

Fuzzy Modelling

Exercise 4

Write a script to calculate the product and algebraic product of fuzzy sets A and B, which are described using trapezoidal membership functions:

a)

$$MFA = \mu_A(x) = \begin{cases} 0 & \text{for } x \leq 2 \\ 1 & \text{for } x \geq 4 \end{cases}$$

$$MFB = \mu_B(x) = \begin{cases} 1 & \text{for } x \leq 2 \\ 0 & \text{for } x \geq 4 \end{cases}$$

$$MFC = \mu_C(x) = \text{prod}(\mu_A(x), \mu_B(x))$$

$$\forall x \in X : \mu_{A \cap B}(x) = \text{prod}(\mu_A(x), \mu_B(x)) = \min(\mu_A(x), \mu_B(x))$$

$$MFD = \mu_D(x) = \text{prod}_{\text{Alg}}(\mu_A(x), \mu_B(x))$$

$$\forall x \in X : \mu_{A \cap B}(x) = \text{prod}_{\text{Alg}}(\mu_A(x), \mu_B(x)) = \mu_A(x) \cdot \mu_B(x)$$

C1 – green

C2 – magenta

Z1 – continuous line

Z2 – continuous line

C3 – blue

K4 – black

Z3 – continuous line
line character „x”

Z4 – continuous line
line character „*”

DS = 0.1

R = [0, 6]

b)

$$MFA = \mu_A(x) = \begin{cases} 0 & \text{for } x \leq 3 \\ 1 & \text{for } x \geq 5 \end{cases}$$

$$MFB = \mu_B(x) = \begin{cases} 1 & \text{for } x \leq 3 \\ 0 & \text{for } x \geq 5 \end{cases}$$

$$MFC = \mu_C(x) = \text{prod}(\mu_A(x), \mu_B(x))$$

$$\forall x \in X : \mu_{A \cap B}(x) = \text{prod}(\mu_A(x), \mu_B(x)) = \min(\mu_A(x), \mu_B(x))$$

$$MFD = \mu_D(x) = \text{prod}_{\text{Alg}}(\mu_A(x), \mu_B(x))$$

$$\forall x \in X : \mu_{A \cap B}(x) = \text{prod}_{\text{Alg}}(\mu_A(x), \mu_B(x)) = \mu_A(x) \cdot \mu_B(x)$$

C1 – red

C2 – blue

Z1 – continuous line	Z2 – continuous line
C3 – cyan	C4 – black
Z3 – continuous line line character „o”	Z4 – continuous line line character „+”

DS = 0.1

R = [1, 7]

Draw the membership functions $\mu_A(x)$, $\mu_B(x)$, $\mu_C(x)$ and $\mu_D(x)$ on one graph in the range of R. Use the following colours $\mu_A(x)$ – C1, $\mu_B(x)$ – C2, $\mu_C(x)$ – C3, $\mu_D(x)$ – C4, and continuous lines for each function and line characters Z1, Z2, Z3, Z4.

Sign the membership functions in the following way: $\mu_A(x)$ – MFA, $\mu_B(x)$ – MFB, $\mu_C(x)$ – MFC, $\mu_D(x)$ – MFD. Use a DS discretization step.

Write the equations describing the support and the power of a fuzzy set. Determine the support of the fuzzy sets: $\text{supp}(C)$, $\text{supp}(D)$ and the power of the fuzzy sets: $\text{card}(C)$, $\text{card}(D)$.