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Paper Code : IT-703B

SOFT COMPUTING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Which theory defines the GA most ?

a) Survivor of the fittest

b) Elimination of the unwanted

c) Gradient decent

d) Vagueness.

ii) Height of a Fuzzy Set *A* is

a) 1

b) maximum membership value

c) 0·5

d) Minimum membership value.

iii) KSOFM is ..... technique.

a) Supervised learning

b) Unsupervised learning

c) Reinforcement learning

d) Semi-supervised learning.

iv) Which crossover technique can be used for Travelling Salesman problem ?

a) Single Point Crossover

b) Multipoint Crossover

c) Uniform Crossover

d) Ordered Crossover.

v) Which of the following is not recurrent network ?

a) Hopfield network

b) Bidirectional associative memory

c) Both (a) and (b)

d) None of these.

vi) What are the following sequence of steps taken in designing a fuzzy logic machine ?

a) Fuzzification > Rule evaluation > Defuzzification

b) Rule evaluation > Fuzzification > Defuzzification

c) Fuzzy Sets > Defuzzification > Rule evaluation

d) Defuzzification > Rule evaluation > Fuzzification.

vii) Let A and B are two fuzzy sets with membership function μ, then $\mu_{A\cup B}(x)$ is equal to

a) $\{\mu_A(x)+\mu_B(x)\}$

b) $\{\mu_A(x)-\mu_B(x)\}$

c) $\min\{\mu_A(x),\mu_B(x)\}$

d) $\max\{\mu_A(x),\mu_B(x)\}$.

viii) In Fuzzy set, the range of membership function is

a) 0 - 100 b) 100 - 1000

c) 1 - 100 d) 0 - 1.

ix) Which Genetic Algorithm Operator elements weak chromosome ?

a) Crossover b) Reproduction

c) Mutation d) Selection.

x) Which concept ensures selection of best chromosome for the next generation ?

a) Ranked Selection

b) Elitism

c) Tournament Selection

d) Roulette Wheel Selection.

xi) α-cut of fuzzy set generates a

a) Fuzzy set b) Rough set

c) Universal set d) Crisp set.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

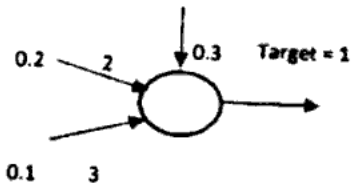
2. Consider two fuzzy sets $A=\left\{\frac{0\cdot2}{1}+\frac{0\cdot3}{2}+\frac{0\cdot4}{3}+\frac{0\cdot5}{4}\right\}$ and $B=\left\{\frac{0\cdot1}{1}+\frac{0\cdot2}{2}+\frac{0\cdot2}{3}+\frac{0\cdot1}{4}\right\}$. Find the algebraic sum and algebraic product of the given fuzzy sets.

3. a) What are the differences between crisp set and fuzzy set ? 2

b) What do you understand by Generalized Modus Ponens ? 3

4. Explain Roulette Wheel Selection with an example.

5. Consider the following ANN with Sigmoidal Activation function and answer the following :



a) Total input to the neuron. 1

b) Final output of the neuron if $\lambda = 1$. 1

c) Error, for $\lambda = 2$, $\lambda = 1$, if the target is 1. 3

6. Implement the XOR function using McCulloh-Pitts neurons using binary data.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) How fuzzy logic is different from probability ? 3

   b) Write the significance of crossover probability (μ_c) and mutation probability (μ_m). 3

   c) Define learning. Differentiate among Supervised, Unsupervised and Reinforcement learning. 2 + 3

   d) How can genetic algorithm be controlled by Fuzzy Logic ? 4

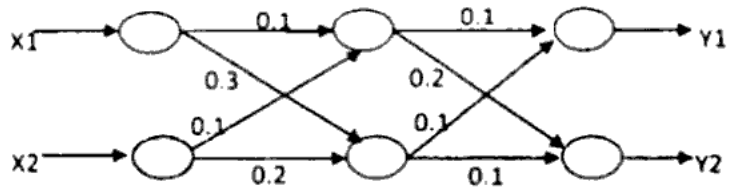
8. a) What do you understand by Gene Encoding ? Explain how gene encoding can affect the GA. 4

   b) How in simple GA does crossover an mutation help to solve the problem of Local Optima ? 4

   c) Minimize $f(X) = X^2$, where $X < 32$, using simple GA. Use Binary Gene Encoding. Start with at least 6 chromosomes at 0th population and use two-point crossover and flip mutation with probability 0·8 and 0·3 respectively. 7

9. a) Define linearly separable problems. Why logical XOR cannot be designed by single layer perceptron ? 5

   b) Calculate the new weight of the following ANN using BP up to one epochs :



   Let input $X_1 = 1$, and $X_2 = 2$ and desired outputs are $Y_1 = 0 \cdot 4$ and $Y_2 = 0 \cdot 5$ respectively. Let momentum $(\alpha) = 0 \cdot 2$ and learning rate $(\eta) = 0 \cdot 5$. Also consider that we have used identity function as Activation Function for input layer and Binary Sigmoidal function as Activation function for hidden and output all layers with $\lambda = 1$. 10

10. a) What is fuzzy quantifier ? Differentiate between absolute and relative quantifier. 3

    b) Differentiate between Mamdani FIS and Sugeno FIS. 3

    c) What are the termination criteria for any optimization techniques of soft computing ? 4

    d) Explain the architectures of popular self-organizing maps. 5

11. a) Show that fuzzy union and fuzzy intersection satisfy the properties of *T*-norm and *S*-norm respectively. 5

b) Compare feed-forward and feedback networks. 3

c) Write a short note on Ant Colony Optimization. 5

d) Define soft computing. 2