M. SC. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)

[M. Sc. (MACS)]

Term-End Examination

December, 2023

MMTE-007 : SOFT COMPUTING AND ITS APPLICATIONS

Time : 2 Hours   *Maximum Marks : 50*

Weightage : 50%

Note : (*i*) *Question No.* **7** *is compulsory.*

(*ii*) *Attempt any* **four** *questions from Question Nos.* **1** *to* **6.**

(*iii*)*Use of non-programmable scientific calculator is allowed.*

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1. (a)   Differentiate between fuzzy sets and classical sets. Perform Union, Intersection, Complement and Difference

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operations over the fuzzy sets A and B, given below : 6

$$A = \left\{ \frac{1}{2} + \frac{0.3}{4} + \frac{0.5}{6} + \frac{0.2}{8} \right\}$$

and $$B = \left\{ \frac{0.5}{2} + \frac{0.4}{4} + \frac{0.1}{6} + \frac{1}{8} \right\}$$

(b) Briefly discuss the term schema. How is it related to gene sequence ? Write the schema for the gene sequence (1000110) and (0001100). 4

2. (a) What are Hopfield networks ? Give *two* major limitations of Hopfield networks. Under which condition, a Hopfield model of 'N' nodes can achieve 100% correct retrieval of 'P' patterns ? 6

(b) Out of three genetic operators viz. selection, crossover and mutation, list and justify which operator or combination thereof will be required for the following : 4

(i) To fill the population with copies of the best individual from the population.

(ii) To cause the algorithms to converge on a good but sub-optimal solution.

(iii) To induce a random walk through the search space.

(iv) To create a parallel, noise-tolerant, hill climbing algorithm.

3. (a) Perform the Normalization of Inputs and calculate the output of each neuron of a simple Kohonen neural network given below :   4
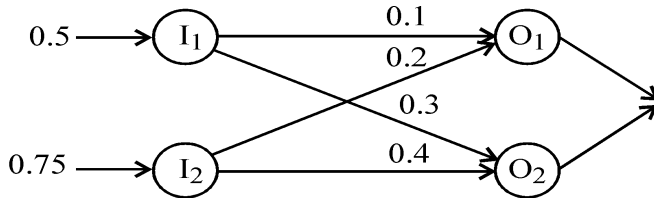
(b) What are Genetic Algorithms (GAs) ? Compare GAs with conventional optimization techniques. Examine, whether GA can improve the solution from one generation to the next generation for maximizing the function $f(x) = \sqrt{x}$, subject to $1 \leq x \leq 16$.   6

4. (a) Write Fuzzy C-mean algorithm. Apply it to find the new cluster centre (after one iteration), for the dataset given below :   6

	x_1	x_2	x_3	x_4
f_1	1	2	3	4
f_2	10	8	6	5

[Use C = m = 1 and V_1 = (4, 4), V_2 = (8, 8)].

(b) Find the length and order of the following schemas :   4

(i) S_1 = 1** 00*1**

(ii) S_2 = *00*1**

(iii) S_3 = ***0****

(iv) S_4 = *1*01*

5. (a) Write Roulette-Wheel criterion. Use it to generate the population in the next iteration, for the data given below :   6

Variable no., K	Fitness Value, F_K
1	3.5
2	4.6
3	5
4	2.8
5	1.8

(b) Briefly discuss the Multilayer Neural Networks with suitable diagram. Also, verify the statement : "A multilayer network with linear transfer function is equivalent to a single layer linear network." 4

6. (a) What do you mean by a feed-forward neural network (NN) ? Using diagram, show how it differs from a recurrent neural network. 4

(b) Consider the two parents which are participating in partially mapped cross-over shown below :

Parent 1 : CD | E A B I | H G F

Parent 2 : AB | C D E F | G H I

Using partially mapped crossover assuming 2nd and 6th as the crossover sites, find the children solution. 6

7. State whether the following statements are True or False. Give reasons for your answers :

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(a) Self Organizing Map is a supervised learning techniques.

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(b) Laws of excluded middle are valid for fuzzy sets.

(c) If $w(k_0) = w(k_0 + 1) = w(k_0 + 2)$, then perceptron is linearly separable.

(d) Hopfield network is a particular case of Kohonen network.

(e) Back propagation reduces to LMS algorithm for a single layer linear network (ADA LINE).