ELG3125 Signal and System Analysis

Signal Manipulation and Graphics (Fall, 2018)

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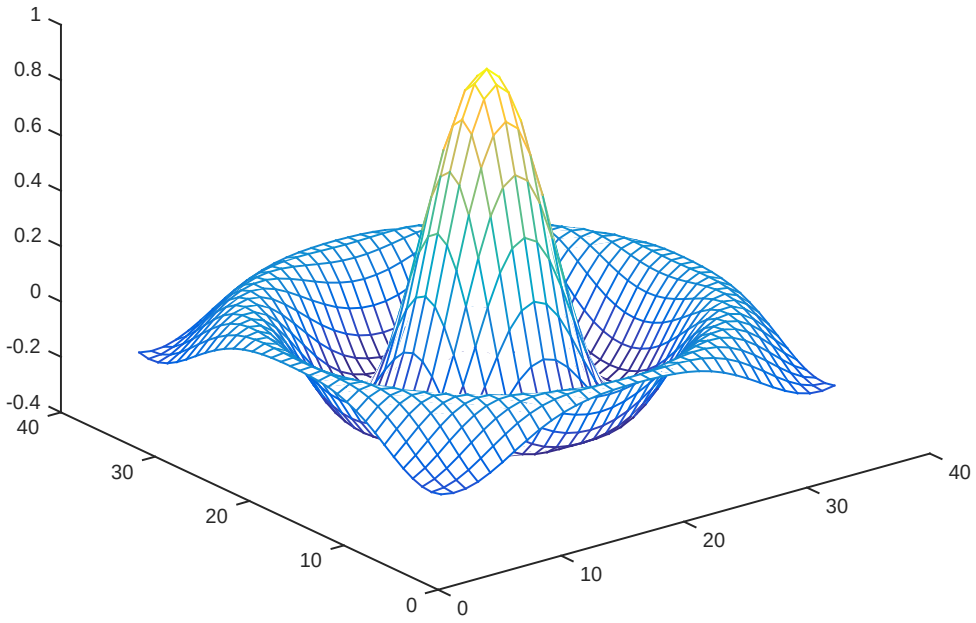
Outline

- plotting
- Periodic Signals
- Signal Combination
- MATLab Graphing
- More examples



http://www.site.uottawa.ca/~msade033/signal/

Basic Task: Plot the function sin(x) between $0 \leq x \leq 4\pi$

Create an x-array of 100 samples between 0 and 4π.

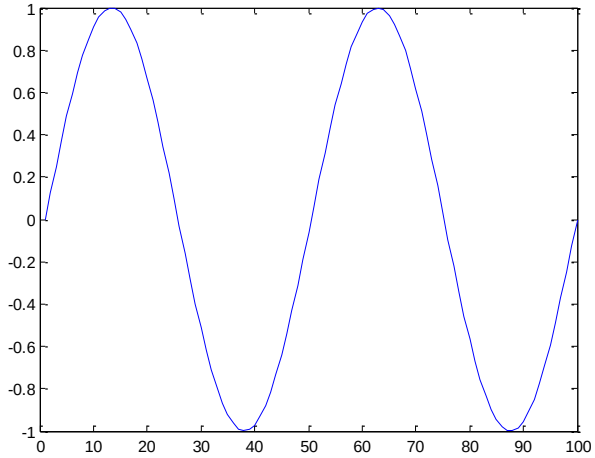
```
>>x=linspace(0,4*pi,100);
```

Calculate sin(.) of the x-array

```
>>y=sin(x);
```

Plot the y-array

```
>>plot(y)
```



Plot the function $e^{-x/3}\sin(x)$ between $0 \le x \le 4\pi$

Create an x-array of 100 samples between 0 and 4π.

```
>>x=linspace(0,4*pi,100);
```

Calculate sin(.) of the x-array

```
>>y=sin(x);
```

Calculate $e^{-x/3}$ of the x-array

```
>>y1=exp(-x/3);
```

Multiply the arrays y and y1

```
>>y2=y*y1;
```

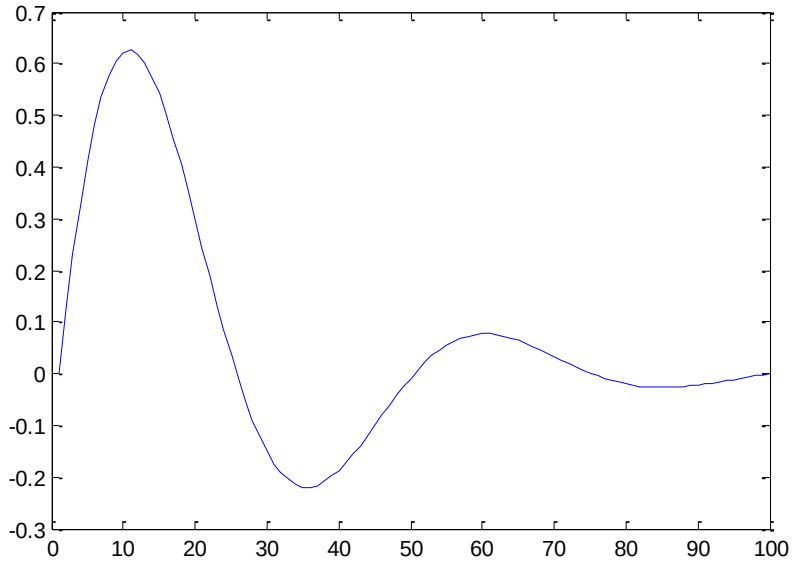
Plot the function $e^{-x/3}\sin(x)$ between $0 \leq x \leq 4\pi$

- **Multiply the arrays y and y1 correctly**

```
>>y2=y.*y1;
```

- **Plot the y2-array**

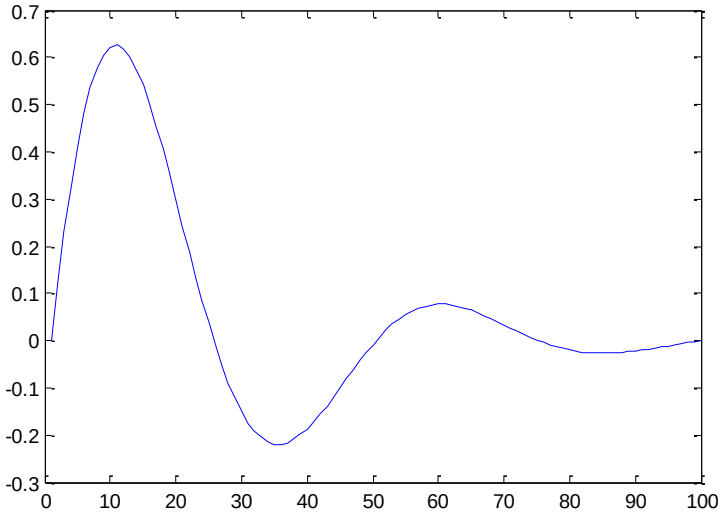
```
>>plot(y2)
```



Display Facilities

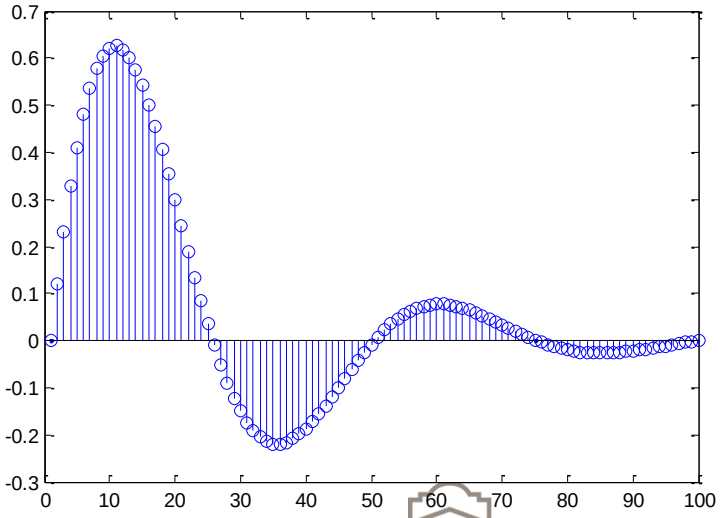
- **plot(.)**

```
Example:
>>x=linspace(0,4*pi,100);
>>y=sin(x);
>>plot(y)
>>plot(x,y)
```



- **stem(.)**

```
Example:
>>stem(y)
>>stem(x,y)
```



Display Facilities

- **title(.)**

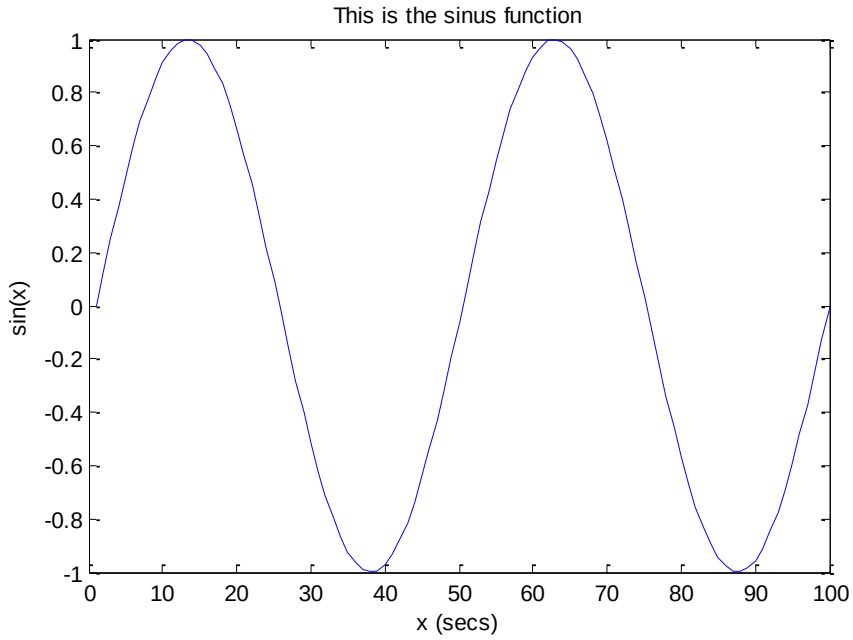
```
>>title('This is the sinus function')
```

- **xlabel(.)**

```
>>xlabel('x (secs)')
```

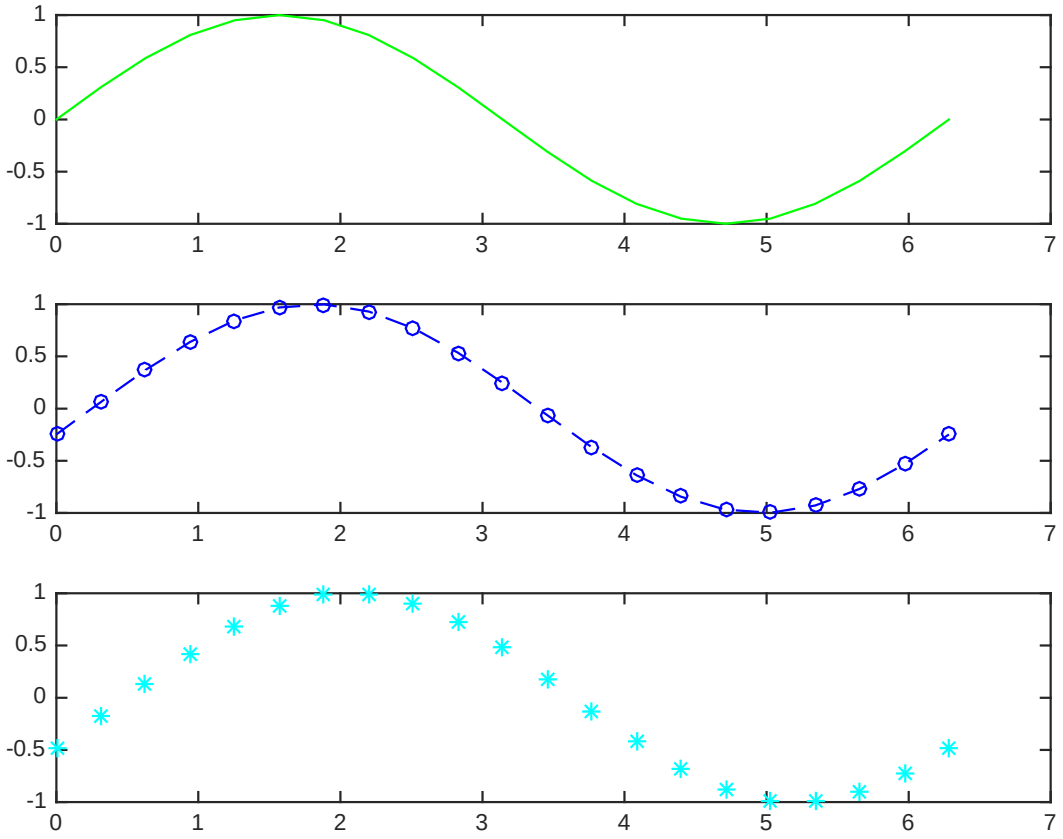
- **ylabel(.)**

```
>>ylabel('sin(x)')
```



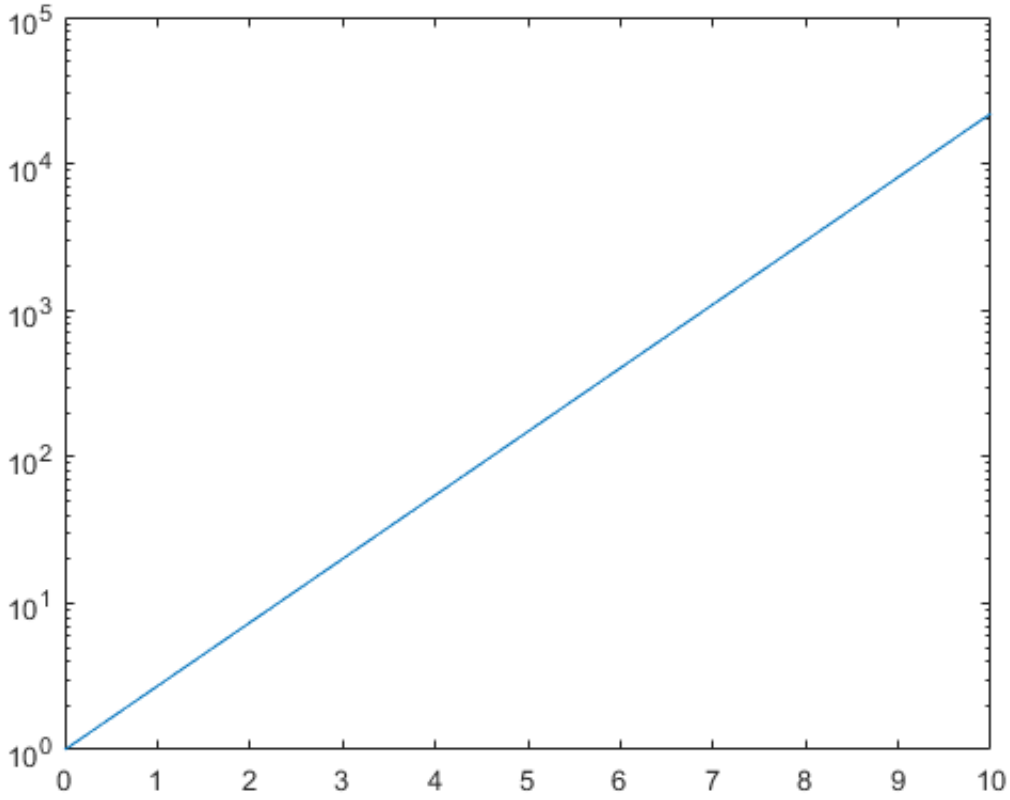
subplot

```
 x = 0:pi/10:2*pi;
y1 = sin(x);
y2 = sin(x-0.25);
y3 = sin(x-0.5);
subplot(3,1,1);
 plot(x,y1,'g')
subplot(3,1,2);
plot(x,y2,'b--o')
subplot(3,1,3);
plot(x,y3,'c*')
```



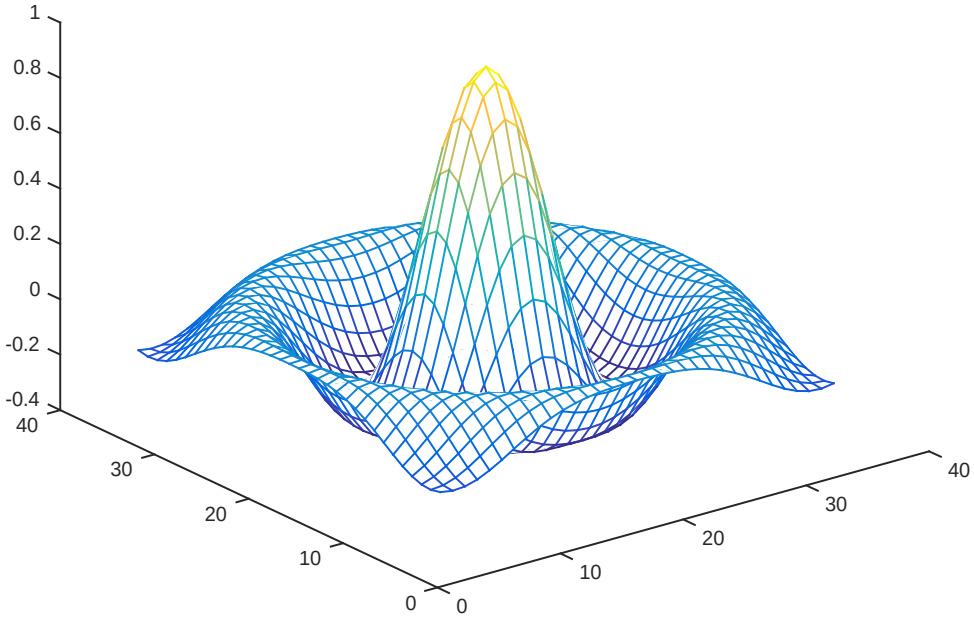
semilogy

```
x = 0:0.1:10;
y = exp(x);
semilogy(x,y)
```



3D plotting

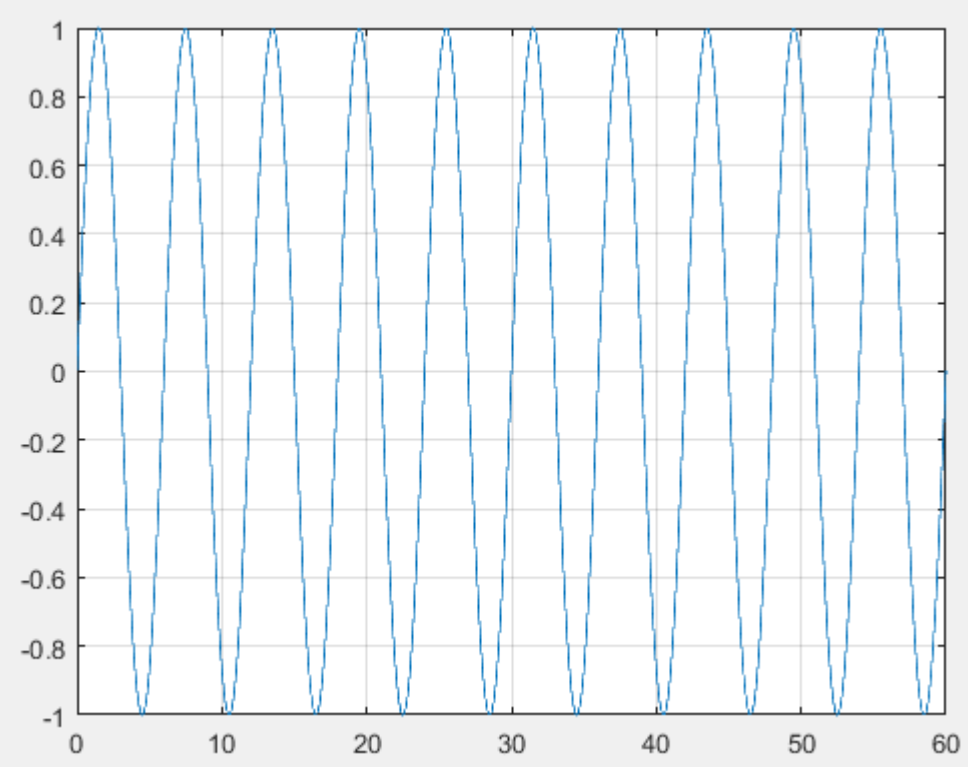
```
[X,Y] = meshgrid(-8:.5:8);
R = sqrt(X.^2 + Y.^2) ;
Z = sin(R)./R;
mesh(Z)
```



Continuous-Time Sinusoidal Signals

Let's plot Sin signal with period T: $y = \sin(\frac{2\pi}{T}t)$

```
T=6; %period
t=0:0.01:60;
y=sin(2*pi/T.*t);
plot(t,y);
grid;
```

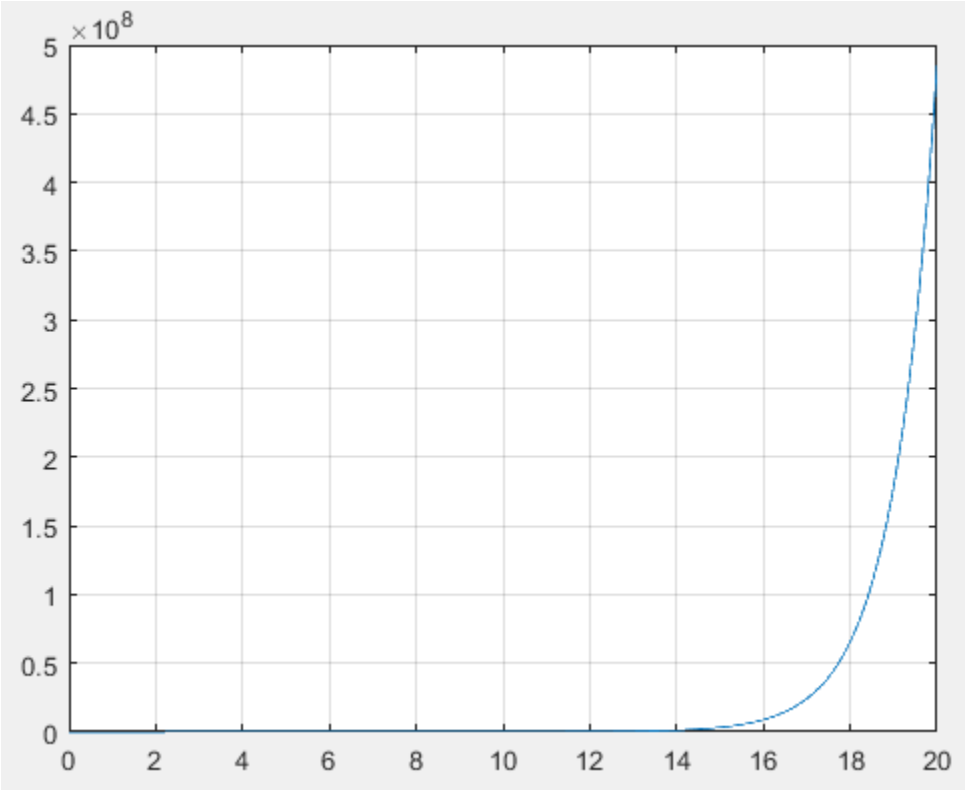


*If you don't see grid use "`grid on`" command!
Do you see grid now?

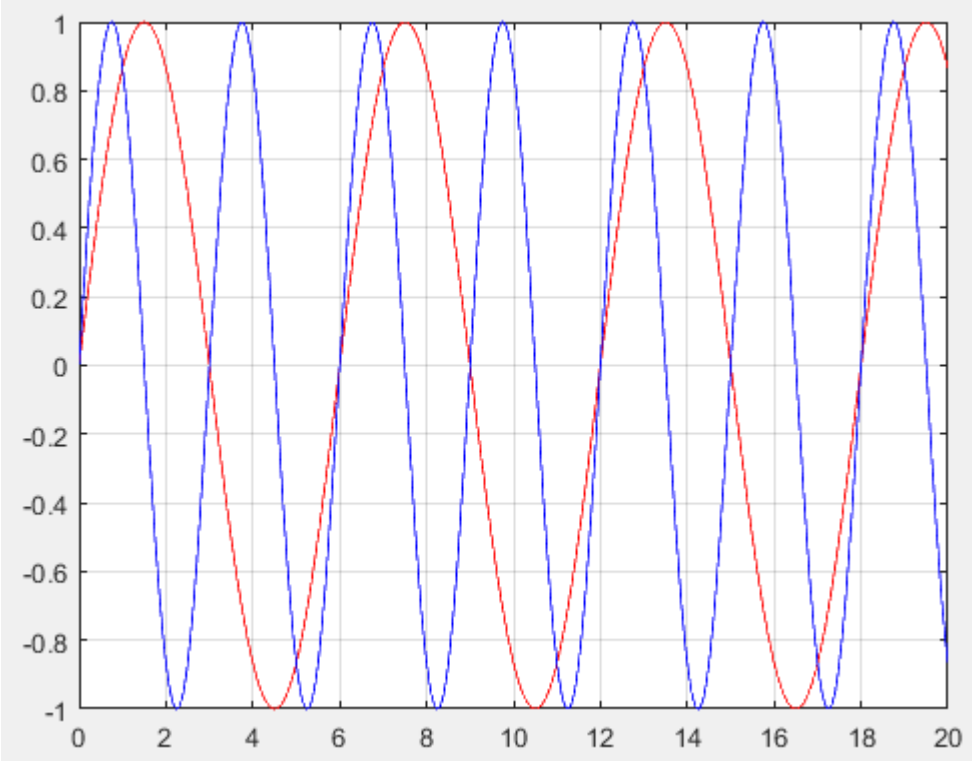
Exponential Function Signal

Let's plot Exponential Function: $x = e^{\omega_0 t}$

```
t=0:0.01:20;
omega=1;
y=exp(omega.*t);
plot(t,y),grid;
```



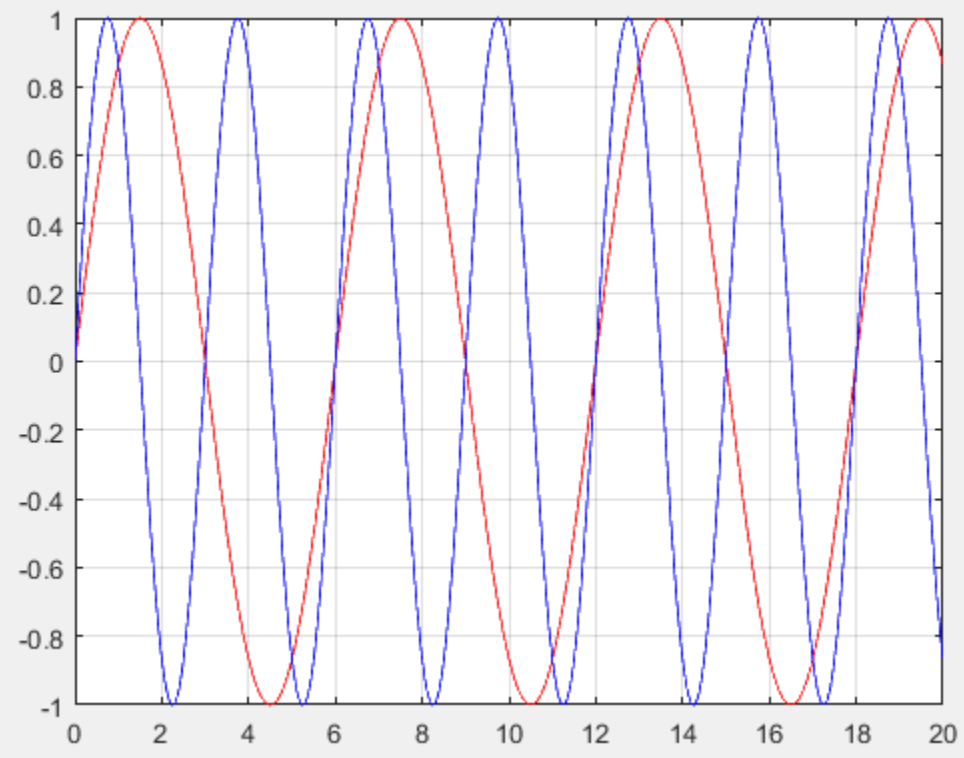
Plot Two Continuous-time Signals in One Graph (Method1)




```
%Use plot function
%Sinusoidal 1
T=6; t=0:0.01:20;
y1=sin(2*pi/T.*t);
%Sinusoidal 2
y2=sin(4*pi/T.*t);
plot(t,y1,'r',t,y2,'b'),
grid;
```

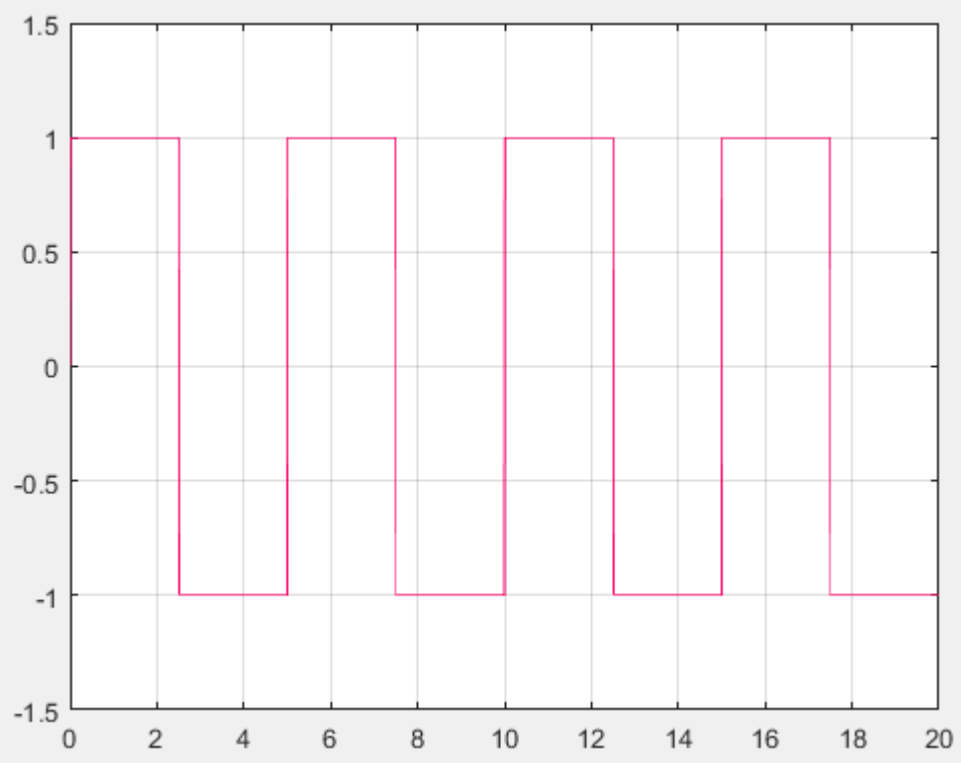
Plot Two Continuous-time Signals in One Graph (Method2) – use "hold on"

```
% Sinusoidal 1
T=6; t=0:0.01:20;
y1=sin(2*pi/T.*t);
plot(t,y1,'r');
hold on
%Sinusoidal 2
y2=sin(4*pi/T.*t);
plot(t,y2,'b');
grid on;
```



Square Wave(with period T)

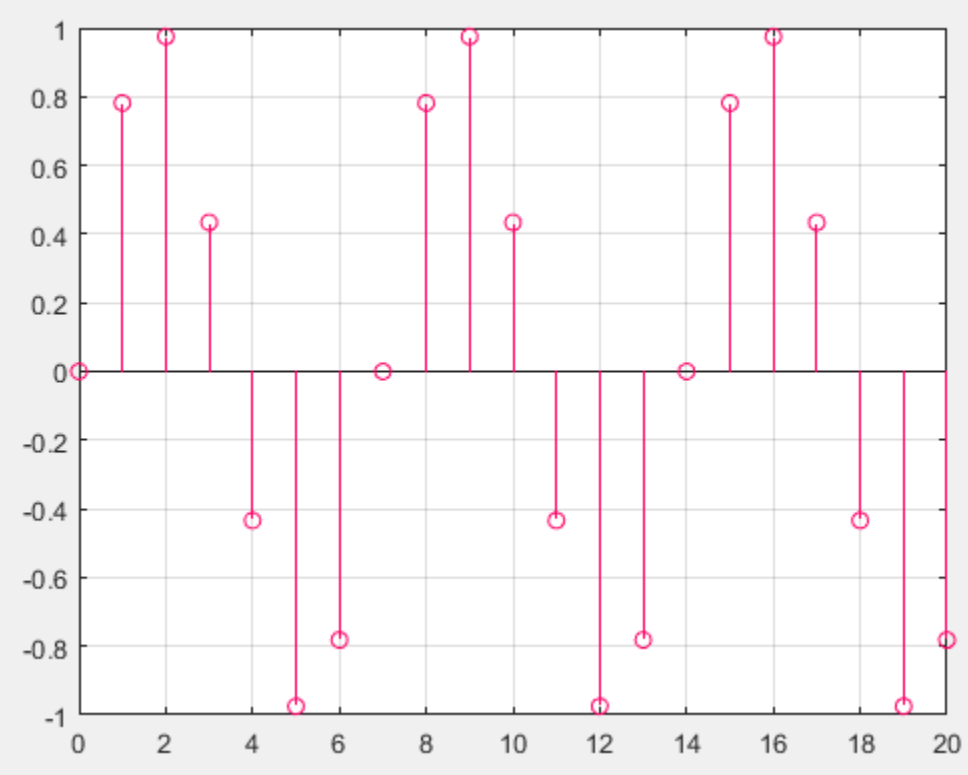
```
t=0:0.01:20;
T=5; %period
y=sign(sin(2*pi/T.*t));
%or
%y=mod(t.*1/T,1)>1/2;
plot(t,y),grid;
axis([0 20 -1.5 1.5]);
grid on;
```



Discrete-Time Sinusoidal Signals

Let's plot Sin signal with period N: $y = sin(\frac{2m\pi}{N}n)$

```
n=0:20;
m=1;
N=7; %period
y=sin(2*pi*m/N.*n);
stem(n,y,'r'),grid;
```



%plot() is for continuous signals and stem() is for discrete signals

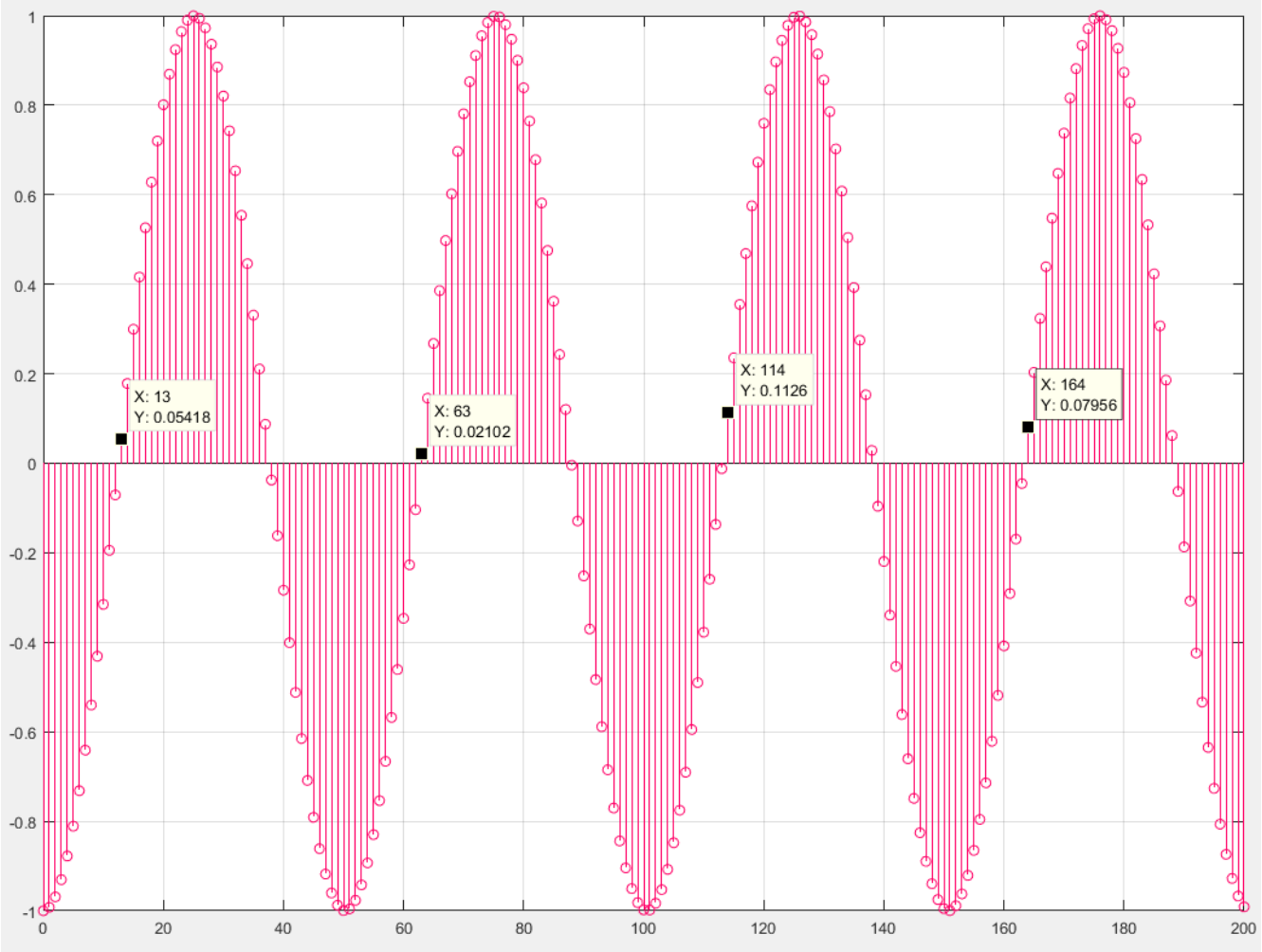
Discrete-Time Sinusoidal Signals (Homework 1-26 b)

Let's plot Cosine signal: $x[n] = \cos(\frac{n}{8} - \pi)$

(Result in the next slide)

```
n=0:200;
x=cos(n./8-pi);
stem(n,x);
grid on;
```

X[n]=cos(n/8-pi) Result: **NOT** periodic: $x[n] \neq x[n+N]$

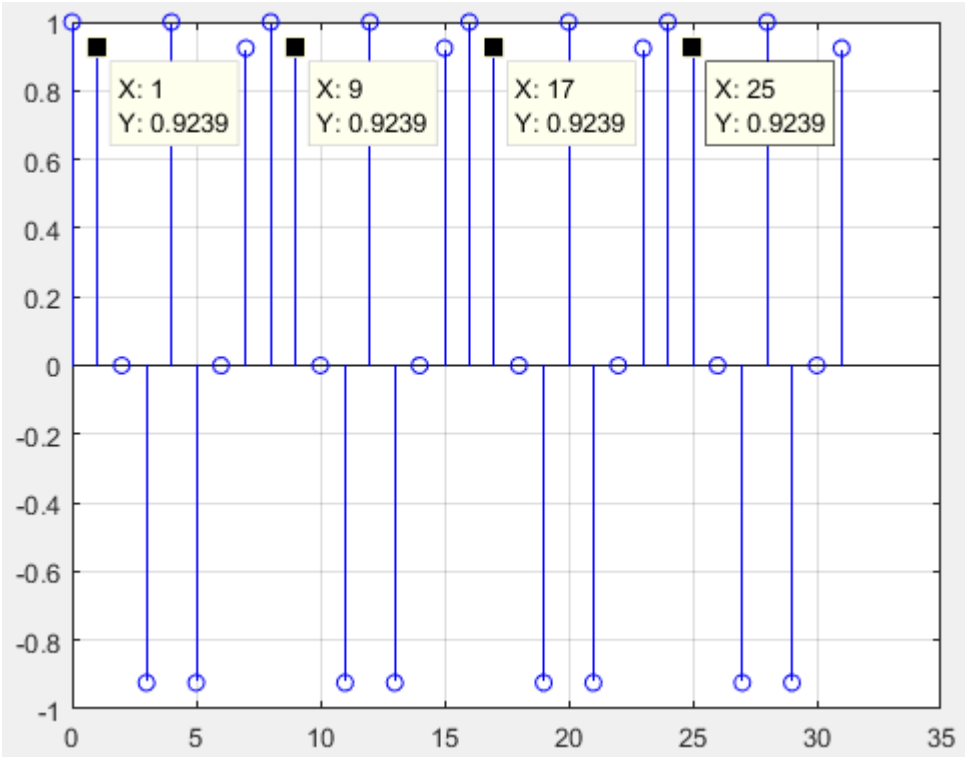


Discrete-Time Sinusoidal Signals
Homework 1-26 c)

$$x[n] = \cos(\frac{\pi}{8} \times n^2)$$

$$x[n] = x[n+N]$$

Periodic and N=8

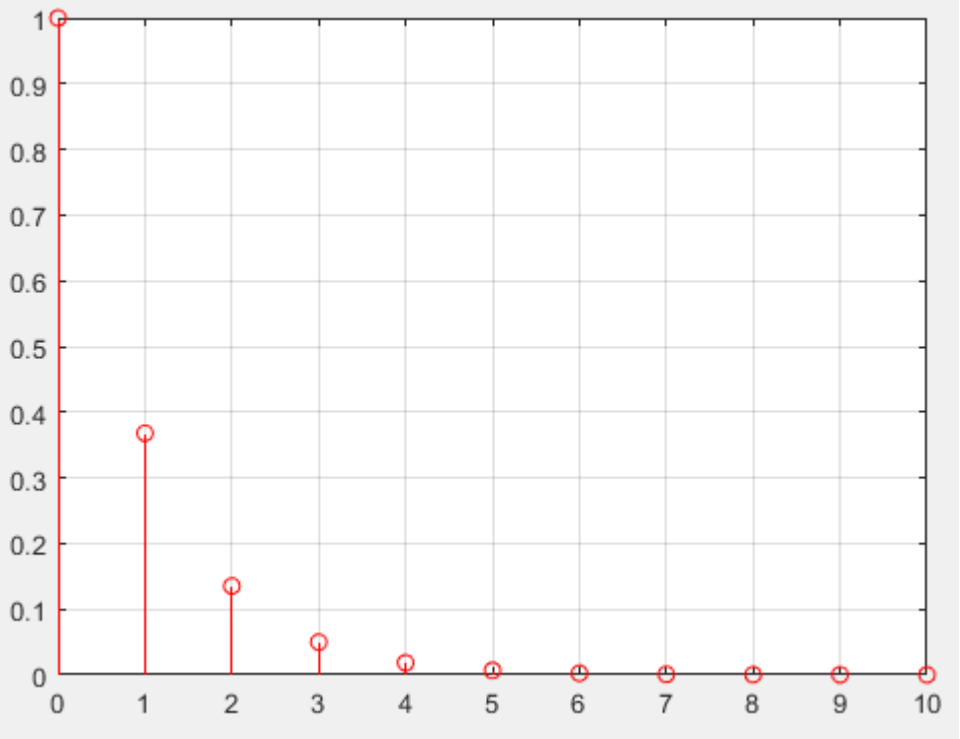



```
n=0:33;
x=cos(power(n,2)*pi/8);
stem(n,x,'b'),grid;
```

Discrete-Time Exponential Signals

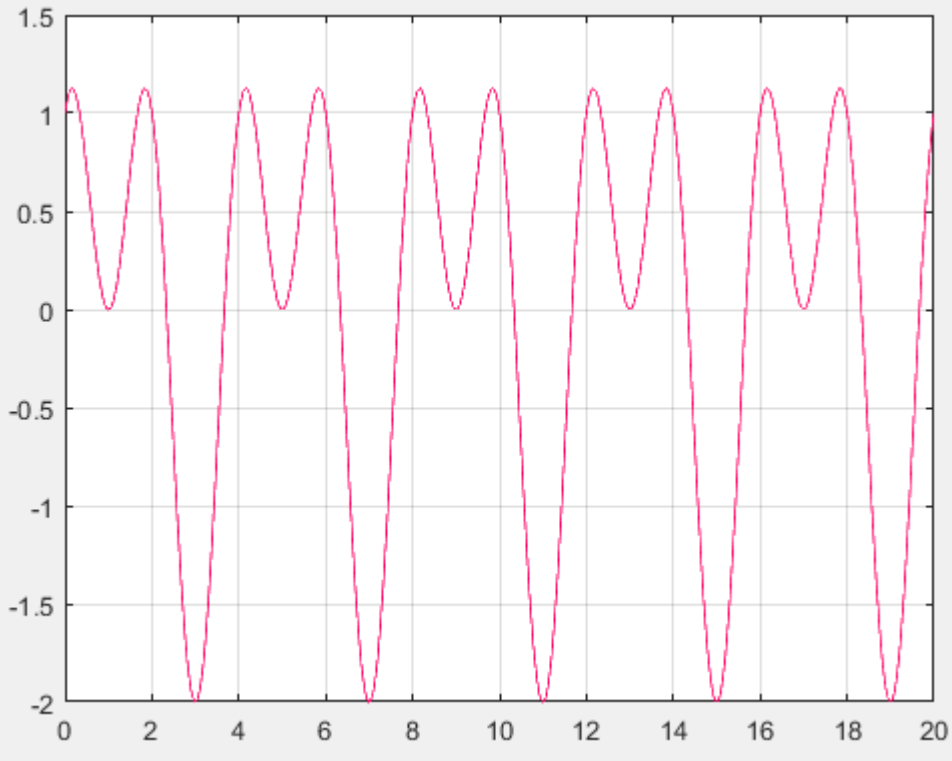
Exponential signal: $y[n]=e^{-n}$

```
n=0:10;
y=exp(-n);
stem(n,y,'r');
grid on;
```



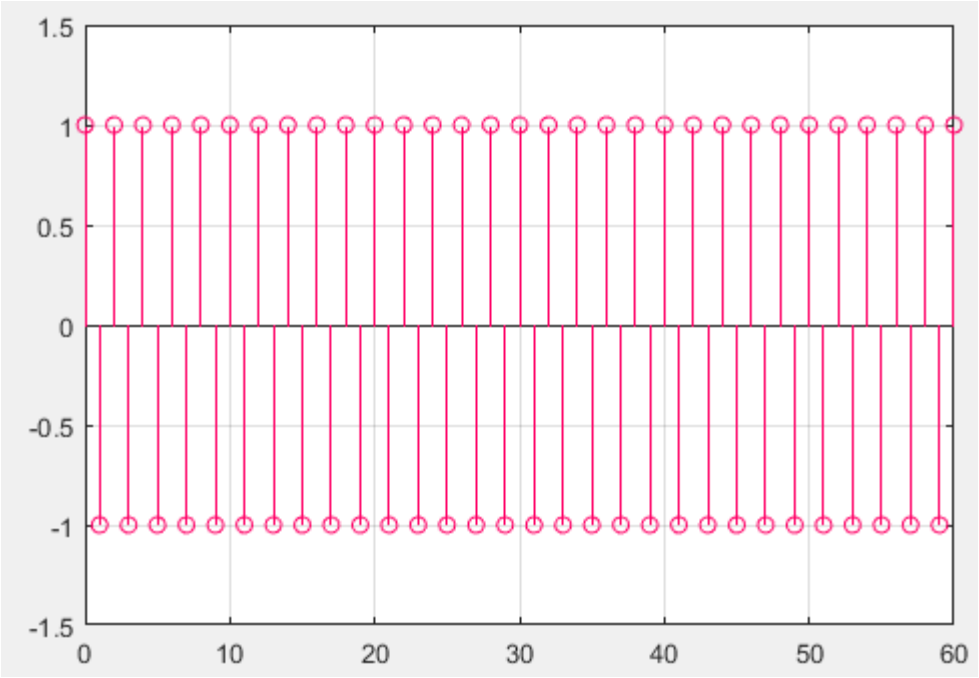
Addition of Two Continuous-Time Signals

```
t=0:0.01:20;
T1=2;
T2=4;
y1=cos(2*pi/T1*t);
y2=sin(2*pi/T2*t);
y3=y1+y2;
plot(t,y3),grid;
```



Addition of Two Discrete-Time Signals

```
n=0:60;
N1=2;
m1=3;
N2=4;
m2=2;
y1=cos(m1/N1*2*pi.*n);
y2=sin(m2/N2*2*pi.*n);
y3=y1+y2;
stem(n,y3),grid;
```

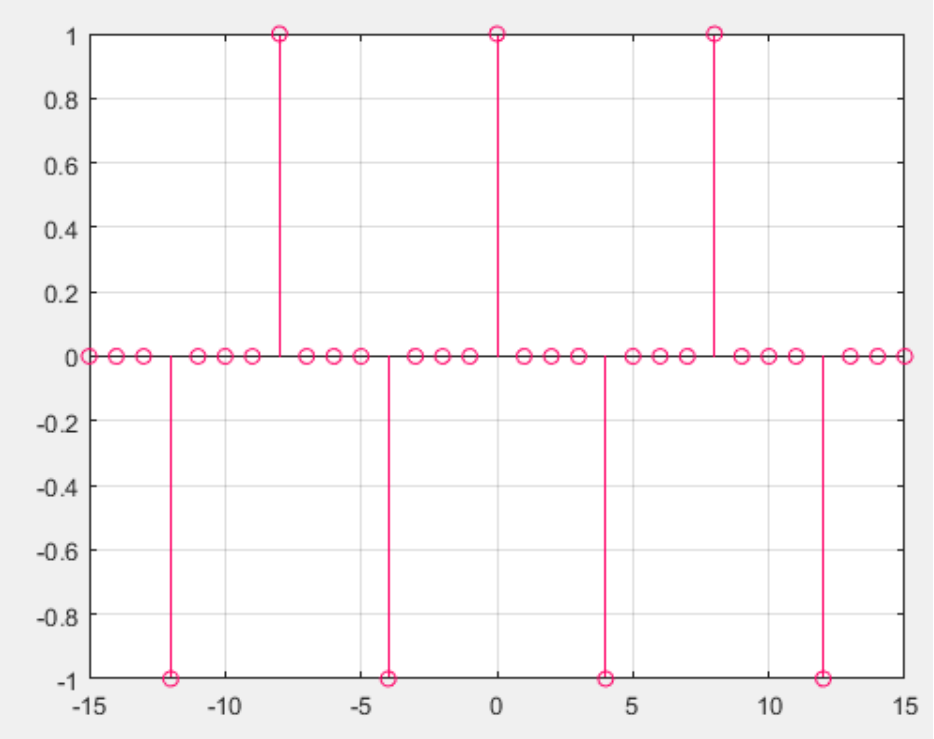


Multiplication of Two Discrete-Time Signals

```
n=-15:15;
x=cos(pi.*n/2).*cos(pi.*(n/4));
stem(n,x);
grid;
```

* $x[n] = x[n+N]$

Periodic and N=8



Thank you!