Total No. of printed pages = 4

MCA 18250 E 21

Roll No. of candidate

13/3/ 2021

M.C.A. 5th Semester End-Term Examination

SOFT COMPUTING

(New Syllabus & New Regulation)

(w.e.f. 2018-19)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.
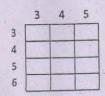
Answer question No. 1 and any *four* from the rest.

1. Choose the correct answer from the following   (10 × 1 = 10)

    (i)   Which of the following parts of a biological neuron is modeled by the weighted interconnections between the input units and the output unit of an artificial neural model?

    (a) Dendrite   (b) Axon

    (c) Soma   (d) Synapse

    (ii)   In an artificial neural model, the activation function of the input unit is:

    (a) The step function   (b) The identity function

    (c) The sigmoid function   (d) None of the above

    (iii) The interconnections of a Hopfield network are

    (a) Bidirectional   (b) Unidirectional

    (c) Both (a) and (b)   (d) None of the above

    (iv)   Recognition of hand written characters is an act of

    (a) Pattern classification   (b) Pattern association

    (c) Both (a) and (b)   (d) None of the above

    (v)   Identification of an object, e.g., a chair, a tree, or a human being, from the visual image of our surroundings, is an act of

    (a) Pattern classification   (b) Pattern association

    (c) Both (a) and (b)   (d) None of the above

[Turn over

(vi) During learning, if a Perceptron misclassifies a training data negatively, i.e., erroneously yields an output -1 instead of $+1$, the interconnection weights are to be

    (a) Increased   (b) Decreased

    (c) Kept unaltered   (d) None the above

(vii) Which of the following learning rule is used in *ADALINE* training?

    (a) Hebb learning   (b) Perceptron learning

    (c) Delta learning   (d) None of the above

(viii) Which of the following activation functions is not suitable for back propagation nets?

    (a) Sigmoid   (b) Hyperbolic tangent

    (c) Arc tangent   (d) Step function

(ix) Which of the following transformations on membership functions of fuzzy sets enhances the membership values?

    (a) Concentration   (b) Dilation

    (c) Fuzzification   (d) None of the above

(x) Let $U = \{a, b, c\}$, and $P = \{(a, 0.5), (c, 0.75)\}$ be a fuzzy set on U. What is the height of P?

    (a) 0.75   (b) 0.5

    (c) 1.25   (d) 1.0

Answer any *four* questions from the following.

2. (a) What is a fuzzy set? How it differs from a crisp set?   (4 + 6 + 2 + 3)

(b) Let $U = \{1, 2, 3, 4, 5, 6\}$, $A = \{(2, 0.5), (3, 0.7), (5, 1), (6, 0.8)\}$,
$B = \{(3, 0.9), (4, 1), (5, 0.8), (6, 0.6)\}$. Find (i) $A \cup B$ (ii) $A \cap B$ (iii) $\overline{A}$.

(c) Let $A = \{(9, 0.8), (7, 0.6), (4, 0.3), (2, 0.1)\}$ be a fuzzy set. Normalize the set A.

(d) Assume two universal sets $A = \{3,4,5,6\}$ and $B = \{3,4,5\}$. Let,

$$\mu_R(x, y) = \begin{cases} \dfrac{(x - y)}{(x + y + 2)} & \text{if } x > y \\ 0 & otherwise \end{cases}$$ be a otherwise be a membership function

where $x \in A$, $y \in B$. Fill up the following relational matrix R of A and B,

	3	4	5
3			
4			
5			
6			

3. (a) Let $A = \{(2, 0.1), (3, 0.4), (6, 0.5), (5, 0.52), (7, 0.63)\}$ (4 + 4 + 4 + 3)

   Calculate,

   (i) Dilation set of A

   (ii) Concentration set of A

(b) Mention four fuzzy membership functions.

(c) What is a α-cut and strong α-cut of a fuzzy set? Let $A = \{(x_1, 0), (x_2, 0.1), (x_3, 0.3), (x_4, 0.5), (x_5, 0.8), (x_6, 1)\}$. Find, (i) $^{0.3}A$ (ii) $^{0.3+}A$.

(d) What are linguistic variables and linguistic hedges?

4. (a) Find min-max composition $A \circ B$ for the following relations A and B respectively,   (7 + 8)

$$A = \begin{bmatrix} 0.3 & 0.5 & 0.8 \\ 0.0 & 0.7 & 1.0 \\ 0.4 & 0.6 & 0.5 \end{bmatrix}$$

$$B = \begin{bmatrix} 0.9 & 0.5 & 0.7 & 0.7 \\ 0.3 & 0.2 & 0.0 & 0.9 \\ 1.0 & 0.0 & 0.5 & 0.5 \end{bmatrix}$$

(b) What is fuzzy predicate, fuzzy modifiers, fuzzy quantifiers and fuzzy truth values? Explain with examples.

5. (a) Design a single layer neural network to classify a 3-bit input pattern as mentioned in set S into two classes A and B as follows   (6 + 5 + 4)

   $S = \{000, 001, 010, 011, 100, 101, 110, 111\}$

   $A = \{000, 001, 010, 100\}$

   $B = \{011, 101, 110, 111\}$

   Draw the network and design appropriate activation function.

(b) What are two kinds of inputs in a MCCULLOCH—PITTS neural model? Mention the salient features of a McCulloch and Pitts neural net.

(c) How will you represent the length of a vector x of size n? What is the Minkowski distance between two vectors x_i and y_i each of size n?

6. (a) What is an epoch and an iteration in a learning algorithm?   (2 + 4 + 3 + 6)

(b) For a neural network with three input and two output weights are given by $w_{11} = 0.3$, $w_{12} = 0.5$, $w_{21} = 0.7$, $w_{22} = 0.3$, $w_{31} = 008$, $w_{32} = 0.1$. It is given with input of [0.2, 0.7, 1.1]. What is the output of neural network if binary step function is used with a threshold value 1?

(c) What is *gradient* in the gradient descent learning algorithm? Why should an activation function used to train a back-propagation neural network be differentiable?

(d) Work out the detail steps to train a perceptron for AND function taking,

$$w_1 = 0.5$$
$$w_2 = 0.5$$
$$\theta = 0.6$$

7. (a) Explain the architecture of a multilayer layer feed-forward neural network with one hidden layer by a suitable diagram. Write appropriate data structures for input vector(input pattern), input and weight matrices for the hidden and output layer. Also show how the outputs are calculated in the hidden and output layer.

(6 + 4 + 5)

(b) Consider a fuzzy set as defined in the following table

x:	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$\mu(x)$:	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5

Find the crisp value for the fuzzy area formed by the above fuzzy function using COG method.

(c) Explain the various mutation methods applied on chromosomes to create new population in genetic algorithm.

8. (a) Explain the architecture and different layers of Adaptive Neuro-Fuzzy Inference system.

(6 + 5 + 4)

(b) Discuss different categories of genetic algorithms

(c) Compare RBFN with FFNN.

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