HACETTEPE UNIVERSITY
Department of Computer Engineering

Fuzzy Modelling Laboratory

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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:

$$MFA = \mu_A(x) = \begin{Bmatrix} 0\ for\ x \le 2 \\ 1\ for\ x \ge 4 \end{Bmatrix}$$

$$MFB = \mu_B(x) = \begin{Bmatrix} 1\ for\ x \le 2 \\ 0\ for\ x \ge 4 \end{Bmatrix}$$

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

$$MFD = \mu_D(x) = prod_{Alg}(\mu_A(x), \mu_B(x))$$
$$\forall\, x \in X : \mu_{A \cap B}(x) = prod_{Alg}(\mu_A(x), \mu_B(x)) = \mu_A(x) \cdot \mu_B(x)$$

C1 – green
Z1 – continous line

C2 – magenta
Z2 – continous line

C3 – blue
Z3 – continous line
line char “x”

K4 – black
Z4 - continous line
line char “*”

DS = 0.1

R=[0, 6]

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, μC(x) – MFC, μD(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: supp(C), supp(D) and the power of the fuzzy sets: card(C), card(D).

Solution

```
% product and algebraic product
x1=[0:0.1:2]
y1=0*x1
x2=[2:0.1:4]
y2=1/2*x2-1
x3=[4:0.1:6]
y3=0*x3+1

xa=[x1 x2 x3]
ya=[y1 y2 y3]

x4=[0:0.1:2]
y4=0*x4+1
x5=[2:0.1:4]
y5=-1/2*x5+2
x6=[4:0.1:6]
y6=0*x6

xb=[x4 x5 x6]
yb=[y4 y5 y6]

p=min(ya,yb)
ap=ya.*yb

% plot the curves
plot(xa,ya,'g',xb,yb,'m',xa,p,'b-x',xa,ap,'k-*')
grid on
legend('MFA','MFB','MFC','MFD')

% axis, line width, font size
set(gca,'fontsize',16)
```

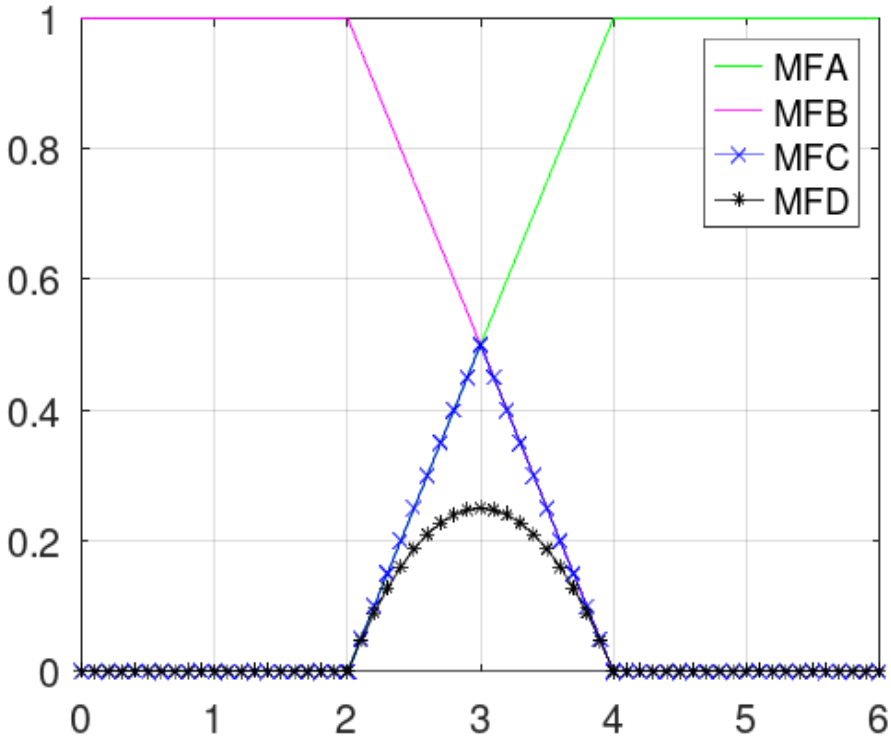

Figure 4.1: The membership functions MFA, MFB and the product MFC and the algebraic product MFD.

support(C) = {2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9}

support(D) = {2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9}

```
% calculate cardinal
cardC=sum(p)
cardD=sum(ap)
```

card(C) = 5.0000

card(D) = 3.3250