

CS/B.Tech/CSE/Odd/Sem-7th/CS-703B/2015-16



**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY,
WEST BENGAL**

CS-703B

SOFT COMPUTING

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.*

**GROUP A
(Multiple Choice Type Questions)**

1. Answer all questions. 10×1 = 10
- (i) The boundary of the fuzzy set A is defined by those elements x of the universe such that
- | | |
|--------------------|------------------------------|
| (A) $\mu_A(x) = 0$ | (B) $0 < \mu_A(x) < 1$ |
| (C) $\mu_A(x) = 1$ | (D) $0 \leq \mu_A(x) \leq 1$ |
- (ii) The Kononen's SOFM is _____ type of learning
- | | |
|-------------------|----------------------|
| (A) supervised | (B) competitive |
| (C) un-supervised | (D) both (A) and (C) |
- (iii) In GA term 'Gene' is termed as
- | | |
|---------------------------|-------------------|
| (A) coded design vector | (B) every bit |
| (C) coded design variable | (D) none of these |

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Turn Over

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- (iv) XNOR problem cannot be separable by
- | | |
|-----------------------------|---------------------------|
| (A) single layer perceptron | (B) multilayer perceptron |
| (C) both (A) and (B) | (D) none of these |
- (v) "Fittest will be survivor" is true for
- | | |
|-------------------------|---------|
| (A) simulated annealing | (B) GA |
| (C) hebbian learning | (D) PSO |
- (vi) A fuzzy number B is a fuzzy set in the real line (R) that satisfies the condition/(s)
- | | |
|----------------------|-------------|
| (A) normal | (B) convex |
| (C) both (A) and (B) | (D) concave |
- (vii) Which one follow the involution property of fuzzy complement?
- | | |
|-------------------------|------------------------|
| (A) Sugeno's complement | (B) Yager's complement |
| (C) Both (A) and (B) | (D) None of these |
- (viii) Fuzzy set theory was introduced by
- | | |
|------------|----------------|
| (A) Zadeh | (B) Rosenblatt |
| (C) Minsky | (D) Goldberg |
- (ix) In simple perceptron learning rule change of synaptic weight is proportional to
- | | |
|--------------------------------------|------------------------------------|
| (A) product of error and i/p signal | (B) product of i/p and o/p signals |
| (C) product of error and o/p signals | (D) gradient of cost function |
- (x) In _____ mode of training, all neurons in Hopfield networks fire at random.
- | | |
|-------------------|------------------|
| (A) stable status | (B) synchronous |
| (C) output | (D) asynchronous |

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GROUP B
(Short Answer Type Questions)

Answer any three questions.

3×5 = 15

2. (a) What is soft computing? What are the components of soft computing? 2+1
(b) Differentiate soft and hard computing. 2
3. Consider two fuzzy set X and Y are define as follows. 1+2+2
 $X = \{0.1/0 + 0.2/1 + 0.3/2 + 0.4/3 + 0.5/4\}$ and
 $Y = \{0.5/0 + 0.4/1 + 0.3/2 + 0.2/3 + 0.1/4\}$
 Find (i) Drastic Sum,
 (ii) Algebraic Sum, and
 (iii) Bounded Product over these two fuzzy sets.
4. Map biological neuron to McCulloch-Pitts mathematical neuron, component-by component. 2+3
5. (a) Differentiate between supervised and unsupervised learning. 2
(b) "XOR function is linearly separable by a single decision boundary line". 3
Comment on the statement.
6. Write an evolutionary algorithm for Particle Swarm Optimization (PSO). 5

GROUP C
(Long Answer Type Questions)

Answer any three questions.

3×15 = 45

7. (a) For a speed control of DC motor, the membership function of series resistance, armature current and speed are given as follows. 6

$$R_s = \left\{ \frac{0.4}{30} + \frac{0.6}{60} + \frac{1.0}{100} + \frac{0.1}{120} \right\}$$

$$I_a = \left\{ \frac{0.2}{20} + \frac{0.3}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.2}{120} \right\}$$

$$N_p = \left\{ \frac{0.8}{30} + \frac{0.3}{60} + \frac{0.0}{100} + \frac{0.9}{120} \right\}$$

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Let R be a relation on $R_e \times I_a$ and S be a relation on $I_a \times N_p$. Obtain Relation T using max-min composition between relations R and S .

- (b) What are fuzzy cardinality and relative cardinality? Give an example. 2
- (c) Define α -cut and strong α -cut with example. 4
- (d) Show that fuzzy intersection satisfies the properties S-norm. 3
8. (a) Discuss the following defuzzification methods with example. 6
 (i) Center of Sum (CoM)
 (ii) Mean of Maxima (MoM)
 (b) Differentiate between Fuzzy logic and Classical Logic. 3
 (c) What do you mean by decomposition of a fuzzy set? Prove that for any 4
 $A \in F(X)$,
 $A = \bigcup_{\alpha \in \lambda(A)} \alpha^A$, where $\lambda(A)$ is the level set of A .
 (d) What is fuzzy rule base? 2
9. (a) Discuss the competitive, cooperative and adaptive process of Kohonen's self-organizing map. 9
 (b) Using Hebb Network, implement AND function with bipolar inputs and targets. 6
10. (a) State and discuss the Roulette wheel and tournament selection procedure with respect to the genetic algorithm. 4
 (b) What do you mean by Two-point crossover and Random Respectful Recombination (RRR) crossover operator? Define with proper example. 4
 (c) Use genetic algorithm to maximize the function $f(x) = 2x^2 + 5x - 1$, for $15 \geq x \geq 0$ and x is integer. The six initial populations with chromosome's size of 4 are selected as 1000, 1001, 0011, 1011, 0101, and 1110. Crossover point is at point 2. Show the first two iterations and justify the improvement of optimal solution of x . 7
11. Write short notes on any three of the following: 3×5
 (a) Schema theorem and building block hypothesis
 (b) Pareto-optimality in GA as fitness function
 (c) Mamdani Fuzzy Models
 (d) Ant Colony Optimization (ACO)
 (e) Reinforced learning.