Accessing Matlab

Open an athena terminal window.
Give the command: add matlab [return]
Give the command: matlab & [return]
(The ampersand (&) after ‘matlab’ allows the xterm to be used for other things, it is not necessary.)
Wait for matlab to start. This can take a few minutes. When it’s ready you should see a Matlab command prompt: >>

If you have a question ask one of the people seated next to you. There’s a good chance they know the answer.

Starting the desktop

If you now have a simple command line window with the Matlab command prompt you might want to give the command: desktop [return]
This will give you some more menus, buttons and windows to work with.

Entering matrices and vectors

In Matlab the variables represent matrices and vectors. The symbol = assigns values on the right side of the equation to the symbol on the left. Type each of these lines in order, and see what you get. (Always hit return to enter the command)

A = [1 2 3; 4 5 6; 7 8 9] (you can use commas instead of spaces: 1,2,3;)
b = [1 0 1]
b' (transpose: gives a column vector)
eye(3) (eye = I, the identity matrix)

Try making a mistake: C=[1 2 3; 4 5]
To edit the mistake, press any of the four arrow keys to get the line back.

Operations with matrices and vectors

<table>
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<th>Operation</th>
<th>Description</th>
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<tr>
<td>Sum, difference</td>
<td>A+B, A-B (matrices must be the same size)</td>
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<tr>
<td>Product</td>
<td>A*B (matrices must be the compatibly sized)</td>
</tr>
<tr>
<td>Powers</td>
<td>A’n (A must be square)</td>
</tr>
<tr>
<td>Transpose</td>
<td>A’</td>
</tr>
<tr>
<td>Inverse</td>
<td>inv(A) (A must be square)</td>
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Try typing (using the values of A and b above): A + eye(3) A*b A*(b’) A*b’

Two-dimensional plots in Matlab

Given the arrays \( x = [x_1 x_2 \cdots x_n] \), \( y = [y_1 y_2 \cdots y_n] \),
plot(\( x, y \)) (plots the \( n \) points \((x_i, y_i)\), joined by solid line segments)
plot(\( x, y,’--’ \)) (plots the \( n \) points joined by dashed line segments)
plot(\( x, y,’*’ \)) (plots the \( n \) points as individual stars—or dots or circles, etc.)
hold (toggles on and off (at the start it’s off); when off, the new plot replaces the old; when on, the new plot is superimposed on the old)
print (gives a print-out of the current screen plot)

All the graphics functions have many properties the user can set. The example below shows how to set color and line width. See the Matlab help page for more details.

Example. The figure below was made with the following series of commands.

```matlab
>> x = [0: .1: 6*pi];
>> plot(x, sin(x), 'LineWidth',2, 'color','magenta')
>> hold on
>> plot(x, cos(x), 'LineWidth',2, 'color', 'blue')
>> u = [0: 0.25: 6]*pi
>> plot(u, sin(u), '*', 'Color', 'black')
```

% array of numbers between 0 and 6π.
% Overlay next plots on current one.
% Put a * on the graph every π/4 units.
>> plot(x, (x/(6*pi)).^3, 'Color', 'red', 'LineWidth', 4) % Note dot before caret.
>> hold off % Turn off overlaying of next plots.

Three-dimensional plots in Matlab

To plot $z = f(x, y)$ you must specify the grid $(x_i, y_j)$ of lattice points: give the vectors $x = [x_1 \cdots x_n]$ and $[y_1 \cdots y_n]$.

**Example.** To make a grid with spacing .1, over the interval $[-2, 2]$ on both axes, type: (In what follows >> is the Matlab prompt, don’t type it. The semicolon at the end of each command tells Matlab not to print out all the numbers and also allows more than one command per line.)

$$x = [-2 : .1 : 2]; \quad y = [-2 : .1 : 2]; \quad [x, y] = 
\text{meshgrid}(x, y);$$

Now, for example, for the function $f(x, y) = y^2 - 2x^2$, type:

$$z = y.^2 - 2 \times x.^2;$$ (Note the dots for array operations)

Plot either a mesh of lines or a filled-in-surface:

$$\text{mesh}(x, y, z) \quad \text{surf}(x, y, z)$$

To change the viewpoint type:

$$\text{rotate3d} \quad \text{(or click on the appropriate desktop button)}$$

Then use the mouse to manipulate the graph: Click and drag – the two numbers on the screen are the azimuth (angle from the negative $y$-axis to the line of sight) and the elevation (angle from the $xy$-plane to the line of sight).

To turn off rotation type the same command again:

$$\text{rotate3d}$$

Hidden lines: try typing:

$$\text{hidden} \quad \text{(type it again to change back)}$$

Changing scale: To change the $x$-axis scale to $[-4, 4]$, $y$-axis to $[-5, 5]$ and $z$-axis to $[-20, 20]$ type:

$$\text{axis([-4 \ 4 -5 \ 5 -20 \ 20])}$$

Contour curves: to get a 2D plot of level curves or a 3D plot with 20 contour curves, type:

$$\text{contour}(x, y, z, 20) \quad \text{contour3}(x, y, z, 20)$$

Printing type:

$$\text{print} \quad \text{(or use the graphical interface)}$$