SLCO4A - Aula Prática 4

Sumário

Sinais

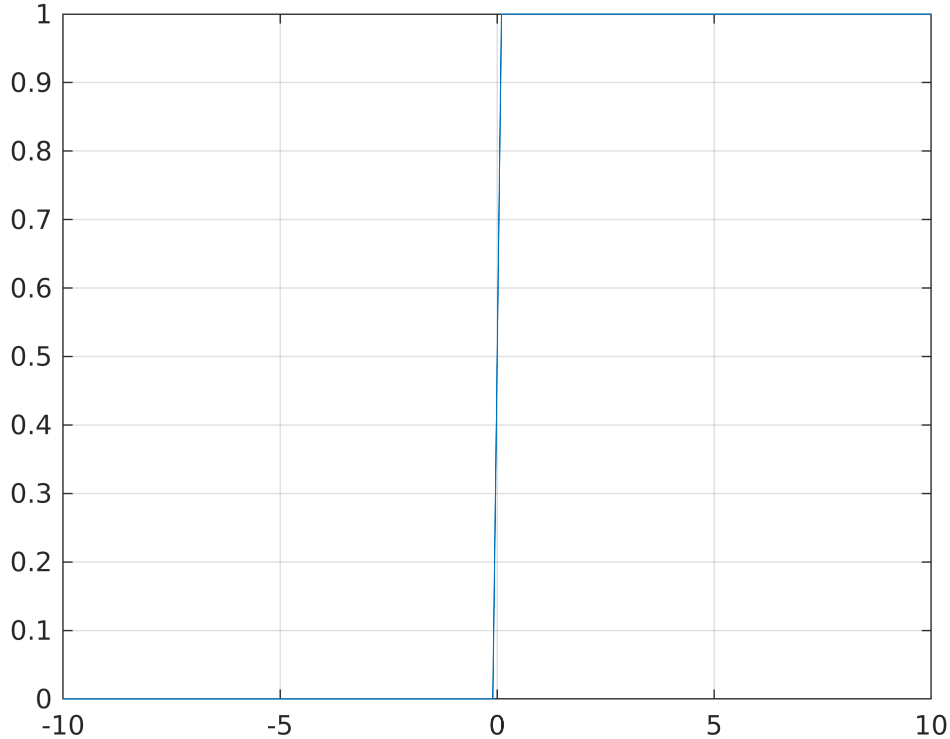
Representação de sinais

Sinal degrau

$$u(t) = \begin{cases} 1 & t \geq 0 \\ 0 & t < 0 \end{cases}$$

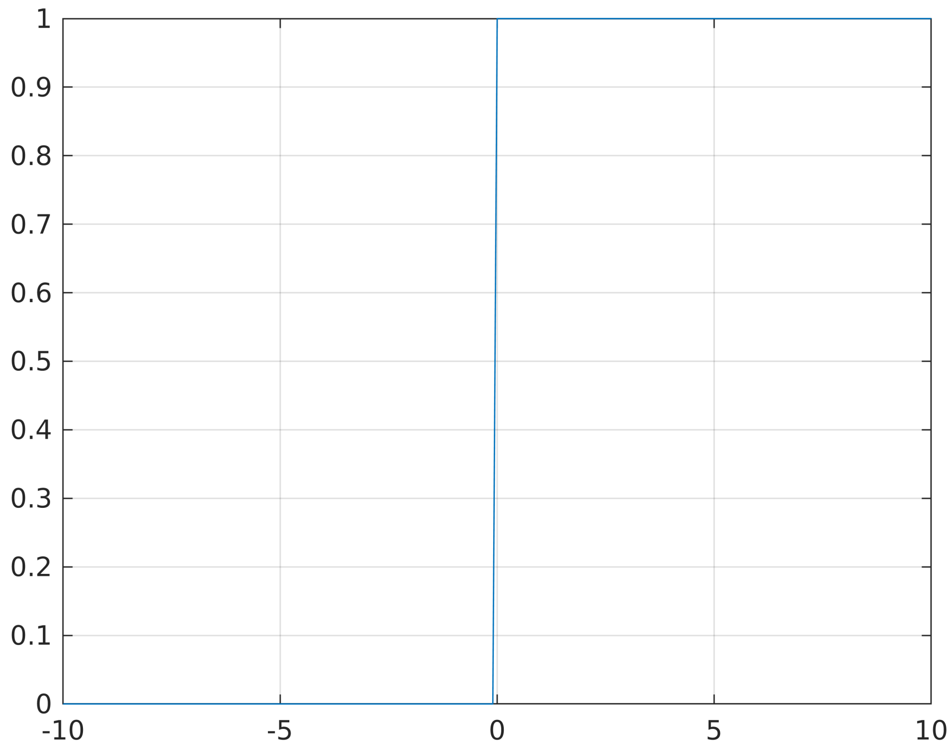
Primeiro método

```
t=-10:0.1:10;
u=heaviside(t);
plot(t,u)
grid on
```



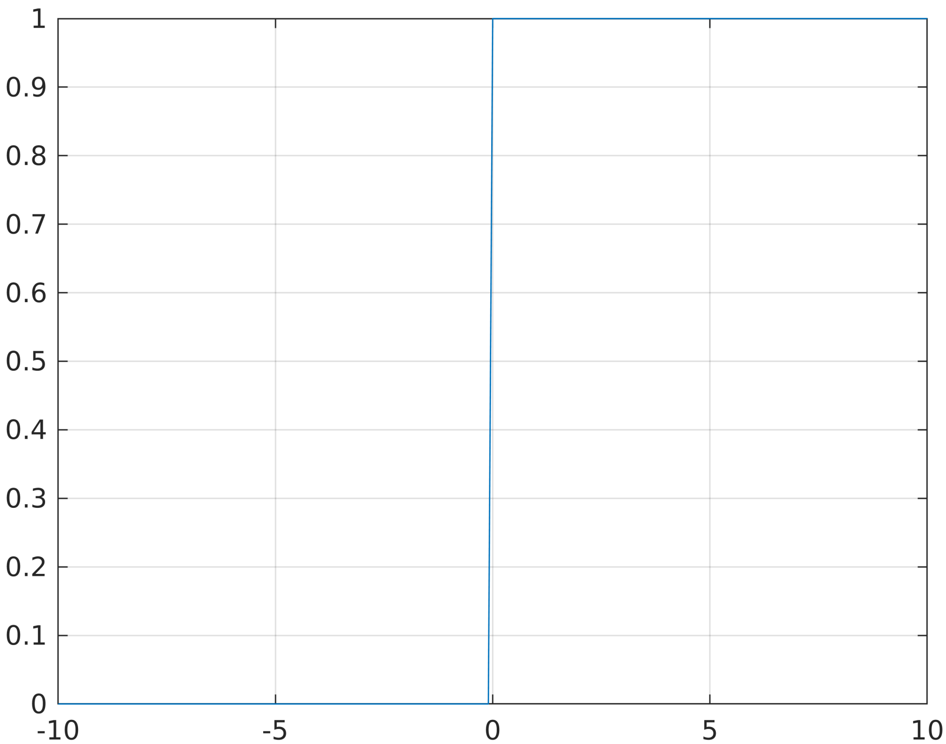
Segundo método

```
t1=-10:0.1:-0.1;
t2=0:0.1:10;
u1=zeros(size(t1));
u2=ones(size(t2));
t=[t1 t2];
u=[u1 u2];
plot(t ,u)
grid on
```



Terceiro método

```
t=-10:0.1:10;
ustep=t>=0; %v ou falso
plot(t,ustep)
grid on
```

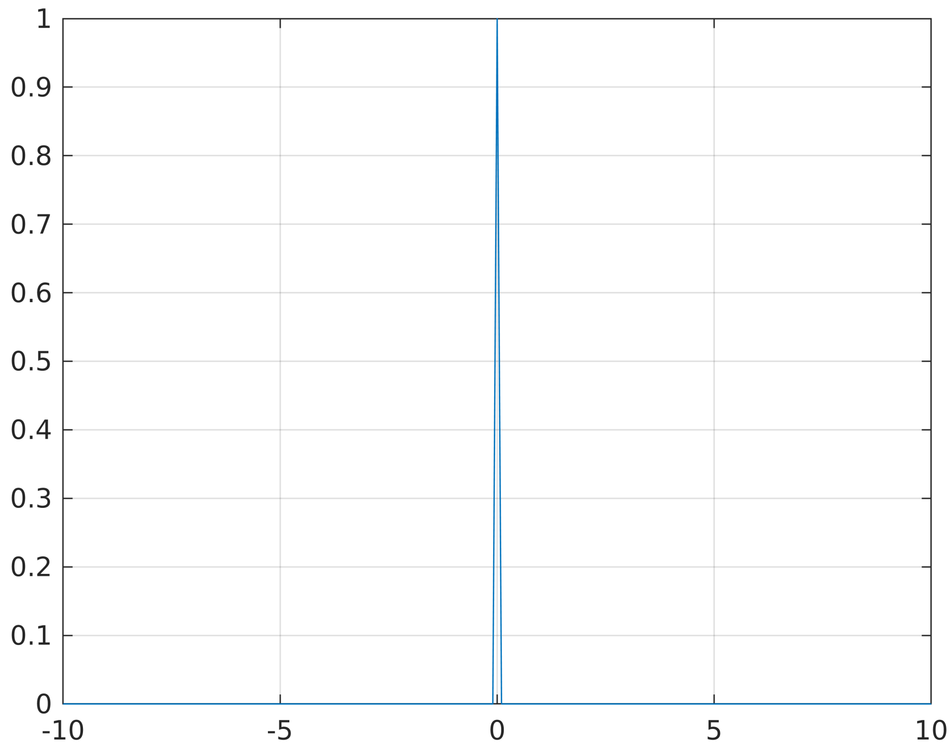


Sinal impulso unitário ou função delta de Dirac $\delta(t)$

$\int_{-\infty}^{\infty} f(t)\delta(t) = 1$, se $f(t) = 1$, $\forall t \in \Re$ então $\int_{-\infty}^{\infty} \delta(t) = 1$

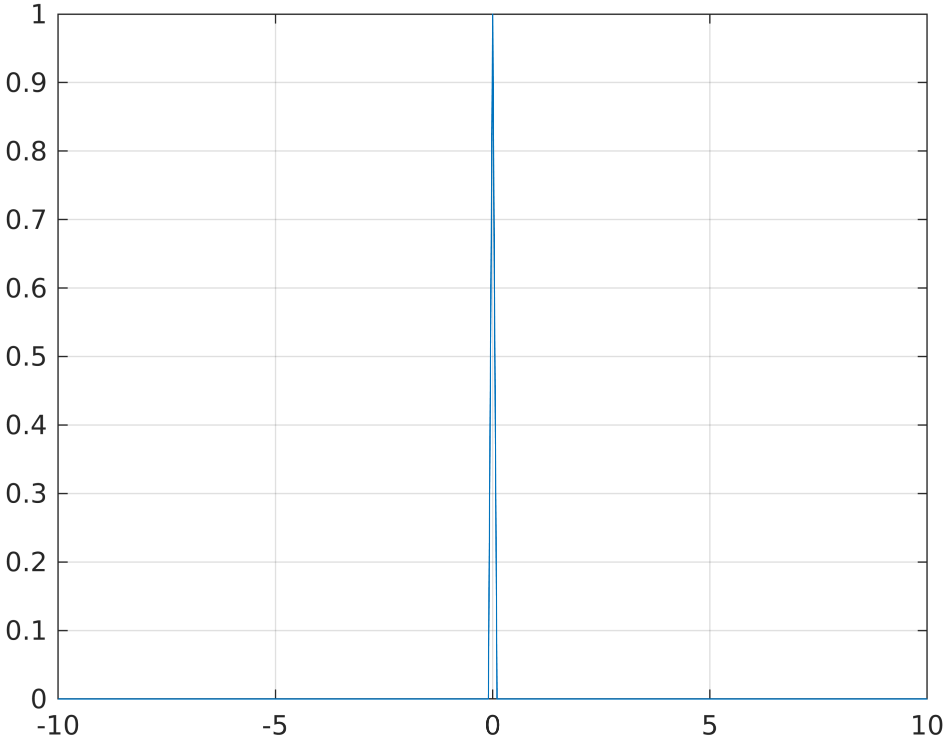
Primeiro método

```
t1=-10:0.1:-0.1;
t2=0;
t3=0.1:0.1:10;
d1=zeros(size(t1));
d2=1;
d3=zeros(size(t3));
t=[t1 t2 t3];
d=[d1 d2 d3];
plot(t,d)
grid on
```



Segundo método

```
t1=-10:0.1:10;
d=t==0;
plot(t, d)
grid on
```

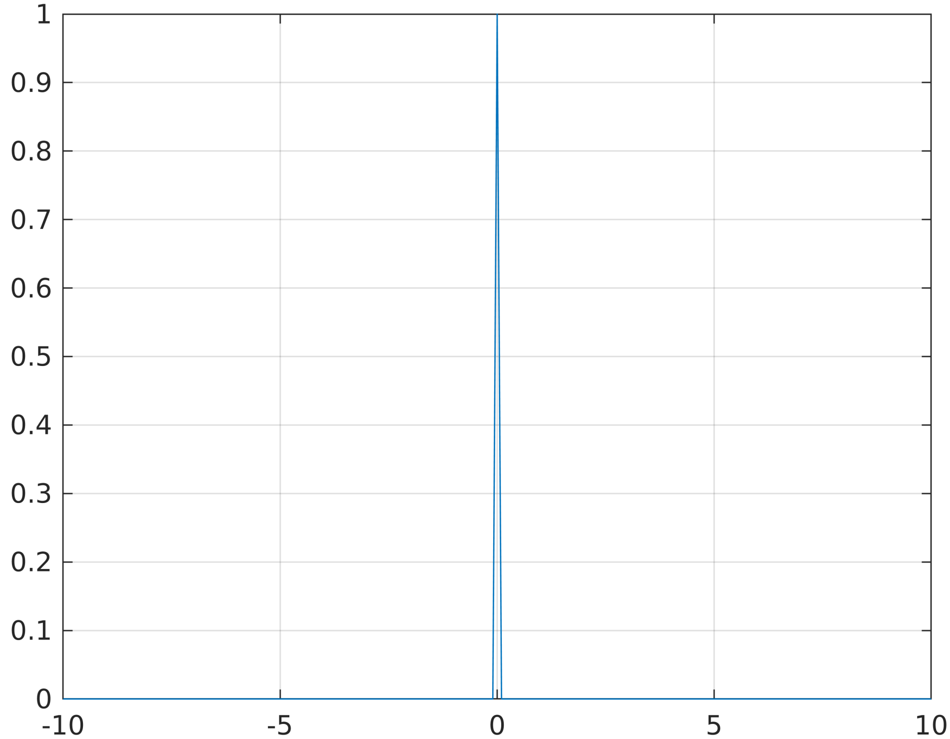


Terceiro método

```
t=-10:0.1:10;
d=gauspuls(t)
```

```
d = 1×201
      0      0      0      0      0      0      0      0      0      0      0      0      0···
```

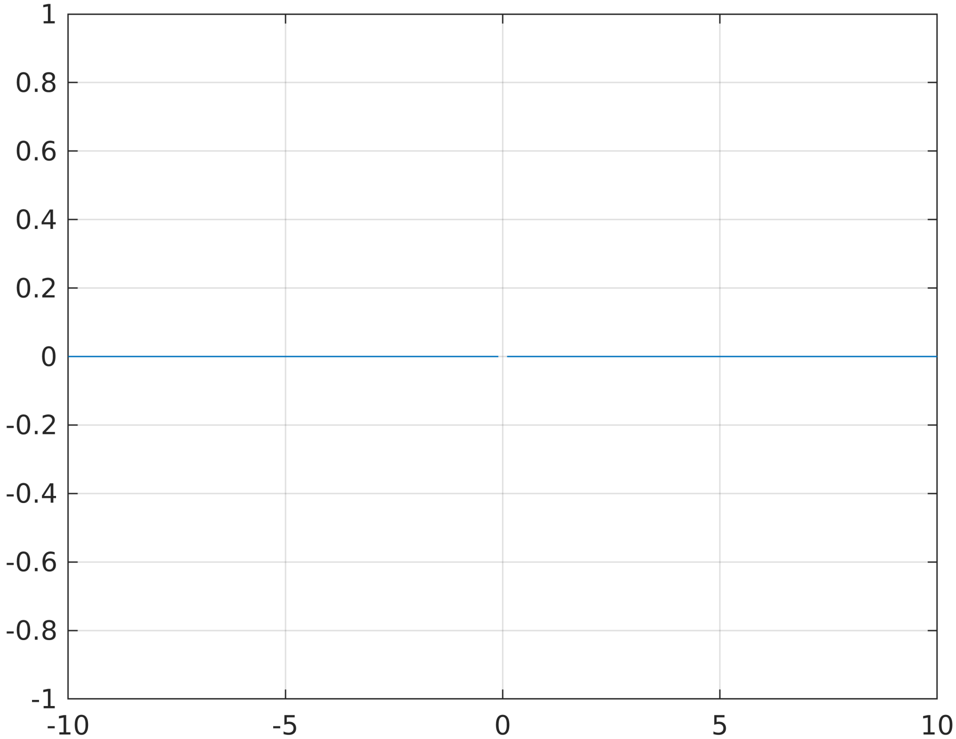
```
plot(t, d)
grid on
```



Quarto método

$$\delta(t) = \begin{cases} \infty & t = 0 \\ 0 & t \neq 0 \end{cases}$$

```
t=-10:0.1:10;
d=dirac(t);
plot(t,d )
grid on
```



Propriedade da integral

$$\int_{-\infty}^{\infty} \delta(t) = 1$$

```
syms t
d=dirac(t)
```

d = $\delta(t)$

```
res=int(d,t,-inf,inf)
```

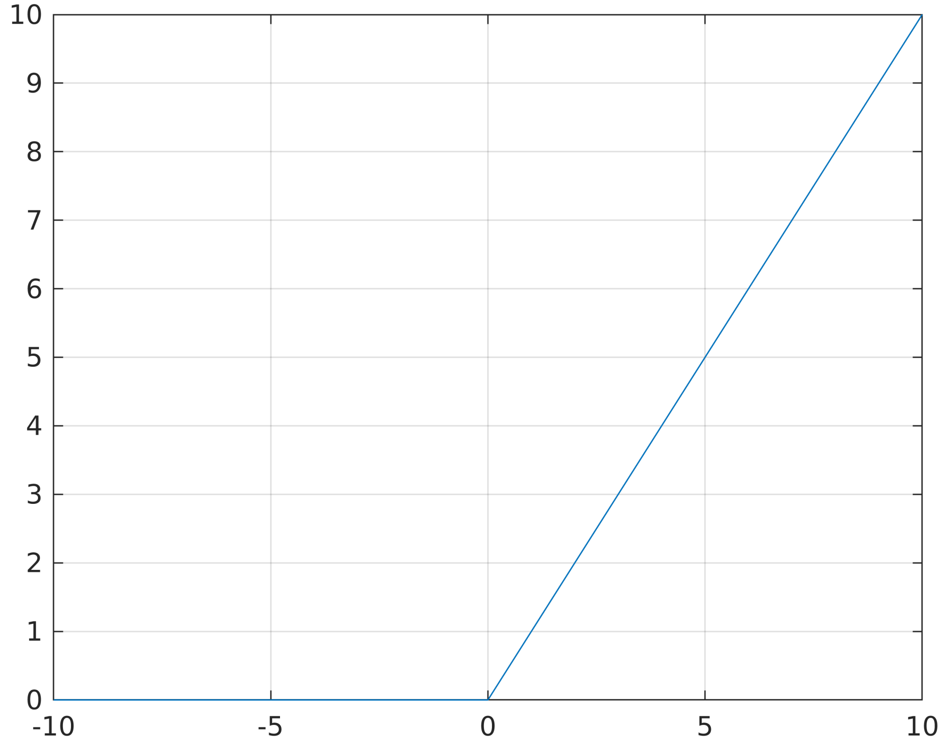
res = 1

Sinal rampa

$$r(t) = t \cdot u(t) = \begin{cases} t & t \geq 0 \\ 0 & t < 0 \end{cases}$$

Primeiro método

```
t=-10:0.1:10;
r=t.*heaviside(t);
plot(t, r)
grid on
```

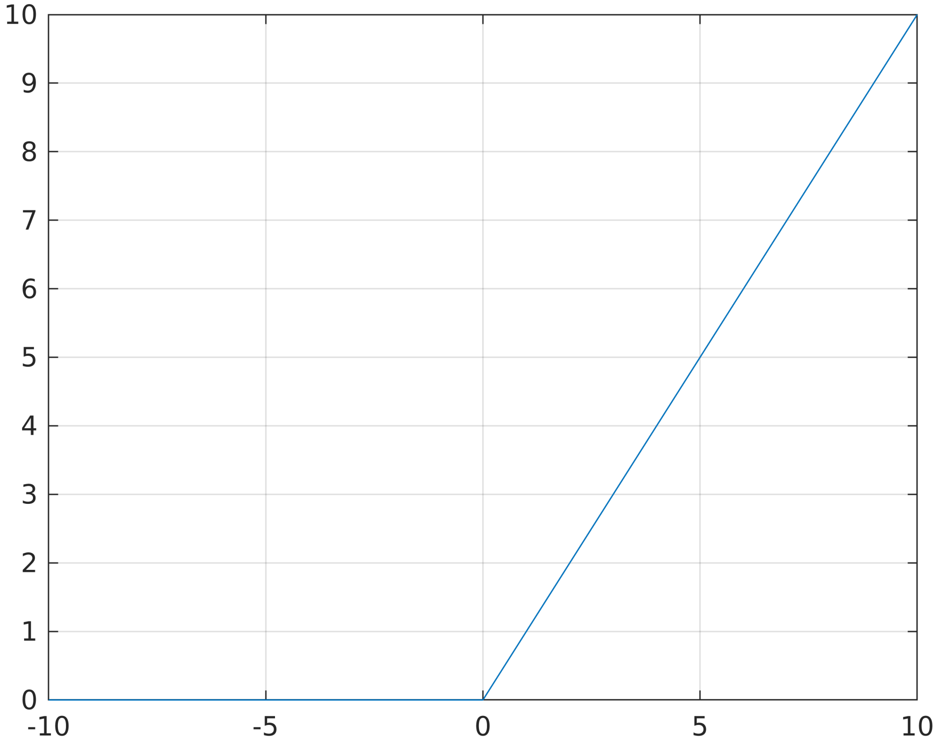


Segundo método

```
t1=-10:0.1:-0.1;
t2=0:0.1:10;
r1=zeros(size(t1))
```

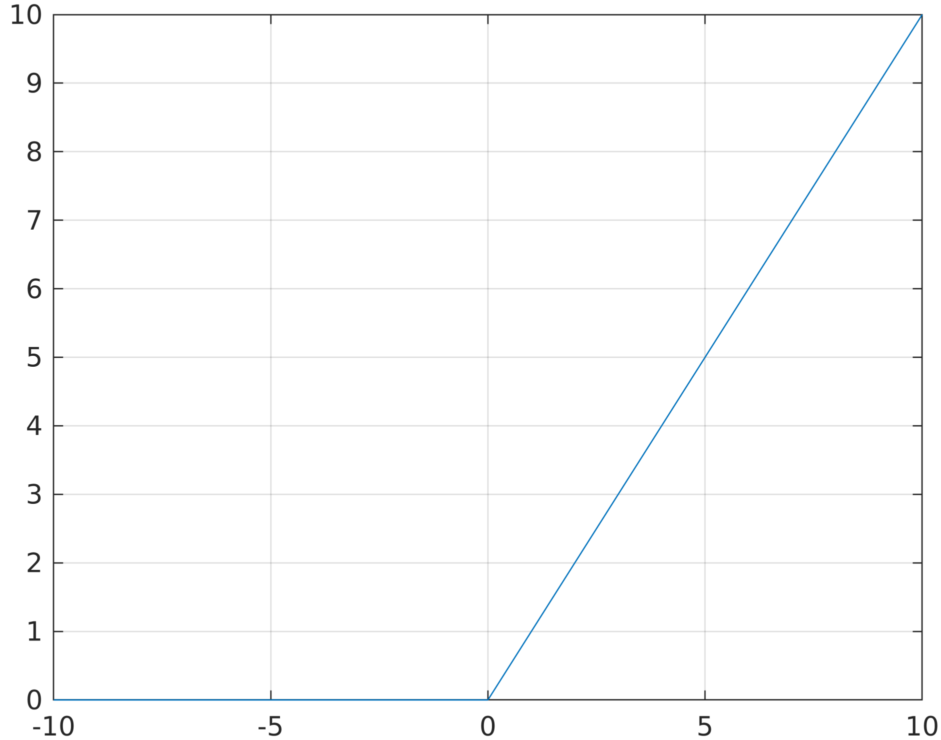
```
r1 = 1×100
     0     0     0     0     0     0     0     0     0     0     0     0     0⋯
```

```
r2=t2;
t=[t1 t2];
r=[r1 r2];
plot(t, r)
grid on
```



Terceiro método

```
t=-10:0.01:10;
r=(t>=0).*t;
plot(t, r)
grid on
```



Sinal pulso retangular

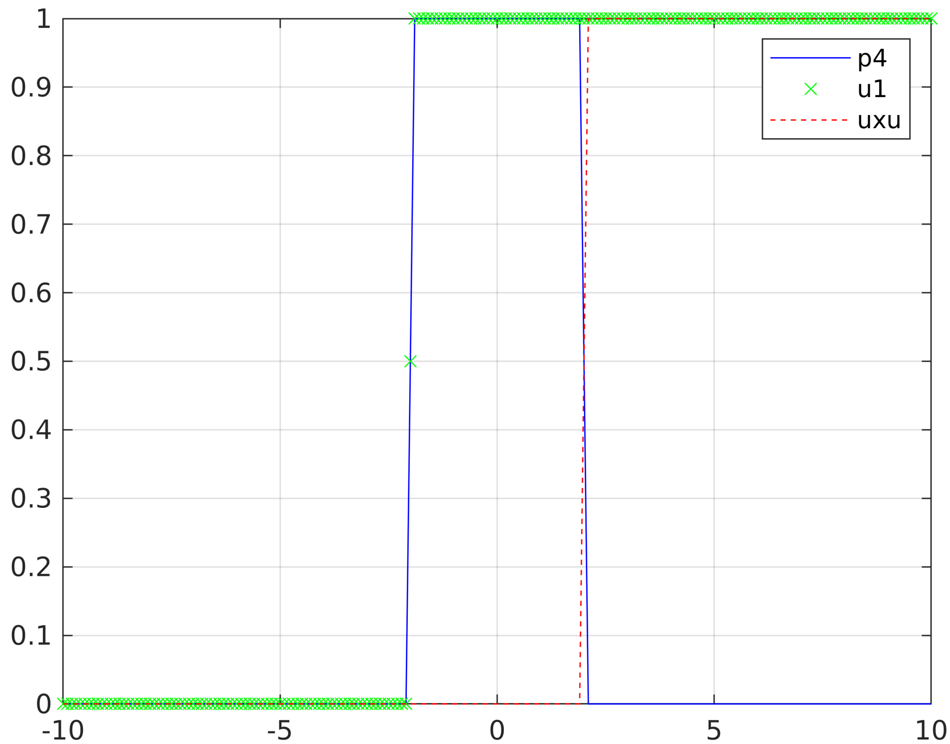
$$\mathrm{pT}(t) = u\left(t+\frac{T}{2}\right) - u\left(t-\frac{T}{2}\right) = \begin{cases} 1 & -\frac{T}{2} \leq t \leq \frac{T}{2} \\ 0 & \mathrm{cc} \end{cases}$$

a) Considere $T = 4$, obtenha a representação gráfica de $\mathrm{p4}(t)$.

Primeiro método

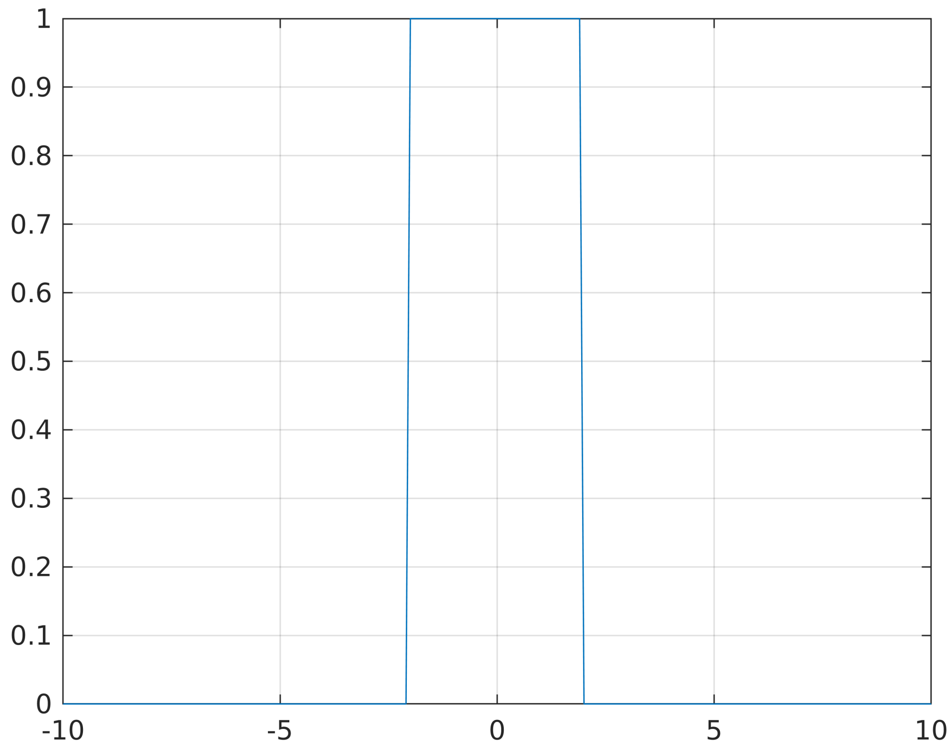
```
% t=-10:0.1:10;
% p4=heaviside(t+2)-heaviside(t-2);
% plot(t,p4)
% grid on

t=-10:0.1:10;
u1=heaviside(t+2);
u2=heaviside(t-2);
p4=u1-u2;
figure
plot(t, p4, 'b')
hold on
plot(t,u1,'gx', t,u2, 'r--')
grid on
legend('p4', 'u1', 'uxu')
```



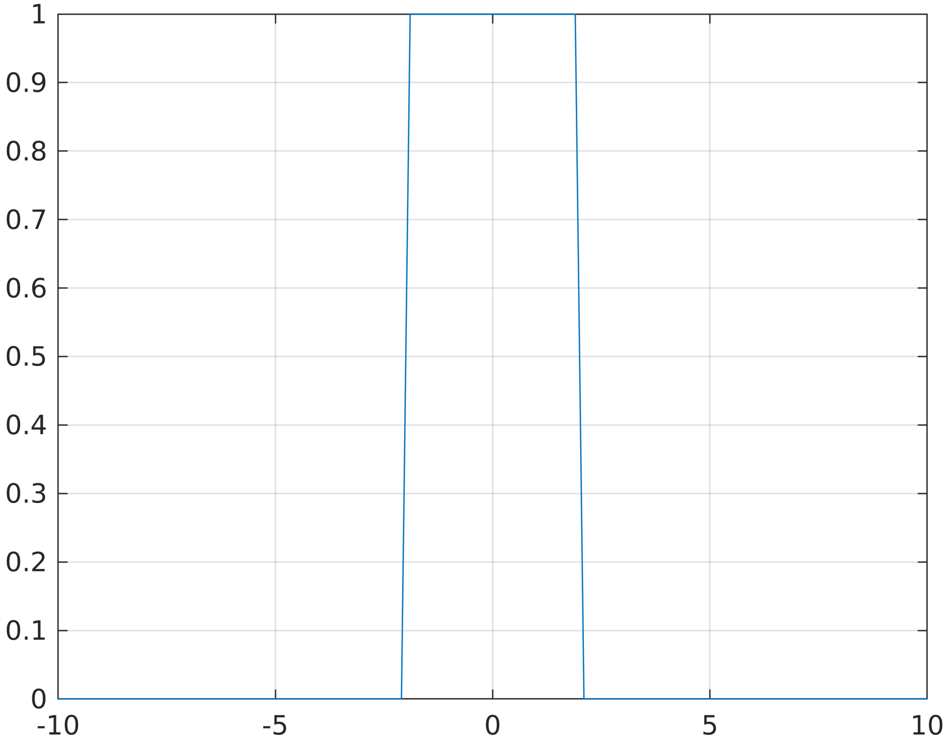
Segundo método

```
t=-10:0.1:10;
s=rectpuls(t, 4);
figure
plot(t, s)
grid on
```



Terceiro método

```
t=-10:0.1:10;
s=rectangularPulse(-2,2,t);
plot(t,s)
grid on
```

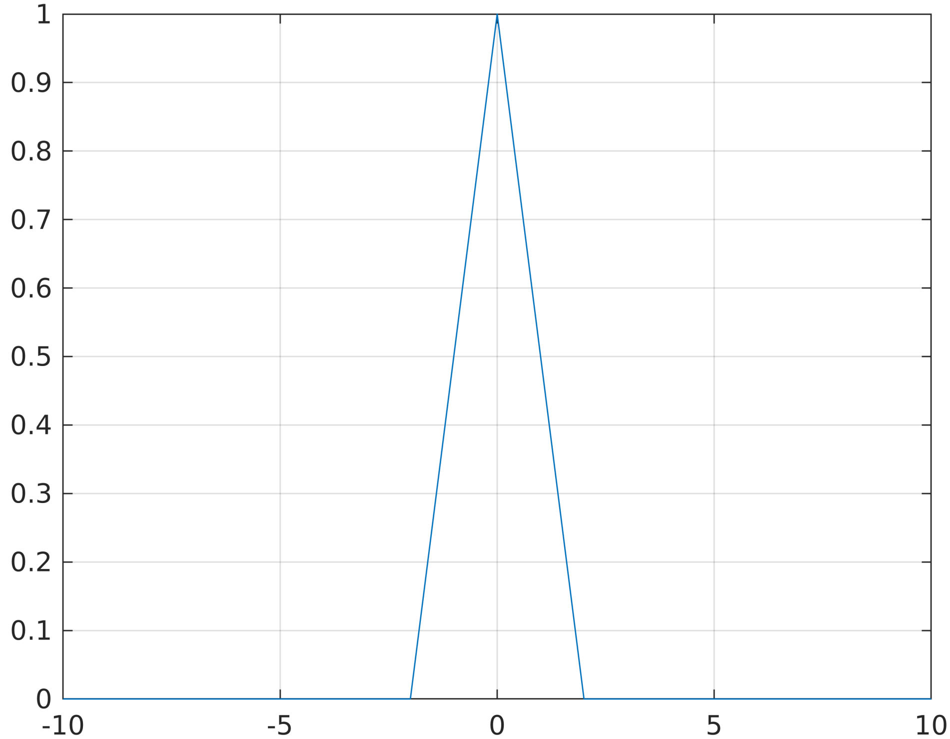


Sinal triangular

```
t=-10:0.1:10;
tri = triangularPulse(-2,0,2,t)
```

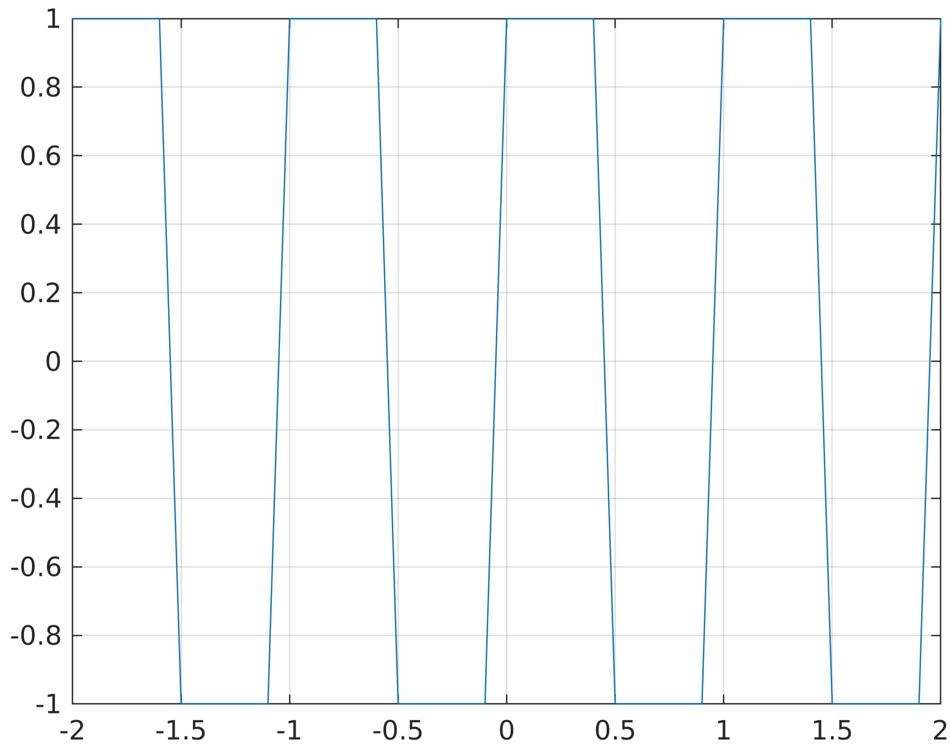
```
tri = 1×201
     0     0     0     0     0     0     0     0     0     0     0     0     0···
```

```
plot(t, tri)
grid on
```



Sinal onda quadrada

```
t=-2:0.1:2;
s=square(2*pi*t);
plot(t, s);
grid on
```

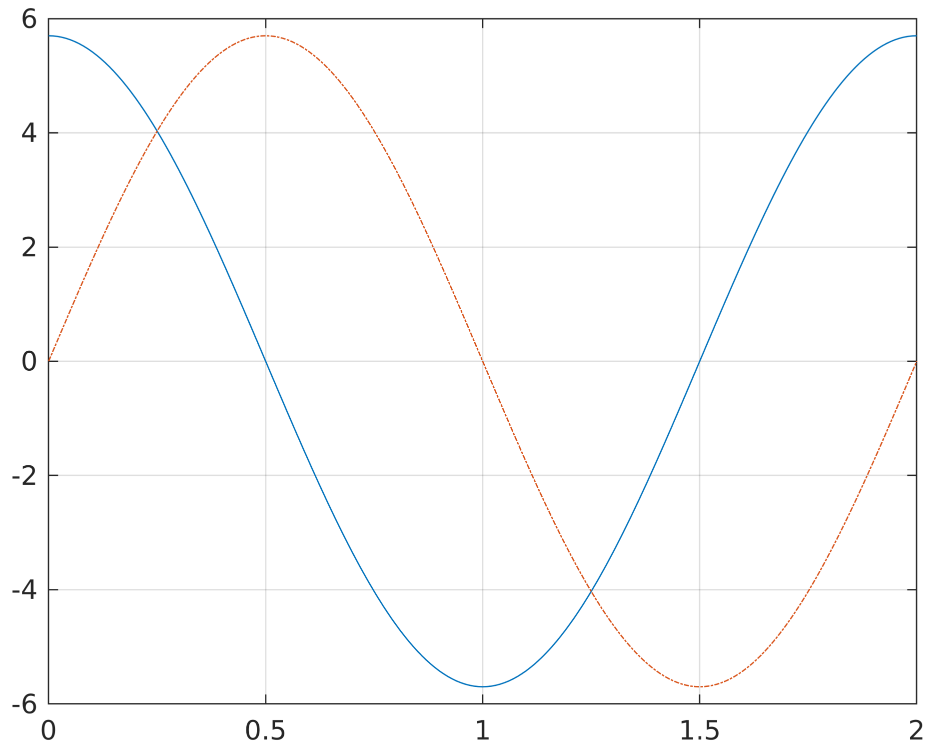


Sinal exponencial complexa

$\mathrm{A}e^{j\Omega t+\theta} = \mathrm{A}\cos(\Omega\, t+\theta\,) + j\,\mathrm{sen}(\Omega\, t+\theta\,)$

a) Obtenha a representação da parte real e imaginária do sinal $y(t) = 2e^{j\pi\, t+\frac{\pi}{3}}$ no intervalo de um período

```
T=2*pi/pi;
t=0:0.01:T;
y_re=real(2*exp(j*pi*t+pi/3));
y_im=imag(2*exp(j*pi*t+pi/3));
plot(t,y_re,t,y_im,'-.')
grid on
```



Propriedades de sinais

Sinais periódicos

$x(t) = x(t + k\,T), \forall t \in \mathfrak{R}$

a) Verifique se o sinal $x(t) = \sin(t)$ é periódico.

Computando o período, obtém-se que $T = \frac{2\pi}{1} = 2\pi$. Analisando a periodicidade para $1 \leq k \leq 10$ e $1 \leq t \leq 5$.

```
t=1:5
```

```
t = 1×5
     1     2     3     4     5
```

```
x=sin(t)
```

```
x = 1×5
    0.8415    0.9093    0.1411   -0.7568   -0.9589
```

```
T=2*pi;
for k=1:10
    xk=sin(t+k*T)
end
```

```
xk = 1×5
    0.8415    0.9093    0.1411   -0.7568   -0.9589
```

```
xk = 1×5
     0.8415    0.9093    0.1411   -0.7568   -0.9589
xk = 1×5
     0.8415    0.9093    0.1411   -0.7568   -0.9589
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     0.8415    0.9093    0.1411   -0.7568   -0.9589
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     0.8415    0.9093    0.1411   -0.7568   -0.9589
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     0.8415    0.9093    0.1411   -0.7568   -0.9589
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     0.8415    0.9093    0.1411   -0.7568   -0.9589
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     0.8415    0.9093    0.1411   -0.7568   -0.9589
xk = 1×5
     0.8415    0.9093    0.1411   -0.7568   -0.9589
xk = 1×5
     0.8415    0.9093    0.1411   -0.7568   -0.9589
```
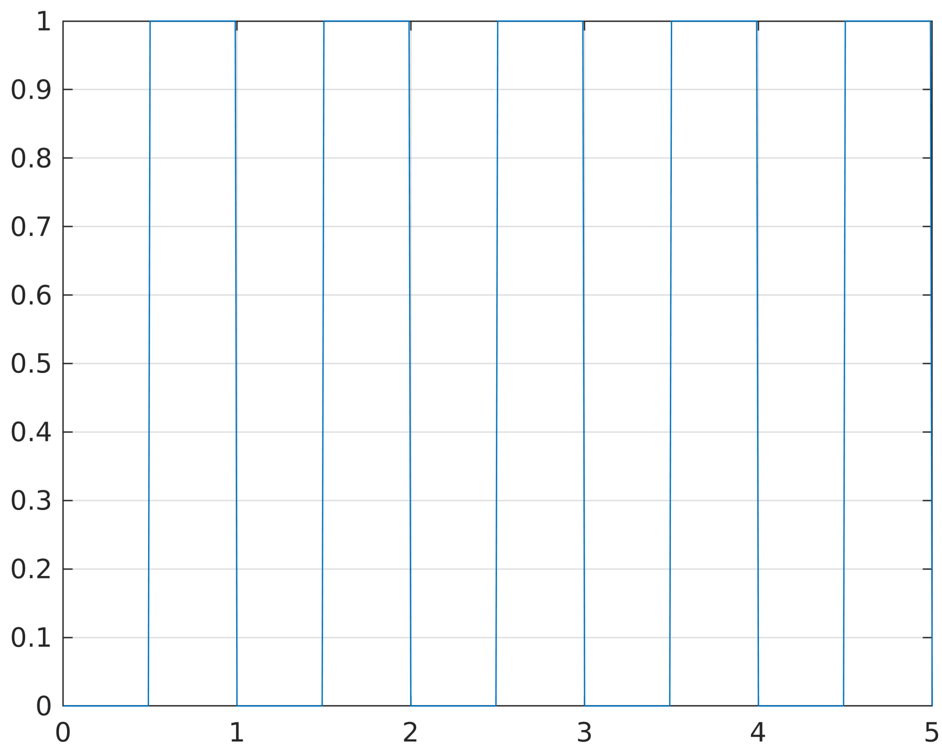

b) Construindo sinais periódicos

```
[s,t]=gensig(type,T,Tf,ts)
type: 'sin', 'square', 'pulse'
```

```
[s,t]= gensig('square',1,5,0.01);
plot(t,s)
grid on
```




```
square(t)
```

```
sawtooth(t,a)
% a é um escalar entre 0 e 1
```

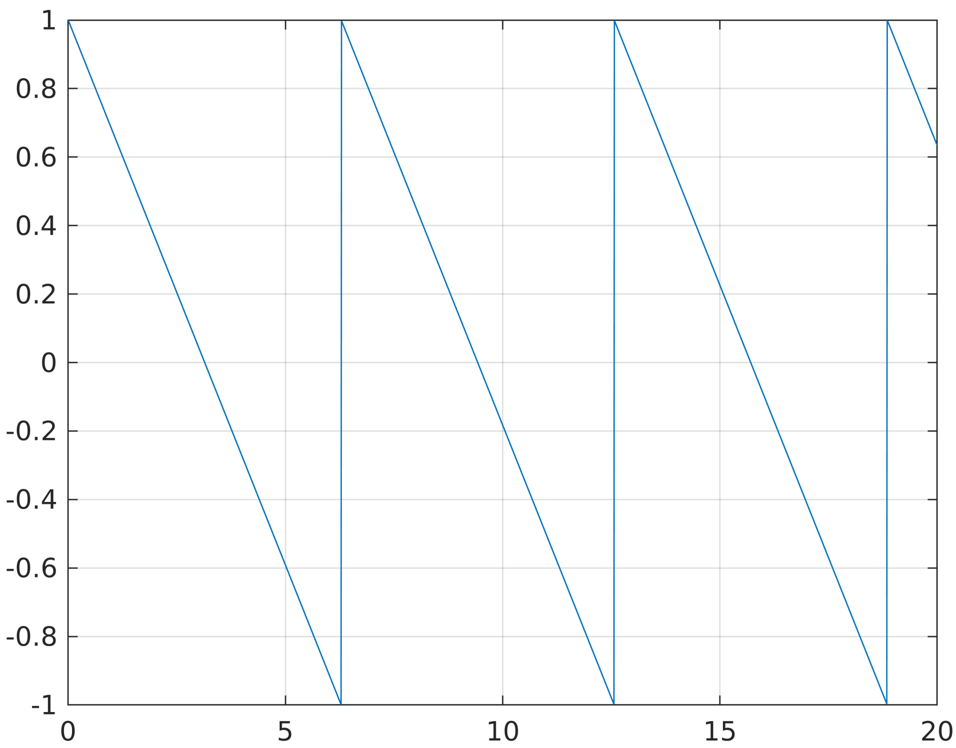
```
t=0:0.01:20
```

```
t = 1×2001
         0    0.0100    0.0200    0.0300    0.0400    0.0500    0.0600    0.0700 ⋯
```

```
sw=sawtooth(t,0)
```

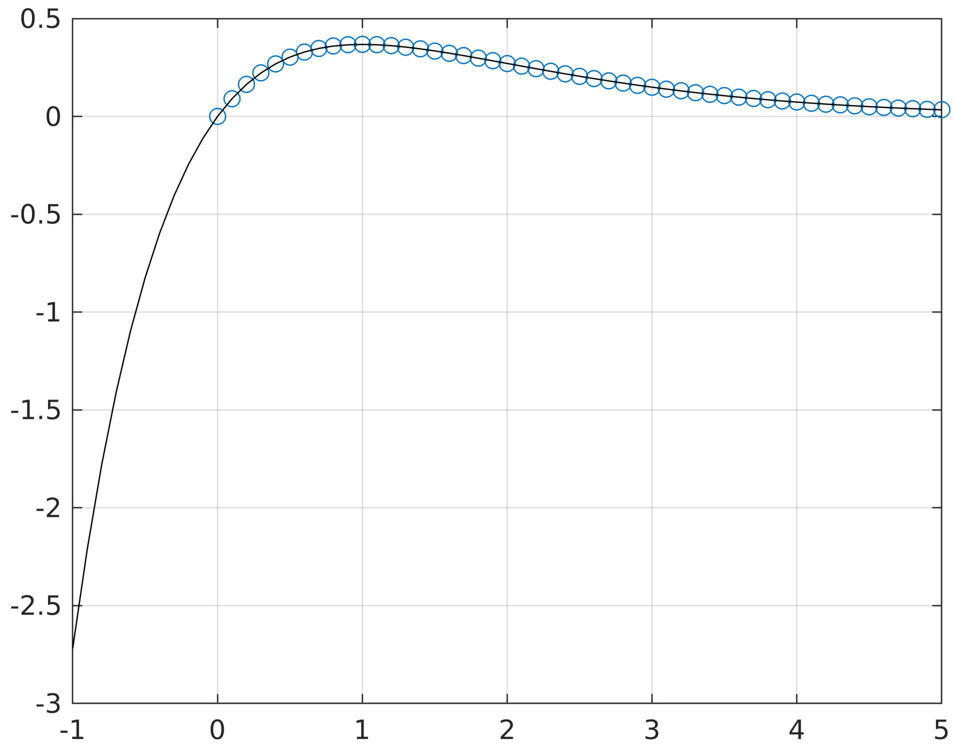
```
sw = 1×2001
    1.0000    0.9968    0.9936    0.9905    0.9873    0.9841    0.9809    0.9777 ⋯
```

```
plot(t, sw)
grid on
```



Sinais causais e não causais

```
t1=0:0.1:5;
t2=-1:0.1:5;
x1=t1.*exp(-t1);
x2=t2.*exp(-t2);
plot(t1,x1,'-o', t2,x2,'-black')
grid on
```



Sinais do tipo par e ímpar

a) Verifique se os sinais $x(t) = t^2$ e $y(t) = t^3$ são do tipo par ou ímpar.

```
t1=0:1:4;
t2=0:-1:-4;
x1=t1.^2
```

```
x1 = 1×5
     0     1     4     9    16
```

```
x2=t2.^2
```

```
x2 = 1×5
     0     1     4     9    16
```

```
y1=t1.^3
```

```
y1 = 1×5
     0     1     8    27    64
```

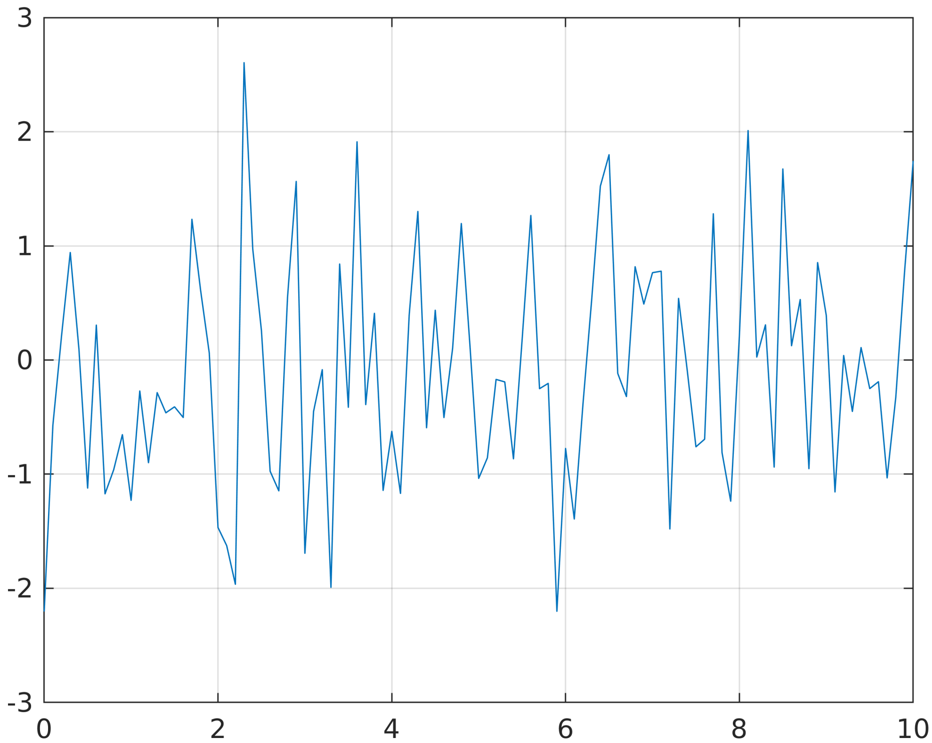
```
y2=t2.^3
```

```
y2 = 1×5
     0    -1    -8   -27   -64
```

```
% plot(t1,x1,x2,'--',t2,y1,y2 )
% grid on
```

Sinais determínistico e estocástico

```
t=0:0.1:10;
x1=randn(size(t));
plot(t, x1)
grid on
```



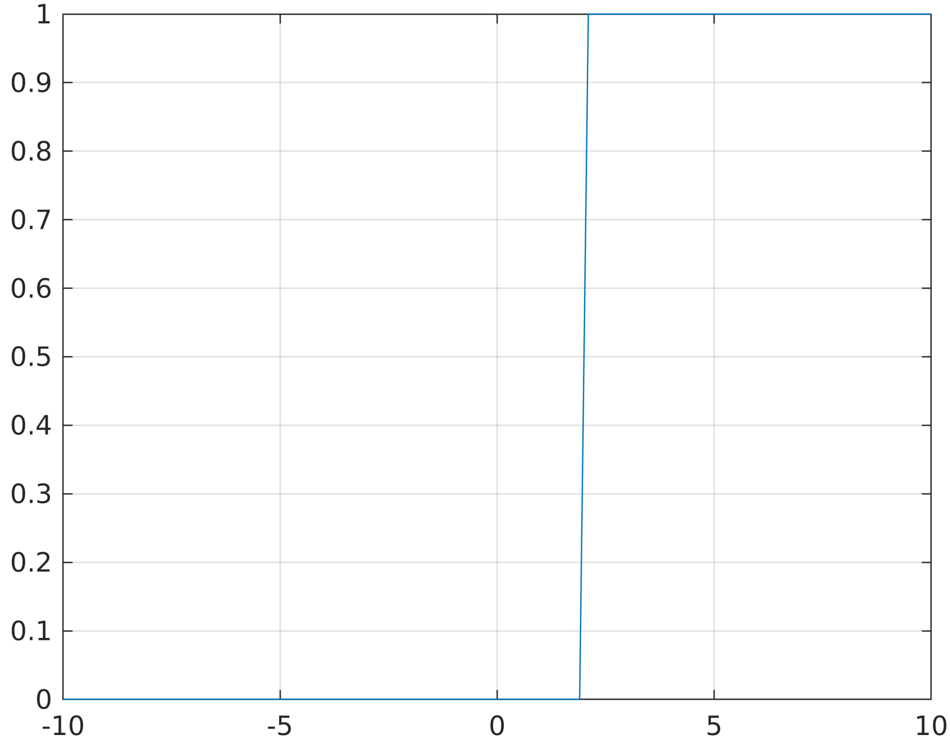
Transformação de sinais

Deslocamento temporal

a) Considere o sinal degrau unitário dado por $u(t-t_0)$, $t_0=2$. Obtenha a representação temporal de $u(t-2)$.

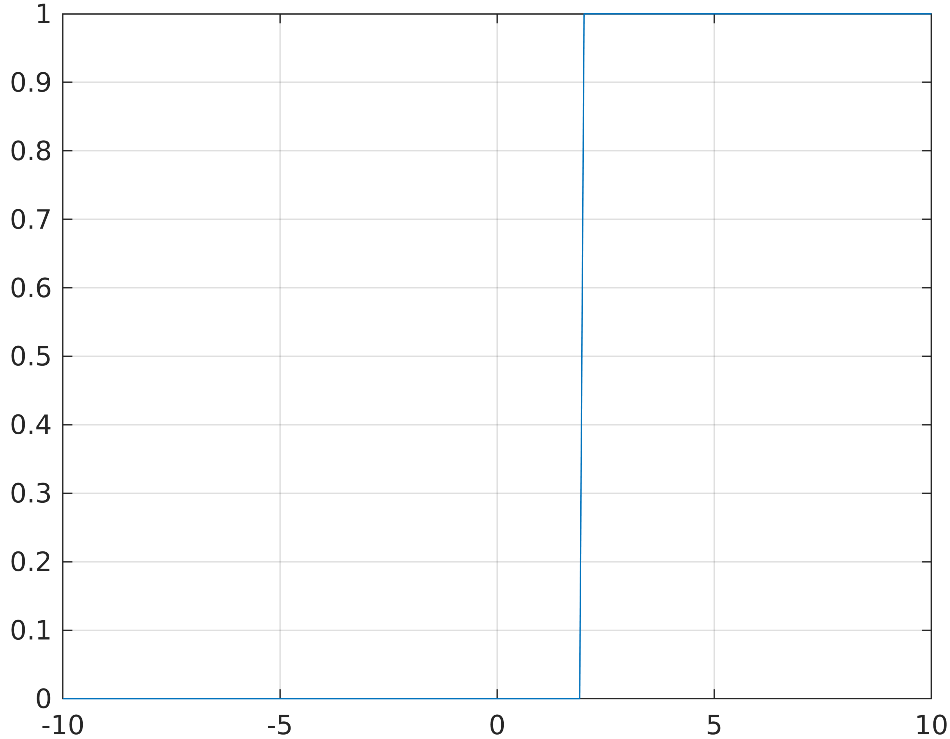
Primeiro método

```
t=-10:0.1:10;
u=heaviside(t-2);
plot(t,u)
grid on
```



Segundo método

```
t1=-10:0.1:1.9;
t2=2:0.1:10;
u1=zeros(size(t1));
u2=ones(size(t2));
t=[t1 t2];
u=[u1 u2];
plot(t, u)
grid on
```

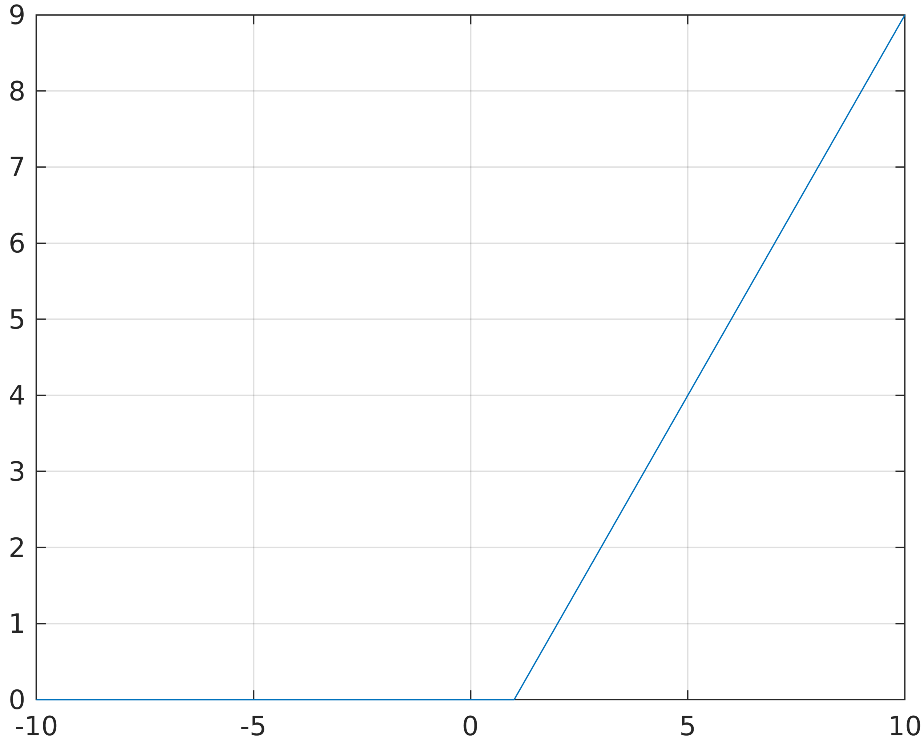


b) Obtenha a representação gráfica de $\delta(t+2)$

c) Obtenha a representação gráfica da função rampa unitária, sendo $t_0 = 1$:

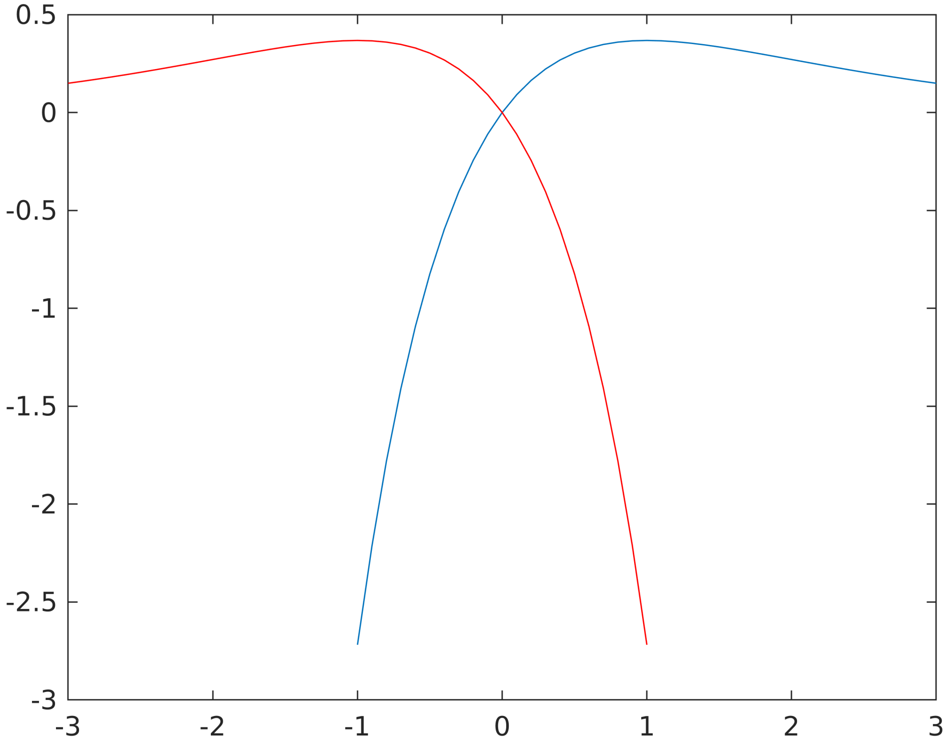
$$r(t-t_0) = (t-t_0)u(t-t_0) = \begin{cases} t-t_0 & t \geq t_0 \\ 0 & t < t_0 \end{cases}$$

```
t=-10:0.1:10;
r=(t-1).*heaviside(t-1);
plot(t,r)
grid on
```



Reversão temporal ou reflexão

```
t=-1:0.1:3;
x=t.*exp(-t);
plot(t,x)
hold on
plot(-t,x, 'r')
```

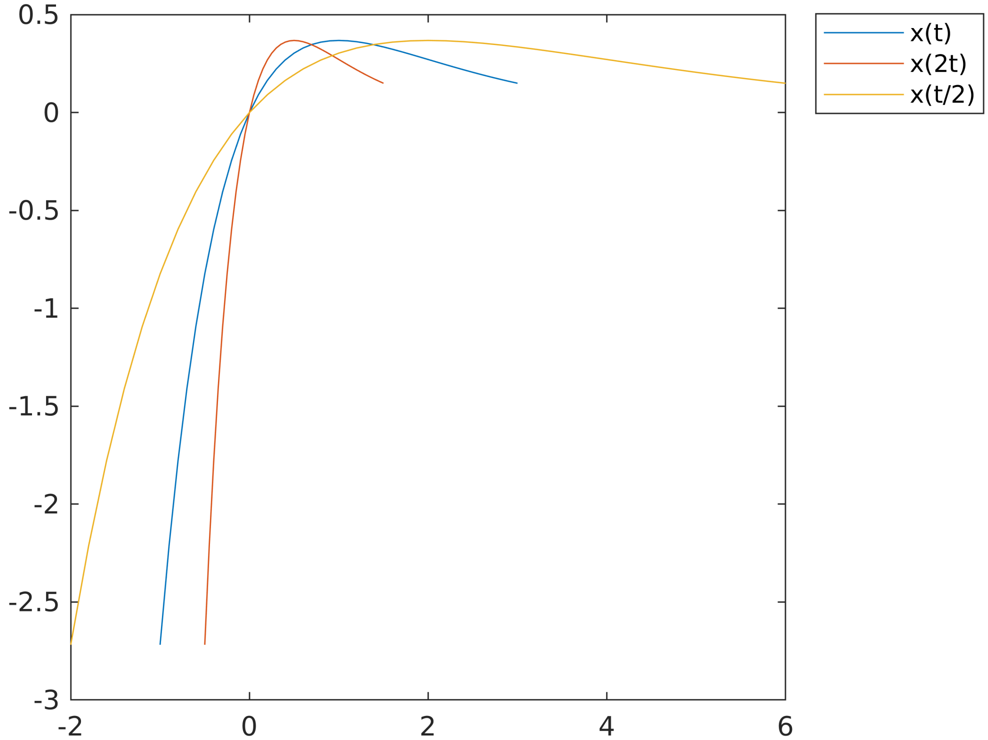


Escalonamento temporal

```
t=-1:0.1:3;
x=t.*exp(-t);
figure
plot(t,x)
hold on

a=2
```

```
a = 2
```

```
plot((1/a)*t,x)

a=0.5;
plot((1/a)*t,x)
legend('x(t)', 'x(2t)', 'x(t/2)', 'Location',"bestoutside")
```


0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-2
0
2
4
6
x(t)
x(2t)
x(t/2)