B.E. Instrumentation Engineering (Model Curriculum) Semester-VII

IN703M - Artificial Intelligence in Instrumentation

P. Pages : 3 **GUG/W/24/14258**

Time : Three Hours * 5 7 4 3 * Max. Marks : 80

Notes : 1. All questions carry as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Diagrams and Chemical equation should be given wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Fuzzy sets A = {0.6/1 + 0.5/2 + 0.2/3 + 0.6/4} and B = {0.9/1 + 0.5/2 + 0.3/3 + 0.1/4} Calculate the following set Theoretic operations on Fuzzy sets. **8**

A. $\bar{A} \cup B$

B. $A \cap \bar{B}$

C. $A \mid \bar{B}$

D. $B \mid \bar{A}$

b) List out the different industrial applications of fuzzy logic based system. Discuss any one application in detail. **8**

OR

2. a) Define membership function. Discuss following MFs in detail. **8**

i) Trapezoidal MF ii) Gaussian MF

iii) Generalized bell-shaped MF iv) Sigmoidal MF

b) Define fuzzy logic. Discuss the potential advantages of fuzzy logic based systems over classical approach. **8**

3. a) Find the intersection of fuzzy sets A and B for the universe of discourse X = {1, 2, 3, 4} using T-norm operators. **8**

A = 0.7/1 + 0.5/2 + 0.1/3 + 0.6/4

B = 0.8/2 + 0.3/3

b) Two fuzzy relations $R_1(x, y)$ and $R_2(y, z)$ are defined on the space X * Y and Y * Z respectively defined as below: **8**

$$R_1(x, y) = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \end{array} \begin{array}{c} \begin{array}{cccc} y_1 & y_2 & y_3 & y_4 \end{array} \\ \begin{bmatrix} 0.7 & 0.6 & 0.3 & 0.4 \\ 0.9 & 0.4 & 0.2 & 0.7 \\ 0.1 & 0.9 & 0.5 & 0.6 \end{bmatrix} \end{array}$$

$$R_2(y, z) = \begin{array}{c} \\ y_1 \\ y_2 \\ y_3 \\ y_4 \end{array} \begin{array}{c} \begin{array}{cc} z_1 & z_2 \end{array} \\ \begin{bmatrix} 0.6 & 0.7 \\ 0.9 & 0.3 \\ 0.4 & 0.8 \\ 0.2 & 0.5 \end{bmatrix} \end{array}$$

Find the Max-product composition of R_1 and R_2.

OR

4. a) Define linguistic variable with help of example. If a linguistic variable "Bright" on the universe of discourse X = {1, 2, 3, 4, 5} is defined as **8**
Bright = {1.0/1 + 0.8/2 + 0.6/3 + 0.4/4 + 0.2/5}
Find the following:
i) Very Bright ii) Very Very Bright
iii) More or Less Bright

b) Two fuzzy sets A and B with universe of discourse X and Y, respectively defined as **8**
$A = 0.2/x_1 + 0.4/x_2 + 0.5/x_3$
$B = 0.5/y_1 + 0.1/y_2 + 0.7/y_3$
Find the following:
i) Fuzzy relation R between A & B ii) Projection of fuzzy relation R on A
iii) Projection of fuzzy relation R on B
iv) Cylindrical extension of R_B in the direction of fuzzy set A i.e. $C(R_B)$

5. a) Define activation function. Discuss different types of activation functions. **8**

b) Draw and discuss the architecture of feedback neural network. **8**

OR

6. a) Draw and discuss the following models of neurons: **6**
i) Hard-limiting neuron ii) Soft-limiting neuron

b) Compute the new updated weights for the network shown in figure 3 using Hebbian learning rule with the initial weight vector. **10**

$W^1 = \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0.5 \end{bmatrix}$. The network needs to be trained using the set of three input vectors as below.

$x_1 = \begin{bmatrix} 1 \\ -2 \\ 1.5 \\ 0 \end{bmatrix}$, $x_2 = \begin{bmatrix} 1 \\ -0.5 \\ -2 \\ -1.5 \end{bmatrix}$, $x_3 = \begin{bmatrix} 0 \\ 1 \\ -1 \\ 1.5 \end{bmatrix}$ With learning constant c = 1.

Assume that bipolar binary neurons are used and thus f(net) = sgn(net).

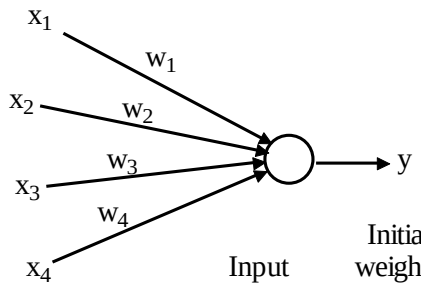

Figure 1

Input Initial weights

$x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$, $w^1 = \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0.5 \end{bmatrix}$

7.	a)	Design and demonstrate a perceptron for performing "OR" function. Also state the limitations single layer perceptron.	**10**
	b)	Define perceptron. Illustrate the basic concept of pattern classifier with block diagram.	**6**

OR

8.		Discuss the feed forward neural network with two continuous perceptron layers with respect to following pointes: i) Architecture of two layer feed forward neural network. ii) Illustrate error back propagation training algorithm using flowchart.	**16**
9.	a)	Discuss the types of machine learning with suitable example.	**8**
	b)	Discuss the concepts of deep learning with suitable example.	**8**

OR

10.	a)	Discuss with an example the principle of reinforcement learning with respect to machine learning.	**8**
	b)	Discuss with an example the principle of supervised learning with respect to machine learning.	**8**

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