Introduction to Matlab

WIAA Technical Workshop #2
10/20/2015
* This presentation is merely an introduction to some of the functions of MATLAB and is not a comprehensive review of their capabilities.

** This presentation is intended to complement an in-person workshop run by members of WIAA, and as such, serves as a resource for some function capabilities, not a step-by-step teaching platform.
Outline

Purpose: Learn the basics of Matlab including creating professional, complete, clear plots to present data, read and write files, and create functions

Throughout this workshop, you will learn about:

• Specifying data
• 2D Plots
• Animated Plots
• 3D Plots
• Read/Write Files
• Writing Functions
Data Specification Commands

- `linspace(initialValue,endValue,amount)`
  - t = linspace(1, 10, 10);

- `t = initialValue:stepSize:endValue;`
  - t = 0:.1:10;

- `y = sin(input), y=2*t+5*pi;`
  - If input is scalar, y will be scalar
  - If input is vector, y will be corresponding vector

*** help function

- Outputs helpful explanation about function
Preliminary Plot Commands

- `clear all;`
  - Clears all previous variables

- `close all;`
  - Closes all previous graphs/plots

- `figure;`
  - Creates new figure to hold plot
  - Can also specify `figure(1), figure(5)` etc.

- `hold on;`
  - Type after new figure
  - Enables multiple graphs on same figure plot.
Plot function

- Plot(x, y, BasicOptions, Advanced Options)
Plot function

- Plot(x, y, BasicOptions, Advanced Options)

clear all; close all;
x = -5:.01:5;
y = sin(x);
figure;
plot(x, y)
Plot function: Basic Options

- **Plot(x,y,**BasicOptions**, Advanced Options)**

  - Line types: --, -, ., :, - (default)

Guidelines:
- Syntax: `plot(x,y,'BasicOptions')` begin and end with `''`
- Specify none, one, two, or all three options in one set of quotes
- Order doesn’t matter
Plot function: Advanced Options

- Plot(x,y,\textit{BasicOptions}, Advanced Options)

```matlab
clear all; close all;
x = -5:.01:5;
y = sin(x);
figure;
plot(x, y, '--r')
```

```matlab
clear all; close all;
x = -5:.1:5;
y = sin(x);
figure;
plot(x, y, '-g*')
```
Plot function: Advanced Options

- Plot(x, y, BasicOptions, Advanced Options)

- 'LineWidth', 2.4
- 'MarkerSize', 10
- 'MarkerEdgeColor', 'b'
- 'MarkerFaceColor', 'g'

Guidelines:
- Specify option name in quotes
- Specify colors in quotes, numbers without quotes
- Commas separate each option
Plot function: Advanced Options

- Plot(x,y, BasicOptions, Advanced Options)

```matlab
clear all; close all;
x = -5:.1:5;
y = sin(x);
figure;
plot(x, y, '-g*', 'LineWidth', 5,
     'MarkerEdgeColor', 'b', 'MarkerSize', 6)
```

```matlab
clear all; close all;
x = -5:.2:5;
y = sin(x);
figure;
plot(x, y, ':rd', 'LineWidth', 3,
     'MarkerEdgeColor', 'g', 'MarkerSize', 8)
```
Axis Labels, Titles, Legends

- xlabel(), ylabel(), title(), legend(), hold on; grid on

```matlab
clear all;close all;
x=-5:.2:5;
y=sin(x);
z=cos(x);
figure;
hold on;
plot(x,y,':rd','LineWidth',3,'...
    MarkerEdgeColor','g','MarkerSize',8);
plot(x,z,'--b*','MarkerEdgeColor','m')
xlabel('Time');
ylabel('y');
title('Sin and Cos vs. Time');
legend('Sin(t)','Cos(t)');
grid on;
```
for loop, pause, drawnow

clear all; close all;
x = -5:.2:5;
y = sin(x);
z = cos(x);
figure;
hold on;
xlim([min(x(:)) max(x(:))])
ylim([min(y(:)) max(y(:))])
xlabel('Time');
ylabel('y');
title('Sin and Cos vs. Time');
for i = 1:length(x)
    pause(0.1)
    plot(x(i), y(i), '-g*')
    plot(x(i), z(i), ':ro')
    drawnow
end
legend('Sin(t)', 'Cos(t)');
clear all; close all;
t = 0:pi/10:10*pi;
x = sin(t);
y = cos(t);

figure;
plot3(x,y,t,':rd','LineWidth',3, ...'MarkerEdgeColor','g','MarkerSize',6)
xlabel('X');
ylabel('Y');
zlabel('t');
title('3D Sin and Cos vs. Time');
3D Plots

- `peaks()`, `surf()`

```matlab
clear all; close all;
[X,Y,Z] = peaks(25);

figure
surf(X,Y,Z);
xlabel('X');
ylabel('Y');
zlabel('z');
title('Surface Plot');
```
3D Plots

- for loop, pause, drawnow

```matlab
clear all; close all;
k = 5;
n = 2^k-1;
[x, y, z] = sphere(n);
c = hadamard(2^k);

figure
surf(x, y, z, c);
colormap([1 1 0; 0 1 1])
axis equal
xlabel('X');
ylabel('Y');
zlabel('z')
title('3D Circle');
```
Reading & Writing Files

- MATLAB allows you to import:
  - Text files (.txt, .csv)
  - Excel (.xls, .xlsx, .xlsm)
  - Images (.bmp, .gif, .jpeg, .tiff)
  - Videos (.mpg, .wmv, .mp4)
  - Audio (.mp4, .wav)

- Each extension has a different read and write commands

- We will also cover switching to different directories
Text Files

- `ls`, `cd`

**ls**: list all the files in the current directory

**cd**: change into directory

- `ls`

- `cd 'C:\location'`
Text Files

- load(), save()

```matlab
Data = load('filename.txt');

X = Data(:,1);

Y = Data(:,2);

save('filename', variable);
```
Excel Sheets

- `xlsread (filename, sheet, range)`

```matlab
xlsread(‘example.xls’, 1, A:B)
```

- `xlswrite (filename, matrix, sheet)`

```matlab
mat = [1 2 3; 4 5 6];
xlswrite(‘example.xls’, mat, 1)
```
Functions

- Function output = equation

• Declare functions that are saved in other .m files

```matlab
function [m,s] = stat(x)
    n = length(x);
    m = sum(x)/n;
    s = sqrt(sum((x-m).^2/n));
end

values = [12.7, 45.4, 98.9, 26.6, 53.1];
[ave,stdev] = stat(values)
```