



AUTUMN END SEMESTER EXAMINATION-2023

5th Semester B.Tech (DE-I & DE-II)

COMPUTATIONAL INTELLIGENCE

CS 3031

(For 2022 (L.E), 2021 & Previous Admitted Batches)

Time: 3 Hours

Full Marks: 50

Answer any SIX questions.

Question paper consists of four SECTIONS i.e. A, B, C and D.

Section A is compulsory.

Attempt minimum one question each from Sections B, C, D.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

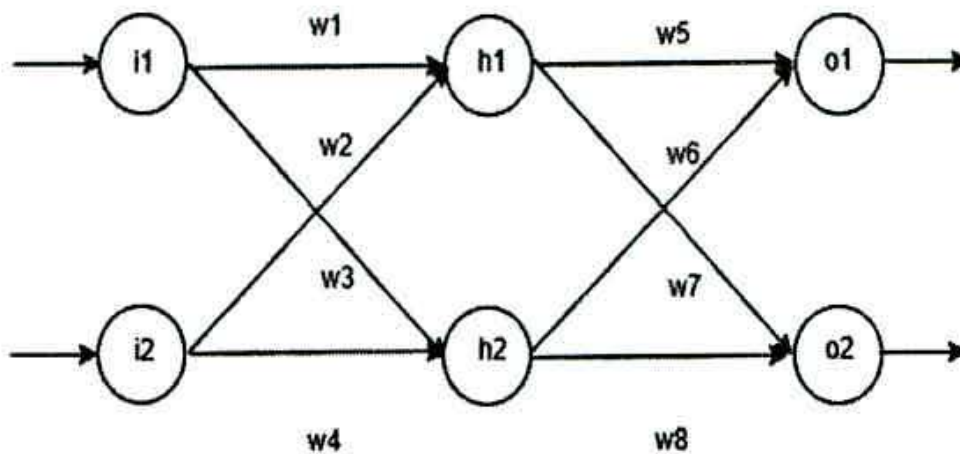
SECTION-A

1. Answer the following questions. [1 × 10]
- (a) What are the constituents of Soft Computing?
 - (b) Briefly describe the Hebbian learning rules.
 - (c) How does the Radial Basis Function Neural Network improves the separability?
 - (d) What is vanishing gradient problem? When does it occur?
 - (e) What are the different types of Fuzzy membership functions?
 - (f) Explain the convexity of Fuzzy Sets.
 - (g) What is max-product composition?
 - (h) Briefly describe the concentration and dilation of linguistic values with examples.
 - (i) What is the role of defuzzification in a fuzzy rule-based system?
 - (j) What is mutation in genetic algorithm? Why is it important in genetic algorithm?

SECTION-B

2. (a) What is Soft Computing? How is it different from Hard Computing? Provide an example illustrating when Hard Computing is typically more suitable than Soft Computing and vice versa. Justify your answer. [4]
- (b) Explain with a proper diagram how XOR classification problem can be solved in higher dimensions. Solve XOR classification by using RBF network with four radial basis functions. [4]

3. (a) [4]



Derive equations suitable to update the weights $w2$ and $w6$ in the above MLP model as per the back-propagation algorithm by using the Chain Rule. Assume sigmoid activation function at the hidden and output layers.

- (b) Explain briefly how threshold logic works in a McCulloch Pitts (MP) neuron? Implement the following boolean function using MP neuron. [4]

- I. AND
- II. OR
- III. NOR
- IV. NOT

SECTION-C

4. (a) Explain the concept of membership functions in fuzzy sets. How do they work, and what is their significance in fuzzy logic? Define the following terms in membership function: [4]
- I. Support
 - II. Core
 - III. Alpha-Cut
 - IV. Fuzzy Singleton
- (b) Illustrate Mamdani Fuzzy Inference System with a suitable example. [4]
5. (a) Describe the following operations in fuzzy sets using suitable examples. Show the graphical representation in each case. [4]
- I. Union
 - II. Complement
 - III. Intersection
- (b) Define the fuzzy max-min composition. If $X = \{x_1, x_2, x_3\}$, $Y = \{y_1, y_2\}$, $Z = \{z_1, z_2, z_3\}$ and R and S be two fuzzy relations defined on $X \times Y$ and $Y \times Z$ respectively such that [4]
- $$R = \begin{bmatrix} 0.5 & 0.1 \\ 0.2 & 0.9 \\ 0.8 & 0.6 \end{bmatrix} \quad S = \begin{bmatrix} 0.6 & 0.4 & 0.7 \\ 0.5 & 0.8 & 0.9 \end{bmatrix}$$
- Then calculate $R \circ S$ using max-min composition.
6. (a) What do you mean by linguistic variable? How are linguistic variables characterized? Define the orthogonality of the linguistic variables. What are the different ways of interpreting the fuzzy rule “if x is A then y is B ”? Explain with proper diagrams. [4]

- (b) Briefly describe the Adaptive Neuro-Fuzzy Inference System (ANFIS). Why does this hybrid approach accomplish better solutions? [4]

SECTION-D

7. (a) How does the neighborhood function influence the weight update process in a Kohonen Self-Organizing Map? Explain the competitive, cooperative, and adaptive process in the Kohonen Self-Organizing Map. [4]
- (b) Describe the concept of elitism in genetic algorithms and its purpose in maintaining the best solutions from one generation to the next. Explain the Steady State Selection technique in Genetic Algorithm. [4]
8. (a) Explain the Uniform crossover with mask. What would happen if we choose parents deterministically in uniform crossover? [4]
- (b) Compare and contrast between Simulated Annealing and Genetic Algorithm. Which one is better at hill climbing? Justify your answer. [4]
