MTL717: Fuzzy sets and Applications

Minor Examination: Monday November 9, 2020

Please write your answer neatly. Scan it and make a pdf.
Name your file as Name_Entry No. (eg: Yuan_2010MT67123.pdf)
Email to: mtl7172020@gmail.com

Total marks: 25 **Time: 5:30 – 6:40 pm**

Q1. Let A be the fuzzy set with $U = \{1,2,3,4,5,6\}$.

a) What will be the core and support for C = A^C if A is defined as follows on entire U :

$$A = 0.5/1 + 1/2 + 0.3/3$$

b) What will be the fuzzy set D defined as $A \cup A^c$ (defined on entire U) if

$$A = 0.4/1 + 1/2 + 0.5/3 + 0.8/4$$

c) What is the Degree of subsethood of C to D?

d) Let A = [0,1], B=[1,3] and C = [-2,1]. Which of the following is/are correct?

a. $A \cdot (B + C) \subset A \cdot B + A \cdot C$
b. $B \cdot (A + C) \subset C \cdot (A + B)$
c. $B \cdot C \subset A \cdot C$
d. $A \cdot (B + C) \subseteq C \cdot (A + B)$

[1+1+1 + 2= 5]

Q2. a. Let the membership function for A, B be defined as follows:

$$\mu_A(x) = \begin{cases} \frac{x-18}{4} & 18 \leq x \leq 22 \\ -\frac{x}{11} + 3 & 22 \leq x \leq 33 \end{cases} \quad and \ \mu_B(y) = \begin{cases} y - 5 & 5 \leq y \leq 6 \\ -\frac{y}{2} + 4 & 6 \leq y \leq 8 \end{cases}$$

Find membership function of A/B.

b. Let the A, B be TFN defined as follows:

$A = [-2 \quad 0 \quad 6]$ and $B = [-4 \quad 3 \quad 5]$.

I. Let$R = MIN(A, B)$. Find $\mu_R(x)$.
II. Let$S = MAX(A, B)$. Find $\mu_S(x)$

[3+ 2 = 5]

Q3. a) Let $A_1, A_2, \dots, A_n \in \mathcal{F}(X)$ be a finite collection of fuzzy subsets of a universal set X and $\cap_b$ denotes fuzzy intersection with bounded difference. Then Prove or disprove:

$$^{\alpha+}(A_1 \cap_b A_2 \cap_b \dots \cap_b A_n) \subseteq {}^{\alpha+}A_1 \cap {}^{\alpha+}A_2 \cap \dots \cap {}^{\alpha+}A_n$$

b) Let $A_1, A_2, \dots, A_n \in \mathcal{F}(X)$ be a finite collection of fuzzy subsets of a universal set X and $\cup_a$ denote fuzzy union with algebraic sum. Then Prove or Disprove:

$$^{\alpha}A_1 \cup {}^{\alpha}A_2 \cup \dots \cup {}^{\alpha}A_n \subseteq {}^{\alpha}(A_1 \cup_a A_2 \cup_a \dots \cup_a A_n)$$

[2+3 = 5]

Q4. Let A= $[-2 \ \ -1 \ \ 1 \ \ 3]$ and $B = [-4 \ \ -1 \ \ 0 \ \ 2]$ be TrFNs. Let $C = A \cap B$. Let $f(x) = \lfloor x \rfloor, x \in X$, where $\lfloor \ \rfloor$ is the floor function. $Find\ \mu_{f(C)}$.

[3]

Q5. Let $A = \left\{\frac{0.3}{0} + \frac{0.6}{\frac{\pi}{6}} + \frac{1}{\frac{\pi}{3}} + \frac{0.2}{\frac{\pi}{2}}\right\}$ and $B = \left\{\frac{0.4}{0} + \frac{0.5}{\frac{\pi}{6}} + \frac{0.2}{\frac{\pi}{3}} + \frac{0.8}{\frac{\pi}{2}}\right\}$ be fuzzy subsets of $\mathbb{Z}$ and $f: \mathbb{R} \times \mathbb{R} \to \mathbb{R}$ given by $f(x, y) = \sin(x - y)$. Find μ_C where $C = f(A, B)$ using extension principle

[3]

Q6. Suppose $X = \{x_1, x_2\}, Y = \{y_1, y_2\}$ and $Z = \{z_1, z_2, z_3\}$.

Let $R = \begin{bmatrix} 0.4 & 0.1 \\ 0.5 & 0.3 \end{bmatrix}$ be a fuzzy relation on $X \times Y$ and $S = \begin{bmatrix} 0.9 & 0.3 & 0.8 \\ 0.7 & 1 & 0.2 \end{bmatrix}$ be a fuzzy relation on $Y \times Z$. Let $\odot_p$ denotes max-product composition.

a) Classify the following as reflexive/ irreflexive/ antireflexive. Justify
   a. $R^{-1} \odot_p R$
   b. $S \odot_p S^{-1}$

b) Is $\left(R \odot_p S\right)^{-1} = S^{-1} \odot_p R^{-1}$? Explain

[2+2 = 4]