ECE 3723 - Electric Circuits II - Fall 2021
Project 1: Introduction to MATLAB

Due: 9/7/21 by midnight in Canvas

1 Introduction

MATLAB®is an extremely powerful programming environment used by engineers and scientists to perform a wide range of numerical computation, visualization, and programming. This tool is particularly valuable for electrical engineers as it is very commonly used for signal, image, and video processing, communications, and electromagnetics. The purpose of this project is introduce some of the basic functionality of MATLAB®.

2 MATLAB®Basics

MATLAB®can be used as an advanced calculator where computations can be written as scripts and functions. So instead of just writing in single line calculations, entire design processes can be coded and optimized to realize complex components and systems. MATLAB®is a scripting environment that uses almost identical syntax as used in C and Java except without the need to create and manipulate specific handles and headers. In other words, MATLAB®can be used to program without having to deal with resource managing.

1. Create and run an m-file with a simple math calculation:
    - Open MATLAB®
    - Go to File->New->Script (or hit Ctrl+N, or click the New Script icon in the toolbar)
    - In the script window start by writing the commands ”clear all”, ”close all”, and ”clc”. Including this in scripts is a good practice to clean up the workspace before writing a script.
      Question: What do these functions do?
    - Save the file as task1.m (File->Save (Ctrl+S) or File->Save as).
    - Write ”y = 2*3 ^ 2*exp(2)”. Then run the script by selecting Run. The shortcut for running a script is F5.
      Question: What is the output in the command window?
    - Now add a semicolon behind the equation in the script.
      Question: What does the semicolon do to the output of the script?
    - Define a new variable x = 2 in the line above the previous equation. And then change the definition of y to y = x*3^x*exp(x). Now the variable x can be changed and y will change automatically when the script is run. This removes the need for manually changing the input to the equation.

2. Create an vector of numbers and plot an output of a function:

   - Use the .m file from above and create a vector called v1 with the command v1 = [1 2 3 4].
     Question: Is this a row or a column vector?
   - Now create v2 = [1; 2; 3; 4].
     Question: What do the semicolons do in this case?
   - Multiply v1 and v2 together.
     Question: Does the order matter? i.e. v1*v2 vs. v2*v1, explain why?
   - Other useful ways of creating these vectors would be v1 = 1:1:4 or v1 = linspace(1,4,4). These functions enable the creation of large vectors without having to manually populate them.
     Questions: What are the input parameters for these functions? How do they differ between the two methods?
   - Define a voltage v as v = linspace(0,12,121).
     Question: What is the purpose of choosing 121 in this equation (as opposed to any other number)?
   - Now define a 4.7 kΩ resistance with R =4.7e3 (note: the powers of ten are represented by e, not exp).
   - To find the current we need to solve Ohm's law: $i = v/R$. Create i and run the function.
     Question: What happens when you run the script?
   - MATLAB®does by default use matrix operations. To suppress those, a period is used in front of the operator. So redefine i = v./R and run it. To access specific element n in a vector in MATLAB®, the command is i(n).
     Question: What is the voltage and current when n = 89?
   - To plot a function the command "plot" can be used. Create a new line in the .m file with the command "plot(v,i)".
   - Type "help plot" to see more options for the plot function. Then add labels on the x and y axis. Add a legend with the equation. Save the plot and include in the report.

3 Deliverables

This project should be written up in a neatly organized report that includes the results from section 2, answers to all the questions and all plots that are generated. The format of the report needs to be formal, which includes a front page, introduction, main body, and conclusions. All the code generated for this project must be included in an appendix (in small font, less than 12pt).