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18AI741

Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024
Fuzzy Logic and Its Application

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain about operations of classical sets and illustrate by using Venn diagram. **(10 Marks)**

b. The Froude number FR is Often used to calculate whether flow in a channel is subcritical, critical or super critical given by expression FR = $V/(g^D)^{1/2}$. V is the velocity of the flow D channel depth, g is the gravitational. In a channel with a constant dept. FR is a maximum flow is high FR is a maximum when the flow is low velocity is given on a universe of non dimensional velocities X = [0, 20, 40, 60, 80, 100] two flow given below, find the intersection, union and difference of the two flows.

Flow 1' = $\frac{1.0}{0}+\frac{0.8}{20}+\frac{0.65}{40}+\frac{0.45}{60}+\frac{0.3}{80}+\frac{0.1}{100}$

Flow 2' = $\frac{0}{0}+\frac{0.45}{20}+\frac{0.6}{40}+\frac{0.8}{60}+\frac{0.95}{80}+\frac{1.0}{100}$ **(10 Marks)**

OR

2 a. Explain about properties of classical (CRISP) sets including special properties (excluded middle axiom De Morgen's principle) **(10 Marks)**

b. To select an implementation technology for a numeric processor, computation through put is directly related to clock speed. Assume that all implementation will be in the same family (e.g CMOS) you are considering whether the design should be implemented using medium scale integration (MSI) with discrete parts. Field Programmable Gate Array (FPGA) (or) Multichip Modules (MCM). Define universe of potential clock frequencies as X = [1, 10, 20, 40, 80, 100] define MSI, FPGA and MCM as fuzzy sets of clock frequencies.

Clock frequency (MHz)	MSI	FPGA	MCM
1	1	0.3	0
10	0.7	1	0
20	0.4	1	0.5
80	0	0.5	0.7
40	0	0.2	1
100	0	0	1

Three sets as MSI = M', FPGA = f' and MCM = c' $M'UF'$, $M'nF'$, complement (M') complement (f') (n complement f'). **(10 Marks)**

Module-2

3 a. Explain about Fuzzy relation and operations on Fuzzy relations. **(10 Marks)**

b. Consider to discrete fuzzy sets namely

$$A' = \frac{0.2}{P1} + \frac{0.6}{P2} + \frac{0.5}{P3} + \frac{0.9}{P4}, \quad B' = \frac{0.4}{g_1} + \frac{0.7}{g_2} + \frac{0.8}{g_3}$$

Calculate $C' = A' \times B'$

D' is defined as g×p as follows

0.3	0.6	0.5	0.2	0.1
0.4	0.7	0.5	0.3	0.3
0.2	0.6	0.8	0.9	0.8

Calculate $E' = C' \times D'$ **(10 Marks)**

OR

4 a. Explain about crisp relation and operations on crisp relations. **(10 Marks)**

b. Define cardinality of crisp relations, provide the set theoretic and membership function – theoretic expression for max-min composition and max-product composition. **(10 Marks)**

Module-3

5 a. Explain first or last of maxima defuzzification methods with an example. **(10 Marks)**

b. Consider the fuzzy sets, A' and B' on universe X and using Zadeh's notation for fuzzy variables.

$$A' = \left\{\frac{1 - 0.1|x|}{\sqrt{x}}\right\} \text{for } x \in [1, +10]$$

$$B' = \left\{\frac{0.2|y|}{\sqrt{y}}\right\}, \text{ for } y \in [1, +5]$$

Find the λ out relations for the following values λ for both A' and B'

$\lambda = 0.3$, $\lambda = 0.5$, $\lambda = 0.9$, $\lambda = 1.0$ **(10 Marks)**

OR

6 a. Explain the λ cuts for fuzzy relation, consider the following fuzzy relation matrix which is reflexive and symmetric.

$$R = \begin{bmatrix} 1 & 0.8 & 0 & 0.1 & 0.2 \\ 0.8 & 1 & 0.4 & 0. & 0.9 \\ 0 & 0.4 & 1 & 0 & 0 \\ 0.1 & 0 & 0 & 1 & 0.5 \\ 0.2 & 0.9 & 0 & 0.5 & 1 \end{bmatrix}$$

Find $\lambda = 1$, $R = 1$

Define the special properties of λ cuts **(10 Marks)**

b. Explain the features of membership function of a fuzzy set includes graphical representation. **(10 Marks)**

Module-4

7 a. Explain the following properties arithmetic interval
   i) Commutative (for additive multiplicative)
   ii) Associative (for additive and multiplicative)

And prove any one of them. **(10 Marks)**

b. Explain about interval analysis in fuzzy arithmetic with relevant examples

$I_1 * I_2 = [a, b] * [c, d]$ **(10 Marks)**

OR

8 a. Explain the DSW method of extension principle. **(10 Marks)**

b. Consider the values of arithmetic interval of [a, b, c, d] as follows [a, b] = [−3.0, 5.0] and [c, d] = [−2.0, 7.0] and perform +, −, *, /]. **(10 Marks)**

Module-5

9 a. Explain the aggregation of fuzzy rules in detail. **(10 Marks)**

b. Consider a universe of integers y = [1, 2, 3, 4, 5] the linguistic terms is mapped into y is

"slightly hot" = $\left\{\frac{1}{1}+\frac{0.8}{2}+\frac{0.6}{3}+\frac{0.4}{4}+\frac{0.5}{5}\right\}$ **(10 Marks)**

"Hot" = $\left\{\frac{0.2}{1}+\frac{0.4}{2}+\frac{0.6}{3}+\frac{0.8}{4}+\frac{1}{5}\right\}$

Now based on these define two more linguistic terms with hudges.

"Almost Cool" = "Slightly hot"^{2}

"Not very Hot" = 1 – Almost cool"

Construct α = not very Hot and Slightly hot"

Using set – theoretic operations.

Derive intensely hot = $1 - 2\,[\,1 - \mu\,\alpha(y)]^2$

OR

10 a. Give an example in a way of single – input, single output of any fuzzy model with the following rules.

IF × is small, THENY is C_1

IF × is medium, THEN Y is C_2

IF × is large, THEN Y is C_2 **(10 Marks)**

b. Explain about rule based systems in fuzzy. **(10 Marks)**

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