

HACETTEPE UNIVERSITY
Department of Computer Engineering

Fuzzy Modelling
Laboratory

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Exercise 3

Write a script to draw the sigmoidal membership functions, which are described by the following mathematical relations:

$$\mu_A(x) = \frac{1}{1 + e^{-4(x-3)}} \quad \mu_B(x) = \frac{1}{1 + e^{-2(x-5)}} \quad \mu_C(x) = \frac{1}{1 + e^{-8(x-5)}}$$

C1 – red

Z1 – line character „*”

DS = 0.25

C2 – green

Z2 – line character „+”

R=[-1, 9]

C3 – blue

Z3 – line character „d”

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

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

Write the equation describing the α -cut of a fuzzy set. Determine the α -cut of the fuzzy sets: α -cut(A) for $\alpha=0.3$ and α -cut(B) for $\alpha=0.6$.

Solution

```
% Sigmoidal membership functions
xa=[-1:0.25:9]
ya=1./(1+exp(-4*(xa-3)))

xb=[-1:0.25:9]
yb=1./(1+exp(-2*(xb-5)))

xc=[-1:0.25:9]
yc=1./(1+exp(-8*(xc-5)))

% plot the curves
plot(xa,ya,'r-*',xb,yb,'g-+',xc,yc,'b-d')
grid on
```

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

% add descriptions to the drawn graphs
text(2.2,0.9,'MFA','fontsize',16)
text(6.5,0.9,'MFB','fontsize',16)
text(4,0.9,'MFC','fontsize',16)
```

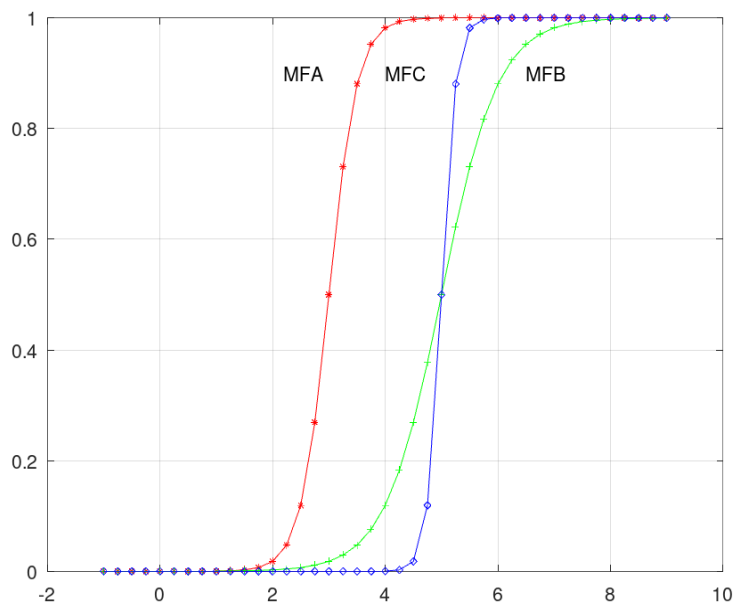


Figure 3.1: The sigmoidal membership functions MFA, MFB and MFC

α -cut(A) for $\alpha=0.3$

α -cut(A) = {3, 3.25, 3.5, 3.75, 4, 4.25, 4.5, 4.75, 5, 5.25, 5.5, 5.75, 6, 6.25, 6.5, 6.75, 7, 7.25, 7.5, 7.75, 8, 8.25, 8.5, 8.75, 9}

α -cut(B) for $\alpha=0.6$

α -cut(B) = {5.25, 5.5, 5.75, 6, 6.25, 6.5, 6.75, 7, 7.25, 7.5, 7.75, 8, 8.25, 8.5, 8.75, 9}

```

% Sigmoidal membership functions
xa=[-1:0.25:9]
ya=1./(1+exp(-4*(xa-3)))

xb=[-1:0.25:9]
yb=1./(1+exp(-2*(xb-5)))

xc=[-1:0.25:9]
yc=1./(1+exp(-8*(xc-5)))

l03=xa*0+0.3
l06=xb*0+0.6

% plot the curves
plot(xa,ya,'r-*',xb,yb,'g-+',xc,yc,'b-
d',xa,l03,'m',xb,l06,'c')
grid on

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

% add descriptions to the drawn graphs
text(2.2,0.9,'MFA','fontsize',16)
text(6.5,0.9,'MFB','fontsize',16)
text(4,0.9,'MFC','fontsize',16)

```

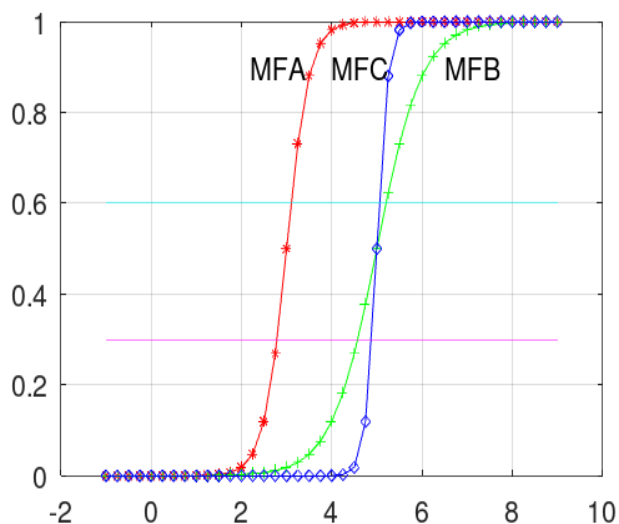


Figure 2.2: The sigmoidal membership functions MFA, MFB and MFC with α -cut lines.