Fuzzy Modelling

LECTURE 2

Example 2.1

Draw the triangular membership functions $\mu_A(x)$, range R = [-8, 7], discretization step DS = 0.2

$$\mu_A(x)=\begin{Bmatrix}0\,for\,x=0\\1\,for\,x=3\\0\,for\,x=5\end{Bmatrix} \qquad (2.1.)$$

Script:

```
% Triangular membership function

x1=[-8:0.2:0]
y1=0*x1
x2=[0:0.2:3]
y2=1/3*x2
x3=[3:0.2:5]
y3=-1/2*x3+2.5
x4=[5:0,2:7]
y4=0*x4
```

```
plot (x1,y1,'g',x2,y2,'g',x3,y3,'g',x4,y4,'g')
grid on
text (4,0.7,'MFA')
```

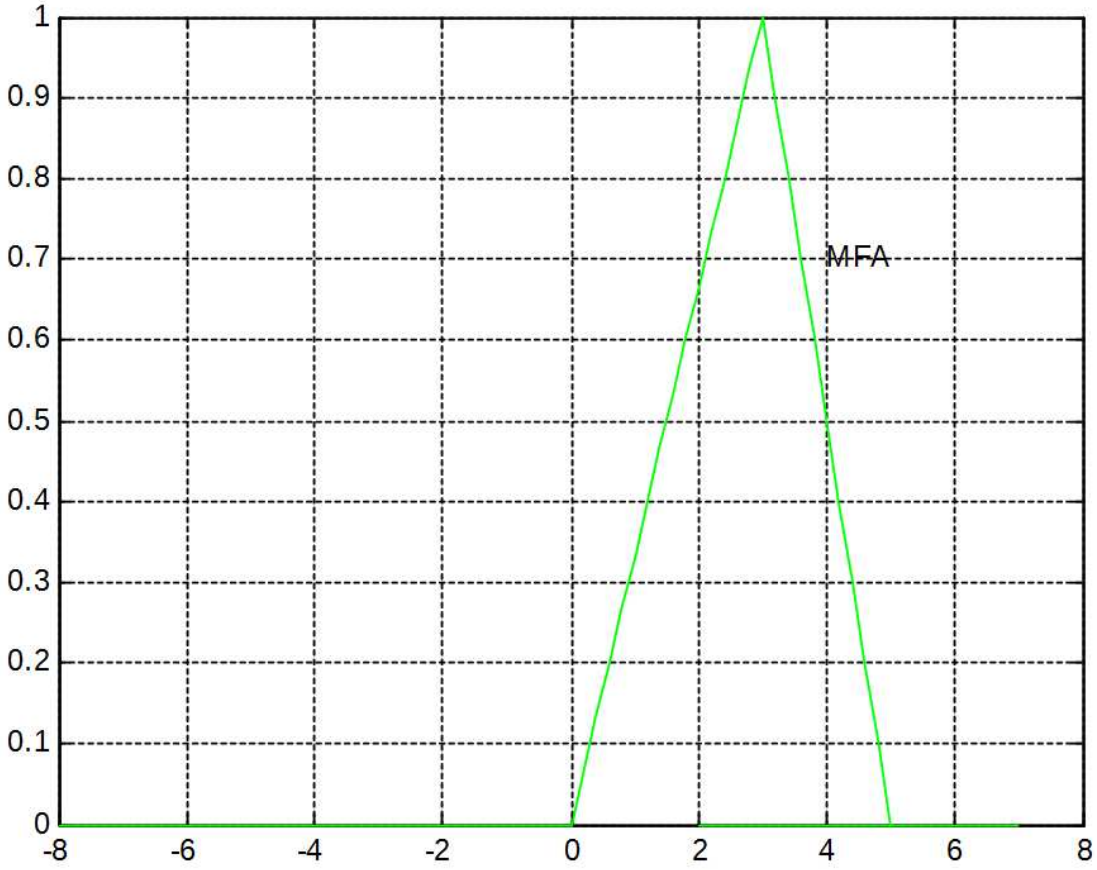

Fig. 2.1. The triangular membership function MFA

core(A) = {3}

supp (A)= { 0,200000000000000 0,400000000000000 0,600000000000000 0,800000000000000 1 1,20000000000000 1,40000000000000 1,60000000000000

1,80000000000000 2 2,20000000000000
2,40000000000000 2,60000000000000
2,80000000000000 3,20000000000000
3,40000000000000 3,60000000000000
3,80000000000000 4 4,20000000000000
4,40000000000000 4,60000000000000
4,80000000000000}

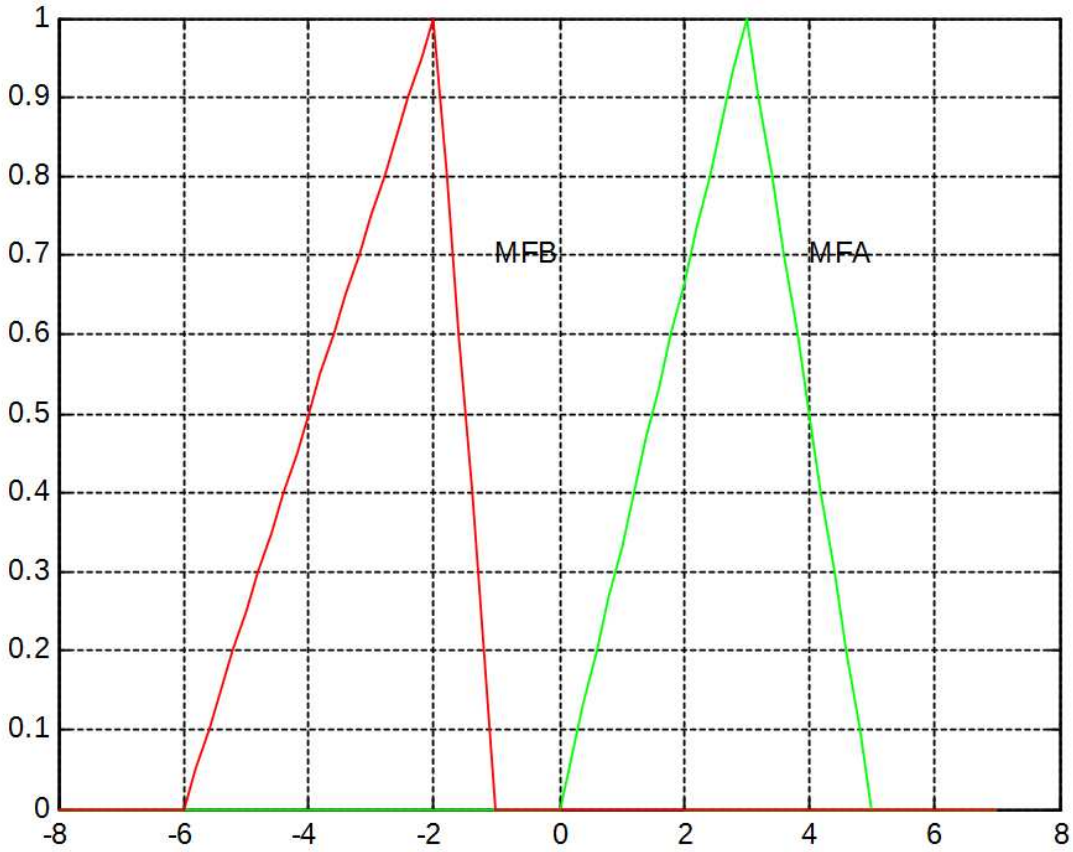

Fig. 2.2. The triangular membership functions MFA and MFB

core(B) = {-2}

Example 2.2

Draw the trapezoidal membership functions $\mu_A(x)$, range R=[-15, 15], discretization step DS = 0.25

$$\mu_A(x)=\begin{Bmatrix} 0\ for\ x=0 \\ 1\ for\ x=3 \\ 0\ for\ x=5 \\ 0\ for\ x=8 \end{Bmatrix} \qquad (2.1.)$$

Script:

```
% Trapezoidal membership function

x1=[-15:0.25:0]
y1=x1*0
x2=[0:0.25:3]
y2=1/3*x2
x3=[3:0.25:5]
y3=0*x3+1
x4=[5:0.25:8]
y4=-1/3*x4+2.66
x5=[8:0.25:15]
y5=x5*0
plot(x1,y1,'m',x2,y2 , 'm',x3,y3,'m',x4,y4,'m',x5,y5
,'m')
grid on
```

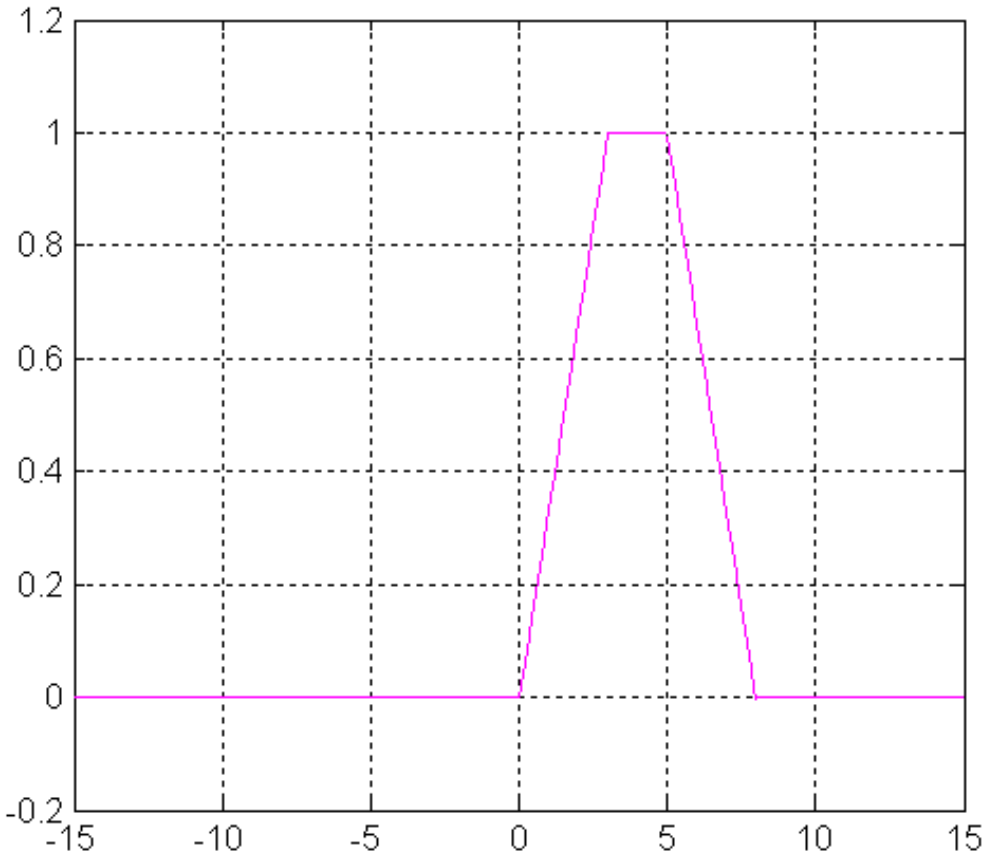

Fig. 2.3. The trapezoidal membership function MFA

core (A)= {3 3,25000000000000 3,50000000000000 3,75000000000000 4 4,25000000000000 4,50000000000000 4,75000000000000 5 }

supp(A)= {0,250000000000000 0,500000000000000 0,750000000000000 1 1,25000000000000 1,50000000000000 1,75000000000000 2 2,25000000000000

2,50000000000000 2,75000000000000 3
3,25000000000000 3,50000000000000
3,75000000000000 4 4,25000000000000
4,50000000000000 4,75000000000000 5
5,25000000000000 5,50000000000000
5,75000000000000 6 6,25000000000000
6,50000000000000 6,75000000000000 7
7,25000000000000 7,50000000000000
7,75000000000000 }

Types of fuzzy sets

The normal fuzzy set:

$$A = N: \quad \sup_{x \in X} \mu_A(x) = 1 \tag{2.1}$$

The normalization procedure:

$$\mu_{An}(x) = \frac{\mu_A(x)}{\sup_{x \in X} \mu_A(x)} \tag{2.2}$$

The subnormal fuzzy set:

$$A = S: \quad \sup_{x \in X} \mu_A(x) < 1 \tag{2.3}$$

The universal fuzzy set:

$$A = U: \quad \forall x \in X \quad \mu_A(x) = 1 \tag{2.4}$$

The empty fuzzy set:

$$A = \varnothing: \quad \forall x \in X \quad \mu_A(x) = 0 \tag{2.5}$$

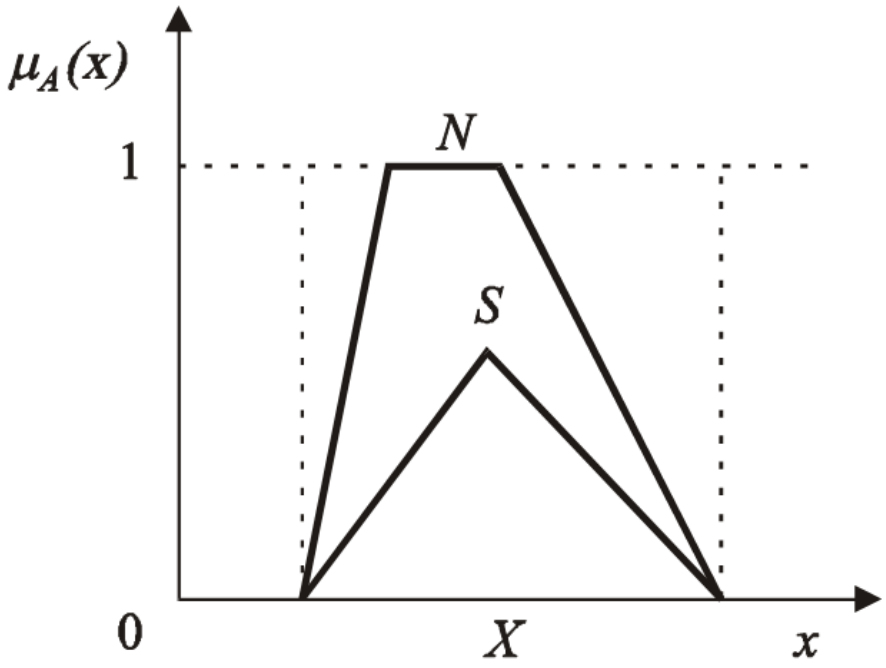

Fig. 2.4. Membership functions of:
N - the normal fuzzy set,
S - the subnormal fuzzy set

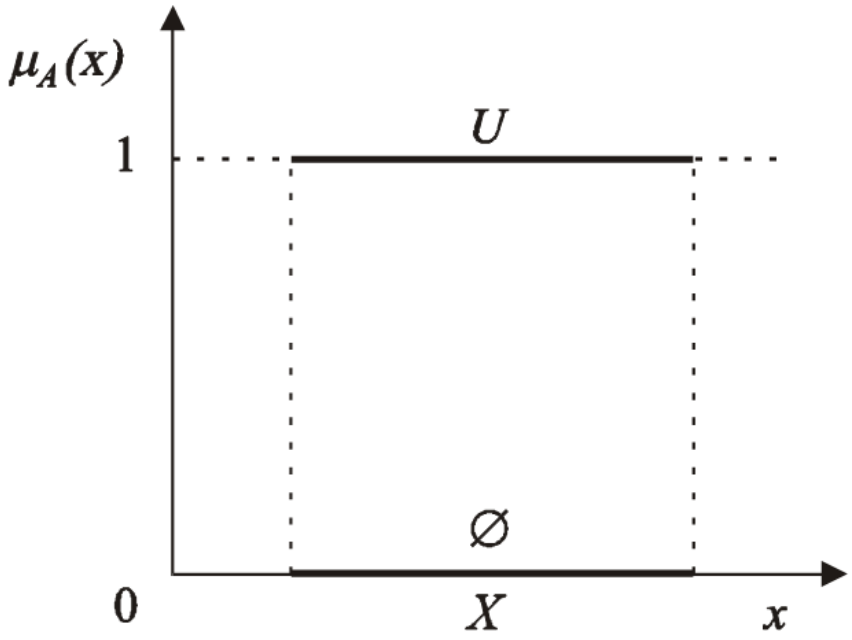

Fig. 2.5. Membership functions of:
U - the universal fuzzy set,
∅ - the empty fuzzy set