SOFT COMPUTING
(CSEN 5202)

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) Supervised Learning in soft computing domain, primarily denotes a technique of _____
(a) learning from historic data
(b) learning from human teacher
(c) learning from action based reward /penalty experience.
(d) none of the above.

(ii) Which of the following function is not differentiable at every point?
(a) Sigmoid function (b) Tan hyperbolic function
(c) Threshold based sign function (d) None of these.

(iii) Consider two given fuzzy sets X and Y are:
X = { 1/ p + 0.3 /q + 0.5/r + 0.2/ s} Y= { 0.5/ p + 0.4/q + 0.1/ r + 1/s }
Then X∪Y =
(a) {1/ p + 0.3 /q + 0.5/r + 0.2/ s }
(b) {0.5/ p + 0.4/q + 0.1/ r + 1/s }
(c) {1/ p + 0.4/q + 0.5/ r + 1/s }
(d) {0.5/ p + 0.2/q + 0.1/ r + 1/s }.

(iv) A self-organizing feature map (SOFM) has 10 input units, and 100 output units arranged in a two dimensional grid. How many weights does this network have?
(a) 100 (b) 800 (c) 1000 (d) 1500.

(v) Genetic Algorithm are a part of
(a) Evolutionary Computing
(b) inspired by Darwin's theory about evolution - "survival of the fittest"
(c) are adaptive heuristic search algorithm based on the evolutionary ideas of natural selection and genetics
(d) all of the above.

(vi) **Statement 1:** The membership values of a crisp set can be either 0 or 1
Statement 2: The membership values of a fuzzy set can be between 0 & 1
Statement 3: The membership values of a crisp set can be between 0 & 1
Statement 4: The membership values of a fuzzy set can be either 0 or 1
(a) Both Statement 1 and Statement2 are false
(b) Both Statement 1 and Statement2 are true
(c) Both Statement 3 and Statement4 are true
(d) Statement2 is false and Statement3 is true.

(vii) Consider two given fuzzy sets A and B are:
A = { 1/ p + 0.3 /q + 0.5/r + 0.2/s}
B= { 0.5/ p + 0.4/q + 0.1/r + 1/s }
Then A∩B =
(a) {1/ p + 0.3 /q + 0.5/r + 0.2/s } (b) {0.5/ p + 0.3/q + 0.1/ r + 0.2/s }
(c) {1/ p + 0.4/q + 0.5/ r + 1/s } (d) {0.5/ p + 0.2/q + 0.1/ r + 1/s }.

(viii) Which of the following problem is not solvable in polynomial time complexity?
(a) Travelling Salesman Problem (b) Shortest path problem in graph
(c) Fractional Knapsack Problem (d) Minimum spanning tree.

(ix) Backpropagation algorithm is generally used _____ .
(a) to learn weights of each connection in multilayer feedforward neural network
(b) to learn weights of each connection in single layer feedforward neural network
(c) to learn weights of each connection of a Radial Basis Network.
(d) none of the above.

(x) Which of the following is related with Radial Basis Function?
(a) K-means clustering (b) Artificial Neural network
(c) Nearest Neighbour (d) All of the above.

Group – B

2. (a) What is Soft Computing Technique? What are the benefits of Fuzzy set theory over Classical set theory? What is the time complexity to determine the exact solution of Travelling Salesperson Problem (TSP) with 'n' number of city?

(b) A = {1/a, 0.3/b, 0.2/c 0.8/d, 0/e},
B = {0.6/a, 0.9/b, 0.1/c, 0.3/d, 0.2/e}
Find for A and B independently:
(i) Support (ii) Core (iii) Cardinality.

(3 + 2 + 1) + 6 = 12

3. $X=\frac{0.2}{10}+\frac{0.5}{20}+\frac{0.8}{40}+\frac{1.0}{60}+\frac{0.6}{80}+\frac{0.1}{100}$

$Y=\frac{0.3}{0.5}+\frac{0.6}{1}+\frac{0.9}{1.5}+\frac{1.0}{4}+\frac{0.6}{8}+\frac{0.3}{20}$

$Z=\frac{0.3}{10}+\frac{0.6}{20}+\frac{0.7}{40}+\frac{0.9}{60}+\frac{1}{80}+\frac{0.5}{100}$

(i) Find the Cartesian Products represented by the relations R= X **x** Y and S=Y **x** Z

(ii) Find R **o** S using max-min composition
(iii) Find R **o** S using max-product composition.

[(2 + 2) + 4 + 4] = 12

Group – C

4. (a) Consider the following 2-dimensional points together with their class labels:

x1	x2	Class
0	0	+1
0	1	+1
1	0	+1
1	1	- 1

Find the weight vector after four iterations using single perceptron model. Assume learning rate $\eta = 1$, initial weight vector $w = [0.5, 0.5]^T$ and bias = 1.

(b) Describe Radial Basis Network as a classifier.

6 + 6 = 12

5. (a) Design an Artificial neural network for following data set with 2 classes having attributes x1 and x2 as given below: (Initializing each connection with random non zero values, show 1 iteration / step of updating the weights of each link of each layer).

x1	x2	Class
0	0	+1
0	1	-1
1	0	-1
1	1	+1

(b) Describe the working principle of Kohonen Self-Organizing Maps using a suitable example.

6 + 6 = 12

Group – D

6. (a) Use genetic algorithm to maximize the function $f(x)=x^2$ for $0 \le x \le 31$. The four initial population chromosome's size of five is selected as 01101, 11000, 01000, 10011. Show details for first two iterations.

(b) Explain with suitable example the various types of crossover?

(c) Explain the roulette wheel selection algorithm with example.

4 + 5 + 3 = 12

7. (a) Consider a TSP problem with fully connected Graph G(V,E), where $|V|=8$ and W_{ij} is the weight associated with the edge city v_i and v_j. As per your choice, assign weight of each edge of the graph G and define Chromosomes, fitness function, cross over and mutation in solving the TSP problem instance using genetic algorithm.

(b) Discuss the importance of mutation operation in genetic algorithm.

8 + 4 = 12

Group – E

8. (a) Define multi objective optimization problem. Discuss with example, the role of Pareto optimal front in solving the problem.

(b) What is non-dominated solution in a Multi Objective Optimization problem?

7 + 5 = 12

9. Briefly discuss **any three** of the followings: **(3 × 4) = 12**
   (i) Stochastic Gradient Descent Algorithm
   (ii) Remainder stochastic sampling
   (iii) Radial Basis Function
   (iv) Competitive Learning Model.

Department & Section	Submission Link
CSE	https://classroom.google.com/c/MzAxNTg5ODAzNTQy/a/MzcxNTc5ODY4MTQ0/details