

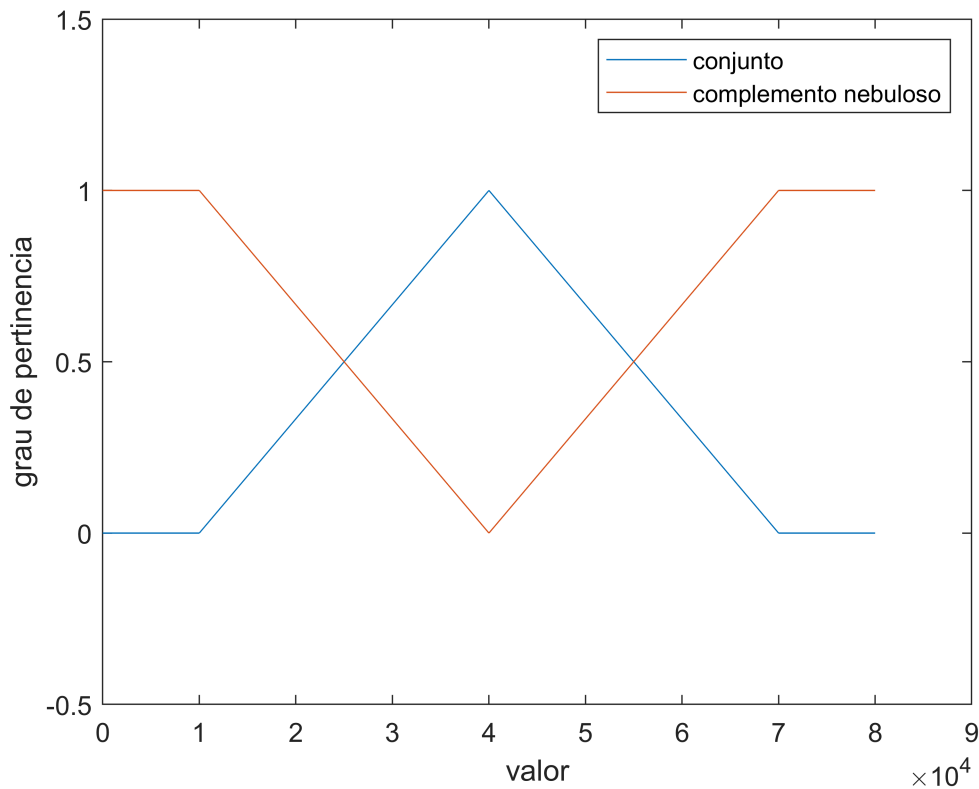
Exercícios computacionais - Parte 1

```
close all
clc

%espaço amostral
t = (0:0.0001:8)';
```

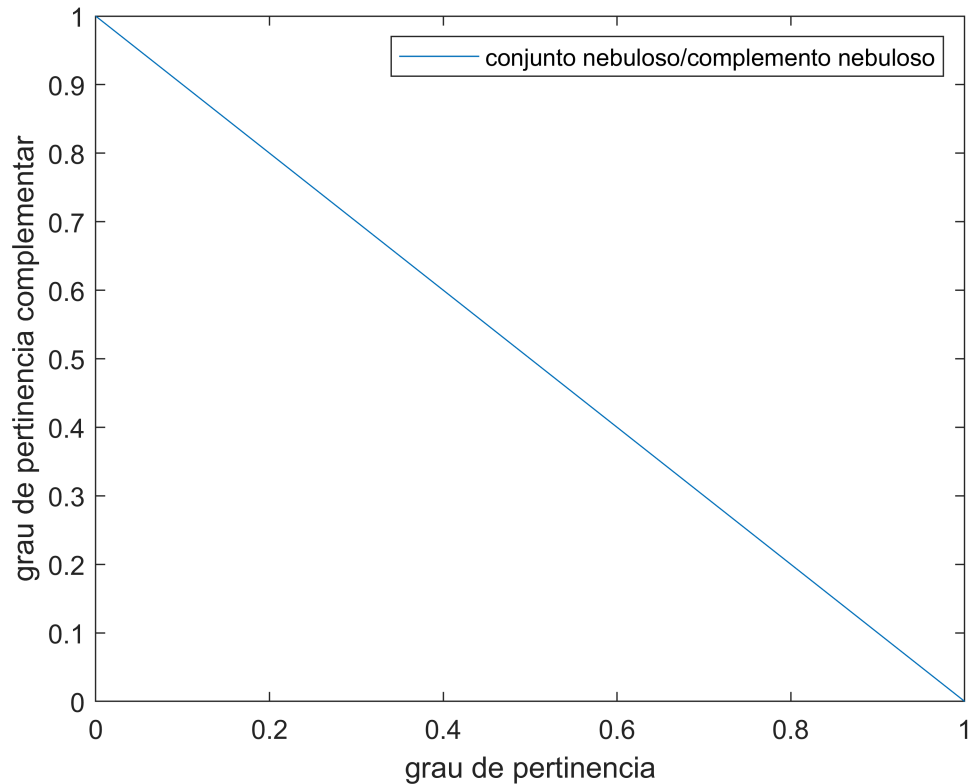
```
%% Operador Complemento de Zadeh
conjNeb = trimf(t,[1,4,7]);
compZadeh = 1 - conjNeb;
```

```
%% Plot Complemento de Zadeh
plot(conjNeb)
ylim([-0.5 1.5]);
hold on
plot(compZadeh)
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend('conjunto', 'complemento nebuloso');
```



```
figure
plot(conjNeb, compZadeh)
hXLabel = xlabel('grau de pertinencia');
hYLabel = ylabel('grau de pertinencia complementar');
```

```
hLegend = legend('conjunto nebuloso/complemento nebuloso');
```

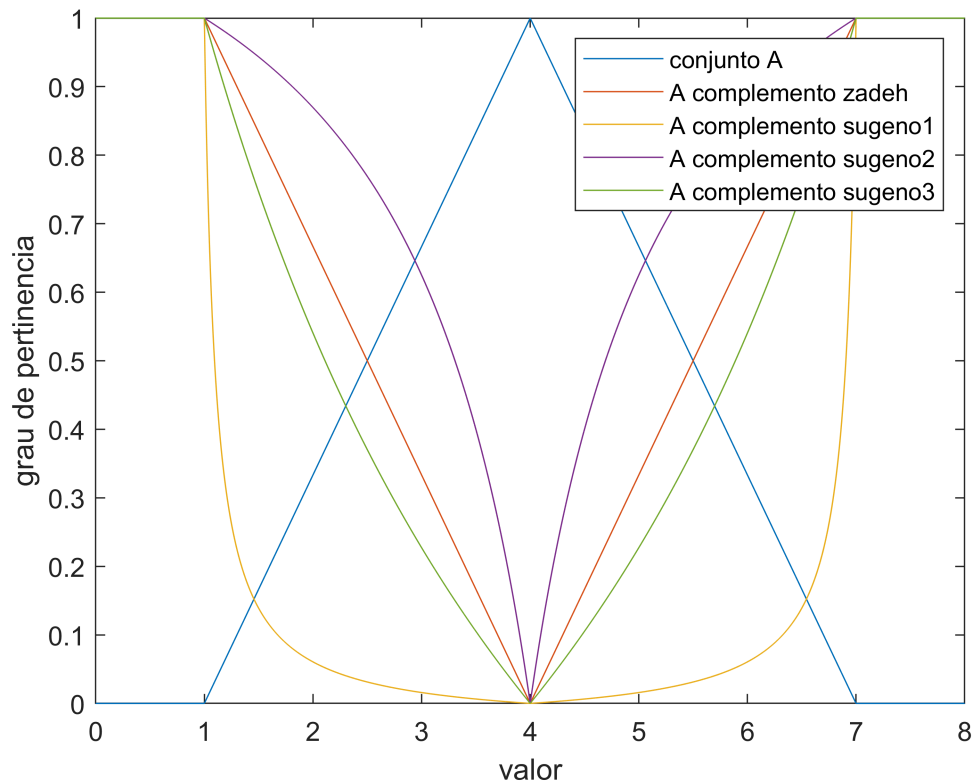


```
%% Operador Complemento de Sugeno
% parametros sugeno
su = 30;
su1 = -0.70;
su2 = 0.70;

% operador
compSugeno2=(1-conjNeb)./(1+su*conjNeb);
compSugeno3=(1-conjNeb)./(1+su1*conjNeb);
compSugeno4=(1-conjNeb)./(1+su2*conjNeb);
```

```
% Plot complemento sugeno
plot( ...
    t,conjNeb, ...
    t,compZadeh, ...
    t,compSugeno2, ...
    t,compSugeno3, ...
    t,compSugeno4)
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'conjunto A', ...
    'A complemento zadeh', ...
    'A complemento sugeno1', ...
```

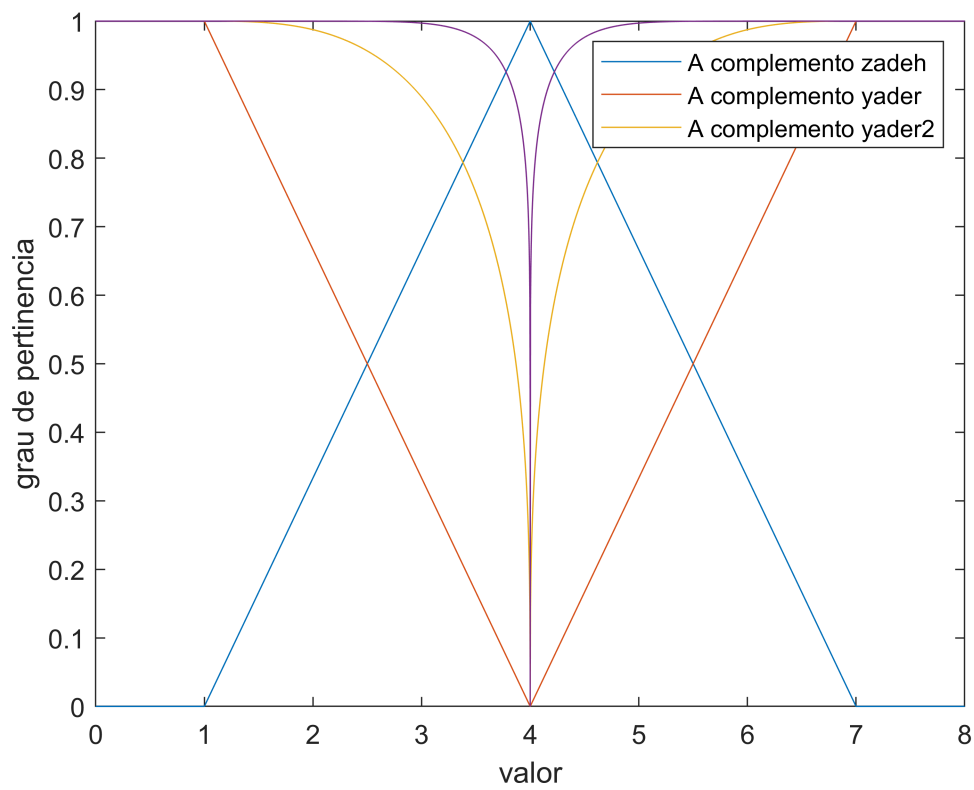
```
'A complemento sugeno2', ...
'A complemento sugeno3');
```



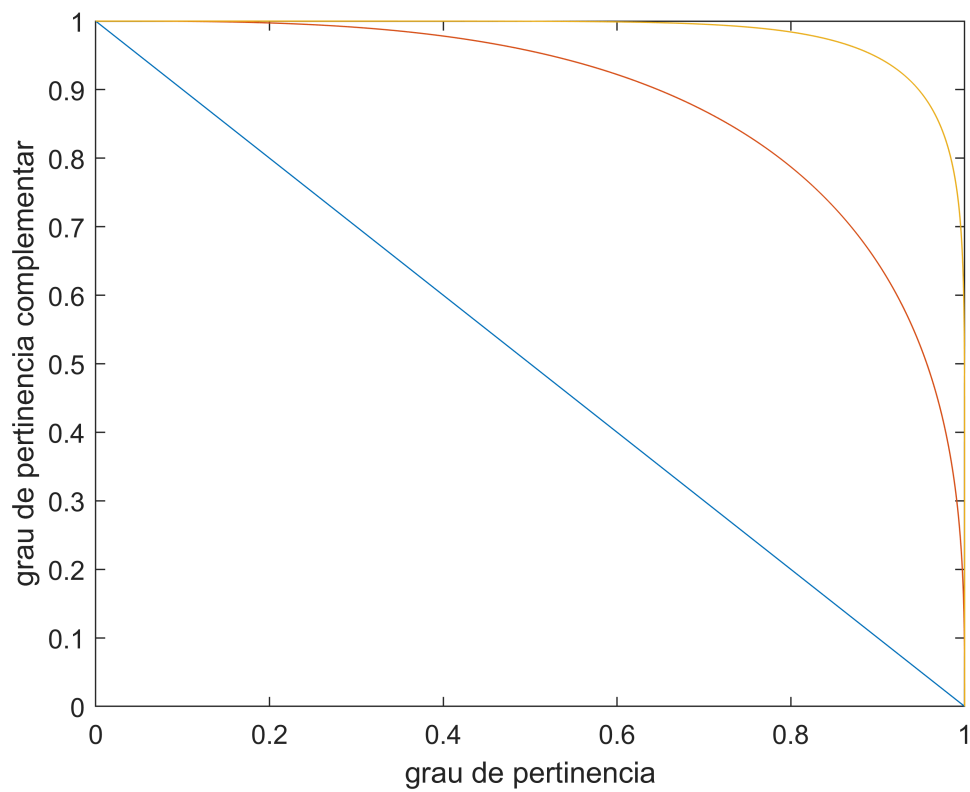
figure

```
%% Operador Complemento de Yader
% parametros de yader
y1 = 3;
y2 = 9;
compYader = (1-conjNeb.^y1).^(1/y1);
compYader2= (1-conjNeb.^y2).^(1/y2);
```

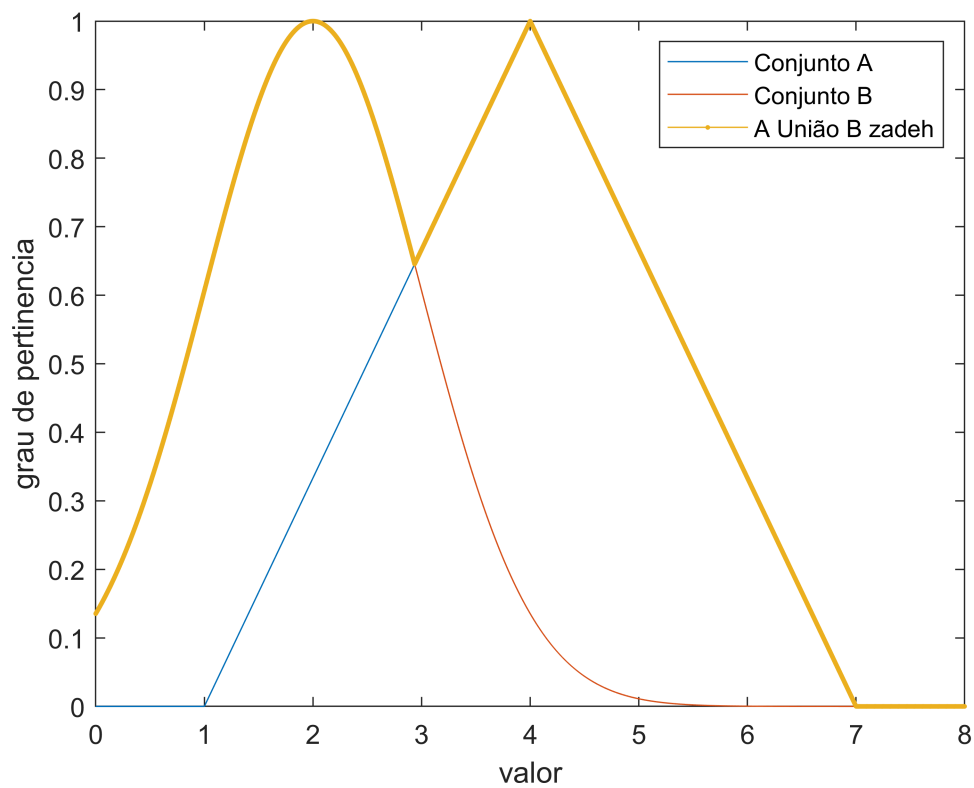
```
% Plot Complemento Yader
% Plot complemento sugeno
plot( ...
    t,conjNeb, ...
    t,compZadeh, ...
    t,compYader, ...
    t,compYader2)
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'A complemento zadeh', ...
    'A complemento yader', ...
    'A complemento yader2');
```



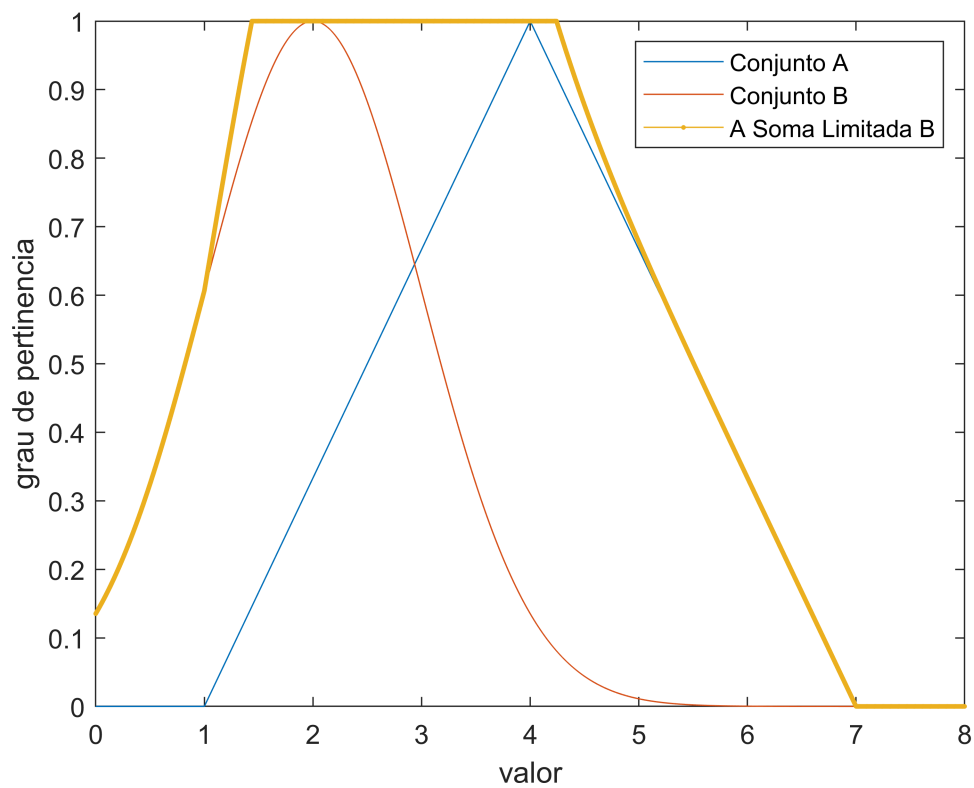
```
figure
plot(...
    conjNeb,compZadeh, ...
    conjNeb,compYader, ...
    conjNeb,compYader2)
hXLabel = xlabel('grau de pertinencia');
hYLabel = ylabel('grau de pertinencia complementar');
```



```
% Operador União de Zadeh
conjNeb2 = gaussmf(t,[1,2]);
uZadeh = max(conjNeb,conjNeb2);
plot(t,conjNeb, ...
      t,conjNeb2, ...
      t,uZadeh,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A União B zadeh');
```

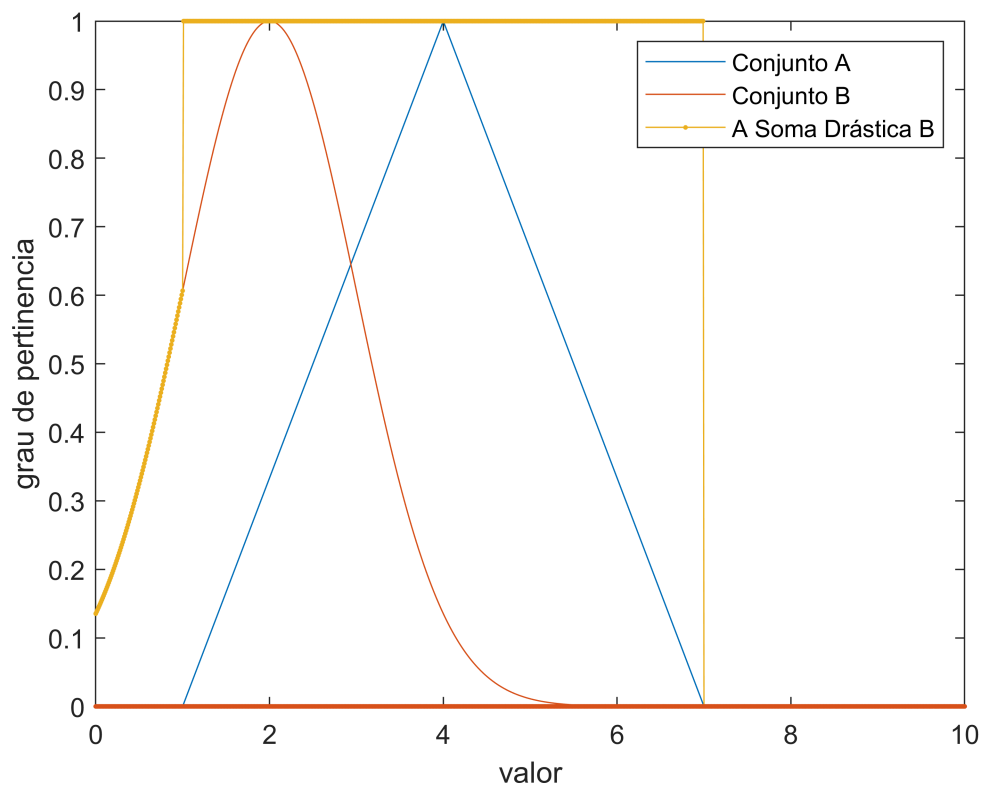


```
% Operador Soma Limitada
somaLimitada = min(1,conjNeb+conjNeb2);
plot(t,conjNeb, ...
      t,conjNeb2, ...
      t,somaLimitada,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A Soma Limitada B');
```

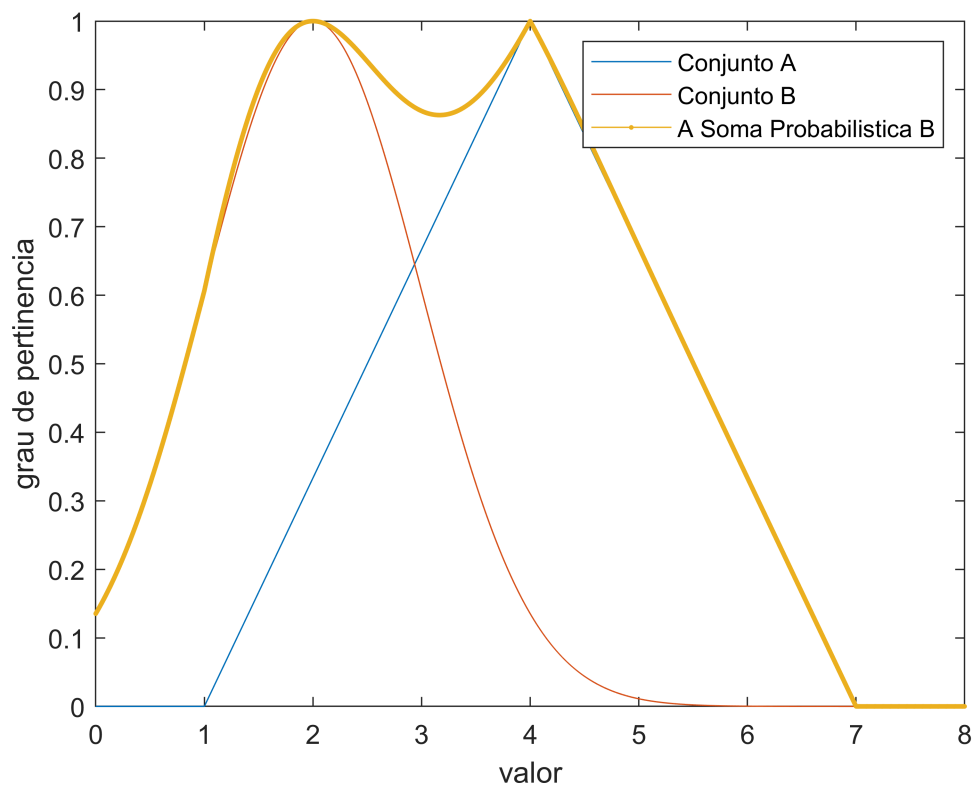


```
% Operador Soma Drástica
sDrastica = zeros(1001)';
x=(0:0.01:10)';
a= trimf(x,[1,4,7]);
b=gaussmf(x,[1,2]);

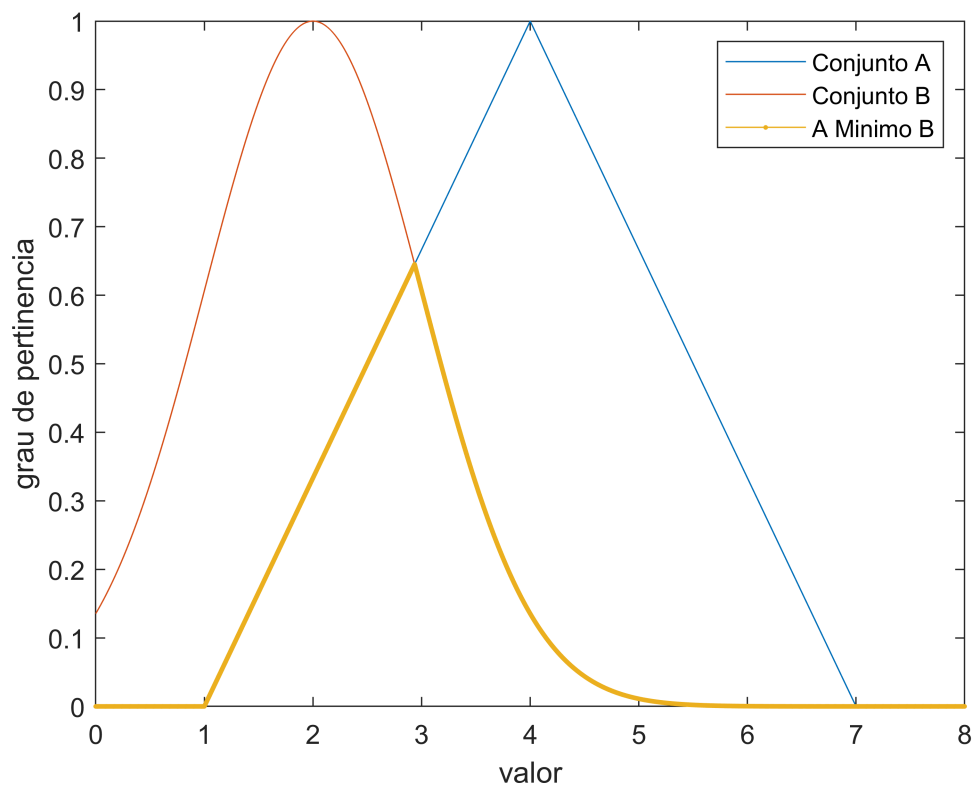
for p = 1: length(x)
    if min(a(p),b(p)) == 0
        sDrastica(p) = max(a(p),b(p));
    else
        sDrastica(p) = 1;
    end
end
plot(x,a, ...
     x,b, ...
     x,sDrastica,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A Soma Drástica B');
```



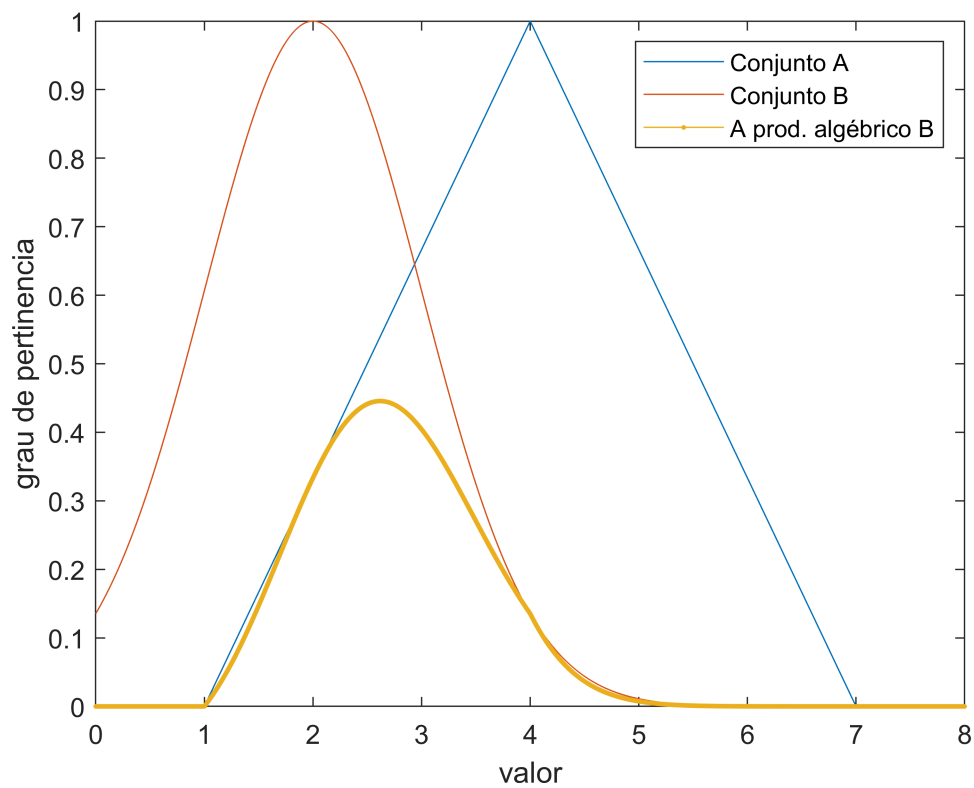
```
% Operador Soma Limitada
prodDrast = conjNeb + conjNeb2 -(conjNeb.*conjNeb2);
plot(t,conjNeb, ...
      t,conjNeb2, ...
      t,prodDrast,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A Soma Probabilística B');
```

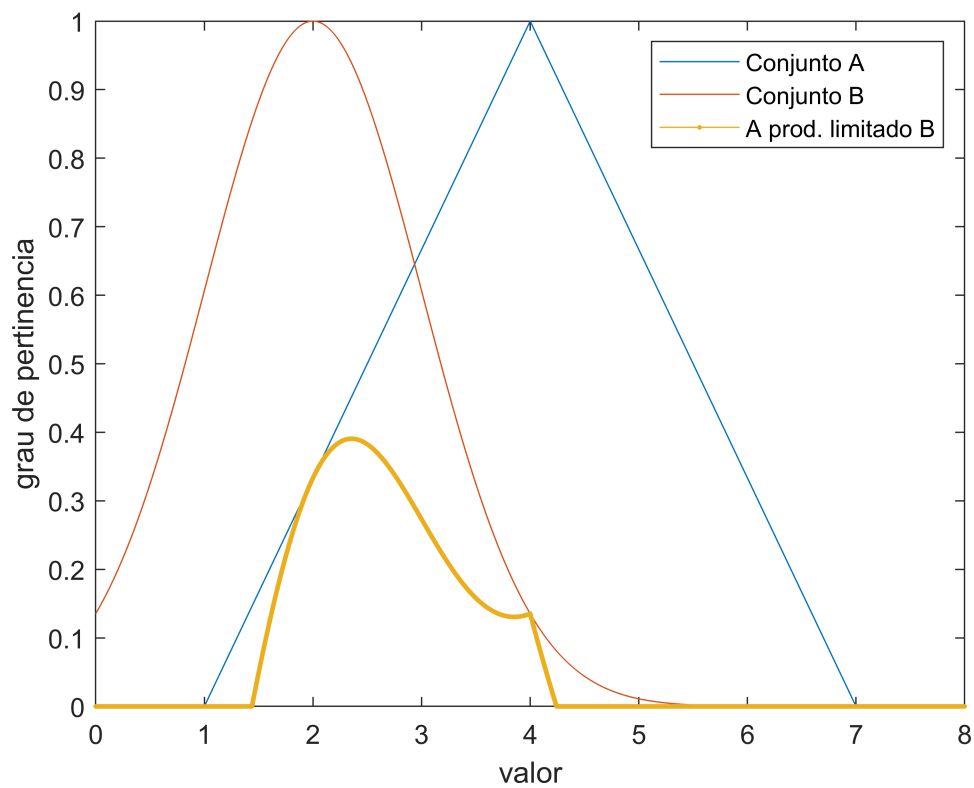
```
% Operador Minimo
prodDrast = min(conjNeb,conjNeb2);
plot(t,conjNeb, ...
      t,conjNeb2, ...
      t,prodDrast,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A Minimo B');
```



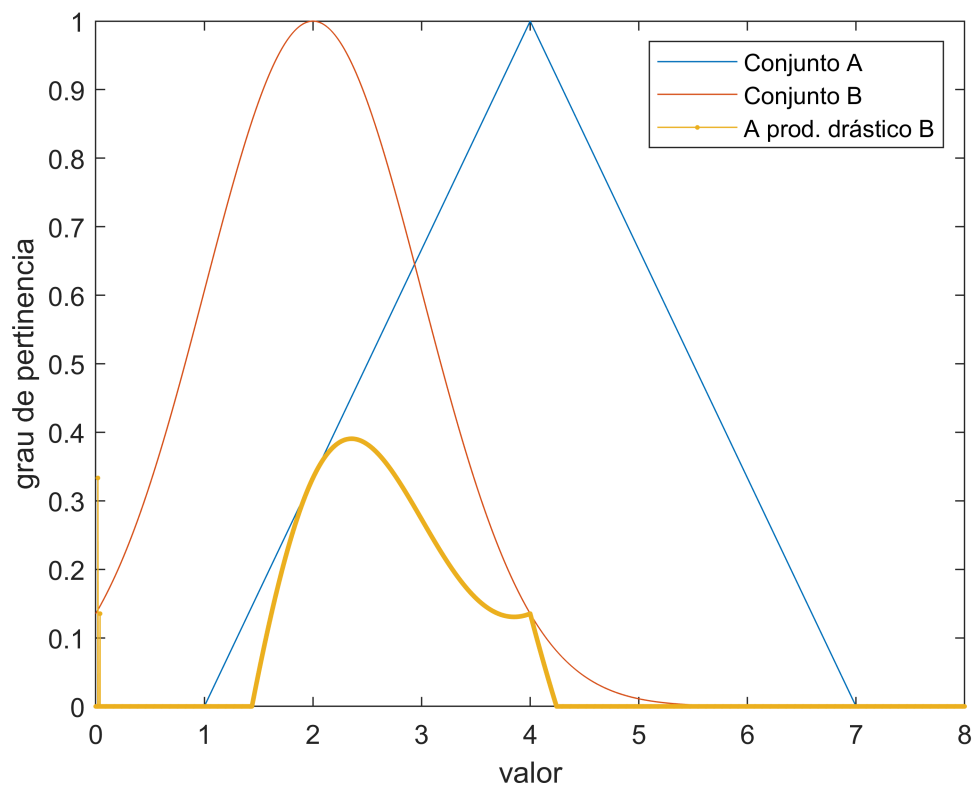
```
% Operador Produto Algebrico
prodDrast = conjNeb.*conjNeb2;
plot(t,conjNeb, ...
      t,conjNeb2, ...
      t,prodDrast,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A prod. algébrico B');
```



```
% Operador Produto Limitado
prodDrast = max(0, conjNeb + conjNeb2 - 1);
plot(t,conjNeb, ...
      t,conjNeb2, ...
      t,prodDrast,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A prod. limitado B');
```



```
% Operador Produto Drastico
prodDrast = max(0, conjNeb + conjNeb2 - 1);
for p = 1: length(x)
    if b(p) == 1
        prodDrast(p) = a(p);
    elseif a(p) == 1
        prodDrast(p) = b(p);
    else
        prodDrast(p) = 0;
    end
end
plot(t,conjNeb, ...
     t,conjNeb2, ...
     t,prodDrast,'.-');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A', ...
    'Conjunto B', ...
    'A prod. drástico B');
```



Erro Quadrático Médio

```
% dados para simulação
```

```
xe = (-2:0.001:2)';
```

```
ye = xe.^2;
```

```
nPts = length(xe);
```

```
sysSugeno = readfis('controle_sugeno.fis');
```

```
ySugeno = evalfis(xe,sysSugeno);
```

Warning: Syntax evalfis(x,fis,options) will be removed in a future release. Use evalfis(fis,x,options) instead.

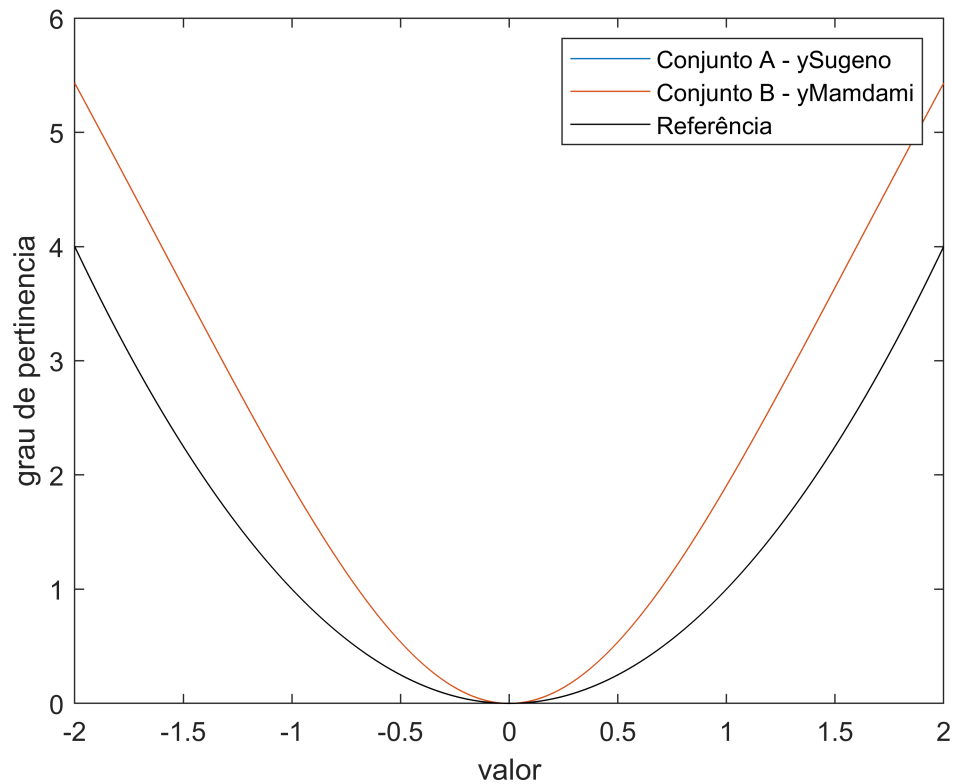
```
sysMamdami = readfis('controle_sugeno.fis');
```

```
yMamdami = evalfis(xe,sysMamdami);
```

Warning: Syntax evalfis(x,fis,options) will be removed in a future release. Use evalfis(fis,x,options) instead.

```
plot(xe,ySugeno, ...
     xe,yMamdami, ...
     xe,ye,'k');
hXLabel = xlabel('valor');
hYLabel = ylabel('grau de pertinencia');
hLegend = legend( ...
    'Conjunto A - ySugeno', ...
```

```
'Conjunto B - yMamdami', ...  
'Referência');
```



```
% erro quadratico  
eSugeno = 0;  
eMamdami = 0;  
for k = 1 :nPts  
    eSugeno = eSugeno + (ySugeno(k) - ye(k))^2;  
    eMamdami = eMamdami + (yMamdami(k) - ye(k))^2;  
end  
eSugeno
```

```
eSugeno = 3.9227e+03
```

```
eMamdami
```

```
eMamdami = 3.9227e+03
```

Mecanismos de Inferência

Configuração do sistema de inferência nebulosa Mamdani

[System]

Name='controle_mamdami'

Type='mamdani'
Version=2.0
NumInputs=1
NumOutputs=1
NumRules=5
AndMethod='min'
OrMethod='max'
ImpMethod='min'
AggMethod='max'
DefuzzMethod='centroid'

[Input1]

Name='X'
Range=[-2 2]
NumMFs=5
MF1='mf1': 'trimf', [-3 -2 -1]
MF2='mf2': 'trimf', [-2 -1 0]
MF3='mf3': 'trimf', [-1 0 1]
MF4='mf4': 'trimf', [0 1 2]
MF5='mf5': 'trimf', [1 2 3]

[Output1]

Name='Y'
Range=[0 4]
NumMFs=3
MF1='mf1': 'trimf', [0 0 1]
MF2='mf2': 'trimf', [0 1 2]
MF3='mf3': 'trimf', [2 4 4]

[Rules]

1, 1 (1) : 1

2, 2 (1) : 1

3, 3 (1) : 1

4, 2 (1) : 1

5, 1 (1) : 1

Configuração Sugeno

Configuração do sistema de inferência nebulosa Sugeno

[System]

Name='controle_sugeno'

Type='sugeno'

Version=2.0

NumInputs=1

NumOutputs=1

NumRules=2

AndMethod='prod'

OrMethod='probor'

ImpMethod='prod'

AggMethod='sum'

DefuzzMethod='wtaver'

[Input1]

Name='X'

Range=[-2 2]

NumMFs=2

MF1='mf1':'gaussmf',[2 -3]

MF2='mf2':'gaussmf',[-2 3]

[Output1]

Name='Y'

Range=[0 4]

NumMFs=2

MF1='mf1':'linear',[3 0]

MF2='mf2':'linear',[-3 0]

[Rules]

1, 2 (1) : 1

2, 1 (1) : 1

Reconhecimento de padrões

Fuzzy Logic Designer: classificador

File Edit View

SAIDA

FIS Name:	classificador	FIS Type:	mamdani
-----------	---------------	-----------	---------

And method	min	Current Variable	
Or method	max	Name	SAIDA
Implication	min	Type	output
Aggregation	max	Range	[0 1]
Defuzzification	centroid		

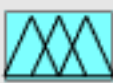
Help Close

Renaming output variable 1 to "SAIDA"

FIS Variables



X



SAIDA

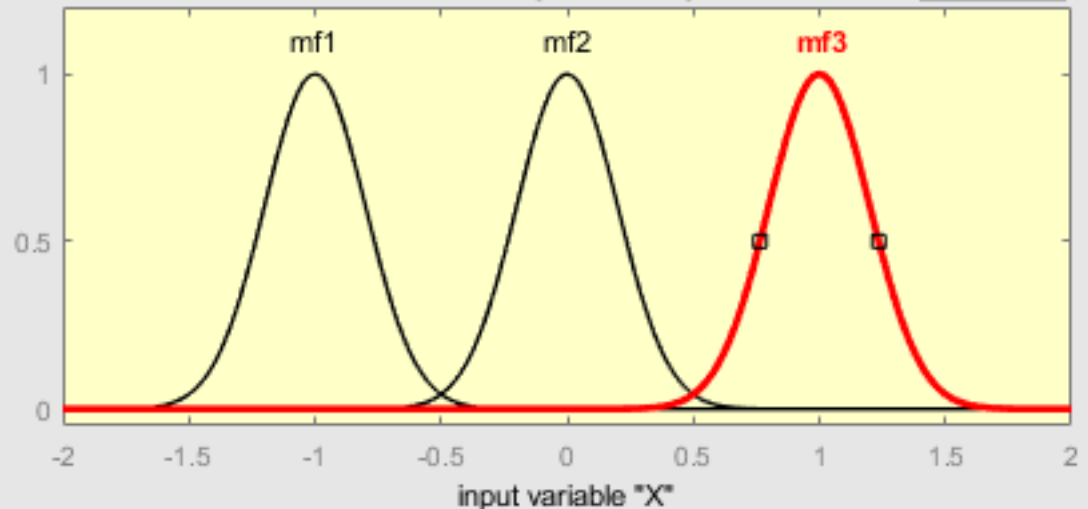


Y

Membership function plots

plot points:

181



Current Variable

Name X

Type input

Range [-2 2]

Display Range [-2 2]

Current Membership Function (click on MF to select)

Name mf3

Type gaussmf

Params [0.2 1]

Help

Close

Changing parameter for MF 3 to [0.2 1]

Rule Editor: controle_mamdami

File Edit View Options

1. If (X is mf1) then (Y is mf3) (1)
2. If (X is mf2) then (Y is mf2) (1)
3. If (X is mf3) then (Y is mf1) (1)
4. If (X is mf4) then (Y is mf2) (1)
5. If (X is mf5) then (Y is mf3) (1)

If X is

mf1
mf2
mf3
mf4
mf5
none

☐ not

Then Y is

mf1
mf2
mf3
none

☐ not

Connection

☐ or
☒ and

Weight: 1

Delete rule Add rule Change rule << >>

Ready Help Close

0