

MATLAB Tutorial

Chapter 3. Basic graphing routines

3.1. 2-D plots

The basic command for making a 2-D plot is "plot". The following code makes a plot of the function $\sin(x)$.

```
x = linspace(0,2*pi,200);  
f1 = sin(x);  
plot(x,f1)
```

we now add a title and labels for the x and y axes

```
title('Plot of f_1 = sin(x)');  
xlabel('x');  
ylabel('f_1');
```

Let us change the axes so that they only plot x from 0 to 2π .

```
axis([0 2*pi -1.1 1.1]); [xmin xmax ymin ymax]
```

Next, we make a new figure with $\cos(x)$

```
f2 = cos(x);  
figure; makes a new figure window  
plot(x,f2);  
title('Plot of f_2 = cos(x)');  
xlabel('x');  
ylabel('f_2');  
axis([0 2*pi -1.1 1.1]);
```

Now, we make a single graph with both plots

```
figure; creates a new graph  
plot(x,f1);  
hold on; tells MATLAB not to overwrite current plot
```

What happens if you forget to type hold on? "hold off" removes the hold.

```
plot(x,f2,'r'); plots with red curve  
title('Plots of f_1 = sin(x), f_2 = cos(x)');  
xlabel('x');  
ylabel('f_1, f_2');  
axis([0 2*pi -1.1 1.1]);
```

Now we add a legend.

```
legend('f_1', 'f_2');
```

If we want to move the legend, we can go to the "Tools" menu of the figure window and turn on "enable plot editing" and then drag the legend to where we want it.

Finally, we use the command "gtext" to add a line of text that we then position on the graph using our cursor.

```
gtext('f_1=f_2 at two places');
```

The command "help plot" tells how to make a graph using various types of points instead of lines and how to select different colors.

```
clear all
```

3.2. 3-D plots

First, we generate a grid containing the x and y values of each point.

```
x = 0:0.2:2*pi; create vector of points on x-axis  
y = 0:0.2:2*pi; create vector of points on y-axis
```

Now if $n = \text{length}(x)$ and $m = \text{length}(y)$, the grid will contain $N = n * m$ grid points. XX and YY are n by m matrices containing the x and y values for each grid point respectively.

```
[XX,YY] = meshgrid(x,y);
```

The convention in numbering the points is apparent from the following lines.

```
x2 = 1:5; y2 = 11:15;  
[XX2,YY2] = meshgrid(x2,y2);  
XX2, YY2
```

This shows that $XX2(i,j)$ contains the j th component of the x vector and $YY2(i,j)$ contains the i th component of the y vector.

Now, we generate a function to save as a separate z-axis value for each (x,y) 2-D grid point.

```
Z1 = sin(XX).*sin(YY); calculate value of function to be plotted
```

create a colored mesh plot

```
figure; mesh(XX,YY,Z1);  
xlabel('x'); ylabel('y'); zlabel('z'); title('sin(x)*sin(y)');
```

create a colored surface plot

```
figure; surf(XX,YY,Z1);  
xlabel('x'); ylabel('y'); zlabel('z'); title('sin(x)*sin(y)');
```

create a contour plot

```
figure; contour(XX,YY,Z1);  
xlabel('x'); ylabel('y'); zlabel('z'); title('sin(x)*sin(y)');
```

create a filled contour plot with bar to show function values

```
figure; contourf(XX,YY,Z1); colorbar;  
xlabel('x'); ylabel('y'); zlabel('z'); title('sin(x)*sin(y)');
```

create a 3-D contour plot

```
figure; contour3(XX,YY,Z1);  
xlabel('x'); ylabel('y'); zlabel('z'); title('sin(x)*sin(y)');
```

clear all

3.3. Making complex figures

Using the subplot command, one can combine multiple plots into a single figure. We want to make a master figure that contains $nrow$ # of rows of figures and $ncol$ # of figures per row. `subplot(nrow,ncolumn,i)` makes a new figure window within the master plot, where i is a number denoting the position within the master plot according to the following order :

```
1 2 3 ... ncol  
ncol+1 ncol+2 ncol+3 ... 2*ncol
```

First, generate the data to be plotted.

```
x = 0:0.2:2*pi;
```

```
y = 0:0.2:2*pi;  
f1 = sin(x);  
f2 = cos(y);  
[XX,YY] = meshgrid(x,y);  
Z1=sin(XX).*cos(YY);
```

The following code creates a figure with four subplots.
figure; create a new figure

```
subplot(2,2,1); create 1st subplot window  
plot(x,f1); title('sin(x)');  
xlabel('x'); ylabel('sin(x)'); axis([0 2*pi -1.1 1.1]);
```

```
subplot(2,2,2); create 2nd subplot window  
plot(y,f2); title('cos(y)');  
xlabel('y'); ylabel('cos(y)'); axis([0 2*pi -1.1 1.1]);
```

```
subplot(2,2,3); create 3rd subplot window  
surf(XX,YY,Z1); title('sin(x)*cos(y)');  
xlabel('x'); ylabel('y'); zlabel('z');
```

```
subplot(2,2,4); create 4th subplot window  
contourf(XX,YY,Z1); colorbar; title('sin(x)*cos(y)');  
xlabel('x'); ylabel('y');
```

```
clear all
```