Graphing Functions with MATLAB [1]

One of the nice features of MATLAB is that this computer algebra system allows you to easily define functions. For example, consider the linear function $u(t) = 0.6t + 1.2$. We are now going to define this function in MATLAB by entering:

```
>> u = inline('0.6*t + 1.2')
```

The word "inline" indicates that the function has been defined right in the command window rather than in a separate file. This command specifies the formula for the function as well as the independent variable. Do *NOT* forget any of the single quotes or the $*$ for the multiplication operation; if you do, MATLAB will give you an error message. If you did everything correctly, MATLAB will show what function has been defined.

Now we can let MATLAB evaluate the function $u(t)$ for various arguments. To find the value of this function at 1, enter

```
>> u(1)
```

To find the y-intercept, enter

```
>> u(0)
```

Now let MATLAB evaluate the value of u for $t = 2.67$.

Another nice feature of MATLAB is that it allows us to plot graphs of functions. The simplest way to do this is by using the command `ezplot`. Let us use this tool to draw the graph of the function $f(x) = 1.2x$ on the interval $[0, 2]$. For that, you enter

```
>> ezplot('1.2*x', [0,2])
```

Don't forget the single quotation marks. If you did everything right, a new window with the graph of the function should appear. Note that the `ezplot` command automatically chooses an appropriate scale for the y-axis. Now you can label your graph as follows: From the "tools" menu on your graph, choose "edit plot." Then click on the A icon in the second bar of your graph. Then click anywhere on your graph. A grey shaded area should appear. Write in this area "$f(x) = 1.2x$." Notice that you can drag around the label until the whole picture looks nice.

Now let us see what happens to the graph of $f(x)$ if we add a constant to it; let us say if we plot the graph of $g(x) = 1.2x + 0.9$. Since you want to make the two graphs appear on the same plot, you first enter

```
>> hold on
```

Next you enter

```
>> ezplot('1.2*x + 0.9', [0,2])
```

and label the graph of the second function as $g(x) = 1.2x + 0.9$ in the same way as you labeled the graph of the previous function. The label for the previous function may now be in the wrong spot;

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make sure to move it next to the graph of the first function. Now let us see, on the same picture, what happens if we make the slope smaller. For that, use `ezplot` to draw the graph of the function $h(x) = 0.5x + 1.2$ on the interval $[0, 2]$. Label the new graph. *Be sure to move any old labels to appropriate places so that you can see which graph is which.*

Finally, let us plot the graph of a linear function with a negative slope; please enter the appropriate command to plot the graph of the function $j(x) = -0.4x + 2$ on the interval $[0, 2]$, and label the graph of your new function. *Be sure to move all old labels where they should be.*

Now we are ready to put the finishing touches on the nice picture you have produced. Enter

```
>> hold off
>> title '(your name) MATLAB Exercise on Graphing'
```

If this MATLAB exercise is being counted in your grade, then print this figure for submission. You can print the figure if you go to the "file" menu in the upper left corner of the window with the graphs, and choose "Print." If you cannot print from the computer you are working at, then you need to save your figure to a file. You can do this in one of two ways. Go to the file menu. If you use the "Save As" option, MATLAB will save the picture as a .fig file that can be read only by MATLAB. If you want to print it eventually from a computer that does not have MATLAB installed, then you should save your picture in a format that your other computer can understand, for example as a .jpg image file. For that, you need to use the "Export" option in the file menu and choose an appropriate file type. Either way, MATLAB's default option is to save the file in the "work" subdirectory of the MATLABdirectory. You may choose a different directory by moving up and down the directory tree. The current directory is shown in the "Save in" field. Once you have saved the figure in a file, you should be able to e-mail it to yourself for future printing.

Let us look at the picture you have produced. Somewhere in the middle of it, there is a point where the graphs of the functions $h(x) = 0.5x + 1.2$ and $j(x) = -0.4x + 2$ intersect. We can use MATLAB to find the x- and y-coordinates of this point. Note that the x-coordinate must satisfy the equation $0.5x + 1.2 = -0.4x + 2$. We can find this x by using the following command:

```
>> solve('0.5*x + 1.2 = -0.4*x + 2')
```

MATLAB gives you the answer to this in a funny format, with many places after the decimal point. Now we want to find the y-coordinate of the point of intersection. For this, we should substitute the x-coordinate either into $0.5x + 1.2$ or into $-0.4x + 2$. However, you probably do not want to type all those digits MATLAB gave you. Here is an economic way of computing the y-coordinate with MATLAB: Enter

```
>> 0.5*ans + 1.2
```

Note that this substitutes the answer to the previous problem in place of "ans."

Now finish your first MATLAB exercise by finding the x- and y-coordinates of the point where the graphs of the functions $g(x) = 1.2x + 0.9$ and $j(x) = -0.4x + 2$ intersect.

Now finish your MATLAB session by entering

```
>> quit
```