MORE MATLAB INSTRUCTIONS

1. Plotting functions

In this section, the basics of plotting functions in MATLAB are described. Throughout we work with the example of two functions, $f(t) = (2t+1)e^{-t}\sin(t)$, and $g(t) = (t-1)e^{-t}\cos(t)$.

Step 1, Specify the domain: Functions are defined on an interval called the *domain*. To plot the function in MATLAB, you need to specify the domain. Every domain has a *left endpoint*, a, and a *right endpoint*, b. Of course MATLAB does not plot the value of the function at every point between the a and b, only finitely many points with a regular spacing h. The syntax to specify the domain is,

```
>> t = a : h : b
```

For example, to plot our function on the interval $[-1, 1]$ with step size 0.05, the syntax is,

```
>> t = -1:0.05:1
```

One word about this. Technically x is a data type called an *array*: just the ordered list of the numbers $a, a+h, a+2h, \ldots$. The syntax for arithmetic with an array in MATLAB is different than the syntax for arithmetic with a number.

Step 2, Specify the function: Here is a list of common operations used to define functions, and the corresponding syntax in MATLAB. In the list, $y(t)$ and $z(t)$ are names for functions or pieces of functions that are already specified.

Operation	MATLAB Syntax
$y(t) + z(t)$	`y + z`
$y(t)z(t)$	`y.* z`
$y(t)^n$	`y.^n`
$y(t)/z(t)$	`y./z`
$\sin(y(t))$	`sin(y)`
$\cos(y(t))$	`cos(y)`
$e^{y(t)}$	`exp(y)`
$\ln(y(t))$	`log(y)`
$\log_{10}(y(t))$	`log10(y)`

For example, if the range t has already been defined, the function $(2t+1)e^{-t}\sin(t)$ is specified by,

```
>> y = ( 2 .* t + 1 ).* exp( -1.* t ).* sin( t )
```

Similarly, the function $(t-1)e^{-t}\cos(t)$ is specified by,

```
>> z = ( t - 1 ).* exp( -1.* t ).* cos( t )
```

Step 3, Plot the function: The syntax to produce a 2D-plot whose domain is t and whose function is y is,

```
>> h = plot(t,y)
```

Note, you do not need to say "$h =$", but this can be useful if you want to manipulate the plot later. MATLAB will produce the plot in a new window.

Step 4, Plotting a parametrized curve; Several plots at once: MATLAB can plot a parametrized figure. For instance, for the parametrized curve (y, z) where $y(t) = (2t+1)e^{-t}\sin(t)$, $z(t) = (t-1)e^{-t}\cos(t)$, the syntax is,

```
>> i = plot(y,z)
```
where y and z are specified as above. Note that when plotting parametrized curves, it is still necessary to specify the t-domain. But t doesn't explicitly appear in the syntax of the plot.

Also, MATLAB can plot several graphs (or parametrized curves) simultaneously. For simplicity, think of a graph as a parametrized curve $(t, y(t))$. For a number of parametrized curves, say $(y_1(t), z_1(t))$, $(y_2(t), z_2(t))$, the syntax to plot both of these curves in a single figure is,
```
>> j = plot(y1,z1,y2,z2)
```
Any number of curves can be plotted in a single figure: just write plot$(y1, z1, \ldots, yn, zn)$, where the functions $y1, \ldots, yn$ and $z1, \ldots, zn$ have already been specified. To simultaneously graph the functions y and z above over the interval t, the syntax is,
```
>> k = plot(t,y,t,z)
```

Step 5, Print or export your plot: To either print your plot or to export it as a JPEG file, click on the "File" button of the new window and then click on "Print" or "Export" in the pop-up menu. There are other extras that you can find out by experimenting (such as adding labels to your axes).