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ASSIGNMENT-7

ENGINEERING MATHEMATICS

Submitted by : YASH VINAYVANSHI
B-TECH 2^{nd} SEM
SECTION C-72
R.NO : 19BCS081
JAMIA MILLIA ISLAMIA
Email : yash.vinayvanshi@gmail.com

Submitted to : PROF. IDRIS QURESHI
PROF. SAIMA
PROF. NAVED AKHTAR
DEPARTMENT OF APPLIED SCIENCES
JMI FET

Q1. Let $\tilde{R}(x,y)$ and $\tilde{S}(x,y)$ be defined by the following relational matrices.

$\tilde{R}(x,y) =$

	y_1	y_2	y_3
x_1	0.1	0.2	0
x_2	0.3	0.5	0
x_3	0.8	0	1

$\tilde{S}(y,z) =$

	z_1	z_2	z_3
y_1	0.9	0	0.3
y_2	0.2	1	0.8
y_3	0.8	0	0.7

Max min composion

$$\tilde{T}(x,y,z) = \tilde{R}(x,y) \circ \tilde{S}(y,z)$$

$$\tilde{T}(x_1, z_1) = \max\{\min(0.1, 0.9), \min(0.2, 0.2), \min(0, 0.8)\}$$
$$= \max\{0.1, 0.2, 0.0\}$$
$$= 0.2$$

$$\tilde{T}(x_1, z_2) = \max\{\min(0.1, 0), \min(0.2, 1), \min(0, 0)\}$$
$$= \max\{0, 0.2, 0\}$$
$$= 0.2.$$

$$\tilde{T}(x_1, z_3) = \max\{\min(0.1, 0.3), \min(0.2, 0.8), \min(0, 0.7)\}$$
$$= \max\{0.1, 0.2, 0\}$$
$$= 0.2$$

$$\tilde{T}(x_2, z_1) = \max\{\min(0.3, 0.9), \min(0.5, 0.2), \min(0, 0.8)\}$$
$$= \max\{0.3, 0.2, 0\}.$$
$$= 0.3.$$

$$\tilde{T}(x_2, z_2) = \max\{\min(0.3, 0), \min(0.5, 1), \min(0, 0)\}$$
$$= \max\{0, 0.5, 0\}$$
$$= 0.5$$

$$\tilde{T}(x_2, z_3) = \max\{\min(0.3, 0.3), \min(0.5, 0.8), \min(0, 0.7)\}$$
$$= \max\{0.3, 0.5, 0\}$$
$$= 0.5$$

$$\tilde{T}(x_3, z_1) = \operatorname{Max}\{\min(0.8, 0.9), \min(0, 0.2), \min(1, 0.8)\}$$
$$= \max\{0.8, 0, 0.8\}$$
$$= 0.8$$

$$\tilde{T}(x_3, z_2) = \max\{\min(0.8, 0), \min(0, 1), \min(1, 0)\}$$
$$= \max\{0, 0, 0\}$$
$$= 0$$

$$\tilde{T}(x_3, z_3) = \max\{\min(0.8, 0.3), \min(0, 0.8), \min(1, 0.7)\}$$
$$= \max\{0.3, 0, 0.7\}.$$
$$= 0.7$$

membership of z_1 close to x_i

$$\therefore \tilde{T} = \tilde{R} \circ \tilde{S} = \begin{array}{c|ccc} & z_1 & z_2 & z_3 \\ \hline x_1 & 0.2 & 0.2 & 0.2 \\ x_2 & 0.3 & 0.5 & 0.5 \\ x_3 & 0.8 & 0 & 0.7 \end{array}$$

Q2. If a fuzzy relation $\tilde{R}(x, y)$ is defined as

	x_1	x_2	x_3	x_4
x_1	1.0	0.0	0.2	0.3
x_2	0.0	1.0	0.0	0.0
x_3	0.0	0.5	1.0	0.4
x_4	0.0	1.0	0.0	1.0

check whether the given relation is reflexive, symmetric, anti-symmetric or perfectly antisymmetric.

(i) Let $\tilde{R}$ be a fuzzy relation in $X \times X$ then R is reflexive if

$$\mu\tilde{R}(x, x) = 1 \quad \forall x \in X$$

$$\tilde{R}(x_1, x_1) = \tilde{R}(x_2, x_2) = \ldots = 1 \rightsquigarrow \tilde{R} \text{ is } \boxed{\text{reflexive}}$$

(ii) A fuzzy relation $\tilde{R}$ is symmetric if

$$\tilde{R}(x, y) = \tilde{R}(y, x) \quad \forall x, y \in X$$

$$\tilde{R}(x_1, x_2) = \tilde{R}(x_2, x_1) = 0.0$$
$$\tilde{R}(x_1, x_3) \neq \tilde{R}(x_3, x_1) \rightsquigarrow \tilde{R} \text{ is } \boxed{\text{not symmetric}}$$

(iii) $\tilde{R}$ is antisymmetric if for $x = y$, either
$$\tilde{R}(x, y) \neq \tilde{R}(y, x) \text{ or } \tilde{R}(x, y) = \tilde{R}(y, x) = 0 \quad \forall x, y \in A$$

$\tilde{R}(x_1, x_2) = \tilde{R}(x_2, x_1) = 0$ ✓
$\tilde{R}(x_1, x_3) \neq \tilde{R}(x_3, x_1)$ ✓
$\tilde{R}(x_1, x_4) \neq \tilde{R}(x_4, x_1)$ ✓
$\tilde{R}(x_2, x_3) \neq \tilde{R}(x_3, x_2)$ ✓
$\tilde{R}(x_2, x_4) \neq \tilde{R}(x_4, x_2)$ ✓
$\tilde{R}(x_3, x_4) \neq \tilde{R}(x_4, x_3)$ ✓ $\quad \therefore$ it is $\boxed{\text{antisymmetric}}$

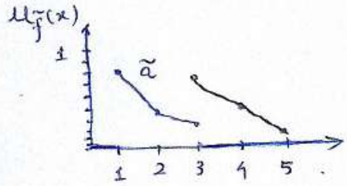
(iv) $\tilde{R}$ is perfect antisymmetric if for $x \neq y$,
$$\tilde{R}(x, y) > 0 \Rightarrow \tilde{R}(y, x) = 0 \quad \forall x, y \in A$$
$\tilde{R}(x_1, x_2) = 0$; $\tilde{R}(x_2, x_1) = 0$

$\therefore$ it is $\boxed{\text{not perfectly antisymm.}}$

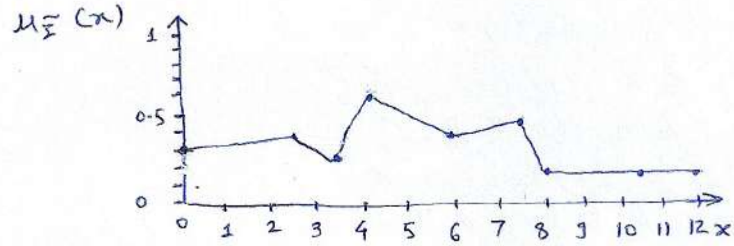
Q3. Let two fuzzy sets be defined as
$$\tilde{a} = \{(1, 0.8), (2, 0.4), (3, 0.3)\}$$
$$\tilde{b} = \{(3, 0.7), (4, 0.5), (5, 0.2)\}$$

and the function,
$$f(x) = x, \quad x \in [\tilde{a}, \tilde{b}] = [1, 5]$$
Evaluate the integral of the function $f(x)$ over interval $[\tilde{a}, \tilde{b}]$

$[\tilde{a}, \tilde{b}]$	$\int_{\tilde{a}}^{\tilde{b}} x\,dx$	$\min[\mu_{\tilde{a}}(x), \mu_{\tilde{b}}(x)]$
$[1, 3]$	$\left[x^2/2\right]_1^3 = 4$	0.7
$[1, 4]$	$\left[x^2/2\right]_1^4 = 7.5$	0.5
$[1, 5]$	$\left[x^2/2\right]_1^5 = 12$	0.2
$[2, 3]$	$\left[x^2/2\right]_2^3 = 2.5$	0.4
$[2, 4]$	$\left[x^2/2\right]_2^4 = 6$	0.4
$[2, 5]$	$\left[x^2/2\right]_2^5 = 10.5$	0.2
$[3, 3]$	$\left[x^2/2\right]_3^3 = 0$	0.3
$[3, 4]$	$\left[x^2/2\right]_3^4 = 3.5$	0.3
$[3, 5]$	$\left[x^2/2\right]_3^5 = 8$	0.2



$$\tilde{I}(\tilde{a}, \tilde{b}) = \{(0, 0.3), (2.5, 0.4), (3.5, 0.3), (4, 0.7), (6, 0.4), (7.5, 0.5), (8, 0.2), (10.5, 0.2), (12, 0.2)\}$$



Q4. Let $\tilde{A}$ be a fuzzy subset of $\mathbb{R}^2$, and the membership func^n of $\tilde{A}$ be given as.

$\tilde{A}(x, y) =$

1.0	0.4	0.2	0.3
0.6	1.0	0.7	0.8
0.9	0.5	1.0	0.4
0.5	1.0	0.7	1.0

Find the Area, height & width of $\tilde{A}(x, y)$.

Height $\quad h(\tilde{A}) = \sum_{y} \max_{x} \{\tilde{A}(x, y)\}$

$$= 1.0 + 1.0 + 1.0 + 1.0 = \boxed{4.0}$$

width $\quad w(\tilde{A}) = \sum_{x} \max_{y} \{\tilde{A}(x, y)\}$

$$= 1.0 + 1.0 + 1.0 + 1.0 = \boxed{4.0}$$

Area $\quad a(\tilde{A}) = \Sigma \tilde{A} = \sum_{x} \sum_{y} \tilde{A}(x, y)$

$$\begin{aligned} &= 1.0 + 0.4 + 0.2 + 0.3 \\ &\quad + 0.6 + 1.0 + 0.7 + 0.8 \\ &\quad + 0.9 + 0.5 + 1.0 + 0.4 \\ &\quad + 0.5 + 1.0 + 0.7 + 1.0 \\ &= \boxed{11.0} \end{aligned}$$

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YASH VINAYVANSHI