

**SOFT COMPUTING
(MCAP 2250)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which of the following GA operator do not help in exploring the various parts of the search space?
(a) Selection (b) Crossover
(c) Mutation (d) None of these
- (ii) Genetic Algorithm are
(a) part of Evolutionary Computing.
(b) inspired by Darwin's theory about evolution - "survival of the fittest".
(c) adaptive heuristic search algorithm based on the evolutionary ideas of natural selection and genetics.
(d) All of the above
- (iii) Let A = (10, 20), B = (5, 15), C = (15, 15) be three solution points in the objective space of a 2-objective minimization problem. Which of the following statements is true?
(a) B dominates A and C
(b) A and C are mutually non-dominating
(c) Both (a) and (b)
(d) None of the above
- (iv) During learning, if a Perceptron misclassifies a training data negatively, i.e., erroneously yields an output -1 instead of +1, the interconnection weights are to be
(a) Increased (b) Decreased
(c) Kept unaltered (d) None the above
- (v) The interconnections of a Hopfield network are
(a) Unidirectional (b) Bidirectional
(c) Both (a) and (b) (d) Feed forward

- (vi) For Perceptron learning, the bias and the threshold are
 (a) Interchangable (b) Not interchangable
 (c) Conditionally interchangable (d) None of the above
- (vii) Which of the following properties is true for arbitrary fuzzy set P?
 (a) $P \cup P' \neq U$ (b) $P \cap P' \neq \Phi$
 (c) Both (a) and (b) (d) None of the above
- (viii) Consider a fuzzy set old as defined below
 $old = \{(20,0), (30,0.2), (40,0.4), (50,0.6), (60,0.8), (70,1), (80,1)\}$
 Then the alpha-cut for $\alpha=0.6$ for the set old will be
 (a) $\{(50, 0.6), (60, 0.8), (70, 1), (80, 1)\}$
 (b) $\{50, 60, 70, 80\}$
 (c) $\{60, 70, 80\}$
 (d) $\{(20,0), (30,0), (40,1), (50,1), (60,1), (70,1), (80,1)\}$
- (ix) The values of the set membership($\mu(x)$) is represented by _____
 (a) Discrete Set (b) Degree of truth
 (c) Probabilities (d) Both Degree of truth & Probabilities
- (x) Let $I = (U, A)$ be an information system and $P \subset Q \subset A$ and $x, y \in U$ be objects of I. Then which of the following statements is true?
 (a) If x and y are P-indiscernible then they are Q-indiscernible
 (b) If x and y are Q-indiscernible then they are P-indiscernible
 (c) The P and Q-indiscernibility of x and y are unrelated
 (d) None of these

Group – B

2. (a) What do you mean by soft computing? Define the future scope of soft computing.
- (b) Consider the population of 4 individuals with fitness values: $f_1 = 0.30$, $f_2 = 0.10$, $f_3 = 0.06$ and $f_4 = 0.04$. Select the two individuals for mating pool using *Roulette-Wheel selection* technique and *Rank-based selection* technique. Comments on results.
- (c) Explain the *Tree encoding* schemes with appropriate example.
- (2 + 2) + 6 + 2 = 12**

3. (a) Consider the parent chromosomes be P_1 and P_2 with length 8 in order-coded GA, given bellow.

P₁:	H	C	D	E	B	F	A	G
P₂:	E	D	H	G	A	B	F	C

Create the edge table and find the offspring(s) using Edge recombination order crossover technique.

- (b) Consider the following Offspring

P:	1	0	0	1	1	0	0	1
-----------	---	---	---	---	---	---	---	---

Find out the Mutated offspring using following methods

- (i) Flipping
- (ii) Interchanging.
- (c) Explain the followings, regarding crossover techniques
 - (i) Positional bias
 - (ii) End-point bias
 - (iii) Hamming cliff problem

5 + (2 + 2) + 3 = 12

Group – C

4. (a) Solve the Exclusive-NOR problem using Perceptron (Multiple feed forward network). Draw the decision boundary and adjust the weight accordingly.
 - (b) Construct and test a heteroassociative memory net to store the given vector pairs:
 $s(1) = (0 \ 0 \ 0 \ 1)$, $t(1) = (0 \ 1)$
 $s(2) = (0 \ 0 \ 1 \ 1)$, $t(2) = (0 \ 1)$
 $s(3) = (0 \ 1 \ 0 \ 0)$, $t(3) = (1 \ 0)$
 $s(4) = (1 \ 1 \ 0 \ 0)$, $t(4) = (1 \ 0)$
 Also test the network with "noisy" input patterns included.
 - (c) What does the momentum do in Back-Propagation training?
5. (a) Define the limitations of single layer perception model. Explain the process to overcome those limitations.
 - (b) Briefly describe the four popular activation functions in neural network.
 - (c) What do you mean linear separability?
 - (d) Explain briefly, the **perceptron learning rule**.

5 + 5 + 2 = 12

4 + 4 + 2 + 2 = 12

Group – D

6. (a) Consider $\tilde{A}(x)$ and $\tilde{B}(x)$ are two fuzzy set define bellow:
 $\tilde{A}(x) = \{(x_1, 0.6), (x_2, 0.5), (x_3, 0.2), (x_4, 0.9)\}$
 $\tilde{B}(x) = \{(x_1, 0.7), (x_2, 0.7), (x_3, 0.7), (x_4, 0.7)\}$
 Find out the value of following fuzzy set
 - i) $(\tilde{A} \cap \tilde{B})(x)$
 - ii) $\tilde{A}(x) + \tilde{B}(x)$
 - iii) $\tilde{A}(x) \ominus \tilde{B}(x)$
- (b) Consider R = "x is considerable larger than y" and S = "x is very close to y" are two fuzzy relations given below.

$$R = \begin{pmatrix} & y_1 & y_2 & y_3 & y_4 \\ x_1 & 0.8 & 0.1 & 0.1 & 0.7 \\ x_2 & 0.0 & 0.8 & 0.3 & 0.6 \\ x_3 & 0.9 & 1.0 & 0.7 & 0.8 \end{pmatrix} \quad S = \begin{pmatrix} & y_1 & y_2 & y_3 & y_4 \\ x_1 & 0.4 & 0.0 & 0.9 & 0.6 \\ x_2 & 0.9 & 0.4 & 0.5 & 0.7 \\ x_3 & 0.3 & 0.0 & 0.8 & 0.5 \end{pmatrix}$$

Find out the following fuzzy relations

- "x is considerable larger than y and x is very close to y"
- "x is not considerable larger than y and x is not very close to y"
- "x is not considerable larger than y or x is very close to y"

$$(2 \times 3) + (3 \times 2) = 12$$

7. (a) Consider the following GMP Inferencing process

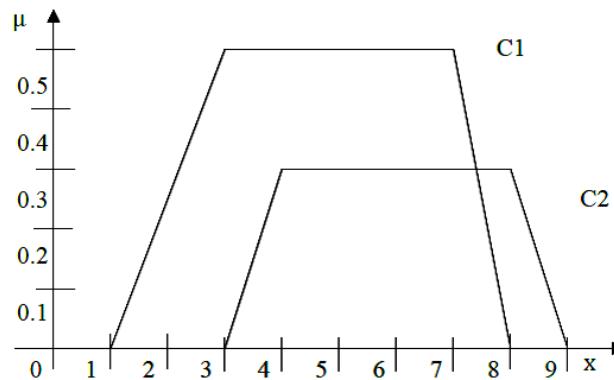
$P: \text{If } x \text{ is } \tilde{A} \text{ then } y \text{ is } \tilde{B}$

$Q: x \text{ is } \tilde{A}'$

Therefore y is $\tilde{B}'$

Let two set of variables x and y be $x = \{x_1, x_2, x_3\}$ and $y = \{y_1, y_2\}$. Also consider two fuzzy set $\tilde{A}$ and $\tilde{B}$ are $\tilde{A} = \{(x_1, 0.4), (x_2, 0.9), (x_3, 0.5)\}$ and $\tilde{B} = \{(y_1, 1), (y_2, 0.6)\}$. Now apply the above Inferencing rule to find $\tilde{B}'$ when $\tilde{A}' = \{(x_1, 0.6), (x_2, 1), (x_3, 0.7)\}$.

- (b) The results of two implication processes are shown bellow



Find the defuzzified output using the following methods:

- Center of Gravity (COG)
- Weighted average method

$$6 + 6 = 12$$

Group - E

8. Consider the decision system presented bellow represents data related to the scholarship information of a number of students. Find the reducts of the decision system as well as the minimal reducts from the set of reducts obtained. Also, extract the rules on the basis of one of the minimal reducts.

#	Degree	CGPA	Backlog	Recommendation	Decision
1	B.Tech	Average	No	High	Granted
2	B.Tech	Fresher	No	None	Not Granted
3	BSc	Low	No	Moderate	Not Granted
4	MCA	High	No	None	Granted
5	MCA	Average	No	None	Not Granted
6	MCA	High	No	High	Granted
7	B.Tech	High	Yes	Moderate	Granted
8	BSc	Low	Yes	High	Not Granted

$$(8 + 1 + 3) = 12$$

MCA/4TH SEM/MCAP 2250/2021

9. (a) Consider similarity ($\approx$) relation of triangles i.e., two triangles are similar if they have the same set of angles. Prove that similarity relation of triangles is an equivalence relation.
- (b) Compare and Contrast—Particle Swarm Optimization and Ant Colony Optimization.
- (c) Explain the algorithm of Artificial Bee Colony Optimization.

4 + 4 + 4 = 12

Department & Section	Submission Link
MCA	https://classroom.google.com/c/MzE2NzA2ODc2NTYx/a/Mzc0MTQ0OTc2NjI1/details