ECEN 455 Lab 0: Basic MATLAB Commands

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Due Monday 1/23/12

Overview:

1. This lab is designed to help students get started with the most basic MATLAB commands. It is very important because the remainder of the labs in this course will use MATLAB.

2. Each student should write MATLAB code to complete the exercises outlined in the lab handout. The TA will be there to assist you and answer questions.

3. For each lab, all students must turn in a report composed using a word processor (e.g., Word, Powerpoint, LaTex, etc...). The report should include cover page with your name and UIN answers. 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 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.

4. MATLAB can be started by typing "matlab" on unix workstations. 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`

   You may also be able check out a copy of "The Student Edition of MATLAB User's Guide" or "The Matlab User's Guide". However, in most cases you should be able to get the explanation of the 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.

Exercises:

1. (Matrix Manipulations) 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. For each MATLAB 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. (Some Array 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.