EP375 Computational Physics

Topic 4

MATLAB TUTORIAL

PLOTTING

Department of Engineering Physics

University of Gaziantep

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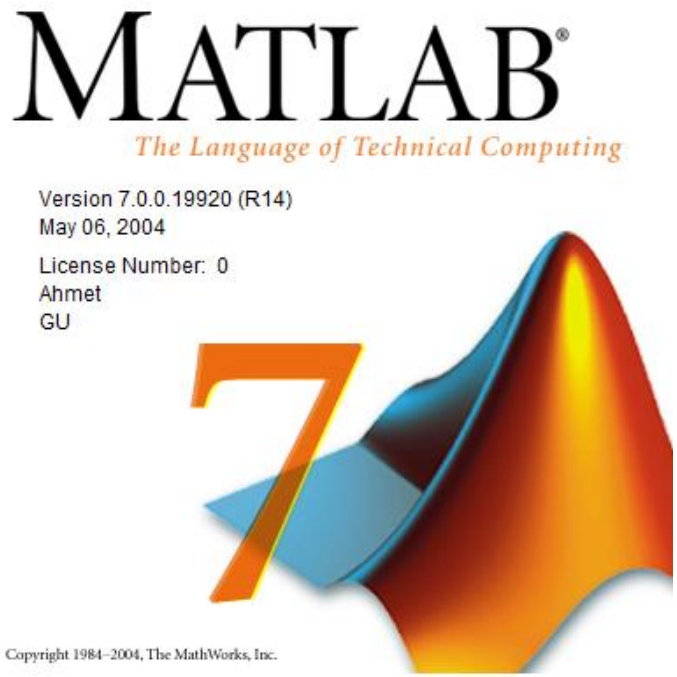
Content

1. **2D and 3D Plotting**

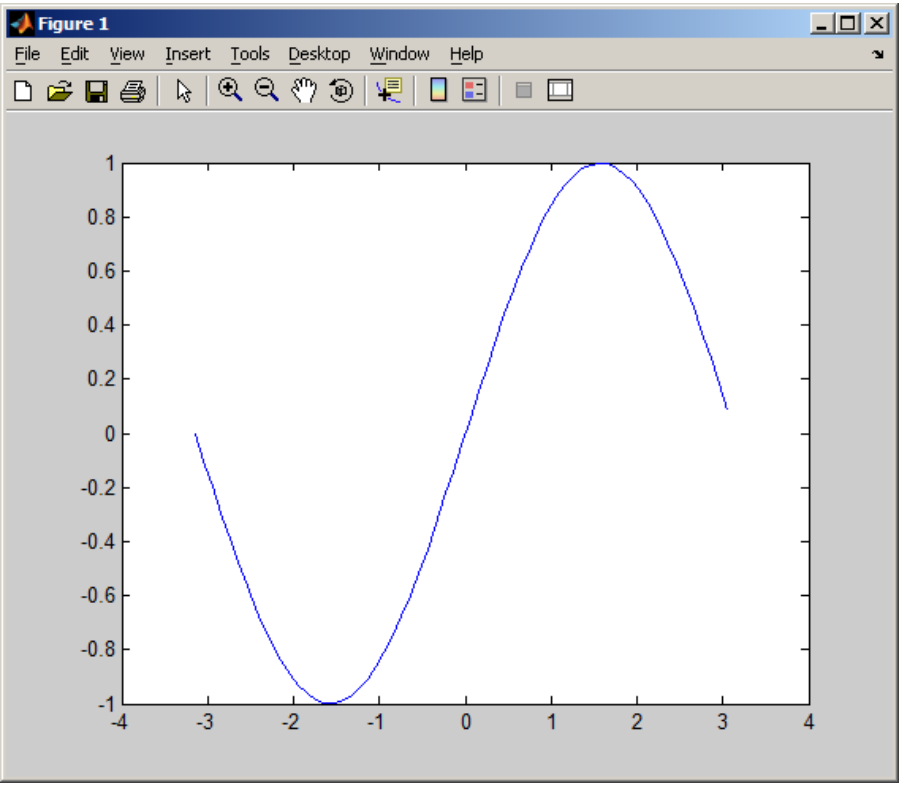


- MATLAB has extensive plotting capabilities.
- Here we illustrate some basic commands for 2D and 3D plots.

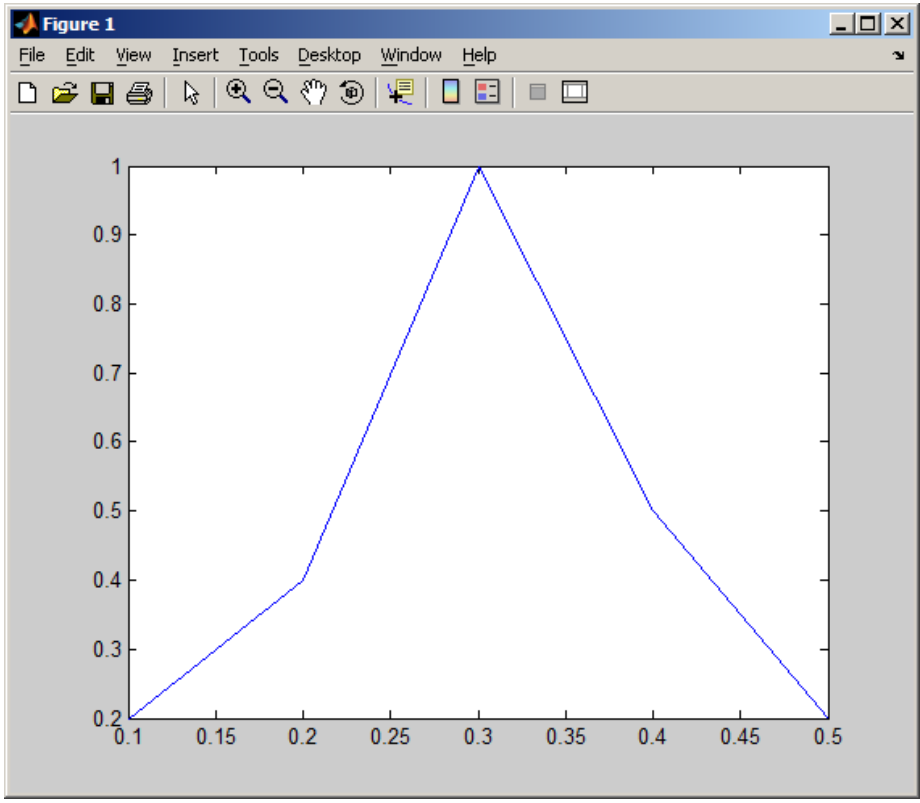
Plotting functions: 3 categories

Management	Generation	characteristics
figure	2-D	xlabel, ylabel, zlabel
subplot	plot	text
zoom	polar	title
hold	fill	legend
view	plotyy	box
rotated	3-D	set
	plot3	grid
	surf, surf3	
	mesh, meshz	
	contour, contour3	

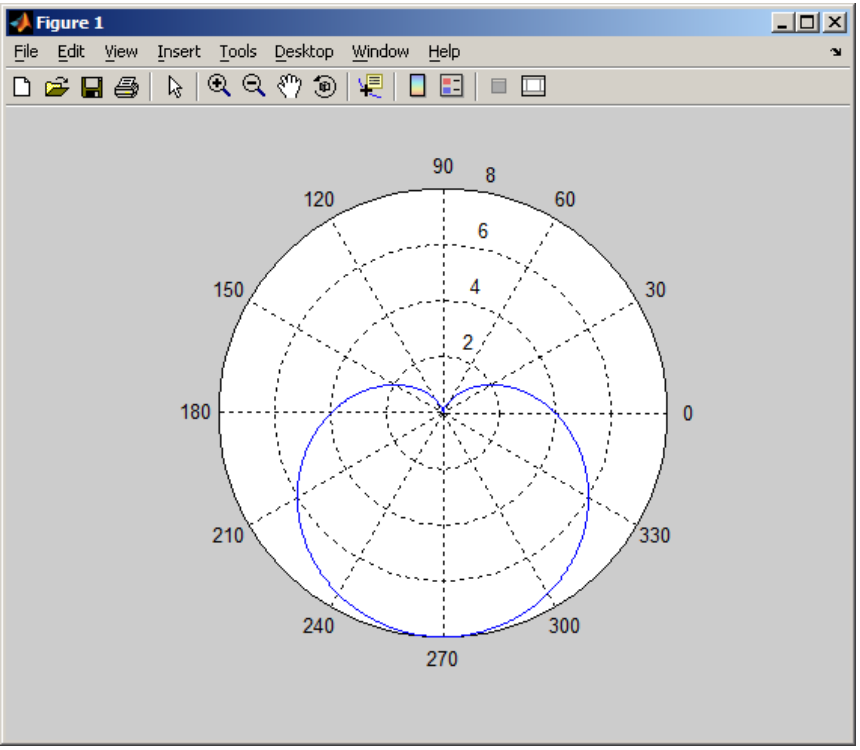
```
>> x = -pi:0.1:pi;
>> y = sin(x);
>> plot(x,y)
>>
```



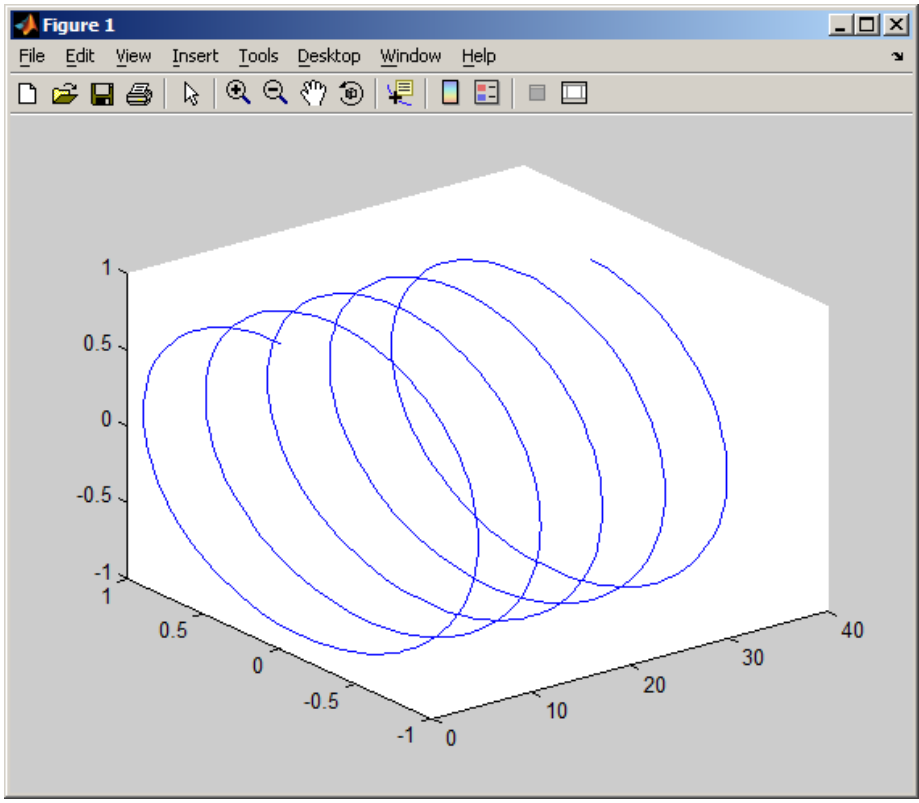

```
>> x = [0.1 0.2 0.3 0.4 0.5];
>> y = [0.2 0.4 1.0 0.5 0.2];
>> plot(x,y);
>>
```



```
>> t = 0:0.01:2*pi;
>> polar(t, 4-4*sin(t));
>>
```



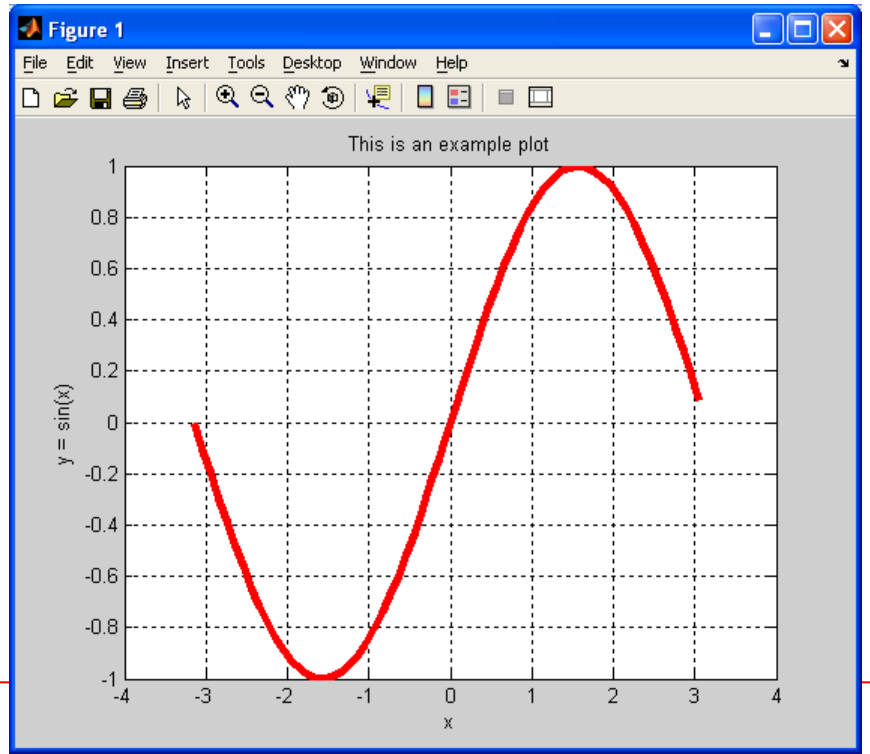

```
>>  p = 0:pi/50:10*pi;
>>  plot3(p,sin(p),cos(p))
>>
```



ciz1.m

```
x = -pi:0.1:pi;
y = sin(x);
p = plot(x,y);
set(p,'Color','red','LineWidth',4);
title('This is an example plot');
xlabel('x');
ylabel('y = sin(x)');
grid on;
```

```
>> ciz1
>>
```



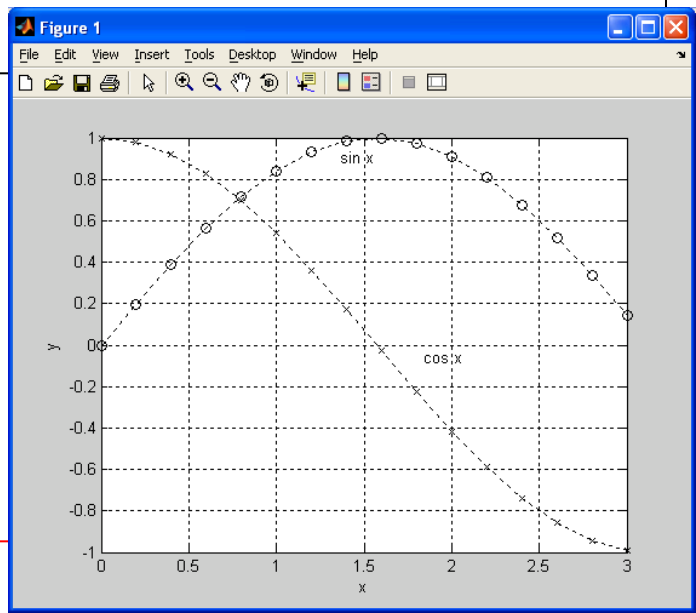
Color Specifiers

Specifier	Color
r	Red
g	Green
b	Blue
c	Cyan
m	Magenta
y	Yellow
k	Black
w	White

ciz2.m

```
x = 0:0.2:pi;       % Create x-array
y = sin(x);         % Create y-array
plot(x,y,'k:o');    % Plot x-y points with specified color
                    % and symbol ('k' = black, 'o' = circles)
hold on;            % Allow overwriting of current plot
z = cos(x);         % Create z-array
plot(x,z,'b:x');    % Plot x-z points ('x' = crosses)
grid on;            % Display coordinate grid
xlabel('x');        % Display label for x-axis
ylabel('y');        % Display label for y-axis
gtext('sin x');     % Create mouse-movable text
gtext('cos x');     %
```

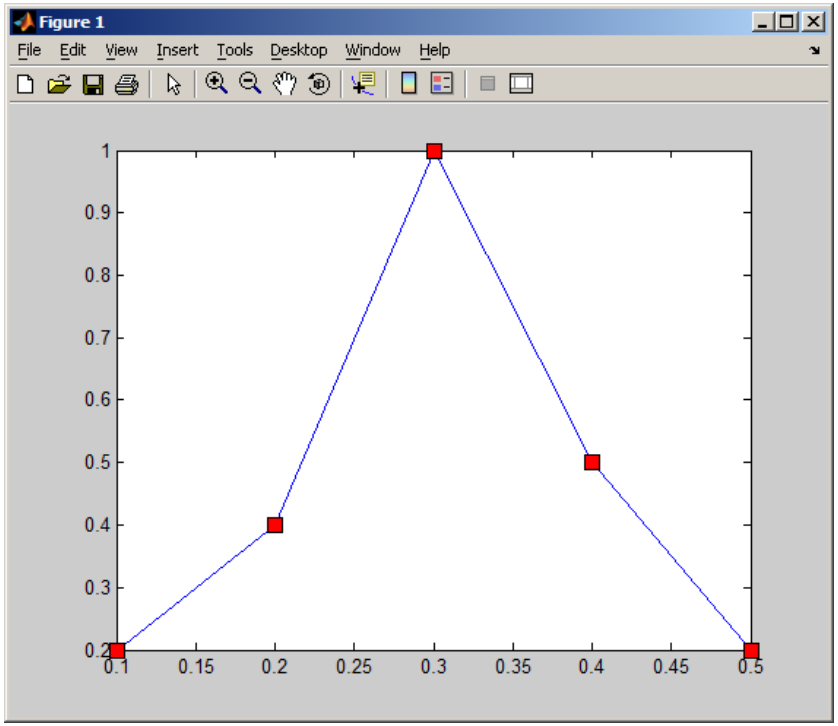
```
>> ciz2
>>
```



ciz3.m

```
x = [0.1 0.2 0.3 0.4 0.5];
y = [0.2 0.4 1.0 0.5 0.2];
plot(x,y,'-s', 'MarkerFaceColor','r',...
               'MarkerEdgeColor','k',...
               'MarkerSize',10);
```

```
>> ciz3
>>
```

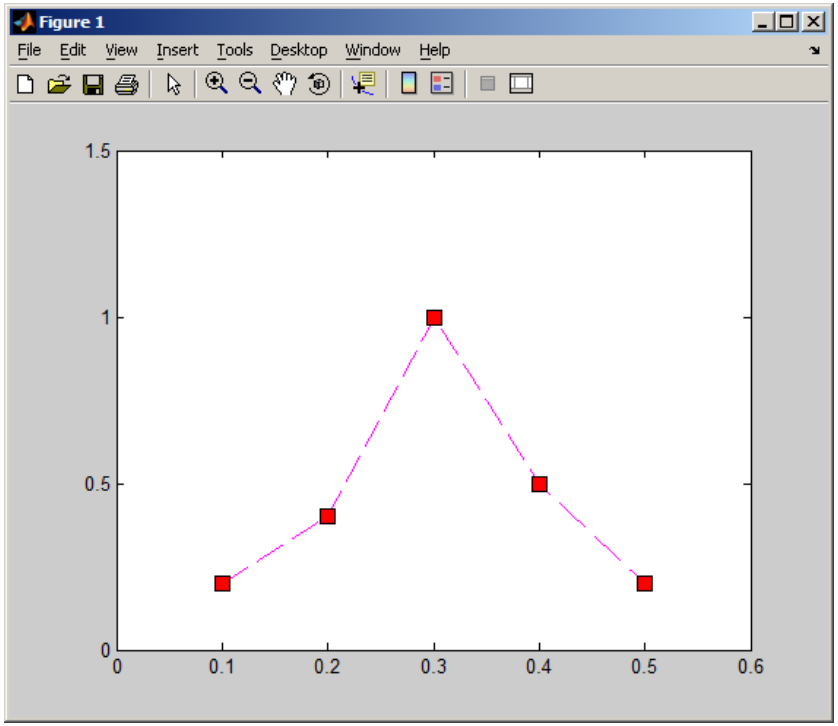


Symbol	Line Style
-	Solid line (default)
--	Dashed line
:	Dotted line
-.	Dash-dot line
none	No line

ciz4.m

```
x = [0.1 0.2 0.3 0.4 0.5];
y = [0.2 0.4 1.0 0.5 0.2];
plot(x,y,'--ms', 'MarkerFaceColor','r',...
                 'MarkerEdgeColor','k',...
                 'MarkerSize',10);
axis([0 0.6 0 1.5]);
```

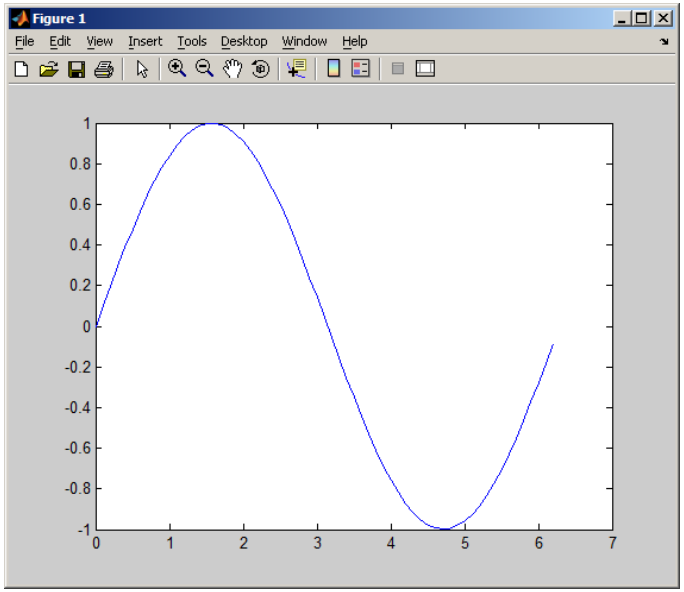
```
>> ciz4
>>
```

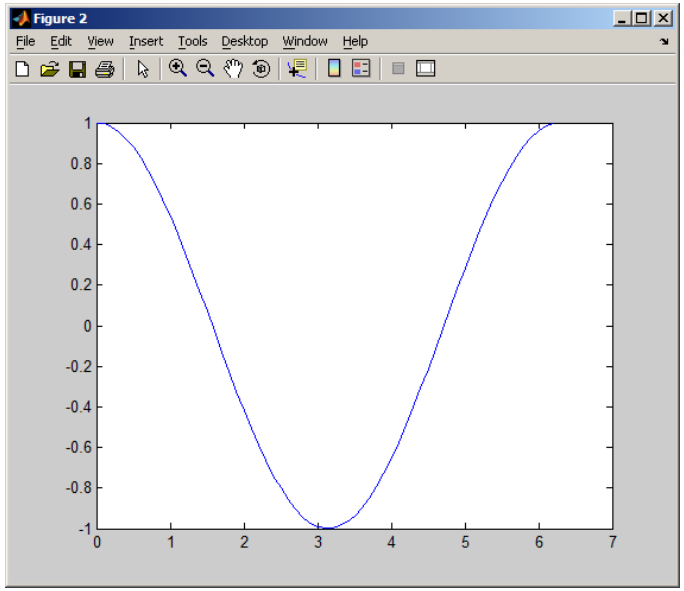


ciz5.m

```
x = 0.0:0.1:2*pi;
y = sin(x);
z = cos(x);

figure(1);
plot(x,y);

figure(2);
plot(x,z);
```

```
>> ciz5
>>
```

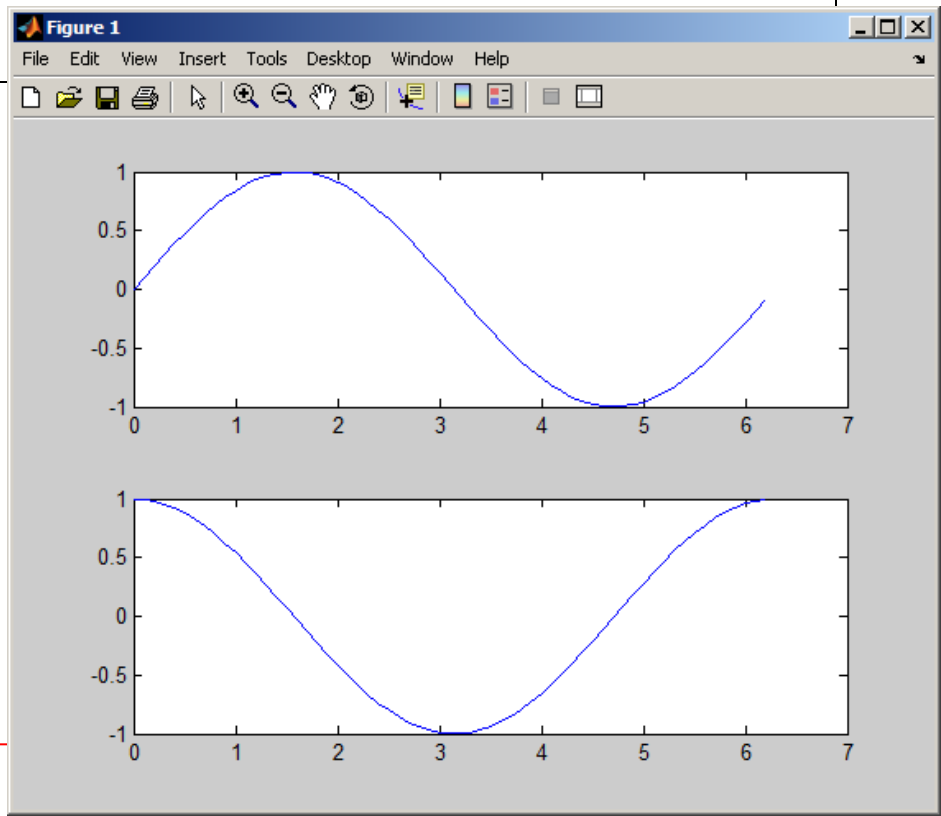




ciz6.m

```
x = 0.0:0.1:2*pi;
y = sin(x);
z = cos(x);

subplot(2,1,1);
plot(x,y);

subplot(2,1,2);
plot(x,z);
```

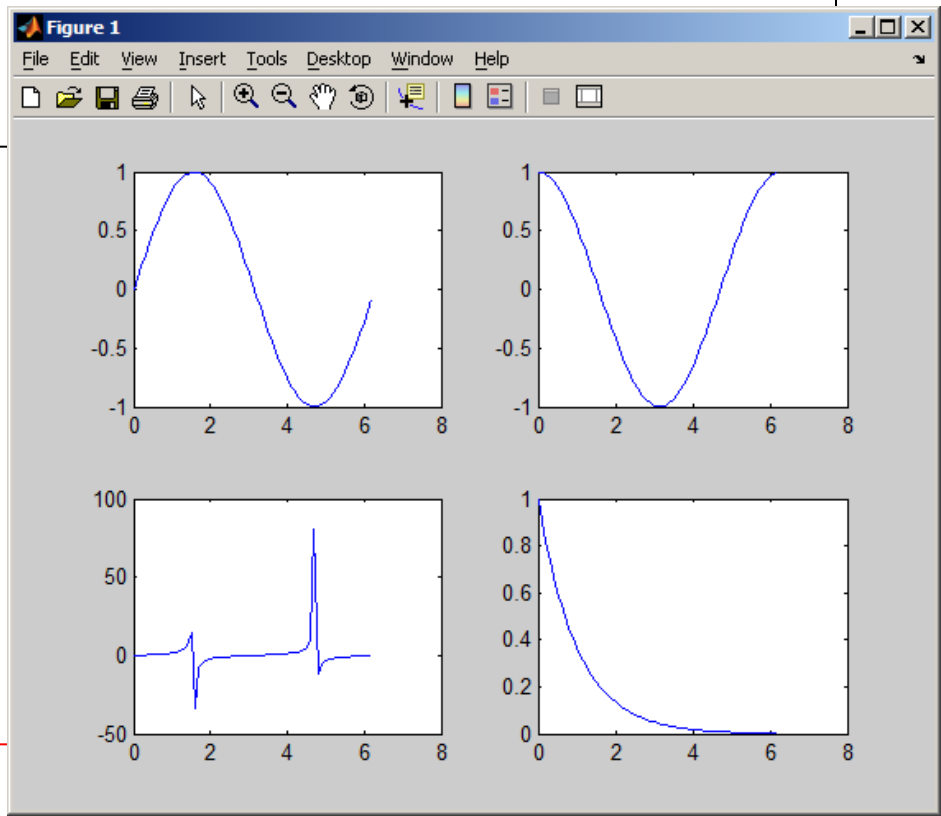
```
>> ciz6
>>
```



ciz7.m

```
x = 0.0:0.1:2*pi;
y = sin(x);
z = cos(x);
w = tan(x);
q = exp(-x);

subplot(2,2,1); plot(x,y);
subplot(2,2,2); plot(x,z);
subplot(2,2,3); plot(x,w);
subplot(2,2,4); plot(x,q);
```

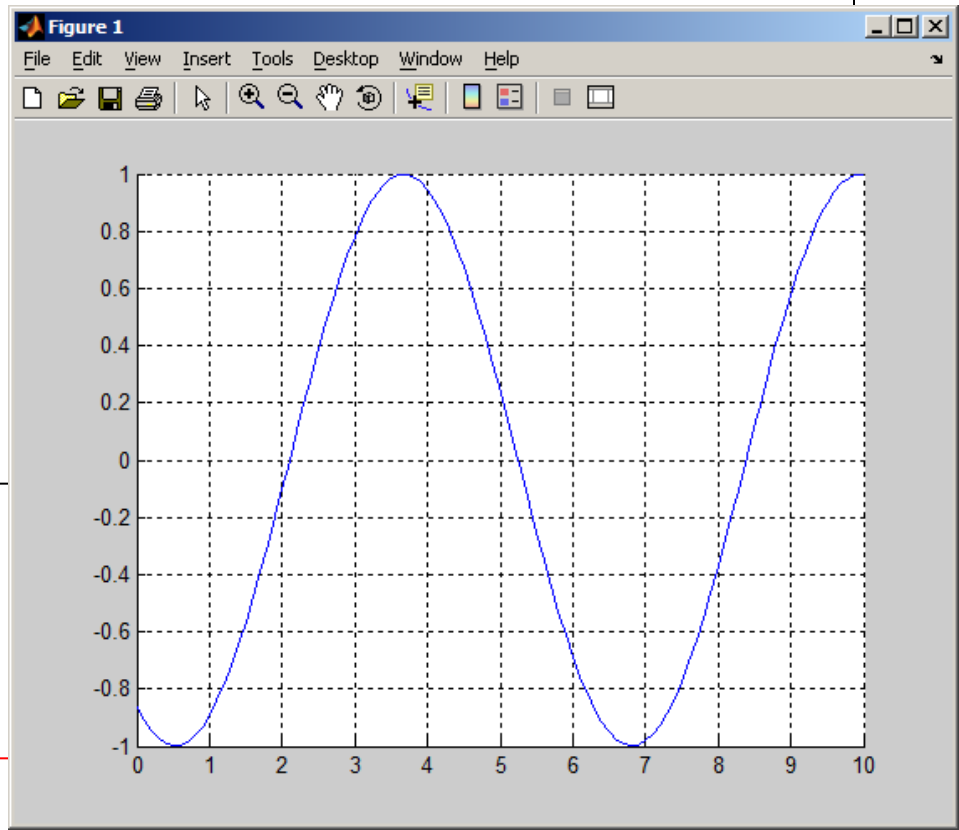
```
>> ciz7
>>
```



ciz8.m

```
% Dynamic Plot
figure;
hold on;
grid on;
v = 10.0;
x = 0.0:0.1:10;
t = 0.0;

while 1
   y = sin(x-v*t);
   h = plot(x,y);
   pause(0.1);
   delete(h);
   t = t + 0.01;
end
```

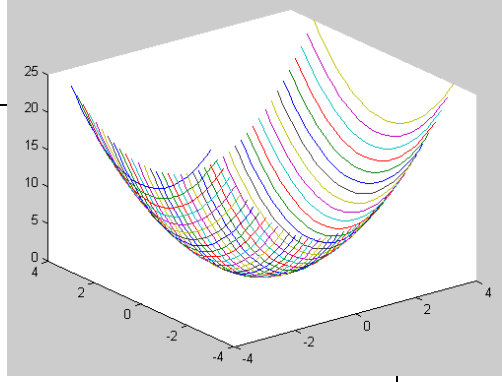
```
>> ciz8
>>
```

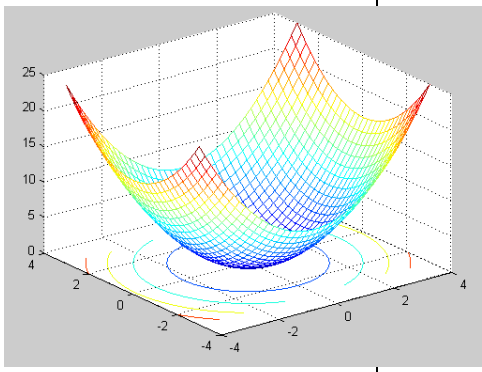


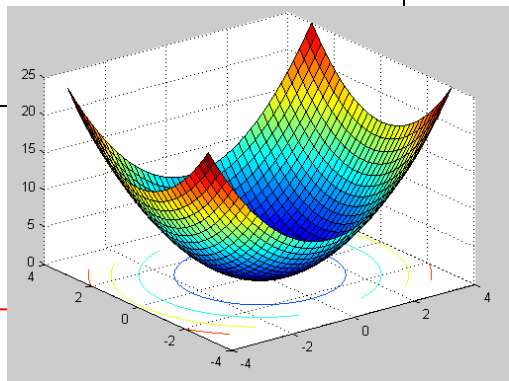
ciz9.m

```
% 3D Plots
clc; clear; close all; grid on;
% defines vectors x and y
vx = -4 :0.2: 4;
vy = -3 :0.2: 3;
% calculates the necessary grid
[x,y] = meshgrid(vx, vy);
% calculates z and avoids a null denominator adding 'eps'
z = x.*x + y.*y;

% generates the first figure using 'plot3'
figure
plot3(x,y,z)

% generates the second figure using 'meshc' to include the
% contour in the figure, and rotates the figure with 'view'
figure
meshc(x,y,z)

% generates the third 3D figure using 'surfc' to include the
% contour in the image, and also rotates the figure with 'view'
figure
surfc(x,y,z)
```

```
>> ciz9
>>
```







Line and Rectangle

* **`line` function**

```
>> axis([0 10 0 10])
>> x = [1 2];
>> y = [5 8];
>> line(x,y);
>> line(x,y,'Color','r')
```

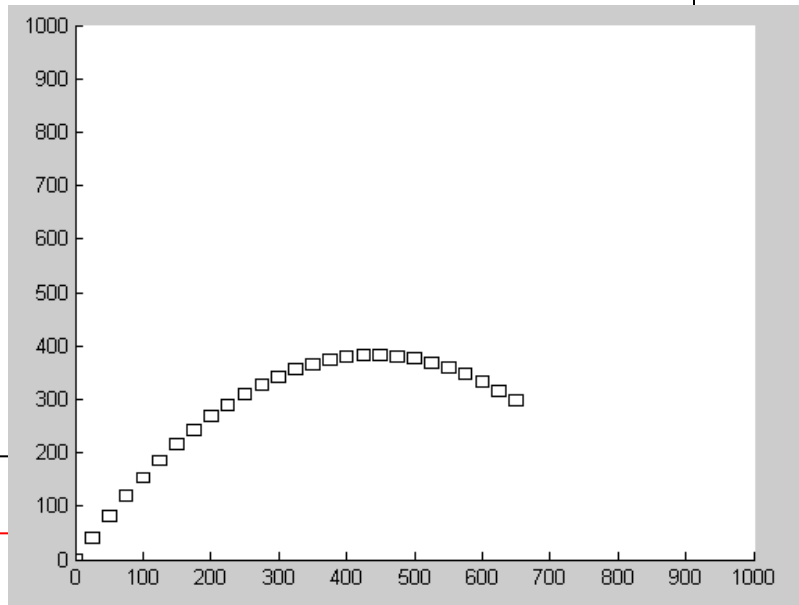
* **`rectangle` function**

```
>> axis([-3 3 -3 3])
>> rectangle('Position',[-1,-1,1,2])
>> rectangle('Position',[0,0,1,2],  ...
             'Curvature',[0.8 0.5], ...
             'FaceColor','r')
```

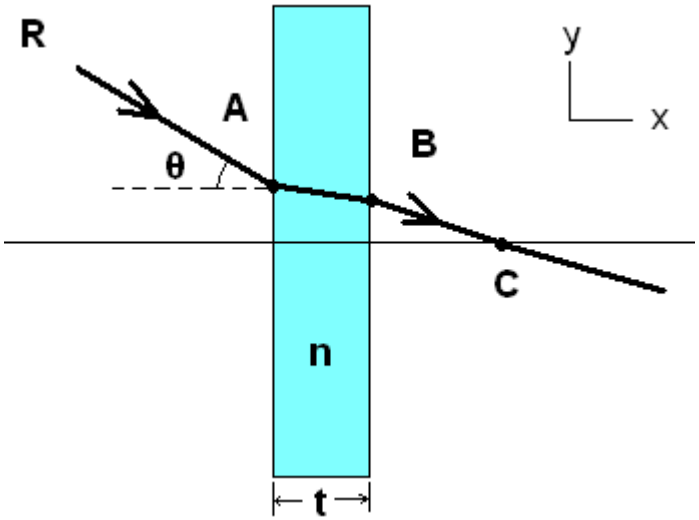
Basic Animation

ciz10.m

```
% Projectile Motion
hold on;
v0 = 100.0;              % initial velocity (m/s)
theta = 60 * pi/180;     % initial angle
g = 9.8;                 % gravitational acceleration
t = 0.0;                 % time
w = 20;                  % width of the object
axis([0 1000 0 1000]); %

while t<=18
  x = v0*cos(theta)*t;
  y = v0*sin(theta)*t-0.5*g*t*t;
  r = rectangle('Position', ...
                [x-w/2,y-w/2,w,w]);
  t = t + 0.5;
  pause(0.5);
  delete(r);
end
```



Exercise 1:



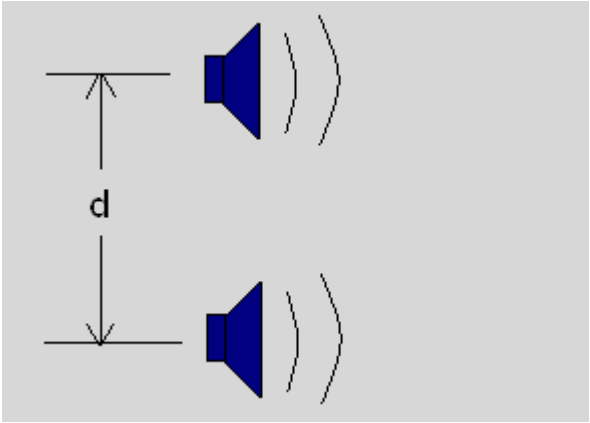
A light ray hits a glass slab, (whose index of refraction is n and thickness is t) at point A(x1,y1) with an angle θ. The ray leaves the glass at point B(x2, y2). Then the ray crosses the point the principle axis at C(x3, 0) as shown. Write a program to simulate and plot this events in MATLAB.

Inputs: (x1,y1), θ, n, t

Outputs: (x2,y2), (x3, 0)

Exercise 2:

Two loudspeakers are placed as shown.
(Let d = 1 m).
For the given frequency of sound,
write a MATLAB program to show
2D distribution of interference pattern.



References

[1]. http://www.mathworks.com/products/matlab

[2]. Numerical Methods in Engineering with MATLAB,
J. Kiusalaas, Cambridge University Press (2005)

[3]. Numerical Methods for Engineers, 6th Ed.
S.C. Chapra, Mc Graw Hill (2010)