Lab 0a: Introduction to MATLAB

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Introduction and Background

Welcome to your first real-time DSP lab. The purpose of this lab, and the next one is to introduce you to two of the software tools that you'll be using in this course, namely MATLAB and Simulink. These tools significantly aid the design, development and implementation of digital signal processing (DSP) algorithms. These tools have several advantages. One of the most significant for this course is that they make it somewhat unnecessary to program DSP hardware using low-level assembly language! This helps to better integrate the design phase (in software) and implementation phase (in hardware) steps of DSP system development resulting in more effective DSP solutions for a given application and rapid prototyping.

Lab Instructions

Go online to:

http://www.mathworks.com/academia/student_center/tutorials/launchpad.html

and select the "Interactive MATLAB Tutorial". You will need to register for this tutorial, which will take approximately 2-2.5 hours to complete.

Deliverables

You must provide answers to the following questions (on pages 3-6 of this lab). Please write directly on the sheets and hand in your solutions by the end of the lab.

You must *each separately* answer the following questions on these lab sheets to be submitted (to the TA) at the end of the lab. You may use the back of the sheets if necessary.

Questions:

1. What are MATLAB command(s) to create the matrix:

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}?$$

2. Provide MATLAB commands(s) to create a vector consisting of all the EVEN numbers between 21 and 65 in ascending order without having to exhaustively enter them.

3. Assume we have a 1×4 vector x = [4 5 2 6] stored in MATLAB. Translate the following operations into simple MATLAB commands one would enter at the MATLAB prompt that make use of x:

    a. Add 16 to each element of the vector x to produce another vector with the results.

    b. Add 3 to only the ODD-index elements (i.e., the first and third elements) of x to produce another vector with the results.

    c. Create a vector where each element value is the square root of each element of x.

    d. Create a vector where each element value is the square of each element of x.

4. Evaluate the following MATLAB expressions by hand first and then verify via MATLAB. Please provide your handwork as well as the final numerical results next to the corresponding expression.

    a. 2 / 2 * 3

    b. 6 - 2 / 5 + 7 ^ 2 – 1

    c. 10 / 2 \ 5 - 3 + 2 * 4

    d. 3 ^ 2 / 4

    e. 3 ^ 2 ^ 2

    f. 2 + round(6 / 9 + 3 * 2) / 2 – 3

    g. 2 + floor(6 / 9 + 3 * 2) / 2 – 3

    h. 2 + ceil(6 / 9 + 3 * 2) / 2 – 3

5. Given the array A = [2 7 9 7 ; 3 1 5 6 ; 8 1 2 5], provide a single-line MATLAB command for the following operations to process A:

    a. assign the even-numbered columns of A to an array called B; what is the value of B?

    b. assign the odd-numbered rows of A to an array called C; what is the value of C?

    c. assign the transpose of A to a new array D: what is the value of D and what are its dimensions?

    d. multiply A with its transpose to produce a new array E; what is the value of E?

6. In your own words describe the following logical commands in MATLAB (i.e., explain the meaning of the symbols) and provide the final results for x=7 and y=-4:

    a. x > y

b. y < x

c. x == y

d. x <= y

e. y >= x

f. x | y

g. x & y

h. x & (~y)

i. (x > y) | (y < x)

j. (x > y) & (y < x)

7. Which of the following statements regarding the writing M-file functions in MATLAB are correct?

   a. M-file functions make tasks more modular and the code more reusable.

   b. M-file functions and scripts share the same workspace.

   c. M-file functions enable the explicit passing of inputs and outputs.

   d. M-files functions maintain a separate workspace that is automatically cleared on exit of the function.

8. Consider the following MATLAB code fragment:

```
if n > 1
     m = n+1
else
     m = n-1
end
```

   and use MATLAB to evaluate the value of m for (please write your answers next to the corresponding value of n below):

   a. n = 7

b. n = 0

c. n = -10

9. Evaluate the following MATLAB code fragment:

```
if (x>0)&(x<10)
        y = 4*x
elseif (x>10)&(x<40)
        y = 10*x
else
        y = 500
end
```

and use MATLAB to evaluate y for (please write your answers next to the corresponding value of x below):

a. x = -1

b. x = 5

c. x = 30

d. x = 100

10. State whether the following states are TRUE or FALSE:

a. Data defined in the workspace is permanently saved in MATLAB.

b. A variable is a container for data in MATLAB.

c. Function declarations always begin with the 'function' keyword. They can have zero to multiple inputs and outputs. Multiple outputs are specified in square brackets separate by commas.