Roll No. .....

Total Pages : 05

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May 2024

B. Tech. (EIC) (Sixth Semester)

Soft Computing (OE-603)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) Compare artificial neuron to biological neuron. **1.5**

(b) Write the learning equation for Kohonen algorithm. **1.5**

(c) What is meant by local minima and global minima ? **1.5**

(d) Consider two fuzzy sets :

$A = [1/2 + 0.3/4 + 0.5/6 + 0.2/8]$,

$B = [0.5/2 + 0.4/6 + 0.1/6 + 1/8]$.

Perform Union, Intersection and Complement operation over fuzzy sets A and B. **1.5**

(e) What is reinforcement learning ? **1.5**

(f) How is fuzzy logic different from probability theory ? **1.5**

(g) Write multiplication and addition properties for fuzzy intervals. **1.5**

(h) Define Linguistic variables. Give some examples. **1.5**

(i) What are the activation fns. used in bi-directional associative memories ? **1.5**

(j) Define (i) Population (ii) Genome (iii) String. **1.5**

Part B

2. (a) Draw and explain the architecture of back error propagation network. List all the stages of learning in back error propagation. **10**

(b) Construct a Kohonen self-organising network with two cluster units and five input units. the weight vectors for the cluster units are given by W1 = [1.0 0.9 0.7 0.5 0.3], W2 = [0.3 0.5 0.7 0.9 1.0]. Use the Eucliedean distance to find the winning cluster unit. The input pattern :

x = [0.0 0.5 1.0 0.5 0.0].

Using a learning rate of 0.25,find the new weights for the winning unit. **5**

3. (a) Realize NAND and NOR gate using Mc Culloch-Pitts neuron model. **8**

(b) Apply the Fuzzy Modus Ponen rule to deduce Infection level, Given :

(i) If the temperature is "high", infection is "low"

(ii) The temperature is "very high".

The Universe of discourse for the temperature is X and infection level is Y, X ={1, 2, 3, 4), Y ={1, 2, 3}.

High (temperature) = {(2, 0.5) (3, 0.8) (4, 1)}, Low (infection) = {(1, 1) (2, 0.6) (3, 0.2)}. **7**

4. (a) Using Hebb's rule, find the weights required to perform the following classification :

The vectors (1 –1 1 –1) and (1 1 1 –1) belong to class (target value + 1), vectors (– 1 – 1 1 1) and (1 1 – 1 – 1) belong to class (target value – 1). Also using each of the training vectors as input, test the response of the net. **10**

(b) Define Perceptron learning rule. Mention the applications of Perceptron network. List its limitations. **5**

5. (a) For the two fuzzy sets :

A = [0.2/LS + 0.5/MS + 0.7/HS],

B = [0.1/P E + 0.55/ZE + 0.85/NE].

Find R = A X B, If C = [0.25/LS + 0.5/MS + 0.75/HS].

Find COD, COR using max-min composition and max-product composition. **8**

(b) Draw the architecture of Hopfield Network and explain its learning mechanism. **7**

6. (a) For the two triangular fuzzy numbers A and B, whose membership functions are respectively :

$$\mu_A(x) = \begin{cases} 2-x & \text{if } 1 \le x \le 2 \\ (x-2)/5 & \text{if } 7 \ge x \ge 2 \\ 0 & \text{otherwise} \end{cases}$$

$$\mu_B(x) = \begin{cases} x+1 & \text{if } -1 \le x \le 0 \\ \frac{3-x}{5} & \text{if } 3 \ge x \ge -2 \\ 0 & \text{otherwise} \end{cases}$$

Compute A + B and A – B.. **10**

(b) Perform the following operations on intervals :

$[5, 3] + [4, 2]$, $[6, 9] - [2, 4]$, $[1, 2] \times [5, 3]$, $[7, 3] + [3, 6]$, $[6, 5]^{-1}$. **5**

7. Write short notes on any *two* of the following : **15**

(a) Associative Memories

(b) Extension Principle and its applications

(c) 0–1 Knapsack problem using GA.