How do I get a Plot?

Here's a quick example to get us started:

```
x=linspace(-pi,3*pi,200);
y=sin(x);
plot(x,y);
```

You'll see that we had to create a domain array and a range array for the function. We then plot the arrays. For example,

```
plot([1,2],[3,4]);
```

will plot a line segment between the points $(1, 3)$ and $(2, 4)$. So, Matlab's plotting feature is drawing small line segments between data points in the plane.

Examples

1. Matlab can also plot multiple functions on one graph. For example:

   ```
   x1=linspace(-2,2);
   y1=sin(x1);
   y2=x1.^2;
   x2=linspace(-2,1);
   y3=exp(x2);
   plot(x1,y1,x1,y2,x2,y3);
   ```

   produces a single plot with all three functions.

2. `plot(x1,y1,'*-');`

   Plots the function `y1`, and also plots the symbol `*` where the data points are.

3. `plot(x1,y1,'k*-',x2,y3,'r^-');`

   Plots the function `y1` using a black (k) line with the asterisk at each data point, PLUS plots the function `y2` using a red line with red triangles at each data point.

   Type `doc plot` to see all the different built in colors and symbols you can use in a plot.

4. The following sequence of commands also puts on a legend, a title, and relabels the $x-$ and $y-$axes: Try it!

```
x=linspace(-2,2);
y1=sin(x);
y2=x.^2;
plot(x,y1,'g*-',x,y2,'k-.');
title('Example One');
legend('The Sine Function','A Quadratic');
xlabel('Dollars');
ylabel('Sense');
```

5. Other Things: If you look at the plotting window from the last example, you'll see lots of things that you can do. For example, there's a zoom in and a zoom out feature. You can also edit the colors and symbols of your plot, and the title, legend and axis labels. Try them out!

M-Files: Functions and Scripts

A function has a given input (from the domain), and produces something (from the range). Some functions are built-in (like sine, etc.). To extend the usefulness of Matlab, we can write our own functions. Here is a simple example that takes in two things- a constant and an array, and outputs three things- The sum of the array and the constant, the product and the difference (not a very useful function).

Open Matlab's editor (type `edit` in the command window), and type the following:

```
function [A,B,C]=myfunc(x,Z)
% [A,B,C]=myfunc(x,Z)
%  Inputs:  x is a constant, Z is an array
%  Outputs:  A=x+Z, B=x*Z and C=Z-x

A=x+Z; B=x*Z; C=Z-x;
temp=A+B+C
```

Save this file as the function name with a `.m.` suffix, or, `myfunc.m`. The line with `temp` is meaningless, but is there to show you something. But first, some things to notice about a function:

The first line should always begin with the word "function". You should always include remarks that tell you how to use the function.

Now in the command window, we can type things like:

```
help myfunc
A=rand(3,2);
c=5;
[H1, H2, H3]=myfunc(c,A)
whos
```

Notice that the array `temp`, while computed during the execution of the function, is gone once the function is finished. Therefore, inside of a function call, you can write your variables as if nothing has been defined (except your input variables).

A **script file** is a file that includes Matlab commands. When Matlab executes a script file, it simply executes the commands that are written there as if you were typing them in.

Here's an example. Open the editor, type these lines in and save as `myscript.m`. It looks very similar to the function-

```
clear
clc
A=rand(3,2);
c=5;
H1=c+A;
H2=c*A;
H3=A-c;
temp=H1+H2+H3
```

To run the script, in the command window type `myscript`, then you can type `whos` to see what the new variables are.

Exercise Set II

1. Let x be a row. What happens if you type `plot(x)`?

2. Write a Matlab script file to plot $y = \sin(x)$ in red, $y = \sin(2x)$ in black, and $y = \sin(3x)$ in green, all on the same plot. You can assume that $x \in [-4, 8]$.

3. When we compute with numbers, some errors can occur. Try typing each of the following into Matlab, and see what happens:

   - `eps` (This is machine epsilon)
   - `1/0` (Think about what this means before trying it!)
   - `-1/0`
   - `0/0`
   - `1/Inf`
   - `Inf+Inf, Inf-Inf, Inf/Inf, Inf/0`

4. Try to reason out what you think Matlab will do with each of the following, then type it in and record what you get:

```
x=[1 3 2 1 3];
max(x)
[vals, idx]=sort(x)
find(x==max(x))
mean(x)
sum(x)
```

5. Write a Matlab function that will take in two matrices A, B of the same dimensions, and will output a matrix C so that

$$C(i,j) = \max\{A(i,j), B(i,j)\}$$

The function will use the built-in `max` function- See Matlab's help file by typing (in the command window) `doc max`

6. What does this function do (think about what each line does individually; use the help features in Matlab)? The input B is an $m \times n$ matrix.

```
function A=mystery(B)

[m,n]=size(B);
Temp=sqrt(sum(B.*B));
A=B./repmat(Temp,m,1);
```

(Hint: It is often very useful to have a matrix where each column has unit length).