Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE MODEL EXAMINATION,NOVEMBER 2017

Course Code: CS 361

Course Name: SOFT COMPUTING (CS ELECTIVE)

Max. Marks:100 Duration: 3 Hours

PART A

(Answer ALL Questions)

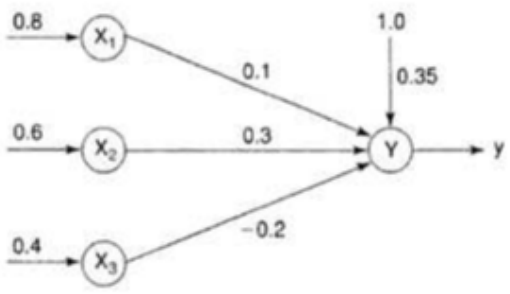
1. Differentiate between supervised and unsupervised learning? (3)
2. Describe the McCulloch-Pitts Neuron? Implement AND function using McCulloch-Pitts neuron (3)
3. Explain Learning algorithm used in ADALINE with flowchart (3)
4. Explain Perceptron Networks? Draw the diagram which represents various units of Perceptron Network (3)

PART B

(Answer Any Two Questions)

5. Describe basic models of Artificial Neural Networks specified by connections and activation functions (9)

6. a.) Obtain the output of the neuron Y for the network shown in figure using activation functions as
   i) Binary Sigmoidal (5)
   ii) Bipolar Sigmoidal



b.) Implement ANDNOT function using McCulloch-Pitts neuron(use binary data representation) (4)

7. a.) Explain the training algorithm used for single output classes Perceptron Network (5)

b.) Describe Back Propagation Networks? Draw the architecture of Back Propagation Networks (4)

PART C

(Answer ALL Questions)

8. What is meant by Fuzzy Set? Which are the operations on a fuzzy set (3)

9. What is meant by fuzzy Relations? Draw the bipartite and simple fuzzy graph of the following fuzzy relation X = {x1,x2,x3,x4} (3)

	X1	x2	x3	x4
X1	0.2	0	0.5	0
X2	0	0.3	0.7	0.8
X3	0.1	0	0.4	0
X4	0	0.6	0	1

10. Explain inference method used for membership value assignment? (3)

11. What is meant by Lambda-Cuts for Fuzzy Sets? (3)

PART D

(Answer Any Two Questions)

12. Design a computer software to perform image processing to locate objects within a scene. The two fuzzy sets representing a plane and a train image are (9)

$$plane = \left\{\frac{0.2}{train} + \frac{0.5}{bike} + \frac{0.3}{boat} + \frac{0.8}{plane} + \frac{0.1}{house}\right\}$$

$$train = \left\{\frac{1}{train} + \frac{0.2}{bike} + \frac{0.4}{boat} + \frac{0.5}{plane} + \frac{0.2}{house}\right\}$$

Find the union, intersection, complement and set difference?

13. a.) Which are the properties of a fuzzy set? (4)

    b.) Which are the operations that we can perform with a fuzzy relation? (5)

14. Explain different defuzzification methods? (9)

PART E

(Answer Any Four Questions)

15. a.) What is meant by fuzzy propositions? Which are the different fuzzy propositions?. (5)

    b.) Mention the general forms that exists for a linguistic variable? (5)

16. What is fuzzy Inference System? Explain different types of FIS. (10)

17. a.) Explain the characteristics of a Neuro Hybrid System? . (5)

    b.) Explain different classifications of a Neuro Hybrid System (5)

18. a.) Explain the various encoding techniques used in genetic algorithm? (5)

    b.) Explain various stopping conditions for genetic algorithm flow? (5)

19. What are the various types of cross over and mutation techniques? (10)

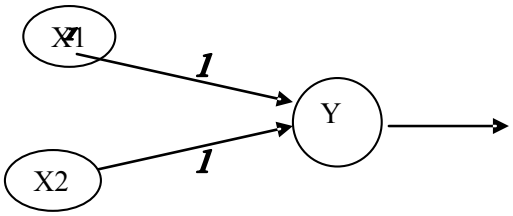
20. What is meant by Genetic-Fuzzy rule based system? Explain in detail (10)

Scheme of Evaluation (Prescribed Text : "Principles of Soft Computing-second edition",S.N.Sivanandam,S.N.Deepa)

1. Differentiate between supervised and unsupervised learning?
   (page no: 20-22)
   Supervised Learning - 1 mark
   Unsupervised Learning - 1 mark
   Difference - 1 mark
2. Describe the McCulloch-Pitts Neuron? Implement AND function using McCulloch-Pitts neuron
   (page no:27-28)
   Explanation with architecture and activation function - 1.5 marks
   Implementation of AND function - 1.5 marks

AND		
X1	X2	Y
1	1	1
1	0	0
0	1	0
0	0	0

For (1,1) y= x1w1+x2w2=1*1+1*1=2
(1,0) y= x1w1+x2w2=1*1+1*0=1
(0,1) y= x1w1+x2w2=1*0+1*1=1
(0,0) y= x1w1+x2w2=1*0+1*0=0



$$Y = \begin{cases} 1 & \text{if } y >= 2 \\ 0 & \text{if } y < 2 \end{cases}$$

3. ADALINE training algorithm with flow chart
   Training Algorithm (Page No : 58) – 1.5 marks
   Flow Chart (Page No : 59, figure 3.6) – 1.5 marks

4. Perceptron Networks

(Page No : 49-51)

Explanation with 3 units and activation function – 2 marks

1. Sensory Unit
2. Associator Unit
3. Response Unit

Diagram (figure 3.1) - 1 mark

PART B

5. Models of ANN

(page no : 17-20)

Models based on Connections with description and corresponding figures – 5 marks

1. SINGLE LAYER FEED FORWARD NETWORK
2. MULTILAYER FEED FORWARD NETWORK
3. SINGLE NODE WITH ITS OWN FEEDBACK
4. SINGLE LAYER RECURRENT NETWORK
5. MULTILAYER RECURRENT NETWORK

Models based on activation Functions with description (Page no: 22-24) – 4 marks

1. IDENTITY FUNCTION
2. BINARY STEP FUNCTION
3. BIPOLAR STEP FUNCTION
4. SIGMOIDAL FUNCTION
5. RAMP FUNCTION

6. a.) (page no : 34) Calculation of y – 2 marks

1. Binary Sigmoidal – 1.5 marks
2. Bipolar Sigmoidal – 1.5 marks

The inputs are given as $[x_1, x_2, x_3] = [0.8, 0.6, 0.4]$ and the weights are $[w_1, w_2, w_3] = [0.1, 0.3, -0.2]$ with bias $b = 0.35$ (its input is always 1).

The net input to the output neuron is

$$y_{in} = b + \sum_{i=1}^{n} x_i w_i \qquad [n = 3, \text{ because only 3 input neurons are given}]$$

$$= b + x_1 w_1 + x_2 w_2 + x_3 w_3$$

$$= 0.35 + 0.8 \times 0.1 + 0.6 \times 0.3 + 0.4 \times (-0.2)$$

$$= 0.35 + 0.08 + 0.18 - 0.08$$

$$y_{in} = 0.53$$

- For binary sigmoidal activation function,

$$y = f(y_{in}) = \frac{1}{1 + e^{-y_{in}}} = \frac{1}{1 + e^{-0.53}} = 0.625$$

- For bipolar sigmoidal activation function,

$$y = f(y_{in}) = \frac{2}{1 + e^{-y_{in}}} - 1 = \frac{2}{1 + e^{-0.53}} - 1 = 0.259$$

b.) (page no : 35)

Solution: In the case of ANDNOT function, the response is true if the first input is true and the second input is false. For all other input variations, the response is false. The truth table for ANDNOT function is given as

x_1	x_2	y
0	0	0
0	1	0
1	0	1
1	1	0

The given function gives an output only when $x_1 = 1$ and $x_2 = 0$.

The weights have to be decided only after the analysis. The net can be represented as shown in Figure 5.

Case 1: Assume that both weights w_1 and w_2 are excitatory, i.e.,

$$w_1 = w_2 = 1$$

Then for the four inputs calculate the net input using

$$y_{in} = x_1 w_1 + x_2 w_2$$

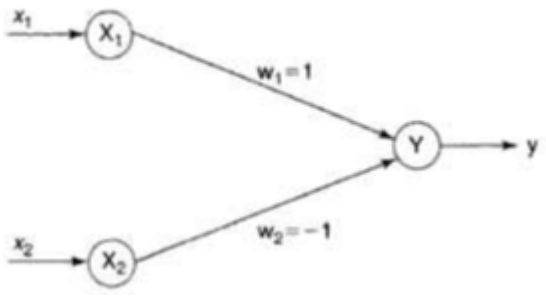
For inputs

$$\begin{aligned}
(1,1). \quad & y_{in} = 1 \times 1 + 1 \times 1 = 2 \\
(1,0). \quad & y_{in} = 1 \times 1 + 0 \times 1 = 1 \\
(0,1). \quad & y_{in} = 0 \times 1 + 1 \times 1 = 1 \\
(0,0). \quad & y_{in} = 0 \times 1 + 0 \times 1 = 0
\end{aligned}$$

From the calculated net inputs, it is not possible to fire the neuron for input (1,0) only. Hence, these weights are not suitable.

Assume one weight as excitatory and the other as inhibitory, i.e.,

$$w_1 = 1, \quad w_2 = -1$$



Truth table – 1 mark

Neural Net – 1 mark

Y calculation for each input pair – 1 mark

Output neuron y – 1 mark

7. a) Explain the training algorithm used for single output classes Perceptron Network

(page no: 54) Algorithm – 3 marks

(page no: 53, figure 3.3) Flow chart – 2 marks

b.) Describe Back Propagation Networks? Draw the architecture of Back Propagation Networks

(page no: 64-65)

Explanation – 2 marks

Architecture (figure 3.9) – 2 marks

8. What is meant by Fuzzy Set? Which are the operations on a fuzzy set

(page no: 260-262)

Explanation with representation(page no: 260) – 1 mark

Operations(page no: 261-262) - 3 marks

1. Union
2. Intersection
3. Complement

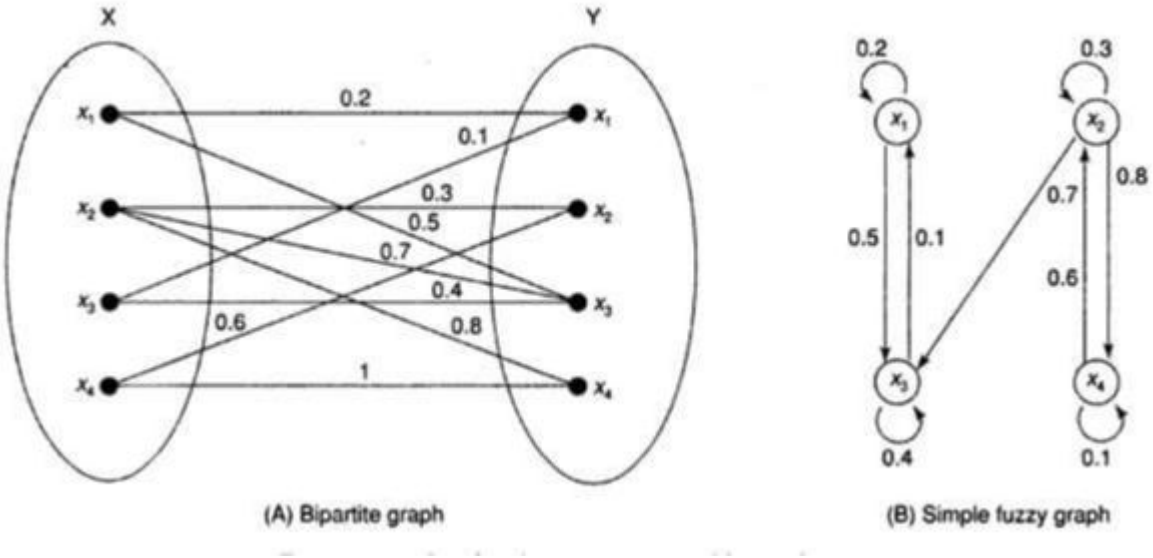
Each with its own graphical representations

9. Fuzzy Relations

Explanation(page no: 279) – 2 marks

Bipartite graph – 1 mark

Simple fuzzy Graph – 1 mark



(A) Bipartite graph

(B) Simple fuzzy graph

10. Explain inference method used for membership value assignment?

(page no : 299-301)

Membership value of 4 different shapes – total 4 marks

Isosceles triangle – 1 mark

Right angled triangle – 1 mark

Isosceles right angled triangle – 1 mark

Other triangles – 1 mark

11. What is meant by Lambda-Cuts for Fuzzy Sets?

(page no : 311-313)

Definition : 1 mark

Strong and weak lambda cut : 1 mark

Features with graphical representation : 1 mark

Properties : 1 mark

PART D

12.

(a) $\text{Plane} \cup \text{Train}$

$$= \max\{\mu_{\text{Plane}}(x), \mu_{\text{Train}}(x)\}$$

$$= \left\{ \frac{1.0}{\text{train}} + \frac{0.5}{\text{bike}} + \frac{0.4}{\text{boat}} + \frac{0.8}{\text{plane}} + \frac{0.2}{\text{house}} \right\}$$

(b) $\text{Plane} \cap \text{Train}$

$$= \min\{\mu_{\text{Plane}}(x), \mu_{\text{Train}}(x)\}$$

$$= \left\{ \frac{0.2}{\text{train}} + \frac{0.2}{\text{bike}} + \frac{0.3}{\text{boat}} + \frac{0.5}{\text{plane}} + \frac{0.1}{\text{house}} \right\}$$

(c) $\overline{\text{Plane}} = 1 - \mu_{\text{Plane}}(x)$

$$= \left\{ \frac{0.8}{\text{train}} + \frac{0.5}{\text{bike}} + \frac{0.7}{\text{boat}} + \frac{0.2}{\text{plane}} + \frac{0.9}{\text{house}} \right\}$$

(d) $\overline{\text{Train}} = 1 - \mu_{\text{Train}}(x)$

$$= \left\{ \frac{0}{\text{train}} + \frac{0.8}{\text{bike}} + \frac{0.6}{\text{boat}} + \frac{0.5}{\text{plane}} + \frac{0.8}{\text{house}} \right\}$$

(e) $\text{Plane} | \text{Train}$

$$= \text{Plane} \cap \overline{\text{Train}}$$

$$= \min\{\mu_{\text{Plane}}(x), \mu_{\overline{\text{Train}}}(x)\}$$

$$= \left\{ \frac{0}{\text{train}} + \frac{0.5}{\text{bike}} + \frac{0.3}{\text{boat}} + \frac{0.5}{\text{plane}} + \frac{0.1}{\text{house}} \right\}$$

Union – 2 marks

Intersection – 2 marks

Complement – 2 marks

Difference – 3 marks

13.a.) Which are the properties of a fuzzy set?

(page no: 263)

8 properties – 0.5 mark for each property (total 4 marks)

1. Commutativity

2. Associativity

3. Distributivity

4. Idemptency

5. Identity

6. Involution

7. Transitivity

8. De Morgan's law

b.) Which are the operations that we can perform with a fuzzy relation?

(page no: 261) operations on fuzzy relation – 5 marks

1. Union

2. Intersection

3. Complement

4. Containment

5. Inverse

6. Projection

14. Explain different defuzzification methods?

(page no: 313-319)

7 methods – 5 marks

Figures of each – 4 marks

1. Max-membership Principle

2. Centroid Method

3. Weighted Average Method

4. Mean- max membership

5. center of sums

6. Center of largest area

7. First of maxima,last of maxima

15. a.) What is meant by fuzzy propositions? Which are the different fuzzy propositions?

(page no: 348-349)

Definition – 1 mark

Fuzzy propositions – 4 marks

1. Fuzzy Predicates
2. Fuzzy Predicate Modifiers
3. Fuzzy Quantifiers
4. Fuzzy Qualifiers

b.) Mention the general forms that exists for a linguistic variable?

(page no: 349-350)

IF-THEN rule based form – 1 mark

3 general forms with examples

1. Assignment statements – 1.5 marks
2. Conditional Statements – 1.5 marks
3. Unconditional Statements – 1 marks

16. What is fuzzy Inference System? Explain different types of FIS

(page no: 355-359)

Construction and working principle – 2 marks

Methods of FIS

1.) Mamdani FIS

Algorithm with explanation – 1 mark

Block Diagram(figure 12.1) – 1.5 marks

Mamdani FIS with a fuzzy input graph – 1.5 marks

2.)Takagi-Sugeno Fuzzzy Model

Explanation – 2 marks

Sugeno Rule Diagram(figure 12.3) – 2 marks

17.a.) Explain the characteristics of a Neuro Hybrid System?

(page no: 466-468)

Explanation – 2 marks

Characteristics with figure(figure 16.1) – 2 marks

b.) Explain different classifications of a Neuro Hybrid System

(page no: 468-470)

1. Cooperative Neural Fuzzy System – 2.5 marks
2. General Neuro-Fuzzy Hybrid Systems – 2.5 marks

18. a.) Explain the various encoding techniques used in genetic algorithm?

(page no: 405-407)

1. Binary Encoding – 1 mark
2. Octal Encoding – 1 mark
3. Hexadecimal Encoding – 0.5 mark
4. Permutation Encoding – 1 mark
5. Value Encoding – 1 mark
6. Tree Encoding – 0.5 mark

b.) Explain various stopping conditions for genetic algorithm flow?

(page no : 416-417)

5 conditions – 4 marks

1. Maximum generation
2. Elapsed Time
3. No change in fitness
4. Stall Generation
5. Stall time limit

19. What are the various types of cross over and mutation techniques?

(page no: 411-415)

10 cross over techniques with example : 6 marks

(page no: 415-416)

3 mutation techniques : 4 marks

20. What is meant by Genetic-Fuzzy rule based system? Expalin in detail

(page no: 480-483)

Block Diagram – 3 marks

Explanation of GFRBS – 2 marks

Genetic tuning process with diagram – 2 marks

Genetic learning of rule bases – 2 marks

Genetic Learning of Knowledge base – 1 mark

END