

Mathematics for Robotics Assignment 4

Fuzzy Logic

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①

$$A = \{(2, 1), (3, 0.5), (4, 0.3), (5, 0.2)\}$$

DISCRETE
X VALUES

$$B = \{(2, 0.5), (3, 0.7), (4, 0.2), (5, 0.4)\}$$

a)

$$A^c = \bar{A} = A \{X, 1 - \mu_A(x)\} =$$

$$\{(2, 0), (3, 0.5), (4, 0.7), (5, 0.8)\}$$

$$d) A - B = A \cap B^c =$$

$$B^c = \{(2, 0.5), (3, 0.3), (4, 0.8), (5, 0.6)\}$$

$$\{(2, 0.5), (3, 0.3), (4, 0.3), (5, 0.2)\}$$

$$b) A \cup B = \max(A(x, y), B(x, y)) =$$

$$\{(2, 1), (3, 0.7), (4, 0.3), (5, 0.4)\}$$

$$e) B - A = B \cap A^c = \{(2, 0), (3, 0.2), (4, 0.2), (5, 0.4)\}$$

$$f) \overline{A \cup B} = \{(2, 0), (3, 0.3), (4, 0.7), (5, 0.6)\}$$

c)

$$A \cap B = \min(A(x, y), B(x, y)) =$$

$$\{(2, 0.5), (3, 0.5), (4, 0.2), (5, 0.2)\}$$

$$g) \overline{A \cap B} = \{(2, 0.5), (3, 0.5), (4, 0.8), (5, 0.8)\}$$

2) a) CARTESIAN PRODUCT $A \times B$

$$\mu_{A \times B}(D, S) = \min\{\mu_A(D), \mu_B(S)\}$$

$$A = \{(D_1, 0.9), (D_2, 0.5), (D_3, 0.4), (D_4, 0.2)\}$$

$$B = \{(S_1, 0.7), (S_2, 0.3), (S_3, 0.8)\}$$

$$A \times B = \begin{matrix} & \begin{matrix} S_1 & S_2 & S_3 \end{matrix} \\ \begin{matrix} D_1 \\ D_2 \\ D_3 \\ D_4 \end{matrix} & \begin{bmatrix} 0.1 & 0.3 & 0.8 \\ 0.1 & 0.3 & 0.5 \\ 0.1 & 0.3 & 0.4 \\ 0.1 & 0.4 & 0.2 \end{bmatrix} \end{matrix}$$

$$b) A \cdot B = \max\{\min\{\mu_A(D), \mu_B(S)\}\}$$

$$\max \left\{ \begin{matrix} D_1 \\ D_2 \\ D_3 \\ D_4 \end{matrix} \begin{bmatrix} 0.1 & 0.3 & 0.8 \\ 0.1 & 0.3 & 0.5 \\ 0.1 & 0.3 & 0.4 \\ 0.1 & 0.4 & 0.2 \end{bmatrix} \right\} = \begin{bmatrix} 0.8 \\ 0.5 \\ 0.4 \\ 0.4 \end{bmatrix}$$

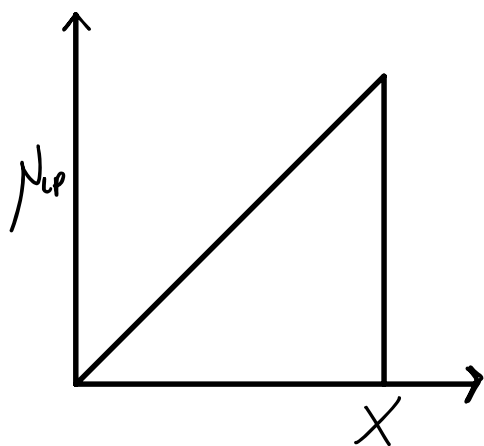
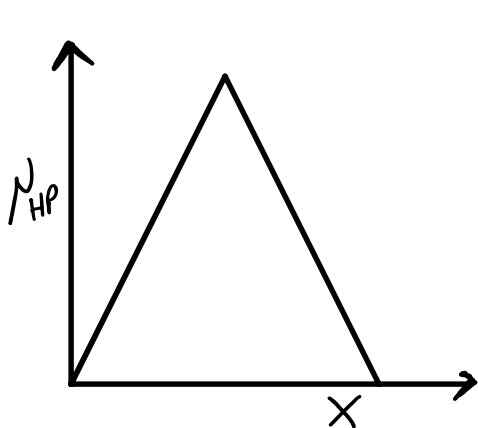
③ SEE MATLAB

4

$$X = \{0, 2, 4, 6, 8, 10\}$$

$$\mu_{HP} = \{0, 0.2, 0.4, 0.6, 0.8, 1\}$$

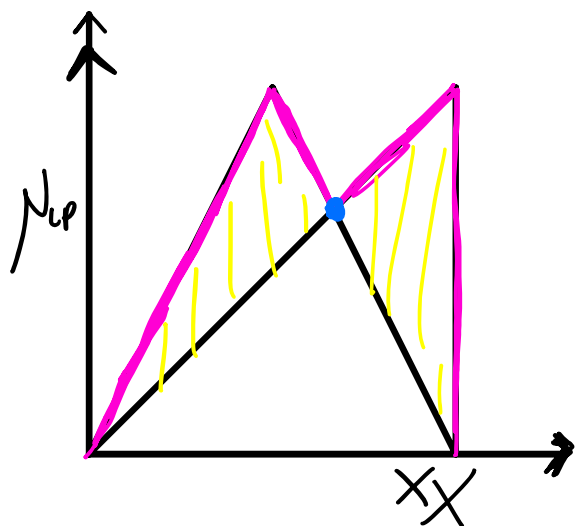
$$\mu_{LP} = \{0, 0.4, 0.8, 0.8, 0.4, 0.2\}$$



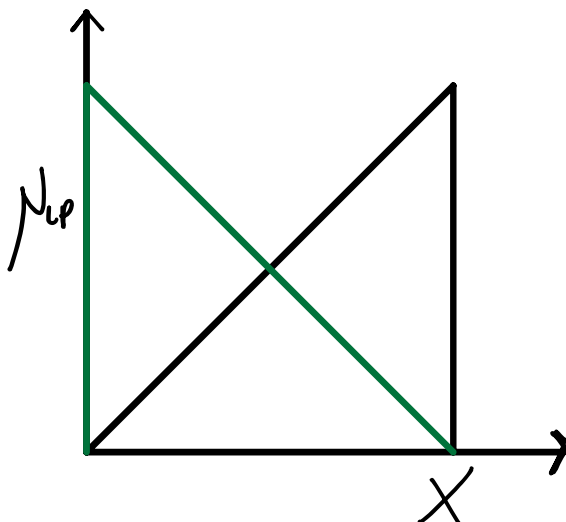
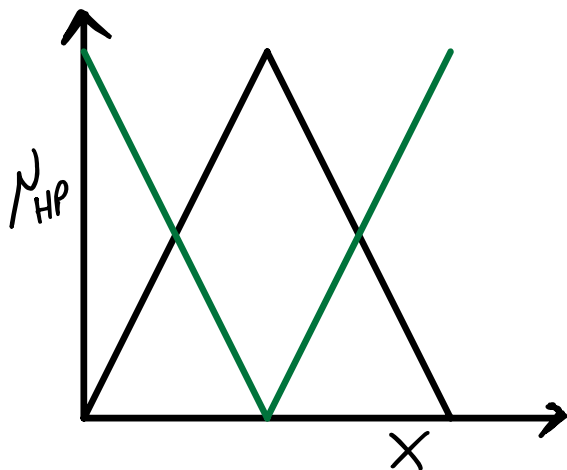
UNION:

INTERSECTION:

DIFFERENCE:

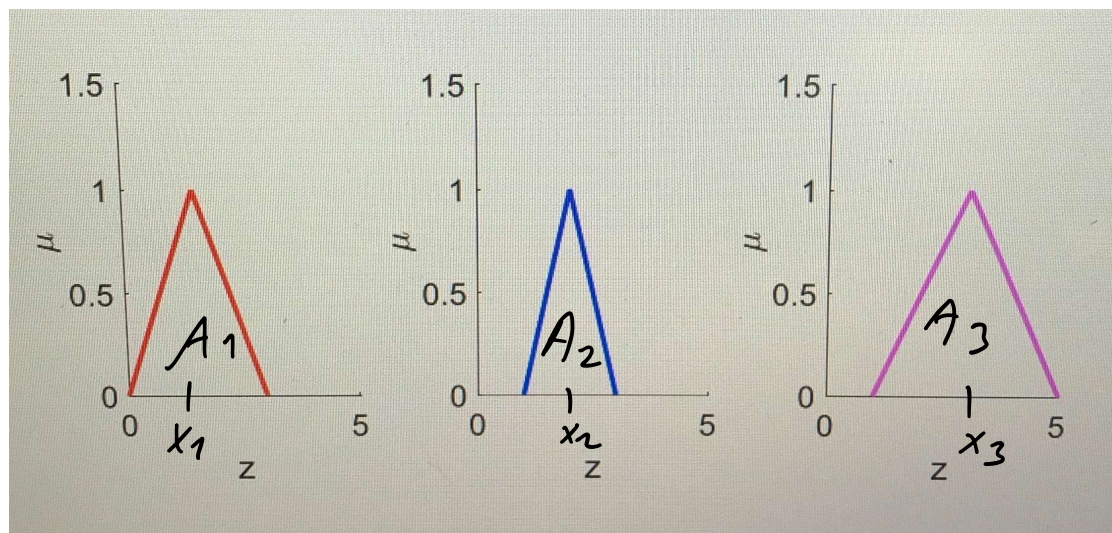
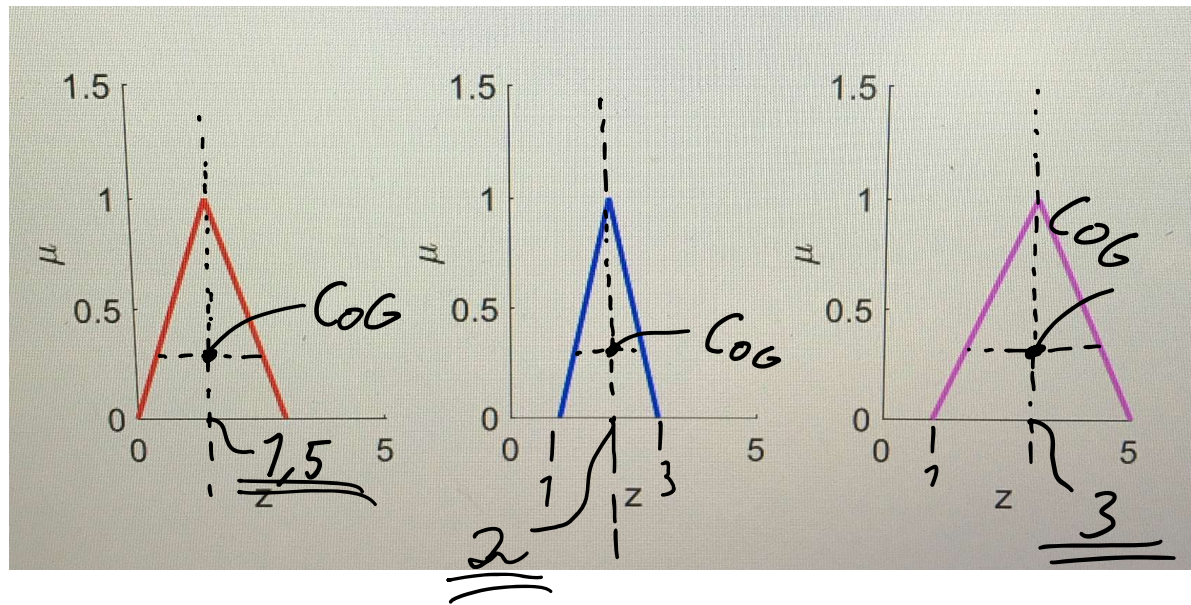


COMPLEMENT



⑤

CENTRE OF GRAVITY:



$x_3 = \text{CENTRE OF LARGEST AREA}$

CENTRE OF SUM

$$C_{OS} = \frac{A_1 x_1 + A_2 x_2 + A_3 x_3}{A_1 + A_2 + A_3}$$

1 Task 3

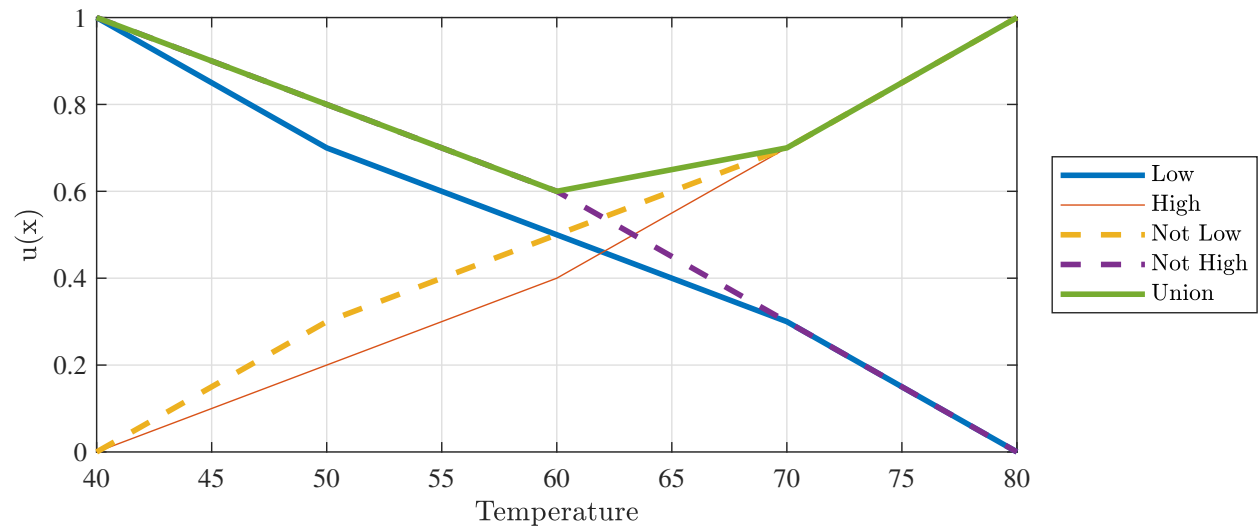


Figure 1: Task 3

```

1  clear; clc; close all;
2  %Task 1 see PDF
3  %Task 2 see PDF
4
5  %Task 3
6
7  x = [40 50 60 70 80];
8  yLow = [1, 0.7, 0.5, 0.3, 0];
9  yHigh = [0 0.2 0.4 0.7 1];
10
11 %a)
12 yNotLow = 1-yLow ;% 0    0.3000    0.5000    0.7000    1.0000
13 %b)
14 yNotHigh = 1-yHigh; %1.0000    0.8000    0.6000    0.3000    0
15 %c)
16 notLow_notHigh = max(yNotLow,yNotHigh)%Union = 1.0000    0.8000    ...
    0.6000    0.7000    1.0000
17
18 plot(x,yLow)
19 hold on
20 plot(x,yHigh)
21 plot(x,yNotLow,'--')
22 plot(x,yNotHigh,'--')
23 plot(x,notLow_notHigh)
24 grid on
25 xlabel("Temperature")
26 ylabel("u(x)")
27 legend("Low","High", "Not Low", "Not High","Not Low U Not High")
28 %a)

```