Lab 0: Basic MATLAB Commands

Optional Review Assignment: Do not submit for grading

Overview:

1. This lab is designed to help students review basic MATLAB commands. It is expected that the majority of students will already be familiar with MATLAB. This review should help you determine if you need to review MATLAB tutorials on your own.

2. The Duke license allows you to install MATLAB for free on your personal computer and it is assumed that you will have access to MATLAB as needed:

   `https://software.oit.duke.edu/comp-print/software/support/matlab.php`

3. Links to some MATLAB tutorials are located on the website and you can also look at:

   `http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.html`

   In most cases, you should be able to understand a functions needed for the homework by typing "`help [function name]`" in the MATLAB command window. Or if you just have some idea of what you are looking for, you may type "`lookfor [keyword]`". It will list all functions related to the keyword. The desktop version of MATLAB also includes a script editor which highlights the syntax.

4. Depending on the complexity, each MATLAB assignment will either be completed individually or in small groups. For each lab, each student (or group) must turn in a report composed using a word processor (e.g., Word, Pages, LaTex, etc...). The report should include cover page with your full name. The remaining pages should contain (in order) the answers and MATLAB scripts for the exercises. MATLAB figures can be pasted into Word and Powerpoint or saved as EPS files for LaTex. When working on the project, please follow the instructions and respond to each item listed. Your project grade is based on: (1) your MATLAB scripts, (2) your report (plots, explanations, etc. as required), and (3) your final results. For all labs, you must clearly write the problem number next to your solution and label the axes on all plots to get full credit. Submission can be done electronically in PDF format or on paper.

Exercises:

1. (Matrix definition) Define the following matrices:

$$X = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 2 \\ 1 \end{bmatrix}, Y = \begin{bmatrix} 0.5 \\ -1 \\ -1 \\ -1 \\ 0.5 \end{bmatrix}, Z = \begin{bmatrix} 5 & 0 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 \\ 0 & 0 & 3 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}.$$

2. (Matrix manipulation) For each command, describe the operation and give the result:

   (a) X'

   (b) $2 * X + 3$

   (c) $0.5 * X + 1i * Y$, where $1i$ is MATLAB's representation of $j = \sqrt{-1}$

   (d) $X./Y$

   (e) $X. * Y$

   (f) $X' * Y$

   (g) $Z * X$

   (h) $X' * Z$

   (i) $[X; Y]$

   (j) $[X, 2 * Y]$

3. (Vector commands) Consider the following signal:

$$X(t) = -2\sin(2\pi f_0 t) + 4\cos(\pi f_0 t + \phi),$$

   where $f_0 = 5$ Hz, $T = 2$ sec, $\phi = \pi/4$, $f_s = 100$ Hz, and $t = 0 : 1/f_s : T$.

   Use MATLAB to find:

   (a) Length of X

   (b) Max of X

   (c) Min of X

   (d) Sum of X

   (e) Mean of X

   (f) Variance of X

   (g) Values of X at $t = 0.1$ sec and $t = 0.51$ sec

4. (Complex signals) Consider the following signal:

$$X(t) = \exp(2\pi j f_0 t + j\phi) + 2\cos(2 * \pi f_0 t),$$

   where $f_0 = 1$ Hz, $T = 2$ sec, $\phi = -\pi/3$, $f_s = 100$ Hz, and $t = 0 : 1/f_s : T$.

   Using MATLAB, plot the following in separate figures:

   (a) Magnitude of X vs t

   (b) Phase of X (in radians) vs t

   (c) Real and imaginary parts of X vs t.

   Please make sure that your figures are labeled. You may want to type help for plot, legend, xlabel, ylabel and grid for assistance.

5. (Audio Input and Output) It is possible to record sound with Matlab (see `help audiorecorder`). Please verify that you can play and record sound in MATLAB using this example:

```
r = audiorecorder(44100, 16, 1);
disp('Recording: press return to stop');
record(r);     % speak into microphone...
pause;
pause(r);
disp('Playing: press return to start recording again');
p = play(r);   % listen
pause;
disp('Continuing to Record: press return to stop');
resume(r);     % speak again
pause
stop(r);
disp('Playing Both Parts');
p = play(r);   % listen to complete recording
myRecording = getaudiodata(r); % get data as double
```