National Institute of Technology, Hamirpur (HP)-177005

MA-324/MA-743: Soft Computing

End-Term Examinations, 2022-23

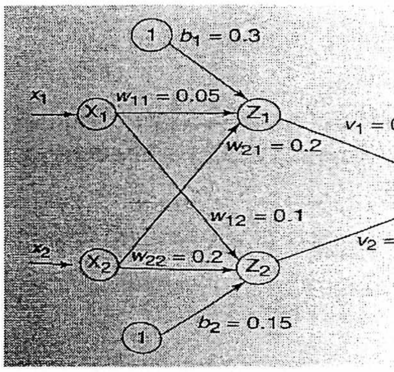
27/5/2023

Time: 3:00 hrs. Max. Marks: 50

Instructions:

- All questions are compulsory. The marks allotted to a question are indicated against it.

Q1. Using Madaline network (perform one epoch), implement XOR function with bipolar inputs and targets. Find the new weights for the net shown in the following figure,



Use a learning rate **α**=0.5 and the activation function $f(x)=\begin{cases}1, & x\geq 0\\ -1, & x<0\end{cases}$. [7]

Q2. Find the weight matrix required to store the vectors $x_1 = [1\ \ 1 -1 -1], x_2 = [-1\ \ 1\ \ 1 -1],\ x_3 = [-1\ \ 1 -1\ \ 1]$. Calculate the total weight matrix to store all the vectors and check whether it is capable to recognizing the same vectors the same vectors presented. Let the weight matrix be with no self-connection. [7]

Q3. (a) Show that the derivatives of unipolar and bipolar sigmoidal functions are $f'(x)=\lambda f(x)[1-f(x)]$ and $f'(x)=\frac{\lambda}{2}[1+f(x)][1-f(x)]$, respectively.

(b) State the training algorithm used for Hebb network. [4+2]

Q4. With a neat flowchart, explain the operation of a simple genetic algorithm and steady state genetic algorithm. [6]

Q5. Let us consider a TSP problem involving nine cities. Determine both children solutions of the following two parents:

Pr1: 1 2 3 4 5 6 7 8 9

Pr2: 9 3 1 4 5 8 2 6 7

Use edge recombination method. The edge information is given below,

City	Connectivity information/Links	City	Connectivity information/Links
1	2, 9, 3, 4	6	5, 7, 2
2	1, 3, 8, 6	7	6, 8, 9
3	2, 4, 9, 1	8	7, 9, 5, 2
4	3, 5, 1	9	8, 1, 7, 3
5	4, 6, 8		

Note: In case of tie for selection of cities, use **min (city1, city2)** [6]

Q6. Using Genetic Algorithm, maximize the function (for one generation) 44 [6]

$$f(x) = x^2$$

Where x is permitted to very between 0 and 31. Assume the population size as 4 and initial population is presented in the table. Also, for crossover operation, consider single point crossover at crossover point 2.

String No.	Initial population
1	01100
2	11001
3	00101
4	10011

Q7. (a) Define (I) Generalized Modus Ponens, and (II) Generalized Modus Tollens. [2+4]

(b) Define two fuzzy sets A and B such that

$$A = \frac{0.0}{-2} + \frac{0.5}{-1} + \frac{1.0}{0} + \frac{0.5}{1} + \frac{0.0}{2}$$

$$B = \frac{0.0}{0} + \frac{0.5}{1} + \frac{1.0}{2} + \frac{0.5}{3} + \frac{0.0}{4}$$

If we introduce a new antecedent

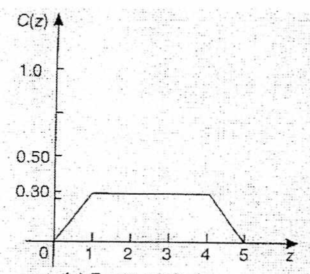
$$A' = \frac{0.0}{-1} + \frac{0.5}{0} + \frac{1.0}{1} + \frac{0.5}{2} + \frac{0.0}{3}$$

Then find the new consequent B' using Generalized Modus Ponens.

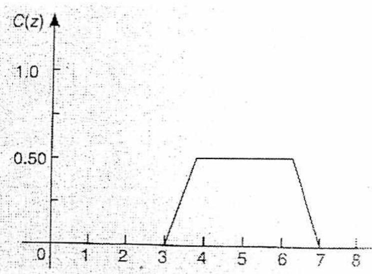
Q8. Define the following Defuzzification methods: [6]

(a) Maximum Membership Method (b) Centroid Method (c) Mean-Max Method.

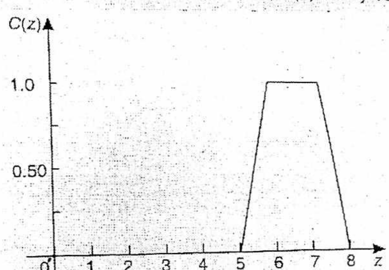
Also for the following three fuzzy sets (as shown in the figures), aggregate the given information and compute the defuzzified value using the each of the above defined methods.



(a) Fuzzy set B_1 for survey-1.



(b) Fuzzy set B_2 for survey-2.



(c) Fuzzy set B_3 for survey-3.

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