Lecture 1 Matlab Interface and Scripts

Matlab (MATrix LABoratory) is a popular programming language and numeric computing enviroment, widely used in engineering, science and ecnomics. A more comprehensive introdcution about Matlab can be found in wikipedia.

Revisit the Matlab Interface

When the application is initiated, you can see the following major components in the interface:

1) **"Current Folder"**, where you stored the matlab files (where opened this file actually!). You can set the initial position in the "Preferences", or otherwise it will automatically show the folder in last Matlab session.

2) **"Command Window"**, "a fancy calculator" which you can type command and generate instant results. Some most frequently used commands and tricks include:

- `help` followed by command name: to display the usage/description of certain command
- `lookfor` followed by keyword: to diaply relevant commands to the keyword
- `clc` : to clear the command window
- press the "tab" key on keyboard: autocomplete the command
- press the "up-arrow" key on keyboard: command history
- output without varaibale names assigned is saved in variable **ans**

3) **"Workspace",** displays all the variables you can use in current Matlab session

- `clear:` remove variables. To selectively remove, follow by certain variable names
- `save:` followed by a file name, save all the varaibles in workspace to that file (suffix with .mat) for later re-use
- `load:` import the variables in certain .mat file
- `whos:` display the workspace in command line
- double-click or right-click the varaibles in workspace window

4) **"Editor"** , where you can edit the **script files** that we're going into the details below.

In-class Exercise

Recall the definition of derivative as $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$. Follow the instructions below to implement the

numerical differentiation for $f(x) = x^3 \sin(x)$ at $x = 2$ in the command window:

1. define `variables` h=10^{-6} and x=2
2. assign the variable named `der` with the value of accuate derivative at $x = 2$
3. assign the variable named `der_appr` with value of the finite difference $\frac{f(x+h) - f(x)}{h}$
4. assign the variable named with the value `der_appr` minus `der`
5. save the current workspace to the file named der_data.mat

6. clear all the variables
7. load the saved file
8. clear the variable h

Hint: You might want to know the expression of basic operations (like powers, multiplication, division...) in Matlab. Besides google them (always the recommended way when confonted with anything unfamiliar in programming), you can find the list here. Memorizing the most frequent operators is our requirement (don't worry now, we will see them repeatedly throughout the course).

Matlab Scripts

The scripts can be understood as **the collection of sequential single-line commands** to perform more complicated tasks. And that is indeed programming!

Plain Scripts (.m files)

- To **edit** a script file, you can either 1) type edit followed by file name in the command window or 2) double-click the file in the current folder window. To **create** a new one, you can also find the one-click button in "**Home**" at the top toolstrip. Once a script is open, more tools are in the "**Editor**" at the top toolstrip (including **save**).
- To **run** a script file, you can either 1) type the file name in command window (without the .m sffuix), or 2) click the "Run" button in the top of editor. The varaibles created during script running are saved in workspace.
- In the script file, 1) use **semicolon**(;) to suppress output of certain line 2) use `disp` function to display the value of certain item to the screen when running and 3) use % to write **comments** in codes
- More complicated sripts include matlab **functions** (have input and output), and the one with **control flows** (will be introduced in detail in later lectures).

Example1: derivative.m

Example2: mysphere.m

Live Scripts (.mlx files)

- You are currently in a live script file !Live scripts allow users to view and interact with both code and output and can include formatted text, equations, and images -- it is helpful to communicate and share results with others
- press ctrl(cmd in mac os) and +/- simutanesouly to zoom in/out the script. More display options can be found in the "VIEW" button of top tool strip (for example, split the views and see multiple files at one time).
- live scripts can be saved as pdf or word
- Two major components in live scripts include **text** and **code.** Compared with plain script m file, the text in live script can have more fancy formats than the comments, and the code can directly display the output in the script, instead of in the command line or sepate figure window. To delete code and the output, just select them all and then press "delete" on keyboard.

- Live scripts can be discomposed into sections and runned seprately -- by inserting the **section break (either click or type %%)**. Sections already runned are asscociated with blue bars on the left, and sections with unexecuted chagnes are with the vertical striping.
- To adjust the format of output, explore the"VIEW" page of top tool strip. To remove all the outputs, click "Clear all Output" button in the "VIEW" page.
- With more outputs in the livescript, it may take longer time to save-- please be patient.

Everyhing above are texts. Below is the example of code:

```matlab
% Create and plot a sphere with radius r.
[x,y,z] = sphere(50);        % Create a unit sphere.
r = 2;
surf(x*r,y*r,z*r);          % Adjust each dimension and plot.
axis equal                  % Use the same scale for each axis.
```

In-Class Excerse:

1. *Create a new section below by insert the section break*
2. *type the expression of derive function in the previous exercise*
3. *Insert a code, and copy-paste the commands in script derivative.m*
4. *Run the section*

Hint: The equations can be typed in the "INSERT" page of tool strip -- either interactively (like in MS Word) or by Latex expressions. If you want to use Latex, please refer here.