Q1) Let $X, Y \subseteq R$ and

$\tilde{A} = \{ (x, \mu_{\tilde{A}}(x)) \mid x \in X \}$

$\tilde{B} = \{ (y, \mu_{\tilde{B}}(y)) \mid y \in Y \}$

be two fuzzy sets then:-

$\tilde{R} = \{ (x,y)\ \mu_R(x,y) \mid (x,y) \in X \times Y \}$ is a fuzzy relation on $\tilde{A}$ and $\tilde{B}$ if

$\mu_R(x,y) \le \min(\mu_{\tilde{A}}(x), \mu_{\tilde{B}}(y)]\ \forall\ (x,y) \in X \times Y$

$\tilde{A} = \{ (a_1, 0.2)\ (a_2, 0.4), (a_3, 0.6) \}$

$\tilde{B} = \{ (b_1, 0.3), (b_2, 0.4), (b_3, 0.5), (b_4, 0.2) \}$

$\tilde{R} = \{ (a_1 b_1, 0.2)\quad (a_1 b_2\ .2)\quad (a_1 b_3, 0.2)\quad (a_1 b_4\ 0.2)$

$(a_2 b_1, 0.3)\quad (a_2 b_2, 0.4)\quad (a_2 b_3, 0.4)\quad (a_2 b_4, 0.2)$

$(a_3 b_1, 0.3)\quad (a_3 b_2, 0.4)\quad (a_3 b_3, 0.5)\quad (a_3 b_4, 0.2) \}$

We can represent above relation in metric form

$$\tilde{R} = \begin{array}{c|cccc} & b_1 & b_2 & b_3 & b_4 \\ \hline a_1 & 0.2 & 0.2 & 0.2 & 0.2 \\ a_2 & 0.3 & 0.4 & 0.4 & 0.2 \\ a_3 & 0.3 & 0.4 & 0.5 & 0.2 \end{array}$$

Q2) Let $X, Y \subseteq R$

$\tilde{A} = \{ (x, \mu_{\tilde{A}}(x)) \mid x \in X \}$

$\tilde{B} = \{ (y, \mu_{\tilde{B}}(y)) \mid y \in Y \}$ be two fuzzy sets

and let $\tilde{R} = \{ [(x,y), \mu_R(x,y)] \mid (x,y) \in X \times Y \}$ be a fuzzy relation on $\tilde{A}$ and $\tilde{B}$.

i) Given that $\tilde{R}$ is symmetric prove R^{-1} is symmetric

Fuzzy relation $\tilde{R}$ is symmetric iff $\forall$ $(x,y) \in X \times Y$ $\mu_R(x,y) = \mu_R(y,x)$

The inverse of a fuzzy relation $\tilde{R}$ is $\tilde{R}^{-1}$ where

$\{(y,x)\ \mu_{R^{-1}}(y,x)\}$ $\forall$ $((x,y), \mu_R(x,y)) \in \tilde{R}$

$\therefore \tilde{R}$ is symmetric, $\mu_{\tilde{R}}(x,y) = \mu_{\tilde{R}}(y,x)$ —— (1)

$\therefore \tilde{R}^{-1}$ is inverse of $\tilde{R}$, $\mu_{\tilde{R}}(x,y) = \mu_{\tilde{R}^{-1}}(x,y)$ —— (2)

From (1) and (2) we can infer that

$\mu_{R^{-1}}(x,y) = \mu_{R^{-1}}(y,x)$ $\forall ((x,y), \mu_{R^{-1}}(x,y)) \in R^{-1}$

$\Rightarrow R^{-1}$ is symmetric

Proof:-

ii) Given that for the fuzzy set $\tilde{R}$, if $\tilde{R} = \tilde{R}^{-1}$ prove that R is symmetric.

We know that

for a rel^n $\tilde{R}$ to be symmetric $\forall$ $(x,y) \in X \times Y$

$\mu_R(x,y) = \mu_R(y,x)$

Given that $\tilde{R} = \tilde{R}^{-1}$ and $\forall$ $[(x,y), \mu_R(x,y), \exists ((y,x), \mu_{R^{-1}}(y,x))$

Let $((x,y), \mu_R(x,y)) \in \tilde{R}$

$\therefore ((x,y), \mu_R(x,y)) \in \tilde{R}^{-1}$ as $\tilde{R} = \tilde{R}^{-1}$

Q3) We are given relation $\tilde{R}_1$

$$\tilde{R}_1 = \begin{array}{c|ccccc} & x_1 & x_2 & x_3 & x_4 & x_5 \\ \hline x_1 & 1 & 0.8 & 0 & 0.1 & 0.2 \\ x_2 & 0.8 & 1 & 0.4 & 0 & 0.9 \\ x_3 & 0 & 0.4 & 1 & 0 & 0 \\ x_4 & 0.1 & 0 & 0 & 1 & 0.5 \\ x_5 & 0.2 & 0.9 & 0 & 0.5 & 1 \end{array}$$

As (x_1, x_1) $(x_2 x_2)$ $(x_3 x_3)$ $(x_4 x_4)$ $(x_5, x_5) = 1$ the above relationship is reflexive

Moreover as $\mu_{\tilde{R}_1}(x_1, x_4) = \mu_{\tilde{R}_1}(x_4\ x_1) = 0.1$

$\mu_{\tilde{R}_1}(x_2 x_5) = \mu_{\tilde{R}_1}(x_5\ x_2) = 0.9$

$\mu_{\tilde{R}_1}(x_1, x_2) = \mu_{\tilde{R}_1}(x_2\ x_1) = 0.1$

$\mu_{\tilde{R}_1}(x_1, x_3) = \mu_{\tilde{R}_1}(x_3\ x_1) = 0$

Similarly for $(x_i, x_j) = \mu_{\tilde{R}}(x_j\ x_i)$

The above relationship is symmetric

To check for transitivity let us assume $\tilde{R}_1(x, y)$ and $\tilde{R}(y, z)$ with λ_1 and λ_2 as their membership functions respectively.

From above matrix $\tilde{R}_1$

$\lambda_1 = 0.8$ and $\lambda_2 = 0.4$

Now assuming $\tilde{R}_1(x_1, x_3)$ from matrix with λ as it's relationship value, we see $\lambda = 0$

The above relationship will be transitive if the following inequality holds :-

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$\lambda \geq \min(\lambda_1, \lambda_2)$

$0 \geq \min(0.8, 0.4)$

$0 \geq 0.4$ which is not true $\Rightarrow\Leftarrow$

$\therefore$ above relation is not an equivalence relation

But the given solution is a proximility relation.

Q4) The membership function of two fuzzy relation $\tilde{R}$ and $\tilde{S}$ are given by:-

$$\mu_{\tilde{R}} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.8 & 0.1 & 0.1 & 0.7 \\ x_2 & 0 & 0.8 & 0 & 0 \\ x_3 & 0.9 & 1 & 0.7 & 0.8 \end{array} \qquad \mu_{\tilde{S}} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.4 & 0 & 0.9 & 0.6 \\ x_2 & 0.9 & 0.4 & 0.5 & 0.7 \\ x_3 & 0.3 & 0 & 0.8 & 0.5 \end{array}$$

i) $$\mu_{\tilde{R}\cap\tilde{S}} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.4 & 0 & 0.1 & 0.6 \\ x_2 & 0 & 0.4 & 0 & 0 \\ x_3 & 0.3 & 0 & 0.7 & 0.5 \end{array}$$

ii) $$\mu_{\tilde{R}\cup\tilde{S}} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.4 & 0 & 0.1 & 0.6 \\ x_2 & 0.4 & 0.4 & 0 & 0 \\ x_3 & 0.3 & & & \end{array}$$

ii) $$\mu_{\tilde{R}\cup\tilde{S}} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.8 & 1 & 0.9 & 0.7 \\ x_2 & 0.9 & 0.8 & 0.5 & 0.7 \\ x_3 & 0.9 & 1 & 0.8 & 0.8 \end{array}$$

iii) $$\mu_{\tilde{R}^c} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.2 & 0 & 0.9 & 0.3 \\ x_2 & 1 & 0.2 & 0.1 & 1 \\ x_3 & 0.1 & 0 & 0.3 & 0.2 \end{array}$$

N) $\mu_{\tilde{S}^c} = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.6 & 1 & 0.1 & 0.4 \\ x_2 & 0.1 & 0.6 & 0.5 & 0.3 \\ x_3 & 0.7 & 1 & 0.2 & 0.5 \end{array}$

Q5) Matrix representation of R_1 is:-

$$\begin{array}{c|ccccc} & y_1 & y_2 & y_3 & y_4 & y_5 \\ \hline x_1 & 0.1 & 0.2 & 0 & 1 & 0.7 \\ x_2 & 0.3 & 0.5 & 0 & 0.2 & 1 \\ x_3 & 0.8 & 0 & 1 & 0.4 & 0.3 \end{array}$$

Similarly for $\tilde{R}_2$

$$\begin{array}{c|cccc} & z_1 & z_2 & z_3 & z_4 \\ \hline y_1 & 0.9 & 0 & 0.3 & 0.6 \\ y_2 & 0.2 & 1 & 0.8 & 0 \\ y_3 & 0.8 & 0 & 0.7 & 1 \\ y_4 & 0.4 & 0.2 & 0.3 & 0 \\ y_5 & 0 & 1 & 0 & 0.8 \end{array}$$

$\tilde{R}_3 = \tilde{R}_1 \circ \tilde{R}_2$ where $\circ$ is the max-min composition

$$\tilde{R}_3 = \begin{array}{c|cccc} & z_1 & z_2 & z_3 & z_4 \\ \hline x_1 & 0.4 & 0.7 & 0.3 & 0.7 \\ x_2 & 0.3 & 1 & 0.5 & 0.8 \\ x_3 & 0.8 & 0.3 & 0.7 & 1 \end{array}$$

This can be written as:-

$\tilde{R}_1 \circ \tilde{R}_2 = \{((x_1 z_1), 0.4)\ (x_1, z_2, 0.7)\ (x_1, z_3, 0.3)\ (x_1, z_4, 0.7),$
$(x_2 z_1, 0.7), (x_2 z_2, 1)\ (x_2 z_3, 0.5)\ (x_2 z_4, 0.8),$
$(x_3 z_1, 0.8), (x_3 z_2\, 0.3), (x_3 z_3, 0.7), (x_3 z_4, 1)\}$

Let $R_0 =$

$$\begin{array}{c|cccc} & x_1 & x_2 & x_3 & x_4 \\ \hline x_1 & 0.7 & 0.5 & 0 & 0 \\ x_2 & 0 & 0 & 0 & 0.1 \\ x_3 & 0.4 & 0.4 & 0 & 0 \\ x_4 & 0 & 0 & 0.8 & 0 \end{array}$$

$\tilde{R}_1 = R_0 \cup (R_0 \circ R_0)$ ['$\circ$' is min max composition operator]

$$R_0 \circ R_0 = \begin{array}{c|cccc} & x_1 & x_2 & x_3 & x_4 \\ \hline x_1 & 0.7 & 0.5 & 0 & 0.1 \\ x_2 & 0 & 0 & 0.1 & 0 \\ x_3 & 0 & 0 & 0 & 0.1 \\ x_4 & 0 & 0.4 & 0 & 0 \end{array}$$

$$R_0 \cup (R_0 \circ R_0) = \begin{array}{c|cccc} & x_1 & x_2 & x_3 & x_4 \\ \hline x_1 & 0.7 & 0.5 & 0 & 0.1 \\ x_2 & 0 & 0 & 0.1 & 0.1 \\ x_3 & 0 & 0.4 & 0 & 0.1 \\ x_4 & 0 & 0.4 & 0.8 & 0 \end{array}$$

$R_2 = R_1 \cup (R_1 \circ R_1)$

$$\therefore R_2 = \begin{array}{c|cccc} & x_1 & x_2 & x_3 & x_4 \\ \hline x_1 & 0.7 & 0.5 & 0.1 & 0.1 \\ x_2 & 0 & 0.1 & 0.1 & 0.1 \\ x_3 & 0 & 0.4 & 0.1 & 0.1 \\ x_4 & 0 & 0.4 & 0.8 & 0.1 \end{array}$$

$\therefore \tilde{R}_1 \neq \tilde{R}_2$

$$R_3 = R_2 \cup (R_2 \circ R_2) = \begin{array}{c|cccc} & x_1 & x_2 & x_3 & x_4 \\ \hline x_1 & 0.7 & 0.5 & 0.1 & 0.1 \\ x_2 & 0.1 & 0.1 & 0.1 & 0.1 \\ x_3 & 0 & 0.4 & 0.1 & 0.1 \\ x_4 & 0 & 0.4 & 0.8 & 0.1 \end{array}$$

$\therefore R_2 \neq R_3$

$$R_4 = R_3 \cup (R_3 \circ R_3) = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \end{array} \begin{array}{c} \begin{array}{cccc} x_1 & x_2 & x_3 & x_4 \end{array} \\ \begin{bmatrix} 0.7 & 0.5 & 0.1 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.1 \\ 0 & 0.4 & 0.1 & 0.1 \\ 0 & 0.4 & 0.8 & 0.1 \end{bmatrix} \end{array}$$

$$\Rightarrow R_3 = R_4$$

Hence we can stop iterating as this gives us the required transitive min-max closure.

Q7)

$$\tilde{R} = \begin{array}{c|cccccc} & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \\ \hline x_1 & 1 & 0.2 & 1 & 0.6 & 0.2 & 0.6 \\ x_2 & 0.2 & 1 & 0.2 & 0.2 & 0.8 & 0.2 \\ x_3 & 1 & 0.2 & 1 & 0.6 & 0.2 & 0.6 \\ x_4 & 0.6 & 0.2 & 0.6 & 1 & 0.2 & 0.8 \\ x_5 & 0.2 & 0.8 & 0.2 & 0.2 & 1 & 0.2 \\ x_6 & 0.6 & 0.2 & 0.6 & 0.8 & 0.2 & 1 \end{array}$$

$\mu_{\tilde{R}}(x_1, x_3) = 1$ $\mu_{\tilde{R}}(x_3, x_4) = 0.6$ $\mu_{\tilde{R}}(x_1, x_4) = 0.6 \ngtr \min(1, 0.6)$

But $\mu_{\tilde{R}}(x_1, x_4) = \min(1, 0.6)$

Similarly we can show the same for all the other values

$\therefore \tilde{R}$ is transitive

to get the equivalence solution, we need to follow these steps :-

i) $k = 0$

ii) $R^{k+1} = R_r^k \circ R^k$

iii) If $R^{k+1} \neq R^k$, then $k = k+1$ and repeat from step 2

Performing the above steps we obtain :-

$k = 0$

$\tilde{R}^0 = \tilde{R}$

$$\tilde{R}^1 = \tilde{R}^0 \circ \tilde{R}^0 = \begin{array}{c|cccccc} & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \\ \hline x_1 & 1 & 0.2 & 1 & 0.6 & 0.2 & 0.6 \\ x_2 & 0.2 & 1 & 0.2 & 0.2 & 0.8 & 0.2 \\ x_3 & 1 & 0.2 & 1 & 0.6 & 0.2 & 0.6 \\ x_4 & 0.6 & 0.2 & 0.6 & 1 & 0.2 & 0.8 \\ x_5 & 0.2 & 0.8 & 0.2 & 0.2 & 0.1 & 0.2 \\ x_6 & 0.6 & 0.2 & 0.6 & 0.8 & 0.2 & 1 \end{array}$$

$\tilde{R}_1 = \tilde{R}_0$ $\therefore$ We have found the equivalence relationship

$\tilde{R}_\alpha$ at $\alpha = \cancel{\alpha}\, 1, 0.8, 0.6, 0.2$

$$\tilde{R}_{\alpha=1} = \begin{array}{c|cccccc} & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \\ \hline x_1 & 1 & 0 & 1 & 0 & 0 & 0 \\ x_2 & 0 & 1 & 0 & 0 & 0 & 0 \\ x_3 & 1 & 0 & 1 & 0 & 0 & 0 \\ x_4 & 0 & 0 & 0 & 1 & 0 & 0 \\ x_5 & 0 & 0 & 0 & 0 & 1 & 0 \\ x_6 & 0 & 0 & 0 & 0 & 0 & 1 \end{array}$$

$$\tilde{R}_{\alpha=0.8} = \begin{array}{c|cccccc} & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \\ \hline x_1 & 1 & 0 & 1 & 0 & 0 & 0 \\ x_2 & 0 & 1 & 0 & 0 & 1 & 0 \\ x_3 & 1 & 0 & 1 & 0 & 0 & 0 \\ x_4 & 0 & 0 & 0 & 1 & 0 & 1 \\ x_5 & 0 & 1 & 0 & 0 & 1 & 0 \\ x_6 & 0 & 0 & 0 & 1 & 0 & 1 \end{array}$$

$$\tilde{R}_{\alpha=0.6} = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \end{array} \begin{array}{c} \begin{array}{cccccc} x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \end{array} \\ \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 \end{bmatrix} \end{array}$$

$R_{\alpha=0.2} = [1]_{6\times 6}$ (Unit Matrix)

Similarity Tree

$\{x_1\ x_2\ x_3\ x_4\ x_5\ x_6\}$ $\alpha = 0.2$

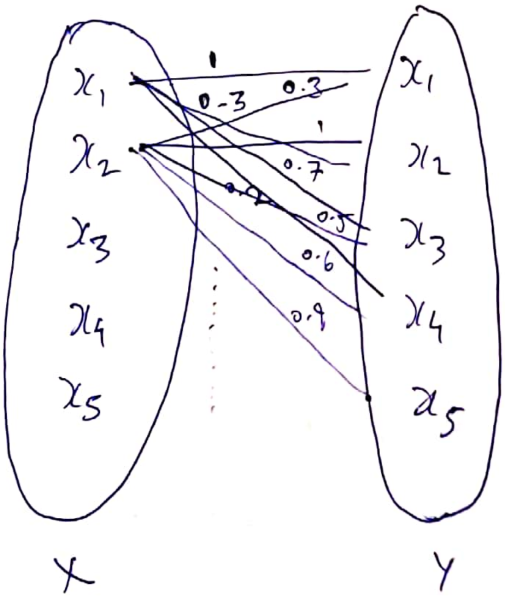
$\{x_1\ x_3 x_4\ x_5\}$ $\{x_2\ x_6\}$ $\alpha = 0.6$

$\{x_1\ x_3\}$ $\{x_2\ x_5\}$ $\{x_4\ x_6\}$ $\alpha = 0.8$

$\{x_1\ x_3\}$ $\{x_2\}$ $\{x_5\}$ $\{x_4\}$ $\{x_6\}$ $\alpha = 1$

The relationship $R(x, y)$ must be reflexive and symmetric to be considered a compatability relation

$$\tilde{R} = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{array} \begin{array}{c} \begin{array}{ccccc} x_1 & x_2 & x_3 & x_4 & x_5 \end{array} \\ \begin{bmatrix} 1 & 0.3 & 0.7 & 0.2 & 0 \\ 0.3 & 1 & 0.5 & 0.6 & 0.9 \\ 0.7 & 0.5 & 1 & 0.2 & 0.2 \\ 0.2 & 0.6 & 0.2 & 1 & 0.8 \\ 0 & 0.9 & 0.2 & 0.8 & 1 \end{bmatrix} \end{array}$$



$x_1 \xrightarrow{1} x_1$ $x_2 \xrightarrow{0.3} x_1$ $x_3 \xrightarrow{0.7} x_1$ $x_4 \xrightarrow{0.2} x_1$ $x_5 \xrightarrow{0} x_1$

$x_1 \xrightarrow{0.3} x_2$ $x_2 \xrightarrow{1} x_2$ $x_3 \xrightarrow{0.5} x_2$ $x_4 \xrightarrow{0.6} x_2$ $x_5 \xrightarrow{0.9} x_2$

$x_1 \xrightarrow{0.7} x_3$ $x_2 \xrightarrow{0.5} x_2$ $x_3 \xrightarrow{1} x_3$ $x_4 \xrightarrow{0.2} x_3$ $x_5 \xrightarrow{0.2} x_3$

$x_1 \xrightarrow{0.2} x_4$ $x_2 \xrightarrow{0.6} x_2$ $x_3 \xrightarrow{0.2} x_4$ $x_4 \xrightarrow{1} x_4$ $x_5 \xrightarrow{0.8} x_4$

$x_1 \xrightarrow{0} x_5$ $x_2 \longrightarrow x_2$ $x_3 \xrightarrow{0.2} x_5$ $x_4 \xrightarrow{0.8} x_5$ $x_5 \xrightarrow{1} x_5$

Q.4) $\tilde{R}_1 = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 0.3 & 0 & 0.3 & 0.3 \\ x_2 & 0 & 1 & 0.2 & 0 \end{array}$ $\tilde{R}_2 = \begin{array}{c|ccc} & & & \\ \hline y_1 & 1 & 0 & 1 \\ y_2 & 0 & 0.5 & 1 \\ y_3 & 0.7 & 0.8 & 0.6 \\ y_4 & 0 & 0 & 0 \end{array}$

i) Max Product

$$\tilde{R}_1 \circ \tilde{R}_2 = \begin{bmatrix} 0.49 & 0.56 & 0.42 \\ 0.14 & 0.5 & 0.4 \end{bmatrix}$$

However

$\mu_R(c, d) \neq \mu_g(\beta, \gamma)$

$\therefore h$ is not homomorphic

h is strong homomorphic if

$y_1 = h(x_i)$, $y_2 = h(x_k)$

$$\max_{x_j, x_k} \mu_R(x_j, x_k) = \mu_g(y_1, y_2)$$

Here $\mu_g(\beta, \gamma) = 0$

$h^{-1}(\beta) = c$ $h^{-1}(\gamma) = d$

$\mu_R(c, d) = 0.4 \neq 0$

Therefore h is not strong homomorphic

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2) $h : a \to b$

$b, c \to \beta$

$d \to \gamma$

clearly,

$\mu_R(c,d) \leq \mu_S(\beta,\gamma) \quad \because 0.4 \nleq 0$

$\therefore h$ is not homomorphic

We have $\mu_S(\beta,\gamma) = 0$

$h^{-1}(\beta) = \{b, c\} \quad h^{-1}(\gamma) = d$

$\max\{\mu_R(b,d), \mu_R(c,d)\} = \max\{0.4, 0\} = 0.4 \neq 0$

$\therefore h$ is not strong homomorphic

2) Max-average

$$\tilde{R}_1 \circ \tilde{R}_2 = \begin{bmatrix} 0.7 & 0.75 & 0.65 \\ 0.5 & 0.75 & 0.7 \end{bmatrix}$$

Q10) An element $x \in X$ is undominated iff $R(x,y) = 0$ for all $y \in X$ and $x \neq y$

An element $x \in X$ is undominating iff

$R(y, x) = 0$ for all $y \in X$ and $y \neq x$

Here $X = \{a, b, c, d, e\}$

$$\tilde{R} = \begin{array}{c|c} & \begin{matrix} a & b & c & d & e \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \\ e \end{matrix} & \begin{bmatrix} 1 & 0.7 & 0 & 1 & 0.7 \\ 0 & 1 & 0 & 0.9 & 0 \\ 0.5 & 0.7 & 1 & 1 & 0.8 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0.1 & 0 & 0.9 & 1 \end{bmatrix} \end{array}$$

Undominated elements $= \{d\}$

Undominating elements $= \{c\}$

Q11)

$$\begin{array}{c|cccc} & a & b & c & d \\ \hline a & 0 & 5 & 0 & 0 \\ b & 0 & 0 & 8 & 0 \\ c & 1 & 0 & 0 & 0.4 \\ d & 0 & 0.4 & 0 & 0 \\ e & & & & \end{array}$$

$$\tilde{g} = \begin{array}{c|ccc} & \alpha & \beta & \gamma \\ \hline \alpha & 0.6 & 0.8 & 0 \\ \beta & 1 & 0.8 & 0 \\ \gamma & 1 & 0 & 0.8 \end{array}$$

$h: a, b \rightarrow \alpha$
$c \rightarrow \beta$
$d \rightarrow \gamma$

We can state it is homomorphic if

$\forall (x_1, x_2) \in \tilde{R} \quad (h(x_1), h(x_2)) \in \tilde{g}$

and $\mu_R(x_1, x_2) \leq \mu_{\tilde{g}}(h(x_1), h(x_2))$

Hence this will not be homomorphic.