School of Information Technology

Indian Institute of Technology Kharagpur

IT60108: Soft Computing Applications

Spring Mid-Semester Examination

F.M. 60   Session $2014 - 2015$ Time: 2 hrs

Answer ALL Questions

- *All answers to a question MUST be placed together.*
- *Clearly state reasonable assumptions, if any, while you are giving answers.*

Q. 1

(a) μ_A(x) and μ_B(x) are the membership functions of the fuzzy sets A and B, respectively.

$\mu_A(x) = e^{\frac{1}{1+x}}$

$\mu_B(x) = \frac{1}{1+(\frac{x-50}{10})^4}$

Decide whether A and B are closed or open.

[2+2]

(b) Given two fuzzy sets A and B defined over universe of discourses X and Y, respectively.
$A = \{(20, 0.2), (25, 0.4), (30, 0.6), (35, 0.6), (40, 0.7), (45, 0.8), (50, 0.8)\}$
$B = \{(1, 0.8), (2, 0.8), (3, 0.6), (4, 0.4)\}$

$$X = \{10, 15, 20, 25, 30, 35, 40, 45, 50, 55\}$$
$$Y = \{0, 1, 2, 3, 4, 5\}$$

Draw the graphs for the following.

  i. $A \times B$

 ii. $A \Longrightarrow B$

[4+4]

Q. 2

(a) Suppose, a fuzzy relation is 'If x is A then y is B'. How to find the following:

  i. x is C, given that y is D
 ii. y is D, given that x is C

[3+3]

(b) Two fuzzy sets P and Q are defined on $x \in$ X as follows.

	x_1	x_2	x_3	x_4	x_5
P	0.1	0.2	0.7	0.5	0.4
Q	0.9	0.6	0.3	0.2	0.8

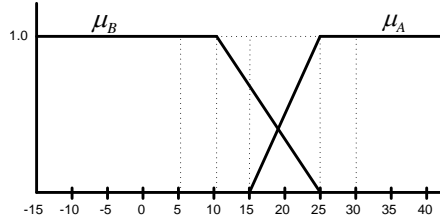Find (i.) $(P \cap \overline{Q})_{0.4}$ (ii.) $(P \times Q)_{0.4}$

[3+3]

Q. 3

(a) The membership functions of two fuzzy sets A and B are shown in the following graph.

A: climate is Hot.
B: climate is Cold.

i. Draw the graph of the membership function, which represents the fuzzy set C: *climate is Extreme*.

ii. What would be the graph of the membership function μ_D of the fuzzy set $D = \overline{(A \cap C)}$? State D in terms of fuzzy linguistic. **[3 + 3]**

(b) Two fuzzy relations 'likes' and 'earns' are defined below.

$$\text{likes} = \begin{array}{c} \\ Dhoni \\ Virat \\ Rohit \\ Sekhar \end{array} \begin{array}{ccc} Football & Hockey & Cricket \\ \left[\begin{array}{ccc} 0.1 & 0.3 & 0.8 \\ 0.2 & 0.7 & 0.5 \\ 0.5 & 0.4 & 0.2 \\ 0.4 & 0.5 & 0.6 \end{array}\right] \end{array}$$

For example, x likes Game.

$$\text{earns} = \begin{array}{c} \\ Dhoni \\ Virat \\ Rohit \\ Sekhar \end{array} \begin{array}{ccc} 10L & 50L & 100L \\ \left[\begin{array}{ccc} 0.6 & 0.3 & 0.2 \\ 0.4 & 0.7 & 0.8 \\ 0.1 & 0.3 & 0.2 \\ 0.5 & 0.2 & 0.6 \end{array}\right] \end{array}$$

For example, x earns Money.

Obtain the relation between a game to a money? **[6]**

3

Q. 4

(a) What are the components you should consider in order to mathematically model an artificial neuron ?

[4]

(b) If $\phi(I) = \frac{1}{1+e^{-\alpha I}}$ is a transfer function in a perceptron, then show that

$$\frac{\partial \phi(I)}{\partial I} = \alpha(1 - \phi(I)).\phi(I)$$

[3]

(c) Draw a schematic diagram of a multi-layer feed-forward artificial neural network architecture and clearly label the different elements in it.

Give one application, where you should apply such an ANN architecture.

[4+1]

Q. 5

(a) Show how the computations in input, hidden and output layers of an ANN can be accomplished in terms of matrix algebra.

[2+2+2]

(b) Explain the basic principle of calculating error in supervised learning.

[2]

(c) Derive the 'delta rule' according to the method of *Steepest descent.* [2+2]