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2002 SCHEME EE752

Seventh Semester B.E. Degree Examination, June-July 2009
Fuzzy Logic Control

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Explain the following with example:
i) Normal fuzzy set
ii) Convex fuzzy set
iii) α- cut
iv) Level set. **(10 Marks)**

b. Let $X = \{x_1, x_2\}$; $Y = \{y_1, y_2\}$; $Z = \{z_1, z_2, z_3\}$ and if R represents the relation between X & Y and S represents the relation between Y and Z which are given as

$$R = \begin{matrix} \\ x_1 \\ x_2 \end{matrix}\begin{matrix} \begin{matrix} y_1 & y_2 \end{matrix} \\ \begin{bmatrix} 0.7 & 0.5 \\ 0.8 & 0.4 \end{bmatrix} \end{matrix} \qquad S = \begin{matrix} \\ y_1 \\ y_2 \end{matrix}\begin{matrix} \begin{matrix} z_1 & z_2 & z_3 \end{matrix} \\ \begin{bmatrix} 0.9 & 0.6 & 0.2 \\ 0.1 & 0.7 & 0.5 \end{bmatrix} \end{matrix}$$

Find out T = R o S by max – min method and max-dot method. **(10 Marks)**

2 a. Write a short note on fuzzy equivalence and tolerance relations. **(06 Marks)**

b. Let X = {a,b,c} & Y = {1,2,3} and A be the fuzzy relation between X and Y and is given by

$$A = \left\{\frac{1}{(a,1)} + \frac{0.6}{(a,2)} + \frac{0.4}{(a,3)} + \frac{0.5}{(b,1)} + \frac{0.8}{(b,2)} + \frac{0.2}{(b,3)} + \frac{0.4}{(c,1)} + \frac{0.1}{(c,2)} + \frac{0.3}{(c,3)}\right\}$$

Find the projection of A on X and projection of A on Y. **(08 Marks)**

c. Given two fuzzy sets $\underset{\sim}{A} = \left\{\frac{1}{1} + \frac{0.5}{2} + \frac{0.65}{3} + \frac{0.85}{4} + \frac{1}{5}\right\}$ $\underset{\sim}{B} = \left\{\frac{0.2}{1} + \frac{0.5}{2} + \frac{0.9}{3} + \frac{0.5}{4}\right\}$

Find (i) $\underset{\sim}{A} \cup \underset{\sim}{B}$ (ii) $\overline{\underset{\sim}{A}} \cup \underset{\sim}{B}$ (iii) $A \cup \overline{B}$ (iv) $A \cap \overline{B}$ **(06 Marks)**

3 a. Let U = {1, 2, 3, 4} and V = {1, 2}. Define a fuzzy set A and U by : (A → 'x is small')

$A = \frac{1}{1} + \frac{0.7}{2} + \frac{0.3}{3} + \frac{0.05}{4}$ Define a relation R between U and V by : (R → 'x is close to y')

$R = \frac{1}{(1,1)} + \frac{1}{(2,2)} + \frac{0.8}{(1,2)} + \frac{0.8}{(2,1)} + \frac{0.8}{(3,2)} + \frac{0.5}{(3,1)} + \frac{0.5}{(4,2)} + \frac{0.2}{(4,1)}$ Use the compositional rule of inference to find the corresponding fuzzy set B defined on V (B → 'y is small'). **(12 Marks)**

b. What is a fuzzy proposition? With example, interpret the connectives AND and OR used in fuzzy propositions. **(08 Marks)**

4 a. What are linguistic variables? Explain their relevance in fuzzy logic control. **(08 Marks)**

b. Suppose X = {1, 2, 3, 4, 5} and small is interpreted as $\mu_{small} = \frac{1}{1} + \frac{0.8}{2} + \frac{0.6}{3} + \frac{0.4}{4} + \frac{0.2}{5}$

and large as $\mu_{large} = \frac{0.2}{1} + \frac{0.4}{2} + \frac{0.6}{3} + \frac{0.8}{4} + \frac{1}{5}$ If R is the relation that represents "if X is small then Y is large else y is not very large" Find R. **(12 Marks)**

5 a. What is scaling factor? Explain the heuristic method of selecting a scaling factor. **(06 Marks)**
b. With a block diagram explain the structure of FKBC. **(08 Marks)**
c. Explain the defuzzification procedure by (i) Centre of gravity (ii) Centre of sums method. **(06 Marks)**

6 Determine the defuzzifier output by centre of gravity, centre of sums, centre of largest area, first of maxima and middle of maxima defuzzification methods. **(20 Marks)**

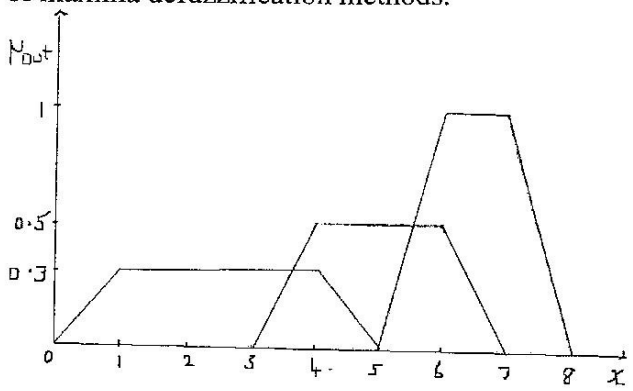

Fig.6

7 a. Show that FKBC is a non-linear transfer element of a system controller. **(10 Marks)**
b. Explain sliding mode FKBC. **(10 Marks)**

8 a. Explain any two adaptation techniques of a fuzzy system. **(10 Marks)**
b. Explain self organizing fuzzy controller. **(10 Marks)**

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