Lab 2 Matlab Basics II

I. Lab Assignments

Part A: Review of Numerical Computations

1. Use a single Matlab command to create a vector consisting of all the EVEN numbers between 7 and 101. Use a Matlab command to find out the number of elements in the vector.

2. Create the following matrices:

   \[
   A = \begin{bmatrix}
   2 & 5 & 1 \\
   4 & 3 & 7 \\
   8 & 6 & 1 \\
   \end{bmatrix}, \quad B = \begin{bmatrix}
   3 & 1 & 6 \\
   2 & 3 & 8 \\
   7 & 2 & 0 \\
   \end{bmatrix}
   \]

   a) Use a single Matlab command, find the sums of all the elements on the same row of A.
   b) Use a single Matlab command, find the summation of the elements on the 2\text{nd} row of A.
   c) Use a single Matlab command, find the product of the elements on the 1\text{st} column of B.
   d) Use a for loop, find the summation of the diagonal elements of A.
   e) Find A*B and A*B manually, and verify your results with Matlab.

3. Use Matlab to create a vector \( x = e^{-2t}, \ t = 0 : 0.1 : 10, \)

   a) Add 5 to each element of x, and store the result in a vector.
   b) Add 3 to only the ODD-index elements of x (e.g. x(1), x(3), x(5)…), and store the result in a new vector y.

4. Load the matrix A stored in random_matrix.mat (can be downloaded from course website).
   a) Find the dimension (size) of the matrix.
   b) Find the number of elements in A that is greater than 0.
   c) Find the number of elements in the 2\text{nd} row of A that is greater than 0.
   d) Find the summation of all the elements in A.
   e) Find the summation of all the even-index element in the 3\text{rd} row of A.

5. Write a Matlab function \( y = \text{rms}(x) \) and save it in rms.m in your work folder.
   The input of the function is a vector \( x \), the output of the function is a scalar \( y \), which is the root mean square value of the elements in \( x \). That is

   \[
   y = \sqrt{\sum_{n=1}^{N} x^2(n)}
   \]

   Test your function with the input \( x = [1 \ 5 \ 2 \ 3 \ 8] \).
Part B: Review of Symbolic Computations

6. Go through pages 43 – 47 of the L. Chaparro book (part of the Section 0.5.2 Soft Introduction to Matlab: Symbolic Computations). Practice all the examples given in the textbook.

7. Plot the following functions for x between 0 and 5
   a) \( \exp(3x^2) \)
   b) \( \exp(-x) \cos(2\pi x) \)
   c) \( \text{sinc}(x) \)
   d) \( \text{sinc}^2(x) \)

8. Consider the function \( x \exp(3x^2) \)
   a) Find the differentiation
   b) Find \( \int_0^3 x \exp(3x^2) \, dx \)
   c) Find \( \int_0^3 x \exp(3x^2) \, dx \)

II. Homework Assignments

Part A: Review of Numerical Computations (please finish all the following problems with numerical computation)

1. Plot the following functions for \(-2 < t < 2\), and save the results as jpeg files.
   a) \( y = \cos(2\pi t) \)
   b) \( y = \cos(2\pi t + \pi / 3) \)
   c) \( y = \begin{cases} e^{-2t}, & t \geq 0 \\ e^{5t}, & t < 0 \end{cases} \)
   d) \( y = e^{-|t|} \cos(2\pi t) \)

Part B: Symbolic Computations (please finish the following problem with symbolic computation)

1. Consider the exponential function \( y = \exp(-ax) \).
   a) Find \( \frac{dy}{dx} \) manually. Use Matlab to verify your calculation.
   b) Find \( \int_a^b \exp(-ax) \, dx \) manually. Use Matlab to verify your calculation.
   c) Plot \( y \) when \( a = 2 \);
   d) Plot \( y \) when \( a = 0.5 \).