Introduction to MATLAB

Week 1

Loosely follows Chapter 1

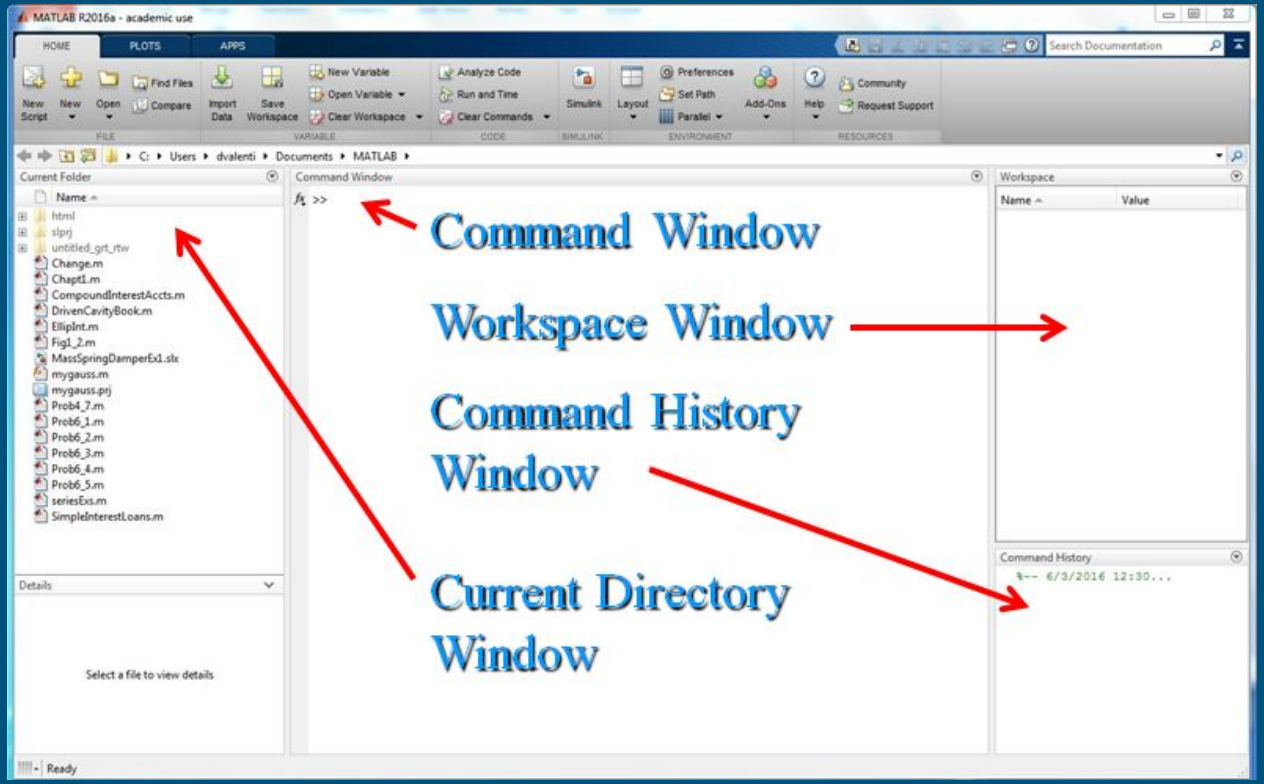
Objectives of this course

- Learn how to use, examine, explore, and evaluate MATLAB.
- Learn how to formulate algorithms by grouping actions to perform a task.
- Learn how to design programs to solve technical problems using a structured plan designed from a set of algorithms

What we'll cover today

- Introduction to the MATLAB interface.
- Learning and executing simple commands.
- Some basics of computer programming terms.

The MATLAB desktop interface



The Command Window

- Real time interaction
- Type in commands and press <Enter> to (optionally) view results.
- The <up arrow> can be used to re-execute previous commands (also seen in the Command History window)
- <ctrl+c> can be used at any time to stop execution
- Some of the most commonly used commands
  - clc clears the command window
  - clear clears variables
  - whos displays a list of current variables (also seen in the Workspace window)

Try using the command prompt

- Enter the following and observe what happens
  - >> 2+3 <Enter>
  - >> clc <Enter>
  - >> whos <Enter>
- Now try re-executing a command using the <up arrow>
- Look at your Command History window and execute a command by double clicking or dragging and dropping.

Computation notation

- >> 3-2 Subtraction
- >> 3*2 Multiplication
- >> 3/2 Division
- >> 3\2 Divides
- >> 3^2 Exponential
- >> inf Infinity

Variables

- Used to store information
- Can hold numerical values or text values and you don’t need to declare them
- Can be recalled later
- Always use informative names
- Use whos to show a list of current variables
- Standard conventions
  - speedOfLightKPH
  - speed_of_light_kph
  - SPEED_OF_LIGHT_KPH
- Case sensitive but do **NOT** use two variables of the same name

Reserved Words/Variables

- May be variables or function names
- Common Reserved Variables:
  - pi
  - inf
- Common Reserved Words:
  - clear
  - clc
  - sqrt
  - sin/cos/tan

A few more noteworthy features

Enter the following and observe any differences

- >> a=5 <Enter>
- >> b=10; <Enter>
- >> c=a*b; <Enter>
- >> who <Enter>
- >> a, b, c <Enter>

General Shortcut Tips

- Keyboard Navigation
  - Home and end keys jump to beginning and end of line
    - Mac users, this is Cmd+left and Cmd+right arrows
  - Arrows move a single character (L/R) or row (U/D)
  - Ctrl and arrow jumps by word
    - Mac users, this is Option+arrow
  - Holding shift while moving the cursor selects text
- Ctrl+c to copy, Ctrl+v to paste
- Double click highlights a word, triple click highlights a row

Problem Solving: Consider the following

Compute the volume of a cone

v = (pi*r^2*h)/3

How would you approach this problem with MATLAB or any other programming language?

Solving the problem

Set up variables and constants

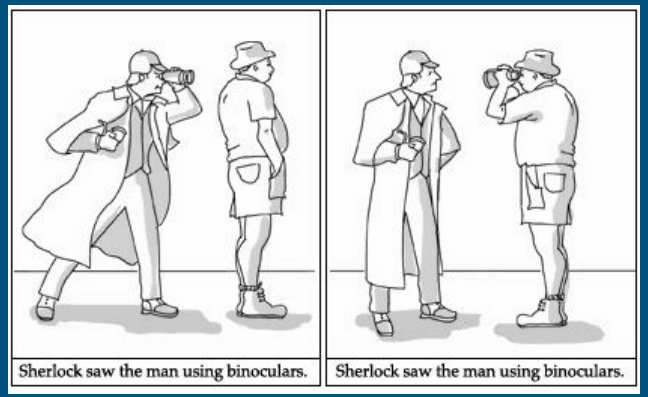
1. ~~pi = 3.14159265358979323~~
2. radius = 6
3. height = 12

Perform calculation(s)

4. volume = (pi*radius^2*height)/3

Things to consider

- Should a semicolon have been used anywhere?
  - If yes, is it necessary and why?
  - If no, why not?
- Do I need to use the element-wise (.) operator?
  - If yes, why?
  - If no, why not and would it make a difference if I did anyway?
  - This particular case is syntax vs semantics



M-Files

- Sometimes you want to repeat a set of commands
- An M-file to MATLAB is like a word document to MS Word.
- M-files allow you to
  - Save your programs as lists of executable commands
  - Execute a list of commands from the command window
  - Save your work while you work through a problem
  - Reopen and modify your program at any time
  - Do much more which we'll discuss later

Creating quality work

- It is important to write quality code that is clear and understandable
- It is imperative that you add comments to document
- You should have a set of header comments which includes
  - The objective of the program
  - Your name (the programmer)
  - The name of anyone who assisted you
  - The date the program was created (can also include modified date)
- You should also include comments throughout your code
- You should write comments before you write code

Creating Comments

- To insert a comment, use the comment operator %, followed by a comment.
- Comments will not be executed, they are for developers only

```
% This is a simple MATLAB program that computes and displays the volume of a cone
%
% Filename: Volume_of_cone
% Developer: Geoff Berl
% Assisted By:
% Date: 11/16/2017

% Declare variables
radius=6        % Radius of the cone (inches)
height=12       % Height of the cone (inches)

% Compute the volume of a cone
volume = (pi*radius^2*height)/3
```

Executing an M-File

- Executing an M-file is easy
  - >> volume_of_cone <Enter>
- Try changing the values of *radius* and *height* and run it again

Handling Runtime Errors

Occasionally you will run into errors so let's walk through one here

- Change the variable name of *radius* to radiuss in Volume_of_cone.m
- Save the file and run it again (be sure to clear any existing variables)

```
>> clear
>> Volume_of_cone
radiuss =  6
height =  12
error: 'radius' undefined near line 13 column 14
error: called from
    Volume_of_cone at line 13 column 8
```

```
1  % This is a simple MATLAB program that c
2  %
3  % Filename: Volume_of_cone
4  % Developer: Geoff Berl
5  % Assisted By:
6  % Date: 11/16/2017
7
8  % Declare variables
9  radius=5  % Radius of the cone (inches)
10 height=10 % Height of the cone (inches)
11
12 % Compute the volume of a cone
13 volume = (pi*radius^2*height)/3
```

Help Feature

- The easiest way to determine what a function does and what possible argument(s) can be passed (also what output, if any, is given)
- You can type help into the command window followed by a function or reserved word to get a summary printout.
- You can right click on a function and select help on a particular function
- You can click the (?) icon in the upper right to view the help center

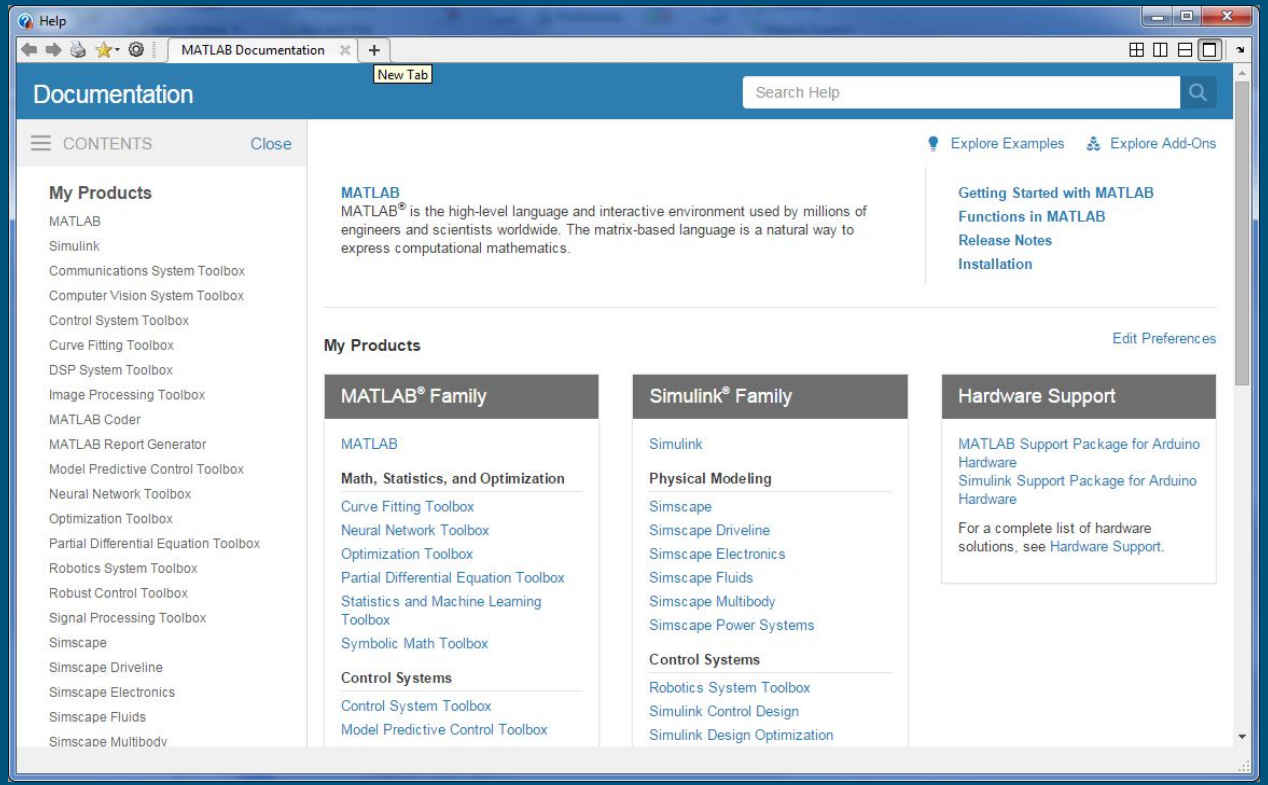
More Specific Help

- For more specific help use help <topic>
- Try entering the following
  - help sin
- It takes you to the short description we saw previously

Help Navigator

- Click on the Help (?) icon in the toolbar.
- A dialog window appears
- Here you can search for topics
- (There should also be a search field in the upper right)

Help Navigator Window



Key Takeaways

- MATLAB can perform real time actions using the command window
- You can define variables to store information and reuse those values
- You can save a set of instructions in an M-file for later use
- Code should be well written and well documented
- Always consider semantical mistakes

Homework

- fprintf, the ‘\n’ character and substituting variables (%s)
- copy/paste is your frienemy

***** USE THE DOCUMENTATION *****