HOMEWORK-4

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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

(i) support ⇒

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

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

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

(ii) core →

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

$$\text{middle} = \left\{ \frac{170}{1} \right\}$$

$$\text{Tall} = \left\{ \frac{170}{1} \right\}$$

(iii) cardinality ⇒

short = 3.9 (sum = 1+1+0.9+0.7+0.3)

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

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

(iv) Complement ⇒

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

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

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

(vi) Union of sets $\Rightarrow \left\{ \frac{140}{1}, \frac{150}{T}, \frac{160}{0.9}, \frac{170}{0.7}, \frac{180}{0.8}, \frac{190}{1} \right\}$

(vii) α - cut for each set where $\alpha = 0.5$

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

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

$$\text{Tall} = \left\{ \frac{190}{T} \right\}$$

2.) Given

$$R = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \begin{array}{c} \begin{array}{cc} y_1 & y_2 \end{array} \\ \begin{bmatrix} 0.7 & 0.5 \\ 0.8 & 0.4 \end{bmatrix} \end{array}$$

$$\begin{array}{c} \\ y_1 \\ y_2 \end{array} \begin{array}{c} \begin{array}{ccc} z_1 & z_2 & z_3 \end{array} \\ \begin{bmatrix} 0.9 & 0.6 & 0.2 \\ 0.1 & 0.7 & 0.5 \end{bmatrix} \end{array}$$

(b) $R \circ S$ max min composition

$$\mu_{R\circ S}(x_1, z_1) = \max(\min(0.7, 0.9), \min(0.5, 1))$$

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

as x_1 can be connected to z_1 through y_1 & y_2

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

$$= \max(0.6, 0.5)$$

$$= 0.6$$

Similarity

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

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

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

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

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

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

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

$= \max(0.2, 0.4) = 0.4$

by min max

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

3.) P_1 = 'P is very true'

P_2 = 'P is false'

where P = 30 is high

Truth value of P is 0.3

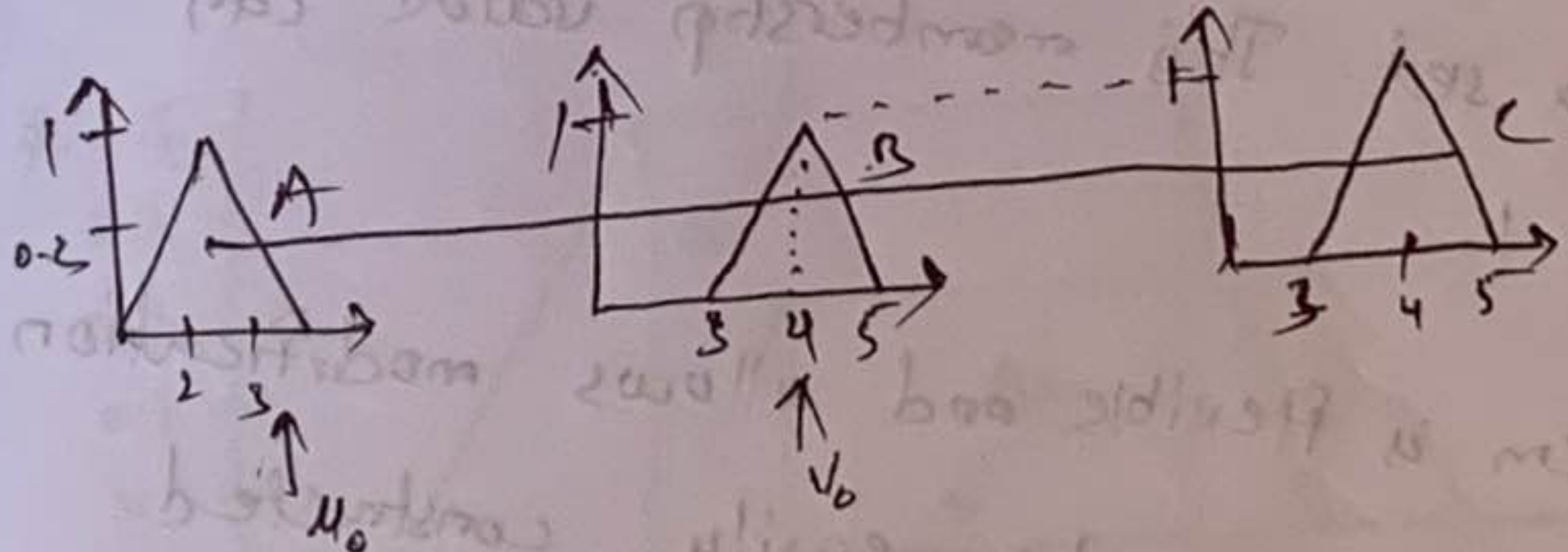
$\mu_{very\ true} = (\mu_{true})^2$

$P_1 = 0.09$

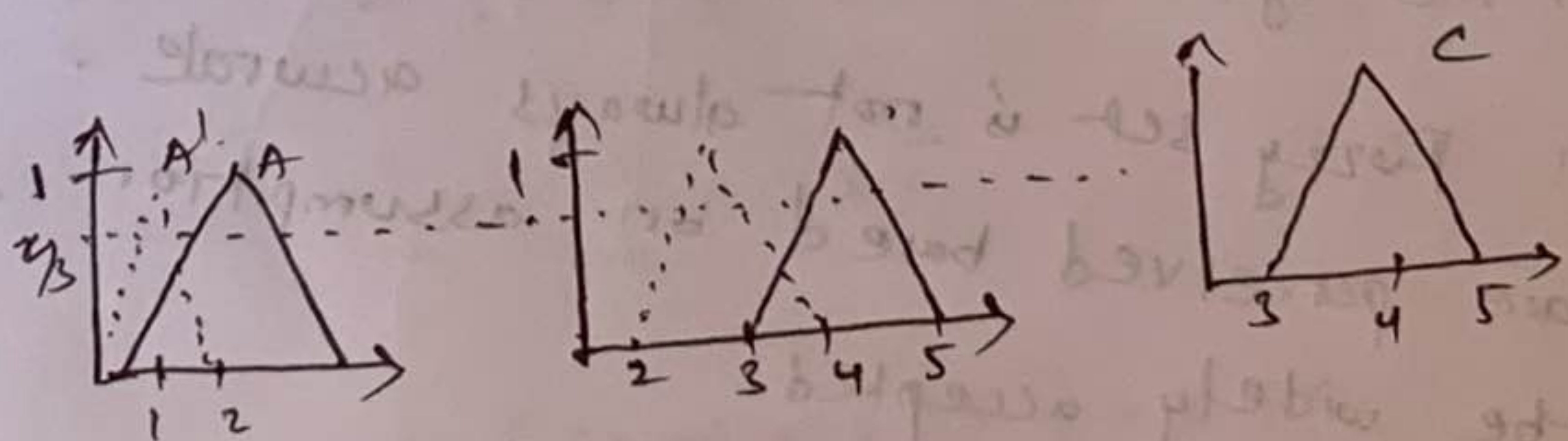
$P_2 = 0.7$

(a) $A = (0, 2, 4)$ $B = (3, 4, 5)$ $C = (3, 4, 5)$

$\mu_0 = 3$ $V_0 = 4$



(b)



4.) Output can be affected by quality of camera as well the quality of film.

possible $X = \{1, 2, 3, 4, 5\}$

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

B = "Above average picture quality"

(a) IF A THEN B

0.4	0.5	0.5
0.4	0.7	0.8

using madami

(b) $A' = \{ 0.8/1, 0.8/2, 0/3, 0/4, 0/5 \}$

B' = Resulting picture rating

$$= \{ 0.6/1, 0.8/2, 0.5/3, 0.1/4, 0/5 \}$$

5.) In crisp set, element is either a member of set or Not. Fuzzy sets on other hand allows elements 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 and allows modification in the rules. The system can be easily constructed.

Limitation: Fuzzy set is not always accurate. Result are perceived based on assumption so may not be widely accepted.

6.) $A = \frac{1}{0} + \frac{0.8}{20} + \frac{0.65}{40} + \frac{0.45}{60} + \frac{0.3}{80} + \frac{0.1}{100}$

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

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

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

$(A \cup B)^c = (1 - \mu_{(A \cup B)x})$

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

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

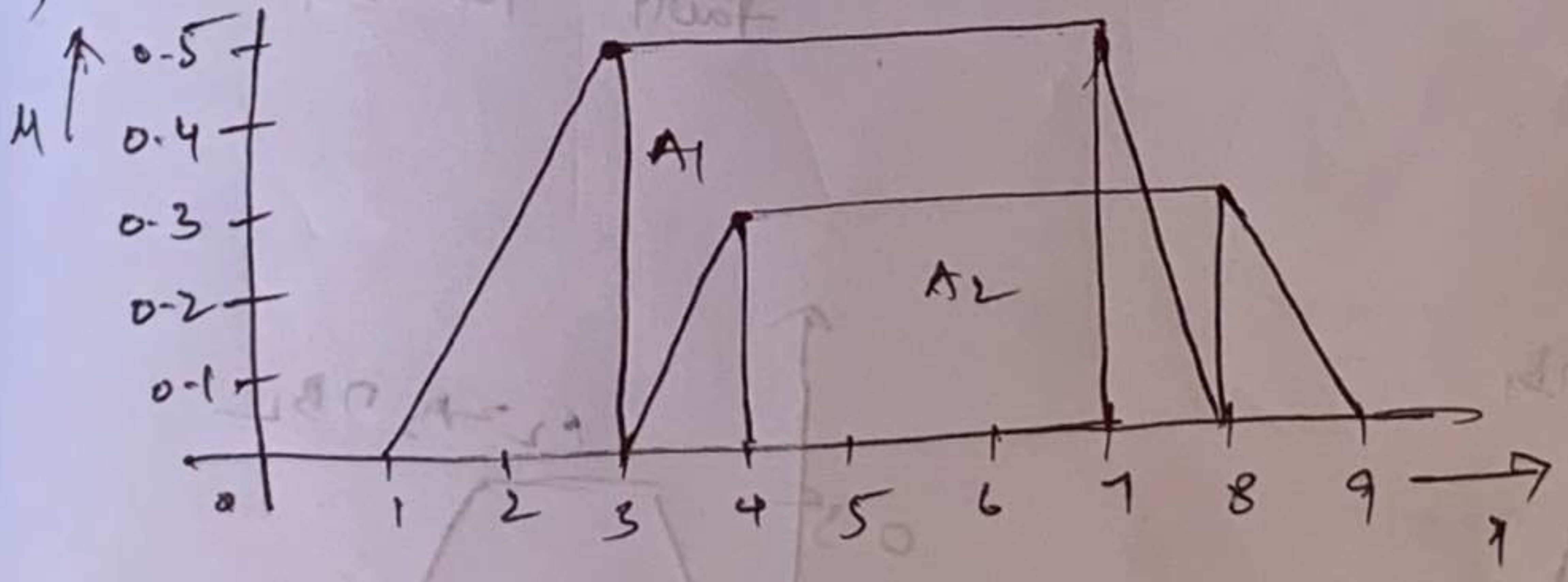
$\bar{B} = 1 - \mu_B(x)$

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

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

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

7.)



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

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

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

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

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

centre of fuzzy set $= \bar{x}_1 = \frac{(7+3)}{2} = \frac{10}{2} = 5$

centre of area of fuzzy set $C_2 = \bar{x}_2 = \frac{8+4}{2} = \frac{12}{2}$

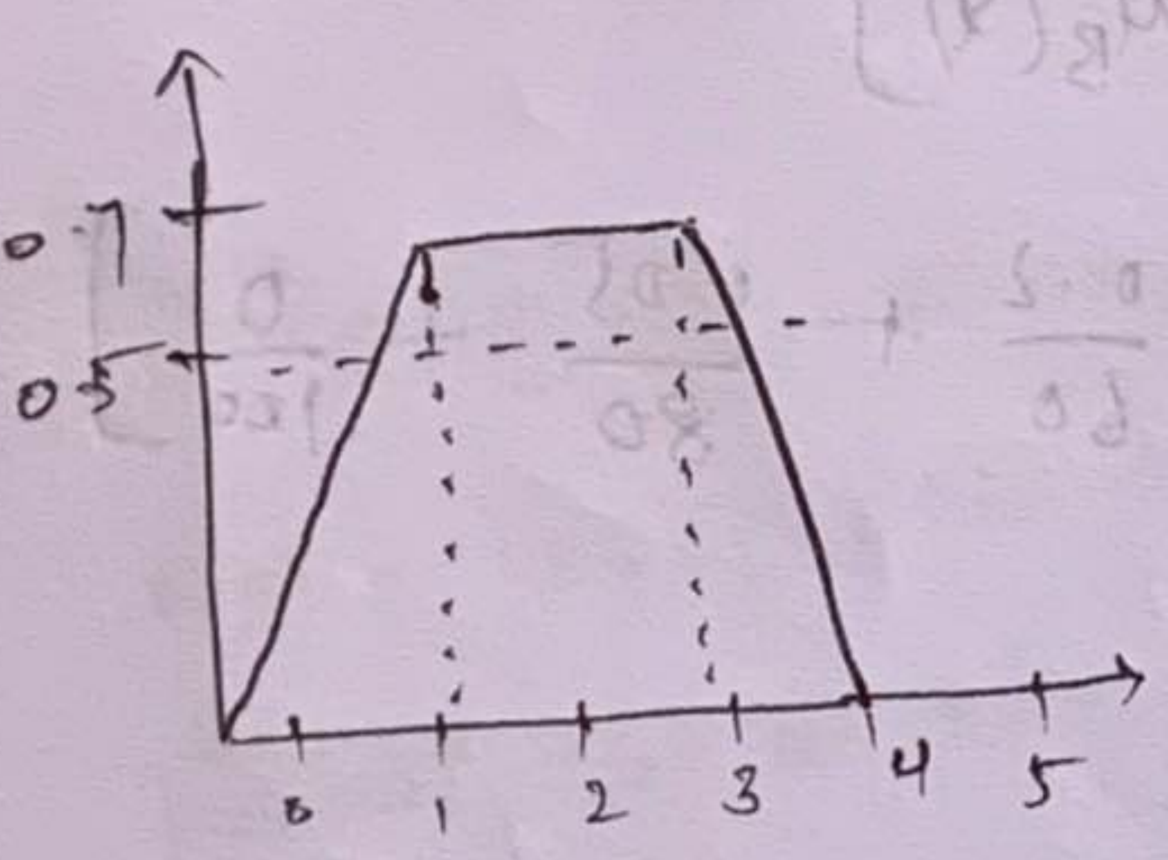
defuzzified value $x = \left(\frac{A_1 \cdot \bar{x}_1 + A_2 \cdot \bar{x}_2}{A_1 + A_2}\right) = \left(\frac{2.75 \times 5 + 1.5 \ldots}{2.75 + 1.5}\right)$

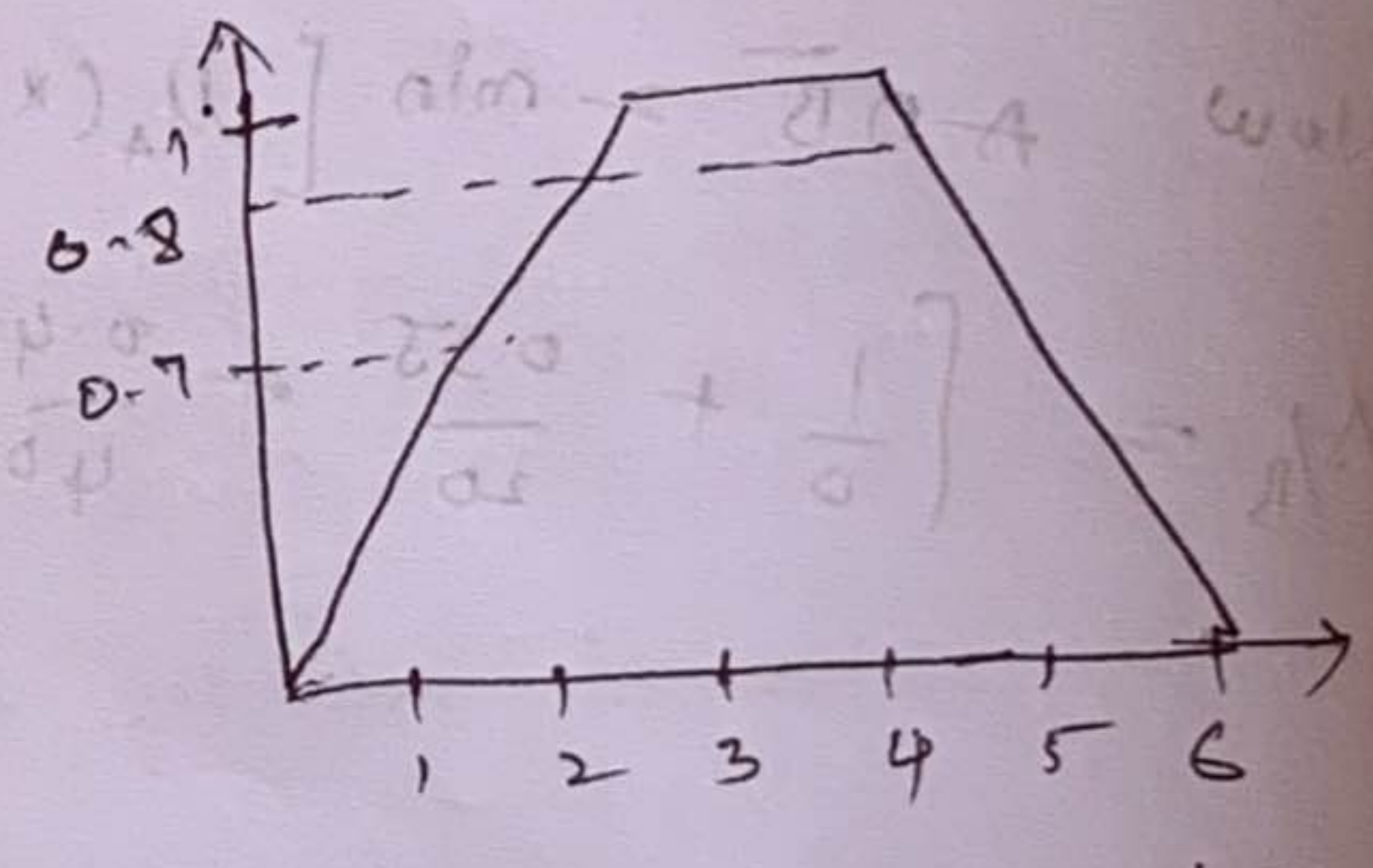
$$= \frac{13.75 + 9}{4.25} = 5.3529$$

8.)

R_1: if (S_1 is A_1) and (S_2 is B_1) then (f is C_1)

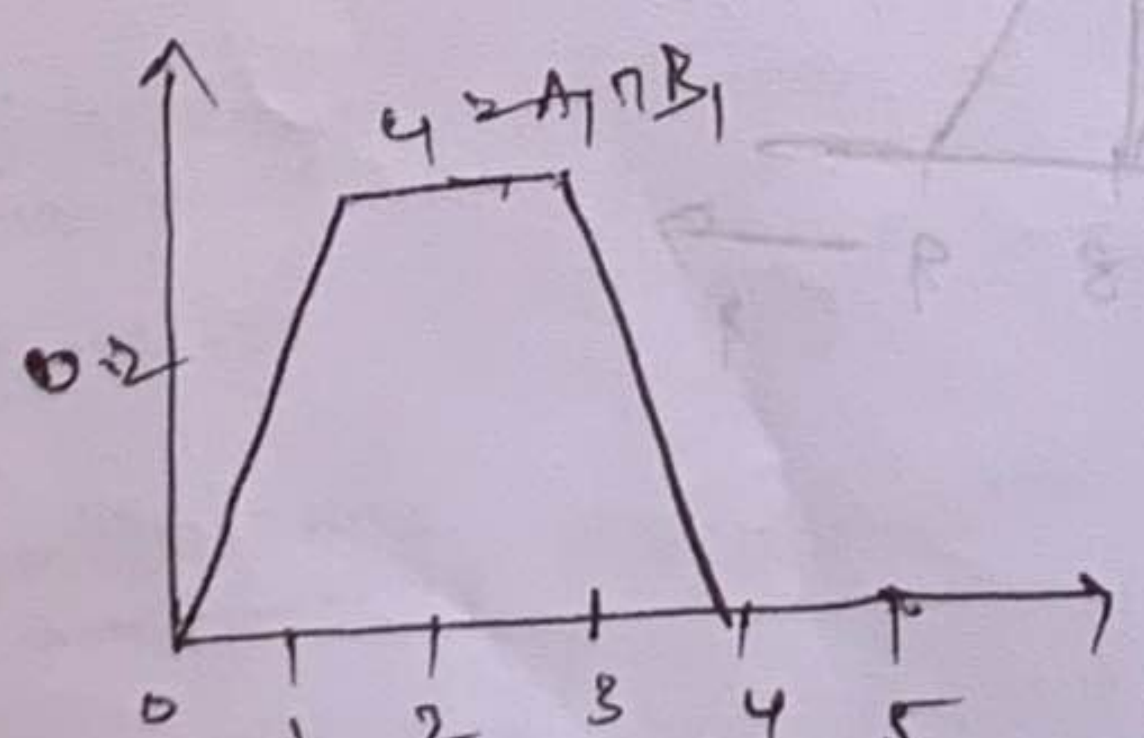
S_1 = Robust $\quad S_2$ = fault tolerant

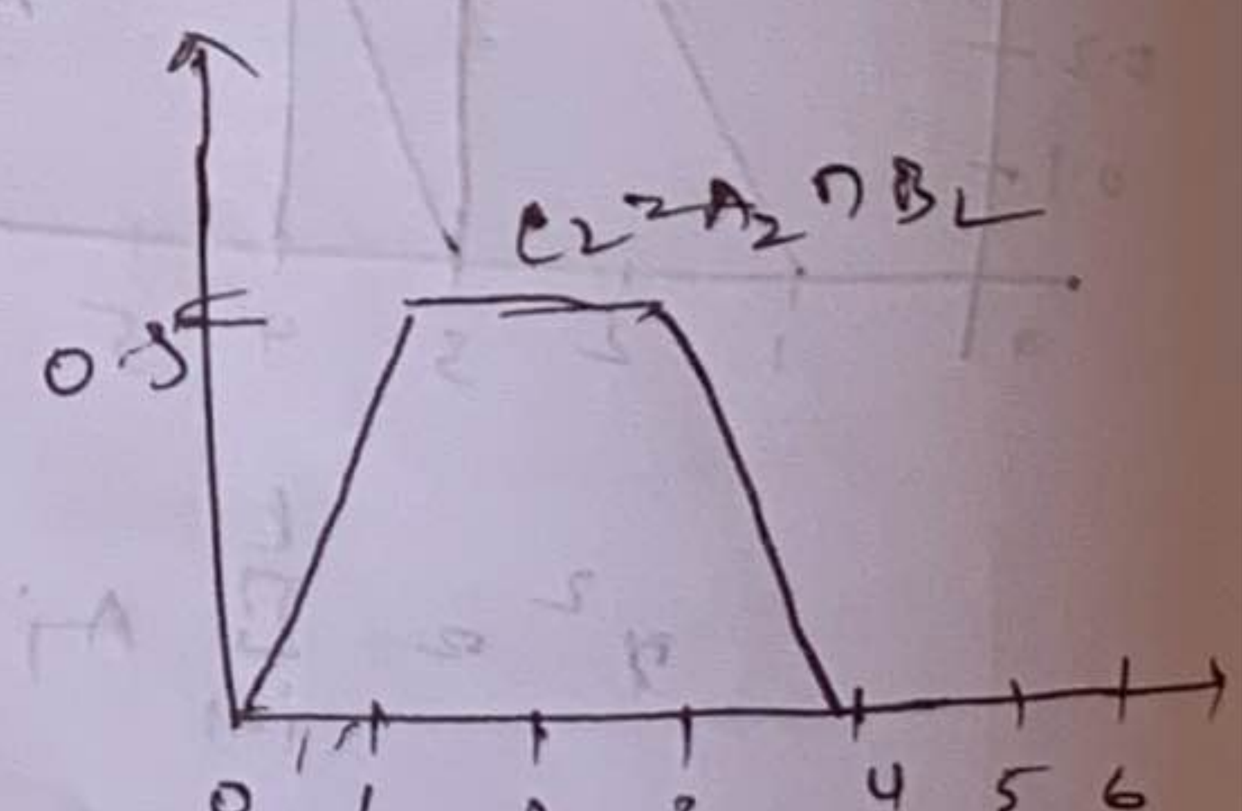




$A_1 = 0.7$ Robust fault tolerant

$B_1 = 0.7$





$A_1 = 0.2$

$B_1 = 0.7$

$A_2 = 0.5$

$B_2 = 0.8$

9.)

(a) Distance represented

VN → very Near

NR → Near

VF → very far

FR → Far

Angle for both θ & δ

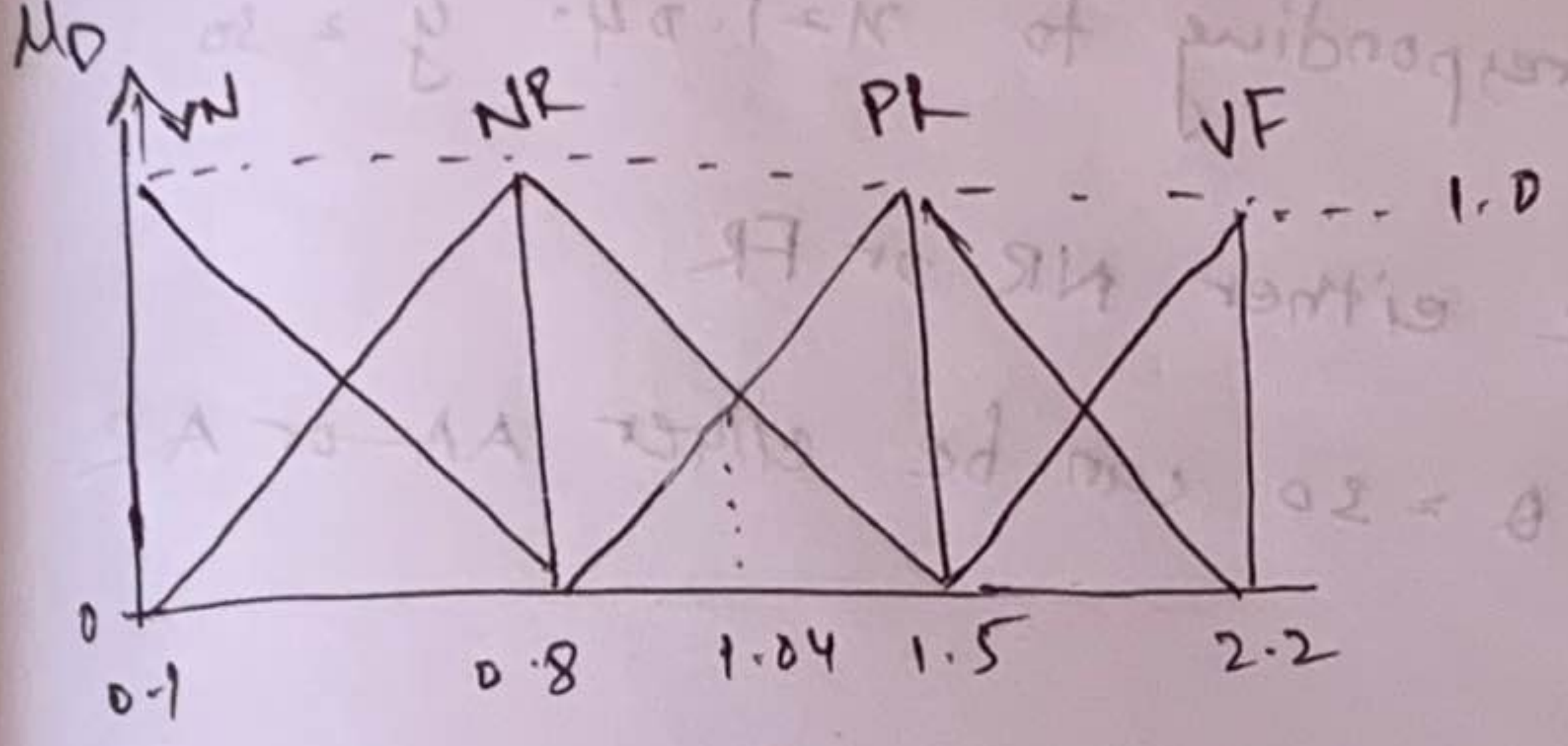
LT → left

AL → Ahead left

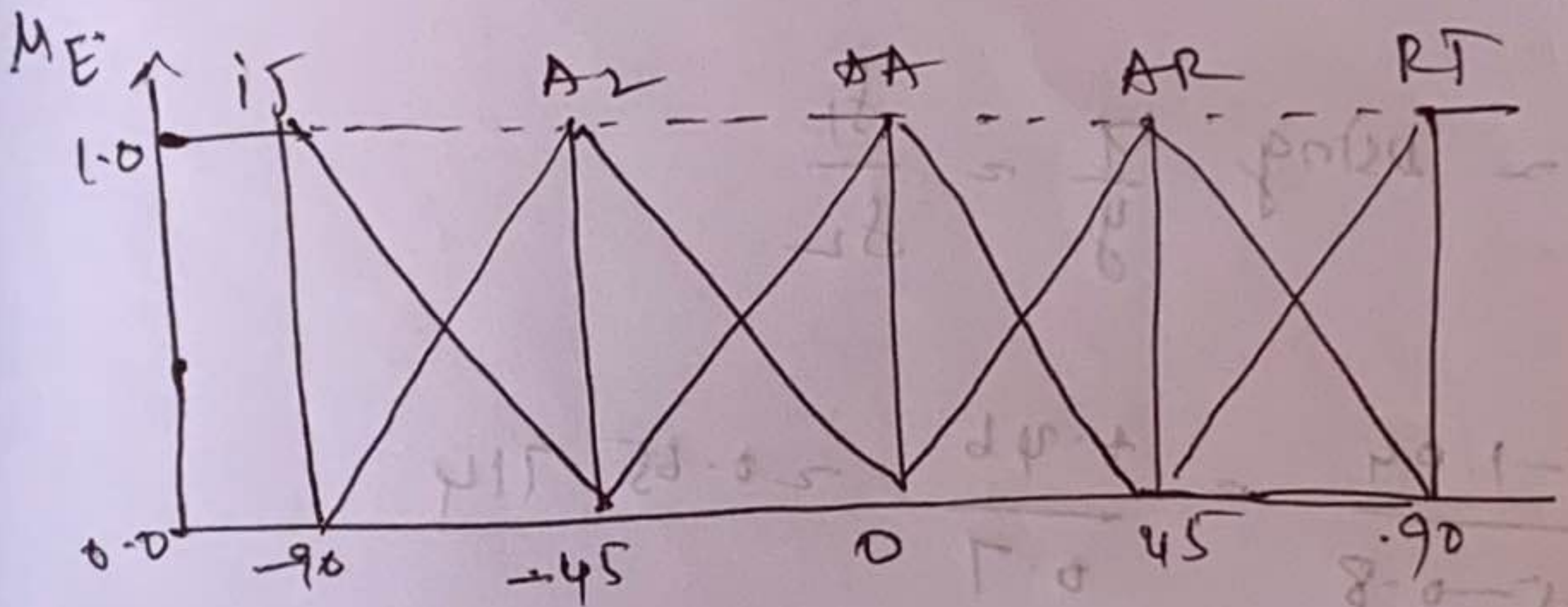
AA → Ahead

AR → Ahead Right

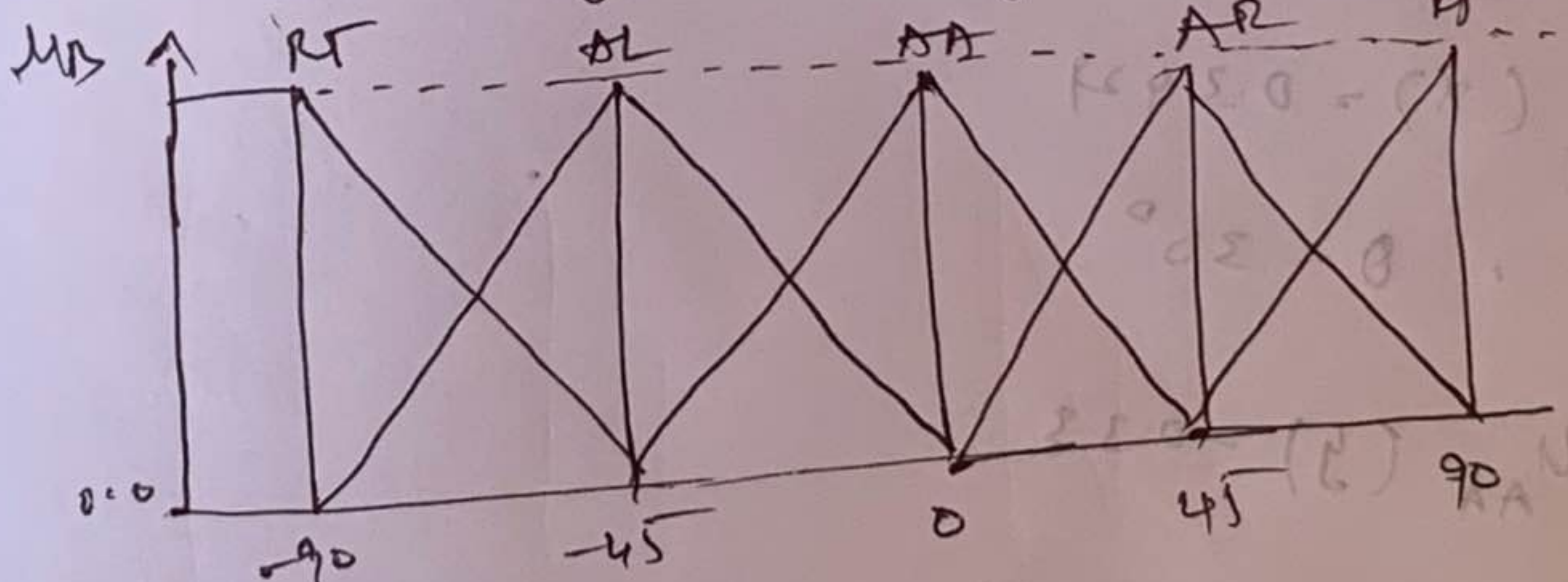
RT → Right



Distance D is metres (not)



Angle θ in degrees.



Distance δ in degree

Rule base

	LT	AL	AA	AL	RT
VN	AA	AR	AL	AL	AA
NR	AA	AA	RT	AA	AA
FR	AA	AA	AR	AA	AA
VF	AA	AA	AA	AA	AA

Membership values corresponding to $x = 1.04$, $y = 30$

→ $D = 1.04$ m may be either NR or FR

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

membership values

$x = 1.04$

$\mu_{NR}(x) =$ using $\frac{x}{y} = \frac{\delta_1}{\delta_2}$

$$\frac{x}{1} = \frac{1.5 - 1.04}{1.5 - 0.8} = \frac{0.46}{0.7} = 0.65714$$

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

$\theta = 30^\circ$

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

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