CT7052 / CT705 - Elective-II : Neural Network & Fuzzy Logic

P. Pages : 3 **GUG/W/18/1866**

Time : Three Hours

|| *1 4 5 4 * ||

Max. Marks : 80

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Notes : 1. All questions carry equal marks.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Draw a neat diagram of a biological neuron and explain different functional terms as referred to neural network. **8**

b) Give McCulloch-Pitts neuron model and explain the construction of memory cell using this model. **8**

OR

2. a) Use perceptron learning rule of the network with $f(net) = sgn(net), c = 1$ and following data set, to find final weight vector **8**

$$w' = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \left(X_1 = \begin{bmatrix} 2 \\ 1 \\ -1 \end{bmatrix}, d_1 = -1 \right)$$

$$\left(X_2 = \begin{bmatrix} 0 \\ -1 \\ -1 \end{bmatrix}, d_2 = 1 \right)$$

b) Describe Widrow-Hoff and correlation learning rule. **8**

3. a) Explain single Discrete perceptron training algorithm. **8**

b) Design a minimum distance classifier for the given prototype pointers. **8**

$$X_1 = \begin{bmatrix} 10 \\ 2 \\ -5 \end{bmatrix} \qquad X_2 = \begin{bmatrix} -20 \\ 10 \\ 8 \end{bmatrix} \qquad X_3 = \begin{bmatrix} -10 \\ -8 \\ -2 \end{bmatrix}$$

OR

4. a) Explain minimum distance classification for two classes. **8**

b) Implement the single discrete perceptron training algorithm for C=1 for the discrete perceptron dichotomizer, which provides the following classification of six patterns. **8**

$X = [0.8 \ 0.5 \ 0]^t$, $[0.9 \ 0.7 \ 0.3]^t$, $[1 \ 0.8 \ 0.5]^t$ for class 1

$X = [0 \ 0.2 \ 0.3]^t$, $[0.2 \ 0.1 \ 0.3]^t$, $[0.2 \ 0.7 \ 0.8]^t$ for class 2

Perform the training task starting from initial weight vector $w = 0$ and obtain the solution weight vector.

5. a) Design a simple layered classifier that is able to classify four linearly nonseparable patterns. The classifier is required to implement the XOR function as defined for two variables. The decision function to be implemented by the classifier as **10**

x_1	x_2	Output
0	0	1
0	1	- 1
1	0	-1
1	1	1

b) What is mean by linearly non-separable patterns? Explain how multilayer n/w is used for classification of linearly non-separable patterns. **6**

OR

6. a) How to choose the number of hidden layers and nodes in a feedforward neural networks? **8**

b) How two-stage transformation input-output mapping can also be achieved through an artificially augmented single-layer network. **8**

7. a) Consider a fuzzy set $\tilde{A}$ and $\tilde{B}$ define over universe of discourse (universal set) X = [0 5] of real numbers. **8**

$$\mu_{\tilde{A}}(x) = \frac{x}{x+1} \quad \mu_{\tilde{B}}(x) = 2^{-x}$$

Determine $\tilde{A}^C$, $\tilde{B}^C$, $\tilde{A} \cap \tilde{B}$, $\tilde{A} \cup \tilde{B}$ graphically & mathematically.

b) Prove that **8**

i) $\tilde{A} \cup \tilde{A}^C \neq X$

ii) $\tilde{A} \cap \tilde{A}^C \neq \phi$

Where

$\tilde{A} \rightarrow$ fuzzy set

$X \rightarrow$ universal set

$\phi \rightarrow$ null set

OR

8. a) Consider fuzzy set **8**

$$\tilde{A} = \left\{ \frac{0.2}{1} + \frac{0.3}{2} + \frac{0.4}{3} + \frac{0.5}{6} + \frac{0.7}{7} + \frac{0.8}{8} + \frac{0.9}{8} \right\}$$

Find out

i) Scalar cardinality

ii) Fuzzy cardinality

iii) 0.5 cut set of $\tilde{A}$

iv) Complement of $\tilde{A}$.

b) Write short note on fuzzy extension principle . **8**

Fuzzy set $\tilde{A}$ be defined on the universal U = {1, 2, 3}. Map elements of this fuzzy set to another universe v, under the function

$v = f(u) = 2u - 1$

The fuzzy set $\tilde{A}$ is given

$\tilde{A} = \left\{ \dfrac{0.6}{1} + \dfrac{1}{2} + \dfrac{0.8}{3} \right\}$

Find $f(\tilde{A})$ using extension principle.

9. a) Let A, B be two fuzzy numbers whose membership function are given by **8**

$A(x) = \begin{cases} (x+2)/3 & ; \text{ for } -2 < x \le 1 \\ (4-x)/3 & ; \text{ for } 1 < x \le 4 \\ 0 & ; \text{ otherwise} \end{cases}$

$B(x) = \begin{cases} x-1 & ; \text{ for } 1 < x \le 2 \\ 3-x & ; \text{ for } 2 < x \le 3 \\ 0 & ; \text{ otherwise} \end{cases}$

Calculate
i) MIN (A, B)
ii) MAX (A, B)
iii) A + B
iv) A – B.

b) Write short notes on **8**
i) Fuzzy Equations.
ii) Arithmetic operation on Intervals.

OR

10. a) Explain t-conorm and show that u(a, b) = max (a, b) is a t-conorm. **8**

b) What do you mean by 'Linguistic variable' with suitable example. **8**

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