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ADDITIONAL CONTROLLER OF EXAMINATIONS CHENNAI

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2024

B.Tech INFORMATION TECHNOLOGY
VI Semester
IT5019 & Soft Computing
(Regulation 2019)

Time:3hrs

Max.Marks: 100

CO1	Identify and describe soft computing techniques and their roles in building intelligent machines.
CO2	Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO3	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO4	Apply genetic algorithms to optimization problems.
CO5	Design neural networks for pattern classification and regression problems.
CO6	Compare different neural network approaches

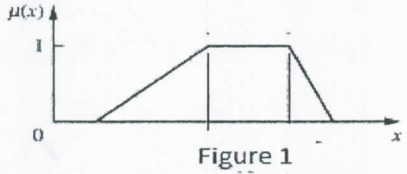
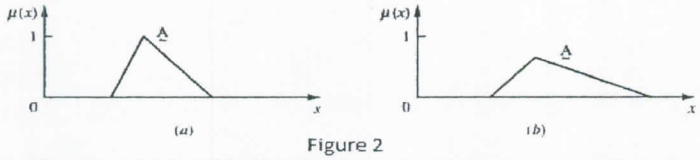
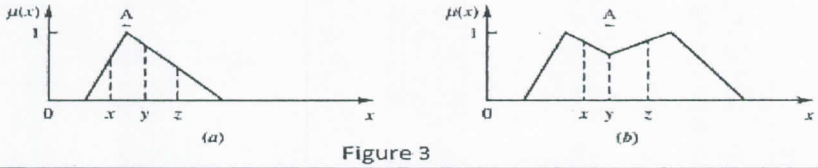
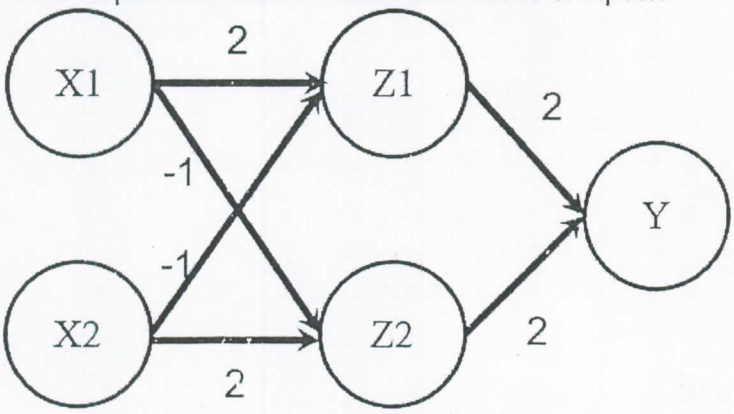
BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

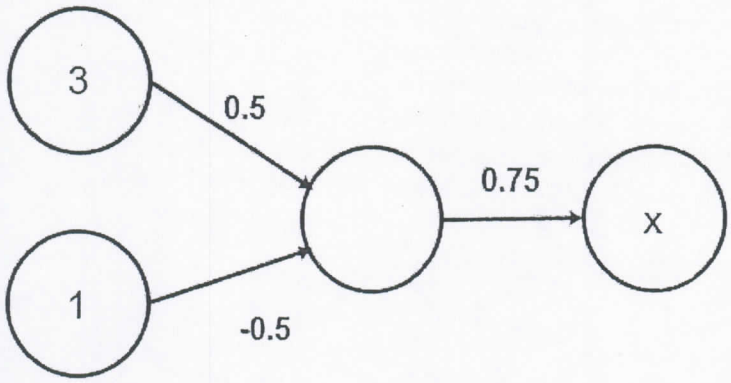
PART- A (10x2=20Marks)
(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	Differentiate hard and soft computing	2	CO1	L1
2	What is Fuzzy Associative Memory (FAM)? Give an example	2	CO3	L1
3	In what way a recurrent network differs from a feed forward network? Name any 2 recurrent networks	2	CO6	L2
4	Assume a neural network is trained initially with 5 features as input and explain the performance of the network if the number of features is increased to 10.	2	CO5	L2
5	What are the different types of activation function? Write the mathematical equation	2	CO6	L1
6	What is the advantage of back propagation of error in a neural network during training? Is the errors back propagated in a multilayer perceptron neural network?	2	CO5	L2
7	What are the conditions for stopping the neural network training?	2	CO5	L1
8	Differentiate supervised and unsupervised learning with examples	2	CO5	L1
9	What is meant by gene and chromosome? What is the advantage of starting with a population of solution in genetic algorithm?	2	CO4	L2
10	How is mutation and crossover children obtained? Obtain single point crossover children from the two parents: [1 1 0 1 1 1 1 0] and [0 0 0 1 1 0 0 0]	2	CO4	L3

PART- B (5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q. No.	Questions	Marks	CO	BL
11 (a) (i)	Explain the fuzzy logic process with complete steps starting from fuzzification of crisp input to defuzzification. What is the output of fuzzy logic process – crisp or fuzzy? Justify	8	C03	L1
(ii)	For the following Fuzzy membership functions	5	C03	L6

	a. Define and mark Core, Support, Boundaries in figure 1  Figure 1 L2 b. Define and identify the normal and subnormal fuzzy set in figure 2 (a) and (b)  Figure 2 c. Define and Identify the convex and nonconvex fuzzy set in figure 3 (a) and (b)  Figure 3			
OR				
11 (b) (i)	Explain the defuzzification methods used to find out the crisp output in fuzzy logic. Write the formulas used and the commonly preferred method for defuzzification with justification	8	C03	L1
(ii)	For designing an automatic AC controller for a room, assume the following 2 inputs are given namely the Room temperature in the range [24 ^{0}C – 40 ^{0}C] and fan speed in the range [400 rpm – 1450 rpm]. The output variable to be controlled is ac temperature from [16^{0}C -30^{0}C]. Fuzzify the crisp input values, choose appropriate membership functions, draw the membership functions for all the 3 quantities, form if-then rules and select a proper defuzzification method to determine the final controlled crisp AC output temperature	5	C03	L6
12 (a) (i)	Explain the biological neural network structure with a neat diagram. Will a biological neuron get activated for an excitatory input?	8	CO5	L2
(ii)	For the neural network shown in the Figure 4 choose a suitable Threshold value so that the activation function is designed and the network predicts the output properly for a two input XOR gate. Show the implementation for all the four cases of inputs.  Figure 4	5	CO5	L5
	OR			

12 (b) (i)	Explain McCulloh-Pitts Neuron model with neat architecture diagram. For a nonlinear separable data is the model suitable?	8	CO5	L2
(ii)	A hetero associative net is trained by Hebb outer product rule for input and output row vectors. Find the weight matrix. Input vector is given by S1=(1 1 0 0), S2= =(1 1 1 0), S3=(0 0 1 1), S4=(0 1 0 0). Output vector is given by t1 = (1 0), t2= (0 1), t3 =(1 0), t4= (1 0).	5	CO5	L5
13 (a) (i)	Explain multilayer perceptron algorithm with a neat diagram. Which activation function is commonly preferred for the hidden layer of multilayer perceptron? Analyze the performance for sigmoid and threshold activation functions	8	CO5	L4
(ii)	 Figure 5 Find the output of a 2 layer feed forward network shown in Figure 5 for sigmoid activation function assuming steepness factor as 1.	5	CO5	L5
	OR			
13 (b) (i)	Explain the back propagation neural network BPN architecture and algorithm. What are the factors associated with BPN training algorithm? Analyze the influence of bias in the network	8	CO5	L4
(ii)	For the feed forward network with the initial weight and bias values given in Figure 6 with a learning rate of 0.9 and sigmoid activation function, with a training tuple X=(1,0,1) and a class label of 1, find the updation in weight and bias after first round of error back propagation	5	CO5	L5

x1	x2	x3	w14	w15	w24	w25	w34	w35	w46	w56	θ4	θ5	θ6
1	0	1	0.2	-0.3	0.4	0.1	-0.5	0.2	-0.3	-0.2	-0.4	0.2	0.1

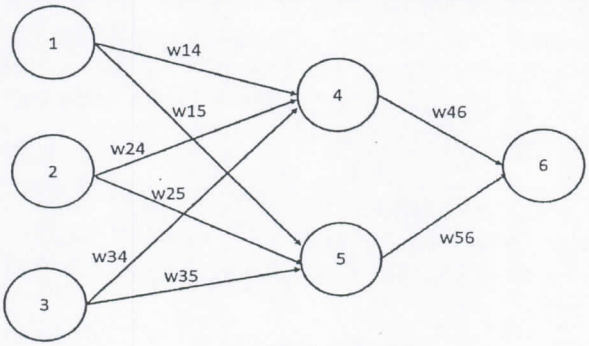
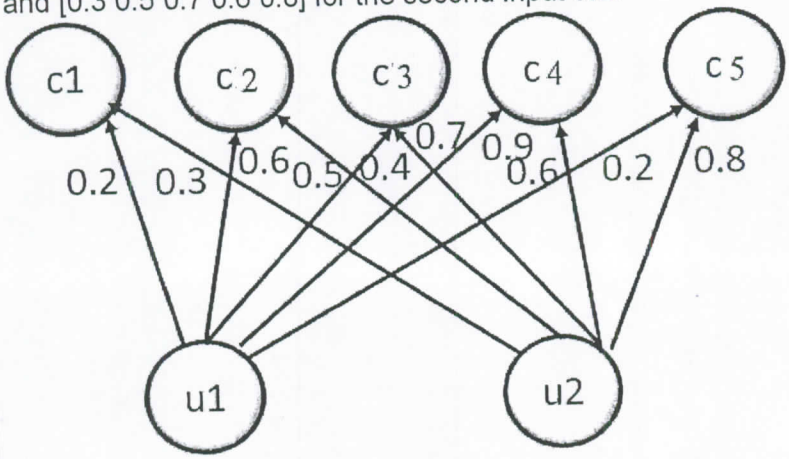


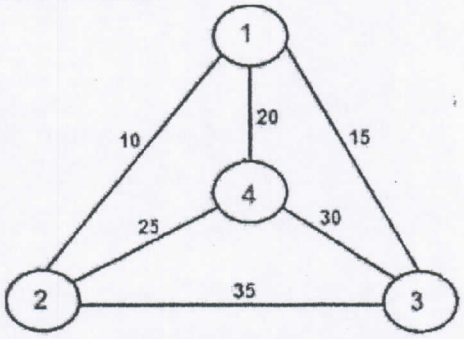
Figure 6

14 (a) (i)	In what way a SOM network differs from a multilayer perceptron? With neat diagram and algorithmic steps explain the architecture and the training process in Self Organizing Map	8	CO6	L3
(ii)	Construct and test LVQ with four vectors assigned to 2 classes. Assume learning rate=0.025 and continue iteration for 2 steps.	5	CO5	L5

	Initialize the reference vectors using the first 2 entries of the table 1 given below. Assume the last 2 vectors as training data Table 1 Vector | Class (1 0 10) | 1 (0 0 1 1) | 2 (1 1 0 0) | 1 (1 0 0 1) | 2			
	OR			
14 (b) (i)	Do you think Adaptive Resonance Theory ART1 network support learning of new inputs and support the plastic property? In what way it differs from a conventional neural network? Justify the answers with architecture and algorithm	8	CO6	L3
(ii)	For the Kohonen self organizing map shown in the Figure 7, find the cluster unit that wins the competition for the input vector (0.3,0.4). Assume neighbours as 2 and learning rate as 0.1. Initial weight matrix is given as [0.2 0.6 0.4 0.9 0.2] for the first input unit and [0.3 0.5 0.7 0.6 0.8] for the second input unit  Figure 7	5	CO5	L5
15 (a) (i)	Explain the execution steps in the process of genetic algorithm using a flow chart. How many mutation, crossover and elite children should be present in the consecutive generations? What is the criteria to select elite children in the population?	8	CO4	L3
(ii)	Assume a population size of 5, and accuracy as the objective function to be maximized for a neural network multiclass prediction. Create 3 elite, 1 mutation and 1 crossover children for the next generation assuming the initial population as [1 0 1 1 1 0; 0 1 1 0 0 1; 0 1 1 1 0 0; 1 1 1 1 0 0; 0 1 1 1 1 1]. Assume the accuracy of the initial population as [95; 87; 92; 90; 79].	5	CO4	L5
	OR			
15 (b) (i)	Explain in detail what is the necessity of mutation and crossover children in the population? How will you fix the maximum number of generations an algorithm should be run for getting an optimal solution?	8	CO4	L3
(ii)	Why genetic algorithm is termed as stochastic process? What will be the changes in the output of the algorithm when the genetic algorithm is run for several times? Explain with an example	5	CO4	L5

PART- C (1x 15=15Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16. (i)	Design any supervised neural network model to train neural net that uses the AND/OR/XOR two input binary/bipolar input and output data. Show the mathematical calculations of first iteration for all the 4 possible combinations of input. Justify soft computing method can be used for the design of logic gates	10	CO2	L3
(ii)	A travelling salesman has to travel to 4 different cities namely Chennai, Trichy, Madurai and Coimbatore. Given a list of cities and the distances between each pair of cities in the Figure 8 shown below, what is the shortest possible route that visits each city exactly once and returns to the origin city? Design a genetic algorithm based optimization problem for visiting all the 4 cities with a minimized travel distance.  Figure 8	5	CO4	L3