



- Notes :
1. Assume suitable data wherever necessary.
  2. Illustrate your answer necessary with the help of neat sketches.
  3. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) What is a fuzzy set & how it differs from Crisp set? Explain why the law of contradiction & the law of exclusive middle are violated in fuzzy set theory? 7
- b) What is defuzzification? Explain any five methods of defuzzification with suitable example each. 7

**OR**

2. a) Explain the following fuzzy relations. 6

i) Equivalence relation. ii) Tolerance relation.

- b) Let X be the universe of military air craft of interest as defined here. 8

$$X = \{ a_{10}, b_{52}, b_{117}, c_5, c_{130}, f_4, f_{14}, f_{15}, f_{16}, f_{17}, f_{111} \}.$$

Let  $\tilde{A}$  be the set of bomber class aircraft.

$$\tilde{A} = \left[ \frac{0.2}{f_{16}} + \frac{0.4}{f_4} + \frac{0.5}{a_{10}} + \frac{0.5}{f_{14}} + \frac{0.6}{f_{15}} + \frac{0.8}{f_{111}} + \frac{1.0}{b_{117}} + \frac{1.0}{b_{52}} \right].$$

Let  $\tilde{B}$  be the set of fighter class aircraft.

$$\tilde{B} = \{ (b_{11}, 0.1), (f_{111}, 0.3), (f_4, 0.5), (f_{15}, 0.8), (f_{14}, 0.9), (f_{16}, 1.0) \}.$$

Find the following.

- |                               |                               |
|-------------------------------|-------------------------------|
| a) $\tilde{A} \cup \tilde{B}$ | b) $\tilde{A} \cap \tilde{B}$ |
| c) $\tilde{A} / \tilde{B}$    | d) $\tilde{B} / \tilde{A}$    |
| e) $\text{CON}(\tilde{A})$    | f) $\text{DIL}(\tilde{B})$    |

3. a) Discuss the formation of fuzzy rules by following techniques. 6

i) Relational inference. ii) Compositional inference.

- b) In satellite image processing, the images captured are in black & white. Defined on the universe of Grey scale are two fuzzy sets 'Black' & 'White'. The membership functions of this two Colours are given on a normalized universe of discourse  $[0, 255]$  with 0 7

indicating 'absolute white' and 255 indicating 'Absolute black'.

$$\text{White} = \{ (0, 1), (4, 0.9), (8, 0.8), (16, 0.7), (32, 0.6), (64, 0.5), (128, 0.25), (255, 0) \}.$$

$$\text{Black} = \{ (0, 0), (4, 0.25), (8, 0.3), (16, 0.4), (32, 0.5), (64, 0.7), (128, 0.9), (255, 1) \}.$$

Calculate the membership function for the linguistic Predicates.

- i) Not very black.
- ii) Very black and Not very white.

OR

4. a) What is a fuzzy vector? Prove that for different fuzzy vector, if they are identical, the Outer product reaches maximum and inner product reaches maximum. Assume suitable vectors if required. 6
- b) Discuss graphical inference technique with suitable example. List the advantages of this technique over other inference techniques. 7
5. a) Draw and explain block schematic of pattern recognition system. 6
- b) Summarize in point form the design steps of a fuzzy logic controller. Also give the block schematic of a Generalize fuzzy logic controller. 7

OR

6. Design a fuzzy logic control of Blood pressure during Anesthesia. Develop Rule base for input and output. Assume suitable input and output variables. 13
7. a) The network shown in fig 7@, when property trained should respond with  $\begin{bmatrix} 01 \\ 02 \end{bmatrix} = \begin{bmatrix} 0.9 \\ -0.9 \end{bmatrix}$  8
- to the augmented input pattern  $\begin{bmatrix} z_1 \\ z_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 4 \end{bmatrix}$ .
- The network has been initialized as shown in fig 7@. Determine weights after one iteration. Given  $\eta = 0.9$  & all neuron operates with continuous activation function.

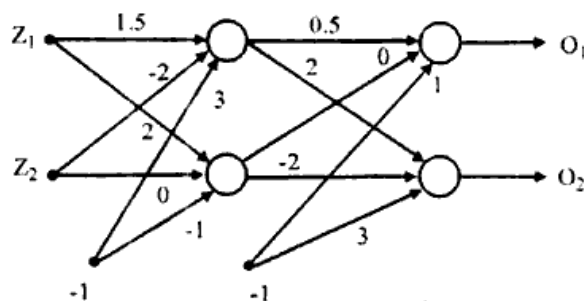


Fig. 7 (a)

- b) With a neat sketch, explain main parts of a biological neuron. Compare it with ANN. 6

OR

8. a) State & prove perceptron convergence theorem. 10
- b) Explain terminating criterion for EBPTA. 4
9. a) Write steps involved in SOFM algorithm. 7
- b) State and explain. 6
- i) Winner take all learning rule.
- ii) Outstar learning rule.

OR

10. The following vectors need to be stored in recurrent auto associative memory. 13

$$s_1 = [1 \ 1 \ 1 \ 1 \ 1]^t$$

$$s_2 = [1 \ -1 \ -1 \ 1 \ -1]^t$$

$$s_3 = [-1 \ 1 \ 1 \ 1 \ 1]^t.$$

i) Compute the weight matrix W.

ii) Apply the input vector.

$$V^o = [1 \ -1 \ -1 \ 1 \ 1]^t.$$

and allow for asynchronous convergence in ascending, node order starting at node 1.

iii) Compute energy associated with  $V^o$ .

11. a) Design a multilayer neural network for printed digit (0 to 9) recognition represented by a 7x5 pixel image. 8

- b) Differentiate between error back propagation training algorithm (EBPTA) & support vector learning algorithm. 5

OR

12. a) Design a robot manipulator using feedforward network. 6

- b) Explain genetic algorithm using suitable example. 7

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