Image data	Sequence data
Input/ Output	The size of the input and output are fixed (i.e. input image with fixed size and outputs the classification)	The size of the input and output may vary (i.e. receiving different texts and generating different translations for examples)
Use cases	Image classification, recognition, medical imagery, image analysis. face detection.	Text translation, natural language processing, language translation, sentiment analysis.
Drawbacks	Large training data	Slow and complex training procedures.
Description	CNN employs neuronal connection patterns. And they are inspired by the arrangement of the individual neurons in the animal visual cortex, which allows them to respond to overlapping areas of the visual field.	Time-series information is used by recurrent neural networks. For instance, a user's previous words could influence the model prediction on what he can says next.

Q.1. (b) Explain about fuzzy logics and its applications. (5)

Ans. Fuzzy Logic is defined as a many-valued logic form which may have truth values of variables in any real number between 0 and 1. It is the handle concept of partial truth. In real life, we may come across a situation where we can't decide whether the statement is true or false. At that time, fuzzy logic offers very valuable flexibility for reasoning. Fuzzy logic algorithm helps to solve a problem after considering all available data. Then it takes the best possible decision for the given the input. The FL method imitates the way of decision making in a human which consider all the possibilities between digital values T and F.

Fuzzy logic applications

- In automobiles, fuzzy logic is used for gear selection and is based on factors such as engine load, road conditions and style of driving.

• In dishwashers, fuzzy logic is used to determine the washing strategy and power needed, which is based on factors such as the number of dishes and the level of food residue on the dishes.

• In copy machines, fuzzy logic is used to adjust drum voltage based on factors such as humidity, picture density and temperature.

• In aerospace, fuzzy logic is used to manage altitude control for satellites and spacecrafts based on environmental factors.

• In medicine, fuzzy logic is used for computer-aided diagnosis, based on factors such as symptoms and medical history.

• In chemical distillation, fuzzy logic is used to control pH and temperature variables.

• In natural language processing, fuzzy logic is used to determine semantic relations between concepts represented by words and other linguistic variables.

• In environmental control systems, such as air conditioners and heaters, fuzzy logic determines output based on factors such as current temperature and target temperature.

• In a business rules engine, fuzzy logic may be used to streamline decision-making according to predetermined criteria.

Q.1. (c) Define uncertainty and its usefulness in soft computing. (5)

Ans. Uncertainty involved in any problem-solving situation is a result of some information deficiency. Information (pertaining to the model within which the situation is conceptualized) may be incomplete, fragmentary, not fully reliable, vague, contradictory, or deficient in some other way.

Uncertainty analysis aims at quantifying the variability of the output that is due to the variability of the input. The quantification is most often performed by estimating statistical quantities of interest such as mean, median, and population quantities. The estimation relies on uncertainty propagation techniques.

Q.1. (d) Explain Genetic algorithm, why these algorithms are known as Genetic Algorithm. How is it usefully over simple traditional algorithm? (5)

Ans. Genetic Algorithm (GA) is a search-based optimization technique based on the principles of **Genetics and Natural Selection.** It is frequently used to find optimal or near-optimal solutions to difficult problems which otherwise would take a lifetime to solve. It is frequently used to solve optimization problems, in research, and in machine learning.

A genetic algorithm is a search heuristic that is inspired by Charles Darwin's theory of natural evolution. This algorithm reflects the process of natural selection where the fittest individuals are selected for reproduction in order to produce offspring of the next generation that's why it is called Genetic algorithm.

Advantages of GA over simple traditional algorithm

• Does not require any derivative information (which may not be available for many real-world problems).

• Is faster and more efficient as compared to the traditional methods.

• Has very good parallel capabilities.

• Optimizes both continuous and discrete functions and also multi-objective problems.

• Provides a list of "good" solutions and not just a single solution.

- Always gets an answer to the problem, which gets better over the time.
- Useful when the search space is very large and there are a large number of parameters involved.

Q.1. (e) Explain Perceptron Model with the help of example. **(5)**

Ans. The Perceptron is a binary classifier which maps its input x (a real-valued vector) to an output value f(x) (a single binary value) across the matrix.

$$f(x) = \begin{cases} 1 \text{ if } w, x + b > 0 \\ 0 \ else \end{cases}$$

where w is vector of real-valued weights and w.x is the dot product (which computes a weighted sum). b is the 'bias', constant term that does not depend on any input value.

The value of f(x) (0 ro 1) is used to classify x as either a positive or a negative instance, in the case of a binary classification problem. If b is negative, then the weighted combination of inputs must produce a positive value greater than $|b|$ in order to push the classifier neuron over the 0 threshold. Spatially, the bias alters the position (though not the orientation) of the decision boundary. The perceptron learning algorithm does not terminate if the learning set is not linearly separable.

The perceptron is considered the simplest kind of feed-forward neural network.

Q.2. (a) Explain and differentiate between Supervised and Unspervised Learning Paradigms. **(6.25)**

Ans. Refer Q.no. 2 (a) End Term Exam 2018.

Q.2. (b) Explain the significance of hidden layer. How it is useful in pattern recognition and control problem. **(6.25)**

Ans. In neural networks, a hidden layer is located between the input and output of the algorithm, in which the function applies weights to the inputs and directs them through an activation function as the output. In short, the hidden layers perform nonlinear transformations of the inputs entered into the network. Hidden layers vary depending on the function of the neural network, and similarly, the layers may vary depending on their associated weights.

The role of the Hidden Layers is to identify features from the input data and use these to correlate between a given input and the correct output. There is a well-known problem of facial recognition, where computer learns to detect human faces. Human face is a complex object, it must have eyes, a nose, a mouth, and to be in a round shape, for computer it means that there are a lot of pixels of different colors that are comprised in different shapes. And in order to decide whether there is a human face on a picture, computer has to detect all those objects. The hidden layers will break down our input image in order to identify features present in the image. The initial layers focus on low-level features such as edges while the later layers progressively get more abstract. At the end of all the layers, we have a fully connected layer with neurons for each of our classification values.

Q.3. (a) What is interpolative mode of counter propagation network? **(6.25)**

Ans. Counter propagation network (CPN) were proposed by Hecht Nielsen in 1987.They are multilayer network based on the combinations of the input, output, and clustering layers. The application of counter propagation net is data compression, function approximation and pattern association. The counter-propagation network is basically constructed from an instar-outstar model. This model is three layer neural network that performs input-output data mapping, producing an output vector y in response to input vector x, on the basis of competitive learning. The three layer in an instar-outstar model are the input layer, the hidden (competitive) layer and the output layer.

There are two stages involved in the training process of a counter propagation net. The input vector are clustered in the first stage. In the second stage of training, the weights from the cluster layer units to the output units are tuned to obtain the desired response.

Q.3. (b) Explain the limitation of back propagation learning. Describe the Boltzmann machine. (6.25)

Ans. The disadvantages of using a backpropagation algorithm are as follows:

- It prefers a matrix-based approach over a mini-batch approach.
- Data mining is sensitive to noise and irregularities.
- Performance is highly dependent on input data.
- Training is time- and resource-intensive.

Boltzmann Machine

A Boltzmann machine is a type of recurrent neural network in which nodes make binary decisions with some bias. Boltzmann machines can be strung together to make more sophisticated systems such as deep belief networks. Some important points about Boltzmann Machine –

- They use recurrent structure.
- They consist of stochastic neurons, which have one of the two possible states, either 1 or 0.
- Some of the neurons in this are adaptive free state and some are clamped frozen state.
- If we apply simulated annealing on discrete Hopfield network, then it would become Boltzmann Machine.

Q.4. (a) Discuss the properties of fuzzy sets. (6.25)

Ans. Fuzzy sets follow some of the properties satisfied by crisp sets. In fact, crisp sets can be thought of as special instances of fuzzy sets. Any fuzzy set $\bar{A}$ is a subset of the refreshment X. Also, the membership of any element belonging to the null set ϕ is 0 and the membership of any element belonging to the reference set is 1.

The properties satisfied by fuzzy sets are:

Commutativity:
$$\bar{A} \cup \bar{B} = \bar{B} \cup \bar{A}$$
$$\bar{A} \cap \bar{B} = \bar{B} \cap \bar{A}$$

Associativity:
$$\bar{A} \cup \left(\bar{B} \cup \bar{C}\right) = \left(\bar{A} \cup \bar{B}\right) \cup \bar{C}$$
$$\bar{A} \cap \left(\bar{B} \cap \bar{C}\right) = \left(\bar{A} \cap \bar{B}\right) \cap \bar{C}$$

Distributivity:
$$\bar{A} \cup \left(\bar{B} \cap \bar{C}\right) = \left(\bar{A} \cup \bar{B}\right) \cap \left(\bar{A} \cup \bar{C}\right)$$
$$\bar{A} \cap \left(\bar{B} \cup \bar{C}\right) = \left(\bar{A} \cap \bar{B}\right) \cup \left(\bar{A} \cup \bar{C}\right)$$

Idempotence:
$$\bar{A} \cup \bar{A} = \bar{A}$$
$$\bar{A} \cap \bar{A} = \bar{A}$$

Identity:
$$\bar{A} \cup \phi = \bar{A}$$

$$\bar{A} \cup X = \bar{A}$$

$$\bar{A} \cap \phi = \phi$$

$$\bar{A} \cup X = X$$

Transitivity: If $\bar{A} \subseteq \bar{B} \subseteq \bar{C}$, then $\bar{A} \subseteq \bar{C}$

Involution: $\left(\bar{A}\right)^c = \bar{A}$

De Morgan's laws: $\left(\bar{A}\cap\right)^c = \left(\bar{A}^c \cup \bar{B}^c\right)$

$$\left(\bar{A}\cup\right)^c = \left(\bar{A}^c \cap \bar{B}^c\right)$$

Since fuzzy sets can overlap, the laws of excluded middle do not hold good.

Thus, $\bar{A} \cup \bar{A}^c \neq X$

$$\bar{A} \cap \bar{A}^c \neq \phi \qquad (6.25)$$

Q.4 (b) Explain fuzzy rule generation with examples?

Ans. Fuzzy Rule Generation

1. apply fuzzy clustering $X \Rightarrow$ fuzzy partition matrix $U = [u_{ij}]$
2. use obtained $U = [u_{ij}]$ to define membership functions

- usually X us multidimensional
- assigning labels for one-dimensional domains is easier $\Rightarrow$

1. project U down to $X_1,\ldots,X_p$ axis, respectively
2. only consider upper envelope of membership degrees
3. linear interpolate membership values $\Rightarrow$ membership functions
4. cylindrically extend membership functions

- original clusters are interpreted as conjunction of cyl. extensions
- e.g., cylindrical extensions "x_1 is low", "x_2 is high"

$\Rightarrow$ multidimensional cluster label "x_1 is low and x_2 is high"

- labeled clusters = classes characterized by labels
- every cluster = one fuzzy rule

Q.5. (a) Discuss and explain Crisp sets with its fundamental concept? (6.25)

Ans. A set defined using a characteristic function that assigns a value of either 0 or 1 to each element of the universe, thereby discriminating between members and non-members of the crisp set under consideration. In the context of fuzzy sets theory, we often refer to crisp sets as "classical" or "ordinary" sets.

The following properties of sets are important for further manipulation of sets.

Commutativity: $A \cup B = B \cup A$

$$A \cap B = B \cap A$$

Associativity: $(A \cup B) \cup C = A \cup (B \cup C)$

$$(A \cap B) \cap C = A \cap (B \cap C)$$

Distributivity: $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

$$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$$

Idempotence: $A \cup A = A$

$$A \cap A = A$$

Identify:

$$A \cup \varnothing = A$$
$$A \cap E = A$$
$$A \cap \varnothing = \varnothing$$
$$A \cup E = E$$

Law of Absorption: $A \cup (A \cap B) = A$

$A \cap (A \cup B) = A$

Transitivity: If $A \subseteq B$, $B \subseteq C$ then $A \subseteq C$

Involution: $(A^c) = A$

Law of the Excluded Middle: $A \cup A^c = E$

Law of Contradiction: $A \cap A^c = \phi$

De Morgan's laws: $(A \cup B)^c = A^c \cap B^c$

$(A \cap B)^c = A^c \cup B^c$

Q.5. (b) Discuss the operations performed on crisp relation? **(6.25)**

Ans. Operations performed on Crisp relation

We will be using the following sets for further discussion:

$X = \{1, 2, 3, 4, 5, 6\}$; $A = \{1, 2, 3\}$; $B = \{2, 3, 4\}$; $C = \{5, 6\}$

Involution:

Involution states that the complement of complement of set A would be set A itself.

For the given data,

$A' = X - A = \{4, 5, 6\}$

$(A')' = X - A' = \{1, 2, 3\} = A$

Commutativity:

The commutativity property states that the operation can be performed irrespective of the order of the operand. For example, addition is a commutative operator, so $2 + 3$ or $3 + 2$ yields the same result. But, subtraction is not commutative, so $3 - 2 \neq 2 - 3$.

Proving union is commutative:

$A \cup B = \{1, 2, 3, 4\} \rightarrow$ LHS

$B \cup A = \{1, 2, 3, 4\} \rightarrow$ RHS

Proving intersection is commutative:

$A \cap B = \{2, 3\} \rightarrow$ LHS

$B \cap A = \{2, 3\} \rightarrow$ RHS

Associativity:

The associativity property allows us to perform the operations by grouping the operands and keeping them in similar order.

$(A \cup B) \cup C = A \cup (B \cup C)$

For given data:

$A \cup B = \{1, 2, 3, 4\}$

$(A \cup B) \cup C = \{1, 2, 3, 4, 5, 6\} \rightarrow$ LHS

$B \cup C = \{2, 3, 4, 5, 6\}$

$A \cup (B \cup C) = \{1, 2, 3, 4, 5, 6\} \rightarrow$ RHS

$(A \cap B) \cap C = A \cap (B \cap C)$

For given data:

$A \cap B = \{2, 3\}$

$(A \cap B) \cap C = \phi \rightarrow$ LHS

$B \cap C = \phi$

$A \cap (B \cap C) = \phi \rightarrow$ RHS

Distributivity:

Mathematically it is defined as,

$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

$B \cap C = \phi$

$A \cup (B \cap C) = \{1, 2, 3\} \rightarrow$ LHS

$A \cup B = \{1, 2, 3, 4\}$

$A \cup C = \{1, 2, 3, 5, 6\}$

$(A \cup B) \cap (A \cup C) = \{1, 2, 3\} \rightarrow$ RHS

$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

$B \cup C = \{2, 3, 4, 5, 6\}$

$A \cap (B \cup C) = \{2, 3\} \rightarrow$ LHS

$A \cap B = \{2, 3\}$

$A \cap C = \phi$

$(A \cap B) \cup (A \cap C) = \{2, 3\} \rightarrow$ RHS

Absorption:

Mathematically absorption is defined as,

$A \cup (A \cap B) = A$

For the given data:

$A \cap B = \{2, 3\}$

Identify: $A \cup \varnothing = A$

$A \cap E = A$

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Proving intersection is commutative:

$A \cap B = \{2, 3\} \rightarrow$ LHS

$B \cap A = \{2, 3\} \rightarrow$ RHS

Associativity:

The associativity property allows us to perform the operations by grouping the operands and keeping them in similar order.

$\mathbf{(A \cup B) \cup C = A \cup (B \cup C)}$

For given data:

$A \cup B = \{1, 2, 3, 4\}$

$(A \cup B) \cup C = \{1, 2, 3, 4, 5, 6\} \rightarrow$ LHS

$B \cup C = \{2, 3, 4, 5, 6\}$

$A \cup (B \cup C) = \{1, 2, 3, 4, 5, 6\} \rightarrow$ RHS

$(A \cap B) \cap C = A \cap (B \cap C)$

For given data:

$A \cap B = \{2, 3\}$

$(A \cap B) \cap C = \phi \rightarrow$ LHS

$B \cap C = \phi$

$A \cap (B \cap C) = \phi \rightarrow$ RHS

Distributivity:

Mathematically it is defined as,

$\mathbf{A \cup (B \cap C) = (A \cup B) \cap (A \cup C)}$

$B \cap C = \phi$

$A \cup (B \cap C) = \{1, 2, 3\} \rightarrow$ LHS

$A \cup B = \{1, 2, 3, 4\}$

$A \cup C = \{1, 2, 3, 5, 6\}$

$(A \cup B) \cap (A \cup C) = \{1, 2, 3\} \rightarrow$ RHS

$\mathbf{A \cap (B \cup C) = (A \cap B) \cup (A \cap C)}$

$B \cup C = \{2, 3, 4, 5, 6\}$

$A \cap (B \cup C) = \{2, 3\} \rightarrow$ LHS

$A \cap B = \{2, 3\}$

$A \cap C = \phi$

$(A \cap B) \cup (A \cap C) = \{2, 3\} \rightarrow$ RHS

Absorption:

Mathematically absorption is defined as,

$\mathbf{A \cup (A \cap B) = A}$

For the given data:

$A \cap B = \{2, 3\}$

$A \cup (A \cap B) = \{1, 2, 3\} = A$

$A \cap (A \cup B) = A$

For the given data:

$A \cup B = \{1, 2, 3, 4\}$

$A \cap (A \cup B) = \{1, 2, 3\} = A$

Idempotency/Tautology:

Idempotency is defined as,

$A \cup A = A$

$A \cap A = A$

For the given data,

$A \cup A = \{1, 2, 3\} = A$

$A \cap A = \{1, 2, 3\} = A$

Identity:

Mathematically, we can define this property as,

$A \cup X = X$

$A \cap X = A$

$A \cup \phi = A$

$A \cap \phi = \phi$

For the given data,

$A \cup X = \{1, 2, 3, 4, 5, 6\} = X$

$A \cap X = \{1, 2, 3\} = A$

$A \cup \phi = \{1, 2, 3\} = A$

$A \cap \phi = \{\ \} = \phi$

De Morgan's Laws:

Mathematically, De Morgan's laws are defined as,

Law 1: $(A \cup B)' = A' \cap B'$

For the given data:

$A \cup B = \{1, 2, 3, 4\}$

$(A \cup B)' = \{5, 6\} \rightarrow$ LHS

$A' = \{4, 5, 6\}$

$B' = \{1, 5, 6\}$

$A' \cap B' = \{5, 6\} = (A \cup B)' \rightarrow$ RHS

$(A \cup B)' = A' \cap B'$

Law 2: $(A \cap B)' = A' \cup B'$

For the given data:

$A \cap B = \{2, 3\}$

$(A \cap B)' = \{1, 4, 5, 6\} \rightarrow$ LHS

$A' = \{4, 5, 6\}$

$B' = \{1, 5, 6\}$

$A' \cup B' = \{1, 4, 5, 6\} = (A \cap B)' \rightarrow$ RHS

$(A \cap B)' = A' \cup B$

Law of Contradiction:

Mathematically it is defined as,

$A \cap A' = \phi$

For the given data:

$A' = \{4, 5, 6\}$

$A \cap A' = \{\ \} = \phi$

Law of Excluded Middle:

Mathematically it is defined as,

$A \cup A' = X$

For the given data:

$A' = \{4, 5, 6\}$

$A \cup A' = \{1, 2, 3, 4, 5, 6\} = X$

Q.6. (a) Discuss learning in Neural network compare different learning rules. (6.25)

Ans. Refer Q.no. 7(a) End Term Examination 2018.

Q.6. (b) Explain back propagation training algorithm with an example. (6.25)

Ans. (a) Refer Q.no. 7(b) End Term Examination 2018.

Q.7. (a) Explain the various properties of Fuzzy Arithmetic and Lattice of fuzzy numbers. (6.25)

Ans. Refer Q.no. 4(a) End Term Examination 2018.

Q.7. (b) Discuss the operations of fuzzy sets and its usefulness. (6.25)

Ans. 1. Union: The union of two fuzzy sets A and B is a new fuzzy set also on X with a membership function defined as.

$$\mu_{A \cup B}(x) = \max(\mu_A(x), \mu_B(x))$$

or

$$\mu_{A \cup B}(x) = \mu_A(x) \vee \mu_B(x)$$

2. Intersection: The intersection of two fuzzy sets A and B is a new fuzzy $A \cap B$ with membership function defined as

$$\mu_{A \cap B}(x) = \mu_A(x) \wedge \mu_B(x)$$

$$\mu_{A \cap B}(x) = \min(\mu_A(x), \mu_B(x)$$

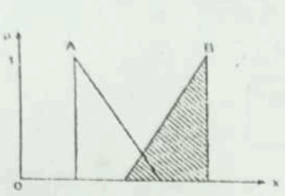


Fig. Union of fuzzy sets

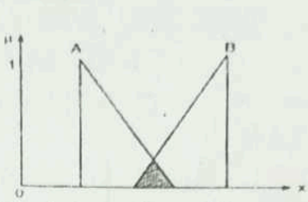


Fig. Intersection of fuzzy sets

3. Complement: The complement of a fuzzy set A is a new fuzzy set is a new fuzzy set A with A membership function

$$\mu_A(x) = 1 - \mu_A(x)$$

4. Product of two fuzzy sets: The product of two fuzzy sets A and B is a new fuzzy A.B whose, membership function is defined as

$$\mu_{A \cap B}(x) = \mu_A(x), \mu_B(x)$$

5. Equality: Two fuzzy sets A and B are said to be equal (A = B) $\mu_A(x) = \mu_B(x)$.

6. Product of a fuzzy set with a crisp number: Multiplying a fuzzy set A by a crisp number result in a new fuzzy set product a. A with the membership function $\mu_{a.A}(x) = a.\ \mu_A(x)$.

7. Power of a fuzzy set: The α power of fuzzy set is a new fuzzy set A whose membership function is given by

$$\mu_A^a(x) = (\mu_A(x))^a$$

Raising a fuzzy set to its second power is called concent (CON) taking the square rool is called Dilation (DIL).

8. Difference: The difference of two fuzzy sets N and B is a new fuzzy set A – B defined as

$$\underline{A} - \underline{B} = \left(\underline{A} \cap \overline{\underline{B}}\right)$$

(A ∩ B)

9. Disjunctive SUM: The disjunctive sum of two fuzzy sets $\underline{A}$ and $\overline{\underline{B}}$ is a fuzzy set $\underline{A} \oplus \underline{B}$ defined as

$$\underline{A} \oplus \underline{B} = (\overline{A} \cap B) \cup (A \cap \overline{B}).$$

Q.8. Write short note on any two:

Q.8. (a) Associative Memories **(6.25)**

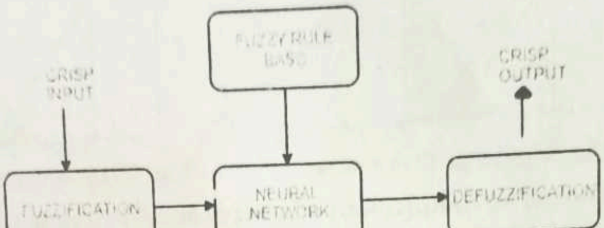
Ans. Refer Q.no. 8(c) End Term Examination 2018.

Q.8. (b) Hopfield's Network

Ans. Refer Q.no. 1 (c) End Term Examination 2018.

Q.8. (c) Neuro Fuzzy System

Ans. The Neuro-fuzzy system is based on fuzzy system which is trained on the basis of the working of neural network theory. The learning process operates only on the local information and causes only local changes in the underlying fuzzy system. A neuro-fuzzy system can be seen as a 3-layer feed forward neural network. The first layer represents input variables, the middle (hidden) layer represents fuzzy rules and the third layer represents output variables. Fuzzy sets are encoded as connection weights within the layers of the network, which provides functionality in processing and training the model.



Working flow:

- In the input layer, each neuron transmits external crisp signals directly to the next layer.
- Each fuzzification neuron receives a crisp input and determines the degree to which the input belongs to the input fuzzy set.
- The fuzzy rule layer receives neurons that represent fuzzy sets.
- An output neuron combines all inputs using fuzzy operation UNION.
- Each defuzzification neuron represents the single output of the neuro-fuzzy system.

Advantages:

- It can handle numeric, linguistic, logic, etc kind of information.
- It can manage imprecise, partial, vague, or imperfect information.
- It can resolve conflicts by collaboration and aggregation.
- It has self-learning, self-organizing and self-tuning capabilities.
- It can mimic the human decision-making process.

Disadvantages:

- Hard to develop a model from a fuzzy system.
- Problems of finding suitable membership values for fuzzy systems.
- Neural networks cannot be used if training data is not available.

Applications:

- Student Modelling
- Medical systems
- Traffic control systems
- Forecasting and predictions

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Q.1. Attempt following in brief:

Q.1. (a) Differentiate between hard and soft computing. (5)

Ans.

S.No.	Soft Computing	Hard Computing
1.	Soft Computing is liberal of inexactness, uncertainty, partial truth and approximation.	Hard computing needs a exactly state analytic model.
2.	Soft Computing relies on formal logic and probabilistic reasoning.	Hard computing relies on binary logic and crisp system.
3.	Soft computing has the features of approximation and dispositionality.	Hard computing has the features of exactitude(precision) and categoricity.
4.	Soft computing is stochastic in nature.	Hard computing is deterministic in nature.
5.	Soft computing works on ambiguous and noisy data.	Hard computing works on exact data.
6.	Soft computing can perform parallel computations.	Hard computing performs sequential computations.
7.	Soft computing produces approximate results.	Hard computing produces precise results.
8.	Soft computing will emerge its own programs.	Hard computing requires programs to be written.
9.	Soft computing incorporates randomness .	Hard computing is settled.
10.	Soft computing will use multivalued logic.	Hard computing uses two-valued logic.

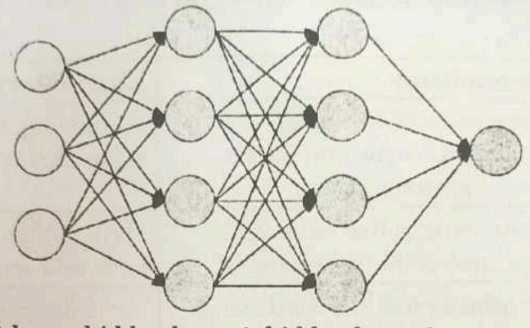
Q.1. (b) Draw an architecture of Neural Network and explain. (5)

Ans. Neural Network Architecture: Neural Networks are complex structures made of artificial neurons that can take in multiple inputs to produce a single output. This is the primary job of a Neural Network – to transform input into a meaningful output. Usually, a Neural Network consists of an input and output layer with one or multiple hidden layers within. It is also known as Artificial Neural Network or ANN. ANN architecture in Neural Network functions just like a human brain and is very important.

In a Neural Network, all the neurons influence each other, and hence, they are all connected. The network can acknowledge and observe every aspect of the dataset at hand and how the different parts of data may or may not relate to each other. This is how Neural Networks are capable of finding extremely complex patterns in vast volumes of data. In a Neural Network, the flow of information occurs in two ways –

•**Feedforward Networks:** In this model, the signals only travel in one direction, towards the output layer. Feedforward Networks have an input layer and a single output layer with zero or multiple hidden layers. They are widely used in pattern recognition.

•**Feedback Networks:** In this model, the recurrent or interactive networks use their internal state (memory) to process the sequence of inputs. In them, signals can travel in both directions through the loops (hidden layer/s) in the network. They are typically used in time-series and sequential tasks.



Input layer hidden layer 1 hidden layer 2 output layer

Q.1. (c) What is Hopfield network? Explain the algorithm to store and recall a set of bipolar patterns in Hopfield network. **(5)**

Ans. The Hopfield Neural Networks, invented by Dr John J. Hopfield consists of one layer of 'n' fully connected recurrent neurons. It is generally used in performing auto association and optimization tasks. It is calculated using a converging interactive process and it generates a different response than our normal neural nets.

Following are some important points to keep in mind about discrete Hopfield network –

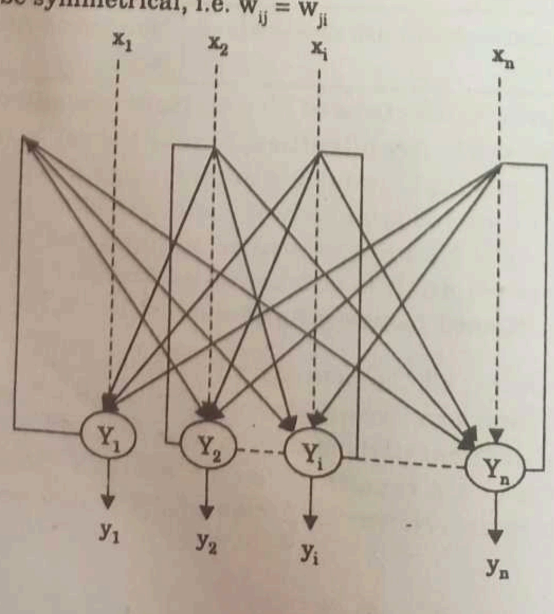
•This model consists of neurons with one inverting and one non-inverting output.

•The output of each neuron should be the input of other neurons but not the input of self.

•Weight/connection strength is represented by w_{ij}.

•Connections can be excitatory as well as inhibitory. It would be excitatory, if the output of the neuron is same as the input, otherwise inhibitory.

•Weights should be symmetrical, i.e. $w_{ij} = w_{ji}$



The output from Y_1 going to Y_2, Y_i and Y_n have the weights w_{12}, w_{1i} and w_{1n} respectively. Similarly, other arcs have the weights on them.

Training Algorithm

During training of discrete Hopfield network, weights will be updated. As we know that we can have the binary input vectors as well as bipolar input vectors. Hence, in both the cases, weight updates can be done with the following relation

Case 1 - Binary input patterns

For a set of binary patterns s p , p = 1 to P

Here, s p $= s_1$ p, s_2 p ,..., s_i p ,...,s_n p

Weight Matrix is given by

$$w_{ij} = \sum_{p=1}^{P}\left[2s_i(p)-1[2s_j(p)-1]\right] \text{ for } i \neq j$$

Case 2 - Bipolar input patterns

For a set of binary patterns s p, p = 1 to P

Here, s p $= s_1$ p, s_2 p,..., s_i p ,..., s_n p

Weight Matrix is given by

$$w_{ij} = \sum_{p=1}^{P}\left[s_i(p)[s_j(p)\right] \text{ for } i \neq j$$

Testing Algorithm

Step 1 – Initialize the weights, which are obtained from training algorithm by using Hebbian principle.

Step 2 – Perform steps 3-9, if the activations of the network is not consolidated.

Step 3 – For each input vector X, perform steps 4-8.

Step 4 – Make initial activation of the network equal to the external input vector X as follows –

$y_i = x_i$ for i = 1 to n

Step 5 - For each unit Y_i, perform steps 6-9.

Step 6 - Calculate the net input of the network as follows-

$$y_i n_i = x_i + \sum_j y_j w_{ji}$$

Step 7 - Apply the activation as follows over the net input to calculate the output - Here θ_i is the threshold.

Step 8 - Broadcast this output y_i to all other units.

Step 9 - Test the network for conjunction.

Q.1. (d) Explain the error correction process and gradient descent rule. (5)

Ans. Error-Correction Learning, used with supervised learning, is the technique of comparing the system output to the desired output value, and using that error to direct the training. In the most direct route, the error values can be used to directly adjust the tap weights, using an algorithm such as the back propagation algorithm. If the system output is y, and the desired system output is known to be d, the error signal can be defined as:

$$e = d - y$$

Error correction learning algorithms attempt to minimize this error signal at each training iteration.

The gradient descent algorithm is not specifically an ANN learning algorithm. It has a large variety of uses in various fields of science, engineering, and mathematics. However, we need to discuss the gradient descent algorithm in order to fully understand the back propagation algorithm. The gradient descent algorithm is used to minimize an error function g(y), through the manipulation of a weight vector w. The cost function should be a linear combination of the weight vector and an input vector x. The algorithm is:

$$w_{ij}[n+1] = w_{ij}[n] + \eta g(w_{ij}[n])$$

Here, η is known as the step-size parameter, and affects the rate of convergence of the algorithm. If the step size is too small, the algorithm will take a long time to converge. If the step size is too large the algorithm might oscillate or diverge.

The gradient descent algorithm works by taking the gradient of the weight space to find the path of steepest descent. By following the path of steepest descent at each iteration, we will either find a minimum, or the algorithm could diverge if the weight space is infinitely decreasing. When a minimum is found, there is no guarantee that it is a global minimum, however.

Q.1. (e) Find A ∪ B and complement of A ∪ B for the following two fuzzy sets:

A = {1/1.0 + 0.75/1.5 + 0.3/2.0 + 0.15/2.5 + 0/3}

B = {1/1.0 + 0.6/1.5 + 0.2/2.0 + 0.1/2.5 + 0/3}

Ans. $\underset{\sim}{A} \cup \underset{\sim}{B} = \max\{M_{\underset{\sim}{A}}(x), M_{\underset{\sim}{B}}(x)\}$

$AUB = \max(\mu_A(x), \mu_B(x))$

$$= \max\left\{\left(\frac{1}{1.0}+\frac{0.75}{1.5}+\frac{0.3}{2.0}+\frac{0.15}{2.5}+\frac{0}{3}\right)\left(\frac{1}{1.0}+\frac{0.6}{1.5}+\frac{0.2}{2.0}+\frac{0.1}{2.5}+\frac{0}{3}\right)\right\}$$

$$\underset{\sim}{A} \cup \underset{\sim}{B} = \left\{\frac{1}{1.0}+\frac{0.75}{1.5}+\frac{0.3}{2.0}+\frac{0.15}{2.5}+\frac{0}{3}\right\}$$

$$\overline{\underset{\sim}{A} \cup \underset{\sim}{B}} = \overline{\underset{\sim}{A}} \cap \overline{\underset{\sim}{B}} = \min\{M_{\underset{\sim}{A}}(x), M_{\underset{\sim}{B}}(x)\}$$

$$= \min\left\{\left(\frac{1}{1.0}+\frac{0.75}{1.5}+\frac{0.3}{2.0}+\frac{0.15}{2.5}+\frac{0}{3}\right)\left(\frac{1}{1.0}+\frac{0.6}{1.5}+\frac{0.2}{2.0}+\frac{0.1}{2.5}+\frac{0}{3}\right)\right\}$$

$$= \left\{\frac{1}{1.0}+\frac{0.6}{1.5}+\frac{0.2}{2.0}+\frac{0.1}{2.5}+\frac{0}{3}\right\}$$

Q.2. (a) Differentiate between supervised and unsupervised learning. Give one example of each. (6

Ans. Refer Q. No. 3 First Term Exam 2017.

Q.2. (b) Describe McCulloch-Pitts Neuron. Implement "AND" function using McCulloch-Pitts Neuron. (6.5

Ans. The idea of the simple neuron model first emerged in the 1940s with the work of McCulloch and Pitts, The cybernetics movement, attempted to combine biology, psychology, engineering and mathematics suiting in architectures for networks of neurons which would perform a number of cast in 1949, Hebb put forward the theory of neural networks developing internal representation related to experience

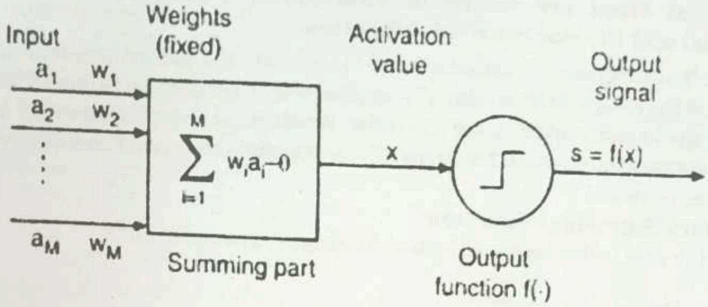


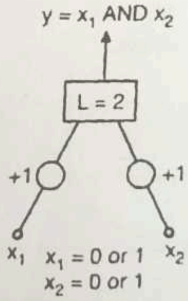
Fig. McCulloch and Pits Model of Neuron

In the 1950s, research continued initially into the development of networks to perform specific tasks but this changed and the goal became to develop machines that could learn. By the end of that decade there here had been a lack of significant developments and work in this field diminished considerably.

The perceptron effectively splits the input patterns into two distinct regions with one region being represented by a 1 on the output and the other a 0. Rosenblatt's training algorithm for the perceptron would converge if the input patterns to the perceptron were linearly separable. The perceptron would therefore approximate the decision boundary between the two classes of outputs.

Perceptrons were successfully trained to perform certain tasks but there were failures that could not be overcome, Minsky and Papert pointed out the serious shortcomings of perceptrons and interest in the study of neural networks again declined,

The 'AND' function using McCulloch-Pits neuron is shown below



AND gate

x_1	x_2	y
0	0	0
0	1	0
1	0	0
1	1	1

Q.3. (a) What are activation function? Differentiate between Binary Sigmodial and Bipolar Sigmoidal function. (6)

Ans. The activation function is used to calculate the output response of a neuron. The sum of the weighted input signal is applied with an activation to obtain the response. For neurons in same layer, same activation functions are used. There may be linear as well as nonlinear activation functions. The nonlinear activation functions are used in a multilayer network.

Binary Sigmoidal Function

This is also called logistic function. It ranges between 0 and 1.

$$f(x) = \log \text{sig}\ (x) = \frac{1}{1+\exp^{-x}}$$

If f(x) is differentiated we get,

$$f(x) = f(x)\,[1 - f(x)]$$

Fig. Shows the binary sigmoidal function.

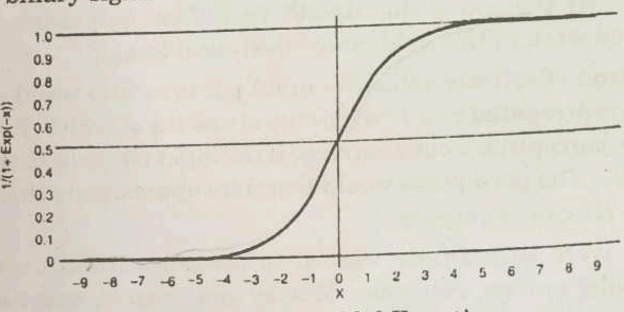


Fig. Binary Sigmoidal Functions

The desired range here is between +1 and −1. The function is related to the hyperbolic tangent function. The bipolar sigmoidal function is given as,

$$y(x) = 2f(x) - 1$$

Substituting the value of f(x) we get,

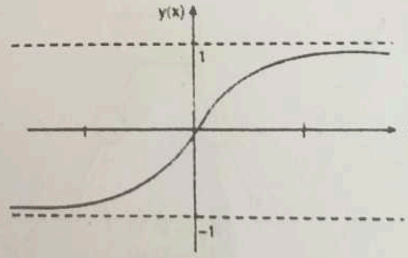
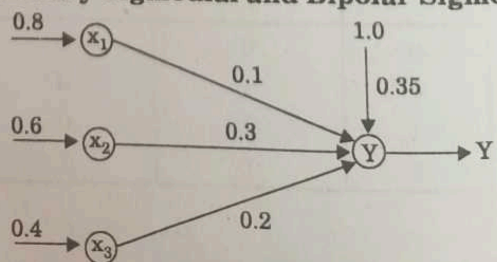


Fig. Bipolar Sigmoidal Function

Q.3. (b) Obtain the output of the neuron Y for the network shown in following figure using Binary Sigmodial and Bipolar Sigmoidal function. (6)



Ans. The given network has three input neurons with bias and one output neuron, These form a layer network,

The inputs are given as,

$[x_1, x_2, x_3] = [0.8, 0.6, 0.4]$

The weights are,

$[w_1, w_2, w_3] = [0.1, 0.3, -0.2]$

The net input can be calculated as,

$$y_{in} = b + \sum_{i=1}^{n} (x_i w_i)$$

$$y_{in} = 0.35 + 0.8 \times 0.1 + 0.6 \times 0.3 + 0.4 \times (-0.2)$$

$$y_{in} = 0.35 + 0.08 + 0.18 - 0.08 = 0.53$$

(i) For Binary Sigmoidal Function,

$$y = f(y_{in}) = \frac{1}{1+e^{-y_{in}}} = \frac{1}{1+e^{-0.53}} = 0.62$$

(ii) For Bipolar Sigmoidal activation function,

$$y = f(y_{in}) = \frac{2}{1+e^{-y_{in}}} - 1 = \frac{1-e^{-y_{in}}}{1+e^{-y_{in}}}$$

$$y = \frac{1-e^{-0.53}}{1+e^{-0.53}} = 0.259$$

Q.4. (a) What are Fuzzy Set? Enlist and explain various operators on Fuzzy Set. What do you mean by Lambda-Cut? (6)

Ans. Fuzzy sets support a flexible sense of membership of elements to a set. A fuzzy set is defined as follows:

If X is universe of discourse and x is a particular element of X, then a fuzzy set. A defined on X may be written as a collection of ordered pairs,

$$A = \left\{(x, \mu_A(x)), x \hat{I} X\right\}$$

where each pair $(x, \mu_A(x)$ is called a singleton.

Operations on Fuzzy set are:

(i) $\mu_{\tilde{A}\cup\tilde{B}}(x) = \max(\mu_{\tilde{A}}(x), \mu_{\tilde{B}}(x))$

(ii) $\mu_{\tilde{A}\cap\tilde{B}}(x_1) = \min(\mu_{\tilde{A}}(x), \mu_{\tilde{B}}(x))$

(iii) $\mu_{\bar{A}}(x) = 1 - \mu_{\tilde{A}\cap\tilde{B}}(x)$

(iv) $\mu_{\tilde{A}\cdot\tilde{B}}(x) = \mu_{\tilde{A}}(x)\mu_{\tilde{B}}(x)$

(v) $\mu_{a\cdot\tilde{A}}(x) = a.\mu_{\tilde{A}}(x)$

(vi) $\mu_{Aa}(x) = (\mu_{\tilde{A}}(x))^{a}$

(vii) $\tilde{A} - \tilde{B} = (\tilde{A} \cap \tilde{B}^c)$

(viii) $\tilde{A} \oplus \tilde{B} = (\tilde{A} \cap \tilde{B}) \cup (\tilde{A} \cap \tilde{B}^c)$

Q.4. (b) What is fuzzy relation? Draw a bipartite and simple fuzzy graph of the following relation X = {X1, X2, X3, X4} **(6.5)**

$$\begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \end{array}\begin{array}{c} \begin{array}{cccc} x1 & x2 & x3 & x4 \end{array} \\ \begin{pmatrix} 0.2 & 0 & 0.5 & 0 \\ 0 & 0.3 & 0.7 & 0.8 \\ 0.1 & 0 & 0.4 & 0 \\ 0 & 0.6 & 0 & 1 \end{pmatrix} \end{array}$$

Ans. Fuzzy relations elements of one universe (say X) to those of another universe (say Y) through the Cartesian product of the two universes. These can also be referred to as fuzzy sets defined on universal sets, which are Cartesian products.

A fuzzy relation is based on the concept that everything is related to some extent or unrelated.

A fuzzy relation is a fuzzy set defined on the Cartesian product of classical $\{X_1, X_2, \ldots X_n\}$ where tuples $(x_1 x_2, \ldots, x_n)$ may have varying degrees of $\mu_R(x_1 x_2, \ldots, x_n)$ within the relation, That is,

$$R(X_1, X_2, \ldots, X_n) = \int_{X_1 \times X_2 \times \ldots \times X_n} \mu_R(x_1, x_2, \ldots, xn) \,|\, (x_1, x_2, \ldots, x_n), \quad x_i \in X_i$$

A fuzzy relation between two sets X and Y is called binary fuzzy relation and is denoted by R(X, Y). A binary relation R(X, Y) is referred to as bipartite graph when $X \neq Y$. The binary relation on a single set X is called directed graph or digraph. This relation occurs when X=Y and is denoted as R(X, X) or $R(X^2)$.

The bipartite graph and simple fuzzy graph of B(X, X) is shown in Figures below:

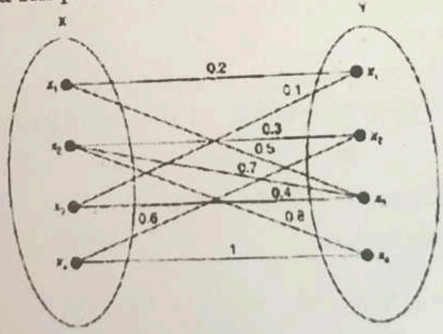


Fig. Bipartite graph

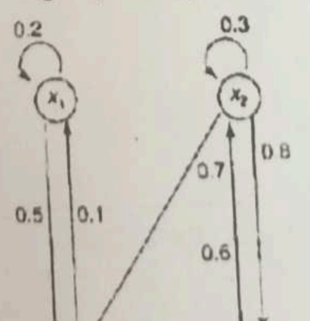


Fig. Simple fuzzy graph

Q.5. (a) What is defuzzification method? Enlist and explain various defuzzification methods. **(6)**

Ans. Refer Q.no. 5 (a) of End Term Exam 2018.

Q.5. (b) What is fuzzy inference system? Explain all types of is fuzzy inference system. What is fuzzy preposition? **(6.5)**

Ans. Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned.

Following are the two important methods of FIS, having different consequent of fuzzy rules –

- Mamdani Fuzzy Inference System
- Takagi-Sugeno Fuzzy Model (TS Method)

Mamdani Fuzzy Inference System

This system was proposed in 1975 by Ebhasim Mamdani. Basically, it was anticipated to control a steam engine and boiler combination by synthesizing a set of fuzzy rules obtained from people working on the system.

Steps for Computing the Output

Following steps need to be followed to compute the output from this FIS –

Step 1 – Set of fuzzy rules need to be determined in this step.

Step 2 – In this step, by using input membership function, the input would be made fuzzy.

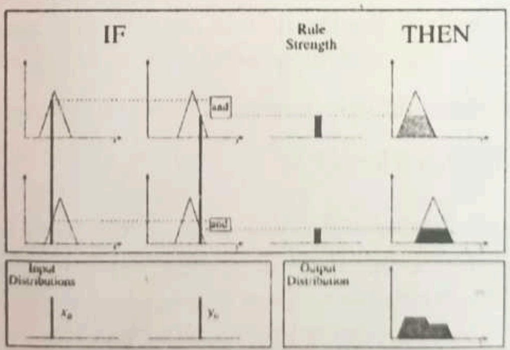
Step 3 – Now establish the rule strength by combining the fuzzified inputs according to fuzzy rules.

Step 4 – In this step, determine the consequent of rule by combining the rule strength and the output membership function.

Step 5 – For getting output distribution combine all the consequents.

Step 6 – Finally, a defuzzified output distribution is obtained.

Following is a block diagram of Mamdani Fuzzy Interface System.



Takagi-Sugeno Fuzzy Model (TS Method)

This model was proposed by Takagi, Sugeno and Kang in 1985. Format of this rule is given as –

$$\text{IF } x \text{ is A and } y \text{ is B THEN Z} = f(x, y)$$

Here, AB are fuzzy sets in antecedents and $z = f(x, y)$ is a crisp function in the consequent.

Fuzzy Inference Process

The fuzzy inference process under Takagi-Sugeno Fuzzy Model (TS Method) works in the following way.

Step 1: Fuzzifying the inputs – Here, the inputs of the system are made fuzzy.

Step 2: Applying the fuzzy operator – In this step, the fuzzy operators must be applied to get the output.

Q.6. (a) What are genetic algorithms? How Mutation, Selection and Crossover works in genetic algorithms? Explain. **(6)**

Ans. Refer Q.no. 1 (f) of End Term Exam 2018.

Q.6. (b) What are linguistic variables? How they are different from numeric variable. **(6.5)**

Ans. Refer Q.no. 3 (a) of First Term Exam 2018.

Q.7. (a) What is learning in neural networks? Explain linear separable and non-linearly separable pattern with example. **(6)**

Ans. Learning, in artificial neural network, is the method of modifying the weights of connections between the neurons of a specified network. Learning in ANN can be classified into three categories namely supervised learning, unsupervised learning, and reinforcement learning.

We say they're separable if there's a classifier whose decision boundary separates the positive objects from the negative ones. If such a decision boundary is a linear function of the features, we say that the classes are linearly separable.

For example, consider a dataset with two features x_1 and x_2 in which the points $(-1, -1), (1, 1), (-3, -3), (4, 4)$ belong to one class and $(-1, 1), (1, -1), (-5, 2), (4, -8)$ belong to the other.

A set of input vectors (or a training set) will be said to be linearly non-separable if no hyperplane exists such that each vector lies on the pre-assigned side of the hyperplane.

Q.7. (b) Explain error back propagation training algorithm with the help of flowchart. **(6.5)**

Ans. Step 1: Normalized the inputs and outputs with respect to their maximum values. It is proved that the neutral networks work better if input and outputs lie between 0-1. For each training pair, assume there are 'l' inputs given by $\frac{(r),}{l \times 1}$ and 'n' outputs $\frac{(O)_a}{n \times 1}$ in a normalized form.

Step 2: Assume the number of neurons in the hidden layer to He between $l < m <$

Step 3: [V] represents the weights of synapses connecting input neurons and hidden neurons and [W] represents weights of synapses connecting hidden neurons and output neurons. Initialize the weights to small random values usually from – 1 to 1. For general problems, λ can be assumed as I and the threshold values can be taken as zero.

$[V]^0$ = [random weights]

$[W]^0$ = [random weights]

$[\Delta V]^0 = [\Delta W]^0 = [0]$

Step 4: For the training data, present one set of inputs and outputs. Present the pattern to the input $(I)_l$ as inputs to the input layer. By using linear activation function, the output of the input layer may be evaluated as

$$\underset{l\times r}{(O)_l} = \underset{l\times 1}{(I)_r}$$

Step 5: Compute the inputs to the hidden layer by multiplying corresponding weights of synapses as

$$\underset{m\times 1}{(I)_H} = \underset{m\times l}{(V)^T}\ \underset{l\times 1}{(O)_l}$$

Step 6: Let the hidden layer units evaluate the output using the sigmoidal function as

$$\{O\}_H = \left\{\begin{matrix} \cdot \\ \cdot \\ \dfrac{1}{(1+e^{-1_{Hi}})} \\ \cdot \\ \cdot \end{matrix}\right\}_{m\times 1}$$

Step 7: Compute the inputs to the output layer by multiplying corresponding weights off synapses as

$$\underset{n\times 1}{\{I\}_o} = \underset{n\times m}{\{W\}^T}\ \underset{m\times 1}{(O)_H}$$

Step 8: Let the output layer units evaluate the output using sigmoidal function as

$$\{O\}_o = \left\{\begin{matrix} \cdot \\ \cdot \\ \dfrac{1}{(1+e^{-1_{oj}})} \\ \cdot \\ \cdot \end{matrix}\right\}$$

The above is the network output,

Step 9: Calculate the error and the difference between the network output and the desired output as for the ith training set as

$$E^p = \frac{\sqrt{\Sigma(T_j - O_{oj})^2}}{n}$$

Step 10: Find {d} as

$$\{d\} = \left\{\begin{matrix} \cdot \\ \cdot \\ (T_k - O_{ok})O_{ok}(1-O_{ok}) \\ \cdot \\ \cdot \end{matrix}\right\}_{n\times 1}$$

• If, a new variable z is created as function of x and y, i.e. $z=f(x, y)$ then f assigns a particular truth value to z for each combination of truth values of x and y.

•Since n logic variables may assume 2^n prospective truth values, there are 2^{2n} possible logic funtions of these variables.

Q.8. (b) Reinforcement of learning (Ph)

Ans. It is a stochastic learning algorithm. The behave an binary units. The machine has an energy function E, given as

$$E = \frac{1}{2}\sum_{j}\sum_{k} w_{kj} x_k x_j$$

$E = \frac{1}{2}\sum_{j}\sum_{k} w_{kj} \cdot x_k x_j$

The states x_k or x_j are denoted by eithers 1 or – 1 w_{kj} in synaptic weight of link between j to k.$j \neq k$ represents a no self feedback neuron.

(i) The machine choses a neuron at random.

(ii) It then flips the state of neuron k from x_k to $-x_k$ with probability.

Where ΔE_k is change in energy function of machine T is temperature.

(iii) This rule is applied repeatedly till a thermal equilithium is attained. These are two types of neurons:

(a) Visible neurons are interface between network and operating environment,

(b) Hidden neurons operate freely.

There are two states of operation of neurons:

(a) Clamped: When invisible neurons are all clamped into specific states (r_{kj}^{+}).

(b) Free running condition: Where all neuron (visible/hidden) freelly (r_{kj}^{-}). According to Boltzmanu rule:

$$\Delta\omega_{kj} = \eta(\rho^{+}_{kj} - \rho_{kj}^{-})\ (j \neq k \text{ i.e., no self loop})$$

Where, ρ_{kj}^{+} correlation between states of neurons j and k in the free-running condition of network.

ρ_{kj}^{+} and ρ_{kj}^{-} between – to + 1.

And η is learning rate.

Q.8. (c) Associative memory (Ph)

Ans. Refer Q.1 (g) of First Term Examination 2017.

Q.8. (d) Fitness functions

Ans. The fitness function simply defined is a function which takes a candidate solution to the problem as input and produces as output how "fit" our how "good" the solution is with respect to the problem in consideration.

Calculation of fitness value is done repeatedly in a GA and therefore it should be sufficiently fast. A slow computation of the fitness value can adversely affect a GA and make it exceptionally slow.

A fitness function should possess the following characteristics –

•The fitness function should be sufficiently fast to compute.

•It must quantitatively measure how fit a given solution is or how fit individuals can be produced from the given solution.

•In some cases, calculating the fitness function directly might not be possible due to the inherent complexities of the problem at hand. In such cases, we do fitness approximation to suit our needs.

• The following image shows the fitness calculation for a solution of the 0/1 Knapsack. It is a simple fitness function which just sums the profit values of the items being picked (which have a 1), scanning the elements from left to right till the knapsack is full.

0	1	2	3	4	5	6	Item Number
0	1	0	1	1	0	1	Chromosome
2	9	8	5	4	0	2	Profit Values
7	5	3	1	5	9	8	Weight Values

Knapsack capacity = 15

Total associated profit = 18

Last item no picked as it exceeds knapsack capacity.

9:30

END TERM EXAMINATION [JULY-2023]
EIGHT SEMESTER [B.TECH]
SOFT COMPUTING [ETIT-410]

Time: 3 Hrs. Max. Marks: 75

Note: Attempt five questions in all including Q. No. 1 which is compulsory.

Q.1. Attempt five questions:

Q.1. (a) Draw an architecture of Neural Network and Explain?

Ans. Refer to Q.1 (b) End Term Examination 2018 (Pg. No. 1-2018).

Q.1. (b) Differentiate Between Hard and Soft Computing.

Ans. Refer to Q.1 (a) End Term Examination 2018 (Pg. No. 1-2018).

Q.1. (c) Explain the error correction process and gradient decent Rule?

Q.1. (d) Explain the algorithm to store and recall a set of bipolar patterns in Hopfield Network.

Q.1. (e) Differentiate between Feed Forward and Feed Backward Neural Networks?

Ans. Refer to Q.1 (a) End Term Examination 2017 (Pg. No. 2-2017).

Q.1. (f) Explain about Fuzzy logic and its applications.

Ans. Refer to Q.1 (b) End Term Examination 2017 (Pg. No. 2-2017).

Q.1. (g) Define Uncertainly and its usefulness in Soft computing.

Ans. Refer to Q.1 (c) End Term Examination 2017 (Pg. No. 3-2017).

Q.1. (h) Explain extension principle using suitable example.

Q.1. (i) How Genetic algorithm is useful over simple Traditional algorithms. Why these algorithms are known as Genetic Algorithm?

Ans. Refer to Q.1 (d) End Term Examination 2017 (Pg. No. 3-2017).

Q.1. (j) Explain Perception Model with the help of Example.

Ans. Refer to Q.1 (e) End Term Examination 2017 (Pg. No. 4-2017).

Q.2. (a) Explain the significance of hidden layer. How it is useful in pattern recognition and control Problem? (6)

Ans. Refer to Q.2 (b) End Term Examination 2017 (Pg. No. 4-2017).

Q.2. (b) Describe McCulloch-Pitts Neuron. Implement "AND" Function using McCulloch-Pitts Neuron. (6.5)

Ans. Refer to Q.2 (b) End Term Examination 2018 (Pg. No. 4-2018).

Q.3. (a) What are activation Function? What is the necessity of activation Function? Differentiate between Binary Sigmodial and Bipolar Sigmodial Function. (6)

Ans. Refer to Q.3 (a) End Term Examination 2018 (Pg. No. 6-2018).

Q.3. (b) Draw and explain discrete Hopfield network architecture and also state the testing algorithm used in discrete Hopfield network?

Ans. Refer to Q.1 (c) End Term Examination 2018 (Pg. No. 2-2018).

Q.4. (a) What are Fuzzy Set? Enlist and explain various operations on Fuzzy Set. What do you mean by Lambda-Cut? (6)

Ans. Refer to Q.4 (a) End Term Examination 2018 (Pg. No. 7-2018).

Q.4. (b) With the suitable example, explain how membership assignment is performed using intuition and genetic algorithm? (6.5)

Ans. Refer to Q.5 (b) End Term Examination 2017 (Pg. No. 18-2017). (Neuro fuzzy system)

Q.5. (a) Find the weight required to perform the following classification using perception network. The vectors (1, 1, 1, 1) and (–1, 1, –1, –1) are belonging to the class (so have target value 1), vectors (1, 1, 1, –1) and (1, –1, –1, 1) are not belonging to the class (so have target value – 1). Assume learning rate as 1 and initial weight as 0. (6)

Q.5. (b) With a suitable case study, demonstrate the canonical rule formation, aggregation of the Fuzzy rules and decomposition of the compound rule formed. (6.5)

Q.6. (a) Define defuzzification. What are the different methods of defuzzification? Which of these techniques of defuzzification is best? (7.5)

Ans. Refer to Q.1 (b) First Term Examination 2019 (Neuro & fuzzy system) (Pg. No. 2-2019).

Q.6. (b) Compare and contrast multi-objective decision making and multi-attribute decision making. (5)

Q.7. (a) Explain the associative memory and its functioning using neat diagram.

Ans. Refer to Q.1 (g) End Term Examination 2017 (Pg. No. 5-2017) (Neuro & fuzzy system).

Q.7. (b) Explain following terms associated with associative memory: (6.5)

(i) Association

(ii) Heteroassociation

Ans. Refer to Q.1 (c) End Term Examination 2019 (Pg. No. 4-2019) (Neuro & fuzzy system).

(iii) Learning

(iv) Retrieval

(v) Reliability of the answer

Q.8. (a) Explain with the help of neat diagram the architecture of neuro fuzzy network. Also explain its application in medicine and economics. (8.5)

Q.8. (b) Explain the operation of genetic programming a neat flowchart. How Mutation, Selection and Crossover works in genetic algorithms? (4)

Ans. Refer to Q.1 (f) & (h) End Term Examination 2018 (Pg. No. 10,11-2018) (Neuro fuzzy system).

Q.9. Write short note on

Q.9. (a) Linguistic variables.

Ans. Refer to Q.3 (a) End Term Examination 2019 (Pg. No. 2-2019) (Neuro fuzzy system).

Q.9. (b) Applications of ANN.

Ans. Refer to Q.3 (b) End Term Examination 2017 (Pg. No. 10-2017) (Neuro fuzzy system).

Q.9. (c) Fitness Function.

Ans. Refer to Q.1 (h) End Term Examination 2019 (Pg. No. 5-2019) (Neuro fuzzy system).

Q.9. (d) Kohonen Self-Organising Feature Maps.

Ans. Refer to Q.2 (a) III Part End Term Examination 2018 (Pg. No. 14-2018) (Neuro fuzzy system).