Group 49

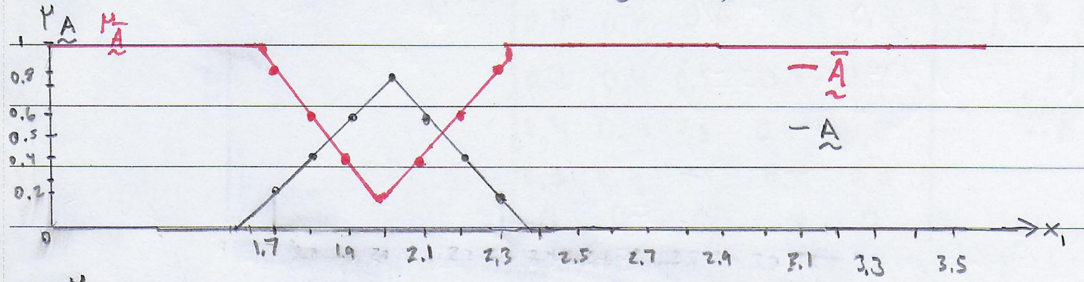
ECE657

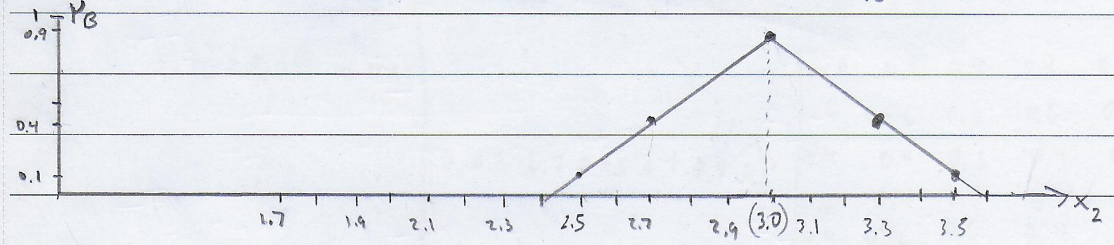
Q2) $\underset{\sim}{A} = \left\{ \frac{0.2}{1.7} + \frac{0.4}{1.8} + \frac{0.6}{1.9} + \frac{0.8}{2.0} + \frac{0.6}{2.1} + \frac{0.4}{2.2} + \frac{0.2}{2.3} \right\}$ for $x_{gb} = 2^\circ/Hr$ $\delta_x = 0.1$

$\underset{\sim}{B} = \left\{ \frac{0.1}{0.25} + \frac{0.4}{0.27} + \frac{0.9}{0.3} + \frac{0.4}{0.33} + \frac{0.1}{0.35} \right\}$ normal bias is $0.3g$

↑ bias in triangle fuzzy set

a) Find R for IF $\underset{\sim}{A}$ Then $\underset{\sim}{B}$ using classical implication $\mu_R = \max[\min(\mu_{\underset{\sim}{A}}, \mu_{\underset{\sim}{B}}), (1-\mu_{\underset{\sim}{A}})]$





$\mu_{\underset{\sim}{R}} = \max[\min(\mu_{\underset{\sim}{A}}, \mu_{\underset{\sim}{B}}), (1-\mu_{\underset{\sim}{A}})] = \max[\min(\mu_{\underset{\sim}{A}}, \mu_{\underset{\sim}{B}}), \mu_{\bar{\underset{\sim}{A}}}]$ $\because 1-\mu_{\underset{\sim}{A}} \triangleq \mu_{\bar{\underset{\sim}{A}}}$ (compliment of $\underset{\sim}{A}$)

$\therefore \bar{\underset{\sim}{A}} = \begin{cases} \frac{1.0}{x} & 2.3 < x < 1.7 \\ \frac{0.8}{1.7} + \frac{0.6}{1.8} + \frac{0.4}{1.9} + \frac{0.2}{2.0} + \frac{0.4}{2.1} + \frac{0.6}{2.2} + \frac{0.8}{2.3} \end{cases}$ (shown in red above)

$\therefore \mu_{\underset{\sim}{R}} = \mu_{\underset{\sim}{A} \to \underset{\sim}{B}}(x_1, x_2) = \max[\min(\mu_{\underset{\sim}{A}}(x_1), \mu_{\underset{\sim}{B}}(x_2)), \mu_{\bar{\underset{\sim}{A}}}(x_1)]$

$\forall x_1, x_2 \in X_1 \times X_2$

$$\underset{\sim}{R} \triangleq \mu_{\underset{\sim}{R}}(x_1, x_2) = \begin{array}{cc} & x_2 \\ x_1 & \begin{bmatrix} 0.8 & 0.8 & 0.8 & 0.8 & 0.8 \\ 0.6 & 0.6 & 0.6 & 0.6 & 0.6 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.2 & 0.4 & 0.8 & 0.4 & 0.2 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.6 & 0.6 & 0.6 & 0.6 & 0.6 \\ 0.8 & 0.8 & 0.8 & 0.8 & 0.8 \end{bmatrix} \end{array}$$

in $\underset{\sim}{A} \times \underset{\sim}{B}$ space

$$\underset{\sim}{A}' = \left\{ \frac{0}{1.7} + \frac{0.5}{1.8} + \frac{0.7}{1.9} + \frac{0.95}{2.0} + \frac{0.7}{2.1} + \frac{0.5}{2.2} + \frac{0}{2.3} \right\}$$

b) i) min-max composition
ii) Max-product composition

i) $$\underset{\sim}{B}' = \underset{\sim}{A}' \circ \underset{\sim}{R} = \max_{\text{row}} \left[\min_{\text{columns}} \left(\begin{matrix} 0 \\ 0.5 \\ 0.7 \\ 0.95 \\ 0.7 \\ 0.5 \\ 0 \end{matrix} , \begin{bmatrix} 0.8 & 0.8 & 0.8 & 0.8 & 0.8 \\ 0.6 & 0.6 & 0.6 & 0.6 & 0.6 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.2 & 0.4 & 0.8 & 0.4 & 0.2 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.6 & 0.6 & 0.6 & 0.6 & 0.6 \\ 0.8 & 0.8 & 0.8 & 0.8 & 0.8 \end{bmatrix} \right) \right]$$

$$= \max_{\text{row}} \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.2 & 0.4 & 0.8 & 0.4 & 0.2 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0.5 & 0.5 & 0.8 & 0.5 & 0.5 \end{bmatrix}$$

$$\therefore \underset{\sim}{B}' = \left\{ \frac{0.5}{0.25} + \frac{0.5}{0.27} + \frac{0.8}{0.3} + \frac{0.5}{0.33} + \frac{0.5}{0.35} \right\}$$

using max min composition

ii) $$\underset{\sim}{B}' = \underset{\sim}{A}' \circ \underset{\sim}{R} = \max_{\text{row}} \left[\begin{bmatrix} 0 & 0.5 & 0.7 & 0.95 & 0.7 & 0.5 & 0 \end{bmatrix} \cdot \begin{bmatrix} 0.8 & 0.8 & 0.8 & 0.8 & 0.8 \\ 0.6 & 0.6 & 0.6 & 0.6 & 0.6 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.2 & 0.4 & 0.8 & 0.4 & 0.2 \\ 0.4 & 0.4 & 0.6 & 0.4 & 0.4 \\ 0.6 & 0.6 & 0.6 & 0.6 & 0.6 \\ 0.8 & 0.8 & 0.8 & 0.8 & 0.8 \end{bmatrix} \right]$$

$$= \max_{\text{row}} \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0.42 & 0.42 & 0.42 & 0.42 & 0.42 \\ 0.19 & 0.38 & 0.76 & 0.38 & 0.19 \\ 0.42 & 0.42 & 0.42 & 0.42 & 0.42 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0.42 & 0.42 & 0.76 & 0.42 & 0.42 \end{bmatrix}$$

$$\therefore \underset{\sim}{B}' = \left\{ \frac{0.42}{0.25} + \frac{0.42}{0.27} + \frac{0.76}{0.3} + \frac{0.42}{0.33} + \frac{0.5}{0.35} \right\}$$

using max-product composition