Hello Earth!

A *grounded* introduction to Matlab

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(Enter teacher)
Something canny *Matlab* can do
Something cunning you can do
1. help
The extreme basics — 1

1. help
2. lookfor
The extreme basics — I

1. help

2. lookfor

3. type
The extreme basics — I

1. help
2. lookfor
3. type
4. who, whos
The extreme basics — I

1. help

2. lookfor

3. type

4. who, whos

6. diary
The extreme basics — II

7. plot
The extreme basics — II

7. plot

8. xlabel, ylabel, title
The extreme basics — II

7. plot

8. xlabel, ylabel, title

11. hold on, hold off
The extreme basics — II

7. plot

8. xlabel, ylabel, title

11. hold on, hold off

13. sprintf
The extreme basics — II

7. plot

8. xlabel, ylabel, title

11. hold on, hold off

13. sprintf

14. print
The extreme basics — II

7. plot

8. xlabel, ylabel, title

11. hold on, hold off

13. sprintf

14. print

15. load, imread
<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>imread</td>
<td>Reads an image file</td>
<td>ix=imread('filename');</td>
</tr>
<tr>
<td>fullfile</td>
<td>Constructs a valid path name</td>
<td>ff=fullfile('dirn','fname');</td>
</tr>
<tr>
<td>size</td>
<td>Queries the size of a variable</td>
<td>s=size(ix);</td>
</tr>
<tr>
<td>plot</td>
<td>Plots ((x, y)) values on a graph</td>
<td>x=[1 2 3]; y=[10 20 30]; plot(x,y,'o')</td>
</tr>
<tr>
<td>xlabel</td>
<td>Uses a quoted string for an (x)-axis label</td>
<td>xlabel('elevation [m]')</td>
</tr>
<tr>
<td>ylabel</td>
<td>Uses a quoted string for a (y)-axis label</td>
<td>ylabel('roughness')</td>
</tr>
<tr>
<td>hold on</td>
<td>Keeps current axes for next time you plot anything</td>
<td>x=[1 2 pi]; y=[10 20 30]; plot(x,y,'bo'); hold on; plot(10<em>x,3</em>y,'rs')</td>
</tr>
<tr>
<td>linspace</td>
<td>Makes an array of (N) evenly spaced values between (a) and (b)</td>
<td>x=linspace(-3,3,100)</td>
</tr>
<tr>
<td>reshape</td>
<td>Changes the dimensions of an array (x) to (a) rows and (b) columns</td>
<td>x=linspace(-3,3,100); xr=reshape(x,20,5)</td>
</tr>
<tr>
<td>hist</td>
<td>Makes a histogram (and plots it)</td>
<td>x=linspace(-3,3,10); hist(x)</td>
</tr>
<tr>
<td>bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>axis xy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>axis ij</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The extreme basics — III

Addressing:

rows, columns, dimensions, range
The extreme basics — III

Addressing:

rows, columns, dimensions, range

17. size
The extreme basics — III

Addressing:
rows, columns, dimensions, range

17. size

18. transpose
The extreme basics — III

Addressing:

rows, columns, dimensions, range

17. size

18. transpose

19. colon
The extreme basics — III

Addressing:
rows, columns, dimensions, range

17. size
18. transpose
19. colon
20. linspace
The extreme basics — III

Addressing:

rows, columns, dimensions, range

17. size

18. transpose

19. colon

20. linspace

Logic:

logical, character, string, double
The extreme basics — III

**Addressing:**
rows, columns, dimensions, range

17. size

18. transpose

19. colon

20. linspace

**Logic:**
logical, character, string, double

21. <, >, ==, ~, & |
Going commando
Walkthrough

I, Frederik Simons, am plotting H1W-18.35-test2.jpg

```
color

grey
```

```
diff(grey)
```

```
diff(grey)
```
Homework 1

Navigate to Course Materials, Software Installation and Templates.

1. Install Matlab as per the instructions.
2. Start Matlab: you will be making a Very Simple Plot.
3. Create ("edit") a new code (*.m) file called "lab01b.m" and in it, type the following few instructions, or some slight variations thereof, according to your taste (i.e. vary the numbers):

   ```matlab
   x=linspace(0,pi,100);
   A=1; B=3; f1=0; f2=0;
   y1=A*sin(x+f1); y2=B*cos(x+f2); y3=y1+y2;
   figure (1)
   plot(x,y1,'r'); hold on; plot(x,y2,'g'); plot(x,y3,'b')
   title('yournetid01b')
   hold off; axis tight
   print('-dpdf','yournetid01b')
   
   ```

4. Save this file, see that you can find it again.

5. In step 3, "yournetid" is once again your Princeton netid of course.

6. Now "run" or "execute" this "script" and make sure that something pops up on your screen - and that a PDF gets made!

7. Find the PDF that you just made ('yournetid01b.pdf'). That is your second Assignment! Upload it to Blackboard by the deadline.
Homework 1
1. “If you type it *twice*, you need to use a *variable*”
Code hygiene

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2. “If you say it in the absolute, you need to reformulate to the relative”
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3. “Annotate all graphs completely, and give them meaningful names”
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**Input/Output**
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Documentation/Help/Date
Input/Output
Computation/Algorithm
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*Documentation/Help/Date*

*Input/Output*

*Computation/Algorithm*

*Figures/Embellishment*

*Variable Output*
Homework 2 — Data collection

Adrian’s GPS data, their means ±2 standard deviations

- CP1
- CP2
- CP3
- CP4
- CL5
Homework 2 — Data curation

Adrian’s GPS data, their means ±2 standard deviations

[Graph showing Adrian’s GPS data with means ±2 standard deviations indicated by different symbols for each point, with axes labeled as easting [m] from 528927 in UTM zone 18 and northing [m] from 4466190 in UTM zone 18.]
Hypothesis. Shorter dune wavelengths appear on steeper slopes because winds are not able to travel far before touching the ground and depositing sediment; higher dune amplitudes occur on steeper slopes because the distance of the slope to the boundary layer decreases at a quicker rate, resulting in higher velocity sediment-carrying winds that can carry and deposit more sediment.

Figure 1: Transect A crosses 8 transverse dune peaks and transect B crosses 6 dune peaks. Transect B follows a steeper slope than transect A. The average dune wavelength found along transect B was 7.54m; along transect A the average dune wavelength was 12.47m. The average dune amplitudes (not shown in figure) were 1.02m for transect B and 0.82m for transect A. Image was downloaded from <http://www.uahirise.org/dtm/dtm.php?ID=ESP0328141670>
Motivation. Studying digital elevation models of dunes on Mars can lead to insights about the surface and weather on Mars.

Hypothesis. As the elevation of the dunes in Iaxartes Tholus increases, the dunes increase in size (wavelength and amplitude), possibly due to a more abundant sand supply.

Figure 1: Intra-crater dunes in Iaxartes Tholus vary with elevation. Transect lines show increasing wavelength and amplitude as the elevation increases. Digital elevation model came from http://www.uahirise.org/dtm/dtm.php?ID=ESP_018938_2520.
Motivation. Mapping and analyzing sand dunes on Mars allows humans to better understand the environment of a place that they've yet to step foot on.

Hypothesis. Based on the geometry in figure 1, the transected dunes are Barchan dunes.

Figure 1: The heat map represents the elevation of sand dunes on Mars, with two transects, A and B, drawn over two specific dunes. The elevation, along with the peaks, of those dunes are then graphed as A and B respectively below the heat map. The histogram is a count of how often certain elevations were measured and the mean and median of those measurements.

Acknowledgements. Thank you to Akshay Mehra and Christopher Harig for helping me detect problems in my code.
Homework 3 — Data reduction
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rms prediction error is 2.78 data units
variance reduction 59.56%

mynetid05 - A 0.16 0.69 4.73 P 9.00 20.00 42.00
Homework 3 — Data reduction

rms prediction error is 0.00 data units
variance reduction 100.00%

mynetid05 – A 1.00 4.00 5.00 P 10.00 30.00 40.00
Homework 3 — Data reduction

rms prediction error is 1.86 data units
variance reduction 81.94%

amplitude [units of the data]

period [s]

mynetidl05 – A 1.04 3.51 4.28 P 10.00 30.00 46.00
Homework 3 — Data reduction

rms prediction error is 3.47 data units
variance reduction 48.87%

mynetidl05 - A  0.39   0.63   4.74  P  9.00  20.00  42.00
rms prediction error is 1.81 data units
variance reduction 86.11%
Homework 3 — Data reduction

rms prediction error is 2.66 data units
variance reduction 70.01%

mynetidl05 – A 1.09 3.74 4.27 P 10.00 30.00 46.00
rms prediction error is 2.83 data units
variance reduction 44.53%

mynetidl05 - A  0.14   0.55   3.55  P  9.00  20.00  42.00
Homework 3 — Data reduction

rms prediction error is 1.85 data units
variance reduction 76.19%

mynetidl05 - A 0.74 3.01 3.78 P 10.00 30.00 40.00
rms prediction error is 2.39 data units
variance reduction 60.47%
Homework 4 — All of the above

rms prediction error is 26.29 data units
variance reduction 4.82%