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MMTE-007

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

M. Sc. (MACS)

Term-End Examination

June, 2020

MMTE-007 : SOFT COMPUTING AND ITS APPLICATIONS

Time : 2 Hours *Maximum Marks : 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) Determine the α-cut of the Fuzzy set (A) are given below, at 0.7 and 0.2. 3

$$A = \left\{\frac{0}{10}, \frac{0}{20}, \frac{0.2}{30}, \frac{0.8}{40}, \frac{1.0}{50}, \frac{1.0}{60}, \frac{0.6}{70}, \frac{0.2}{80}, \frac{0}{90}, \frac{0}{100}\right\}$$

Also, compare the α-cut of the two outcomes, and give comments for status of α-value variation.

(b) Consider the following table for the connections between input neurons and the hidden layer neurons :

Input Neurons	Hidden Layer Neurons	Connection Weight
1	1	-1
1	2	-0.1
1	3	1
2	1	-1
2	2	1
2	3	1
3	1	-0.2
3	2	-0.3
3	3	-0.6

The connection weights from the hidden layer neurons to the output neurons are – 0.6, – 0.3 and – 0.6, for the first, second and third neurons, respectively. Corresponding threshold value for the output layer is 0.5 and for the hidden layer is 1.8, 0.05 and 0.2 for the first, second and third neurons, respectively. 5

(i) Draw the diagram of the network.

(ii) Write the output at each node.

(c) Using diagram, show the difference between feed-forward neural network and recurrent neural network. 2

2. (a) Let A and B be two Fuzzy sets as given below : 4

$$A = \left\{ \frac{0.5}{\text{Mohan}}, \frac{0.9}{\text{Sohan}}, \frac{0.7}{\text{John}}, \frac{0}{\text{Abdul}}, \frac{0.2}{\text{Abraham}} \right\}$$

$$B = \left\{ \frac{0.75}{\text{Mohan}}, \frac{0.4}{\text{Sohan}}, \frac{0}{\text{John}}, \frac{0.8}{\text{Abdul}}, \frac{0}{\text{Abrahm}} \right\}$$

Determine the following :

(i) Universe of discourse for Set A and Set B

(ii) Complements of Set A and Set B

(iii) $A \cap B$

(iv) $A \cup B$

(b) Write schema for the Gene Sequence (1000111) and (0001100). Also, write two different gene sequences from the schema. 2

(c) Consider the following travelling salesman problem involving 10 cities : 4

Parent 1	Parent 2
A	E
B	G

C	I
D	D
E	C
F	B
G	J
H	H
I	A
J	F

Determine the children solution using order cross-over (#1), assuming 4th and 8th sites as cross-overs and cyclic cross-over with 4th position as initial position.

3. (a) Implement AND function using McCulloch-Pitts neuron. 5

(b) Maximize :

$$f(x) = \frac{-x^2}{10} + 3x$$

where $0 \leq x \leq 31$, using Genetic Algorithm. 5

4. Approximate the function $f(x) = 1 + \cos \pi x$ for $-1 \le x \le 1$, by solving 1–2–1 network, using Back propagation algorithm. The weighted structure and initial input are as follows :

Weighted structures are :

$$[W]^{\circ} = \begin{bmatrix} -0.25 \\ -0.40 \end{bmatrix} \text{ and bias } \phi^{(1)}_{(0)} = \begin{bmatrix} -0.50 \\ -0.1 \end{bmatrix}$$

$$[V]^{\circ} = \begin{bmatrix} 0.1 & -0.2 \end{bmatrix} \text{ and bias } \phi^{(2)}_{(0)} = \begin{bmatrix} 0.5 \end{bmatrix}$$

The initial input is 1. 10

Draw the architecture of the model. Perform one iteration.

5. (a) Consider a dataset of five observations given in the following table, each of which has two features f_1 and f_2 :

	x_1	x_2	x_3	x_4	x_5
f_1	2	3	4	3	5
f_2	6	7	5	4	6

Assume the number of cluster $c = 3$ and the real number $m = 2$. Also, assume the initial cluster centers as $V_1 = (1,1)$ and $V_2 = (2,2)$. Apply fuzzy c-mean algorithm to find the modified cluster center after one iteration. 6

(b) Generate the population in the next iteration by using Roulette-Wheel criterion : 4

k	F_k
1	3.5
2	4.6
3	5
4	2.8
5	1.8

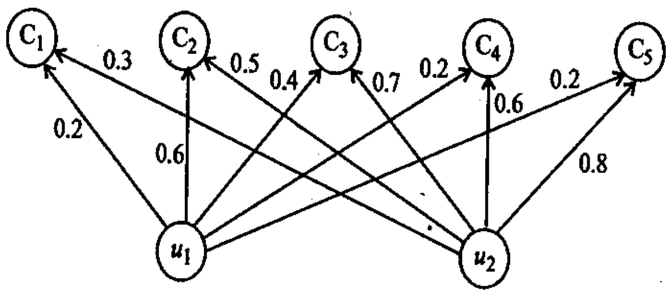
6. (a) Out of three genetic operators viz. selection, cross-over and mutation, list and

justify which operator or combination there of will be required for the following : 2

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

(ii) For the convergence of an algorithm to good but sub-optimal solution.

(b) A Kohonen self-organizing map with weights in shown below : 6



Find cluster unit C_j, $j = 1, 2, 3, 4, 5$ that is closest to the input vector (0.3, 0.6) by using square of the Euclidean distance.

(c) Consider a two-input neuron with $b = 1.5, w = [2, 3]$ and $x^t = [6 \quad -5]$. Find the neuron output for the following transfer function : 2

(i) linear transfer function

(ii) tan sigmoid transfer function

7. State whether the following statements are true or false. Give a short proof or a counter example in support of your answer : 10

(a) A multilayer network with linear transfer function is equivalent to a single-layer network.

(b) Radial basis function (RBF) is a function, whose, response function has a constant distance from a central point.

(c) The order of schema ** 10** is 6.

(d) Every original pattern of a discrete Hopfield network with a synchronous update provides a global minimum.

(e) If **R** is a Fuzzy relation between the Fuzzy sets A and B, then the membership function of **R** is :

$$\mu_{\mathrm{R}}(x, y) = \max(\mu_{\mathrm{A}}(x), \mu_{\mathrm{B}}(y))$$