CI Homework

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①

cm	short	middle	tall
140	1	0	0
150	1	0	0
160	0.9	0.1	0
170	0.7	1	0
180	0.3	0.8	0.3
190	0	0	1

(a) Support =>

$$Short = \left\{ \frac{140}{1}, \frac{150}{1}, \frac{160}{0.9}, \frac{170}{0.7}, \frac{180}{0.3}, \frac{180}{0.3} \right\}$$

$$middle = \left\{ \frac{160}{0.1}, \frac{170}{1}, \frac{180}{0.8} \right\}$$

$$Tall = \left\{ \frac{180}{0.3}, \frac{190}{1} \right\}$$

(b) Core

$$Short = \left\{ \frac{160}{0.1}, \frac{170}{1} \right\}$$

$$middle = \{170_1\}$$

$$Tall = \left\{ \frac{190}{1} \right\}$$

(c) cardinality

Short = 1.9 (sum = 1+1+0.9+0.7+0.3)

middle = 1.9 (sum = 0+0+0.1+1+0.8)

Tall = 1.3 (= 0+0+0+0+0.3+1)

(d) Complement

$$\text{Short} = \left\{\frac{140}{0}, \frac{150}{0}, \frac{160}{0}, \frac{170}{0.3}, \frac{180}{0.7}, \frac{190}{1}\right\}$$

$$\text{middle} = \left\{\frac{140}{1}, \frac{150}{1}, \frac{160}{0.9}, \frac{170}{0}, \frac{180}{0.2}, \frac{190}{1}\right\}$$

$$\overline{\text{tall}} = \left\{\frac{140}{1}, \frac{150}{1}, \frac{160}{1}, \frac{170}{0.7}, \frac{180}{0.7}, \frac{190}{0}\right\}$$

(e) union of sets

$$= \left\{\frac{140}{1}, \frac{150}{1}, \frac{160}{0.9}, \frac{170}{0.7}, \frac{180}{0.8}, \frac{190}{1}\right\}$$

(f) d-Cut for each set where $d = 0.5$

$$\text{Short} = \left\{\frac{140}{1}, \frac{150}{1}, \frac{160}{0.9}, \frac{170}{0.7}\right\}$$

$$\text{Middle} = \left\{\frac{170}{1}, \frac{180}{0.8}\right\}$$

$$\overline{\text{tall}} = \left\{\frac{190}{1}\right\}$$

(g) $$R = \begin{matrix} \\ x_1 \\ x_2 \end{matrix}\begin{matrix} \begin{matrix} y_1 & y_2 \end{matrix} \\ \begin{bmatrix} 0.7 & 0.5 \\ 0.8 & 0.4 \end{bmatrix} \end{matrix} \quad S = \begin{matrix} \\ y_1 \\ y_2 \end{matrix}\begin{matrix} \begin{matrix} 0.9 & 0.6 & 0.2 \end{matrix} \\ \begin{bmatrix} 0.1 & 0.7 & 0.5 \end{bmatrix} \end{matrix}$$

(h) $$R \times S = \begin{bmatrix} 0.1 & 0.5 & 0.2 \\ 0.1 & 0.4 & 0.2 \end{bmatrix}$$

$x_{11} = \text{Min}[0.7\ 0.9) = 0.7$ Min $(0.5, 0.1) = 0.1$

$= \text{Min}(0.7, 0.1) = 0.1$

$x_{12} = \text{Min}(0.7, 0.6) = 0.6$ Min $(0.5, 0.7) = 0.5$

$x_{13} = \text{Min}(0.7, 0.2) = 0.2$ Min $(0.5, 0.5) = 0.5$

$x_{21} = \min(0.8, 0.9) = 0.8 \quad \min(0.4, 0.1) = 0.1 = 01$

$x_{22} = \min(0.8, 0.6) = 0.6 \quad \min(0.4, 0.7) = 0.4$

$x_{23} = \min(0.8, 0.2) = 0.2, \quad \min(0.4, 0.5) = 0.4 = 0.2$

(5) Rof Max-Min composition

$$M_{Rof}(x_1, z_1) = \max(\min(0.7, 0.9), \min(0.5, 1))$$

$$= \max(0.7, 0.1) = 0.7$$

as x_1 can be connected to z_1 through y_1 & y_2.

$$\mu_{Rof}(x_1, z_2) = \max(\min(0.7, 0.6), \min(0.5, 0.7))$$

$$= \max(0.6, 0.7)$$

$$= 0.6$$

Similarly

$$\mu(x_1, z_3) = \max(\min(0.7, 0.2), \min(0.5, 0.5))$$

$$= \max(0.2, 0.5) = 0.5$$

$$\mu(x_2, z_1) = \max(\min(0.8, 0.9), \min(0.4, 0.1))$$

$$= \max(0.8, 0.1) = 0.8.$$

$\mu(x_2, z_2) = \max(\min(0.8, 0.6), \min(0.4, 0.7))$

$= \max(0.6, 0.4) = 0.6$

$\mu(x_2, z_3) = \max(\min(0.8, 0.2), \min(0.4, 0.5))$

by minmax] $= \max(0.2, 0.4) = 0.4$.

$$T = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \begin{array}{c} \begin{array}{ccc} z_1 & z_2 & z_3 \end{array} \\ \begin{bmatrix} 0.7 & 0.6 & 0.5 \\ 0.8 & 0.6 & 0.4 \end{bmatrix} \end{array}$$

(5) P_1 = "P is very true"

P_2 = "P is false"

where P = "30°, high"

Truth value of P is 0.7

$\mu_{very\ true} = (\mu_{true})^2$

$P_1 = 0.09$

$P_2 = 0.7$

(6) $A = (0.2, 4)$ $B = (3, 4.5)$ $C = (3, 4, 5)$

$u_0 = 3$, $v_0 = 4$.

④ output can be affected by Quality of camera as well as the quality of film

Possible x = {1, 2, 3, 4, 5}

A = {0.7/1, 0.9/2, 0.2/3, 0.4/4, 0/5}

A = "above average picture quality"

a) If A then B

0.4	0.5	0.5
0.4	0.7	0.8

using Mamdani

⑤ $A' = \{0.8/1, 0.8/2.0, 1/3, 0/4, 0/5\}$

⑦ In crisp set, element is either a member of set of not fuzzy sets on other hand allows element to be partially in a set, each element is given degree of membership in a set. This membership value can range from 0 to 1

Advantage

System is flexible is allows modification in the rule. The system can be easily constructed.

limitation.

fuzzy set is Not always accurate results are Perceived based on assumption, so may not be widely accepted.

(6) $A = 1/0 + \frac{0.8}{20} + \frac{0.65}{40} + \frac{0.45}{60} + \frac{0.7}{80} + \frac{0.1}{100}$

$B = 0/0 + \frac{0.45}{20} + \frac{0.6}{40} + \frac{0.8}{60} + \frac{0.95}{80} + 1/100.$

$(A \cup B) = \max [\mu_A(x), \mu_B(x)].$

$(A \cup B) = \{ 1/0 + \frac{0.8}{20} + \frac{0.65}{40} + \frac{0.8}{60} + \frac{0.95}{80} + 1/100 \}$

$(A \cup B)^c = (1 - \mu(A \cup B)x).$

$(A \cup B)^c = (0/0 + \frac{0.2}{20} + \frac{0.35}{40} + \frac{0.2}{60} + \frac{0.05}{80} + 0/100)$

$A/B = A \cap \bar{B}$

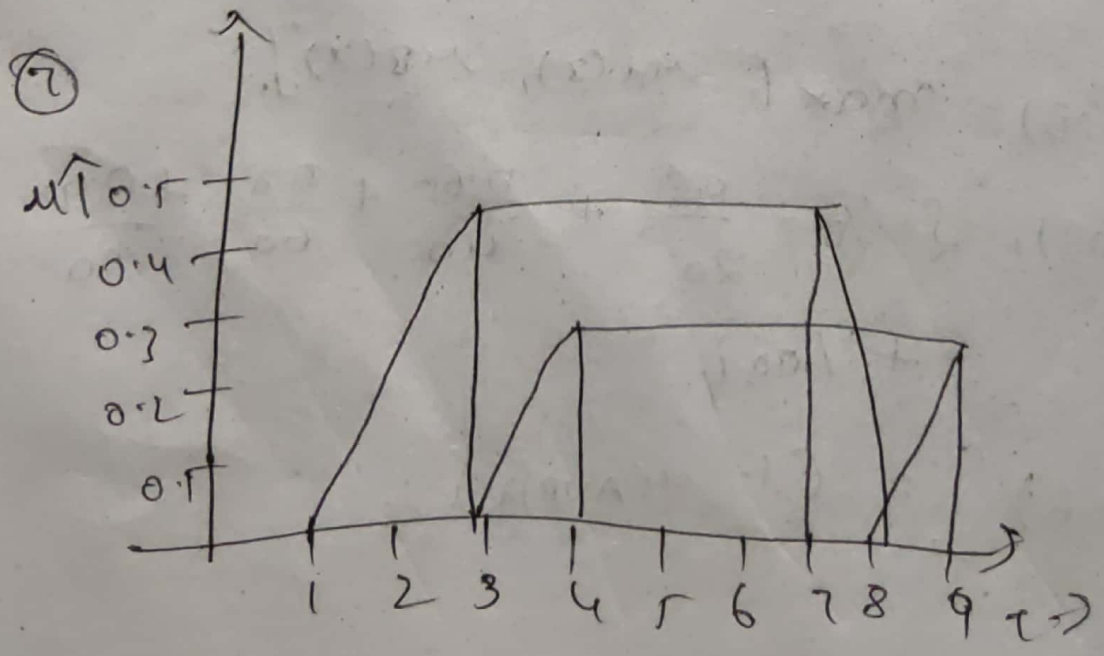
$\bar{B} = 1 - \mu_B(x)$

$\bar{B} = [1/0 + \frac{0.55}{20} + \frac{0.4}{40} + \frac{0.2}{60} + \frac{0.05}{80} + 0/100]$

Now $A \cap \bar{B} = \min [\mu_A(x), \mu_{\bar{B}}(x)]$

$A/B = [1/0 + \frac{0.55}{20} + \frac{0.4}{40} + \frac{0.2}{60} + \frac{0.05}{80} + 0/100]$

(7)



$$x^* = \frac{\sum_{i=1}^{ic} A_i \times \bar{x}_i}{\sum_{i=1}^{ic} A_i}$$

$$A_1 = \frac{1}{2}[(8-1)(7-3)] \times 0.5$$

$$= \frac{11 \times 0.5}{2} = 2.75$$

$$A_2 = \frac{1}{2}[(9-3)+(8-4)] \times 0.3$$

$$= \frac{1}{2}[10 \times 0.3] = 1.5$$

Centre of fuzzy set $= \bar{x}_1 = \left(\frac{7+7}{2}\right) = 10/2 = 5$

Centre of area of fuzzy set $(2 = \bar{x}_2 = \left(\frac{8+4}{2}\right)$

$= 12/2 = 6.$

defuzified value $x = \left(\frac{A_1 \cdot \bar{x}_1 + A_2 \cdot \bar{x}_2}{A_1 + A_2}\right)$

$$= \left(\frac{2.75 * 5 + 1.5 \times 6}{2.75 \times 1.5}\right)$$

$$= \frac{13.75 + 9}{4.25} = 5.3529$$

⑨ a) Distance represented — Angle for both θ & ∅

VH → very Near

NR → Near

VF → very Far

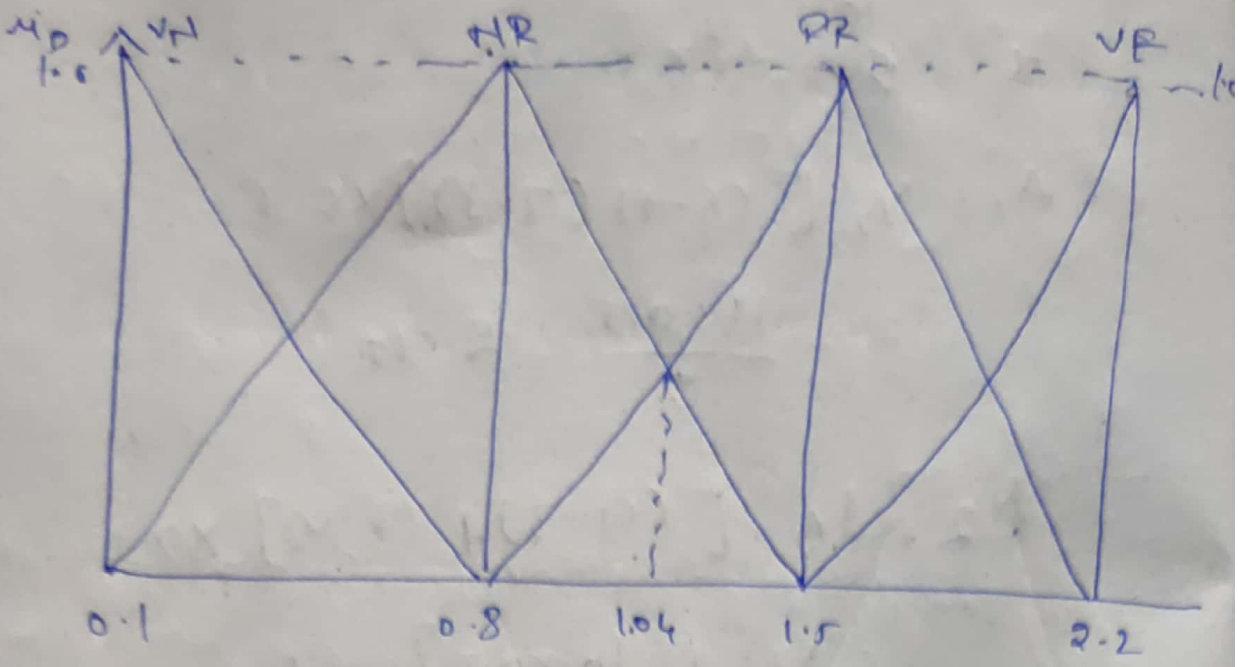
FR → Far

LT → left

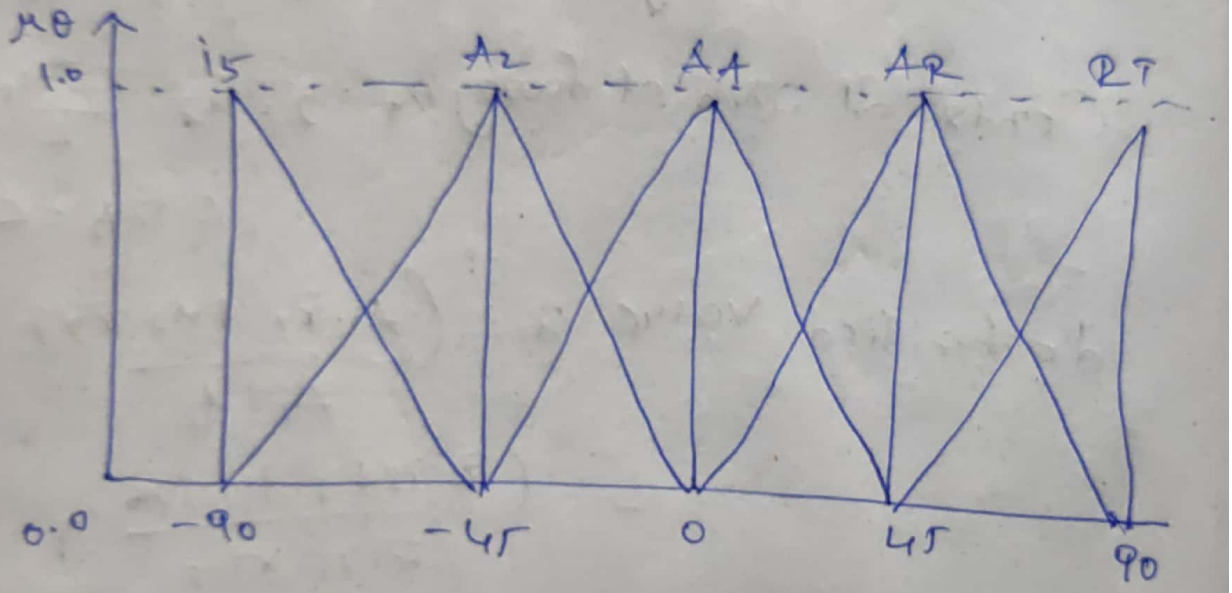
AL → ahead left

AA → ahead

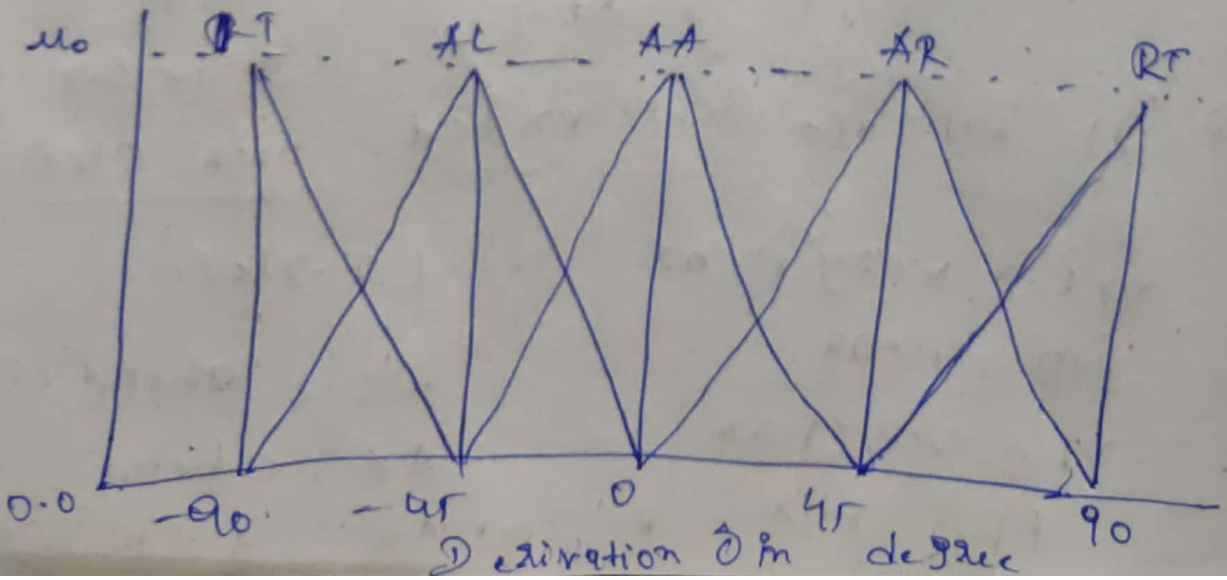
RT → Right AR → ahead Right



Distance D in metres (m+)



Angle θ in degree



Deviation ∂ in degree

Rule base :

	LT	AL	AA	AR	RT
VR	AA	AR	AL	AL	AA
HR	AA	AA	RT	AA	AA
FR	AA	AA	AR	AA	AA
VF	AA	AA	AA	AA	AA

Membership value corresponding to $x = 1.04$ cm
$y = 30^\circ$

$\Rightarrow D = 1.04$ cm may be either HR or FR

In the same way $\theta = 30$ can be either AA or AR

Membership value

$x = 1.04$

$\mu_{HR}(x) = \text{using } x \text{ or } y = \frac{\theta_1}{\theta_2}$

$$\frac{x}{1} = \frac{1.5 - 1.04}{1.5 - 0.8} = \frac{0.46}{0.7} = 0.6571$$

$\mu_{FR}(x) = 0.3429$

$\theta = 30^\circ$

$\mu_{AA}(y) = 0.33$

$\mu_{AR}(y) = 0.66$

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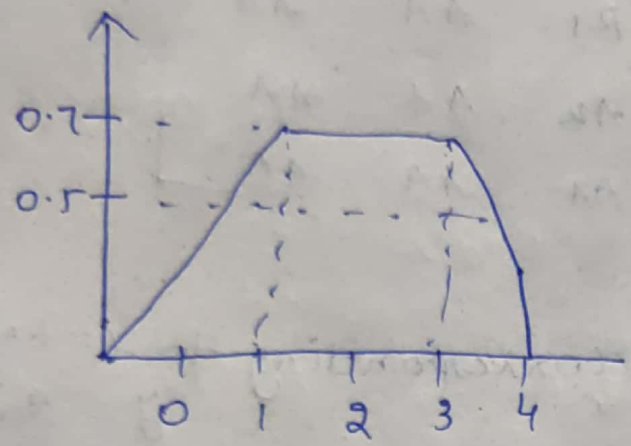
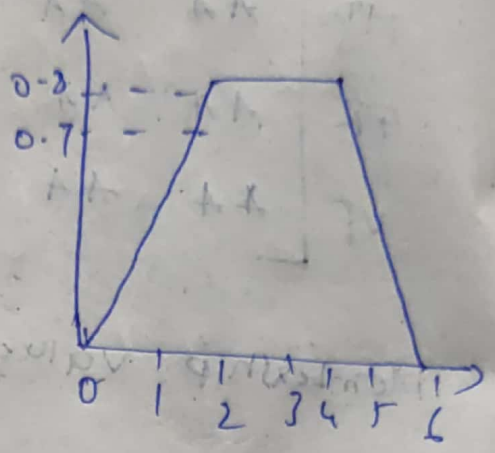
8) If (S_1 is A_1) and (S_2 is B_1) then (f is C_1)

S_1 = Robust S_2 = Fault tolerant



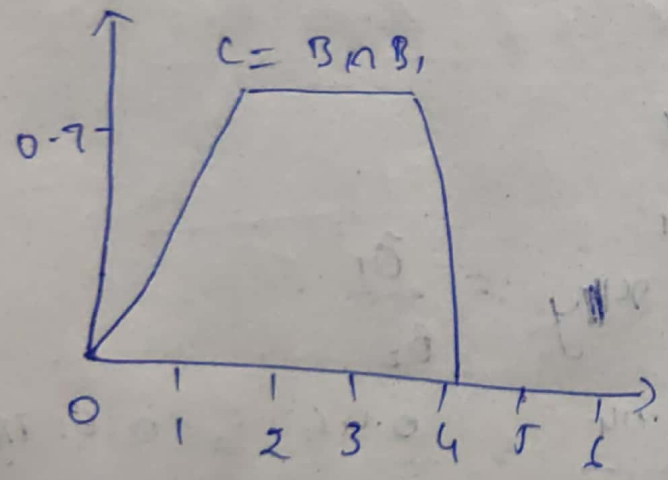


$A_1 = 0.7$ Robust

$B_1 = 0.7$ fault tolerance

$A_1 = 0.7$

$B_1 = 0.7$



$A_2 = 0.5$, $B_2 = 0.8$