ENGR15100: SOFTWARE TOOLS FOR ENGINEERS

Laboratory 8

PURPOSE: Learn about Loops/Iterative Statements.

For each problem, create a MATLAB script file and name it FIRSTNAME_LASTNAME_LAB8_problemX.m. Put ALL the commands for the required steps in your script file:

- Be sure to clear the display and the memory.
- Display your name.
- Separate and label different steps using comments.
- For each plot question, you can use pause and close functions to stop and check the plots, and then close the figure window.

You can use following template for each of the Problem.

```
%{
Class         : ENGR15100: Software Tools for Engineers
Instructor    : Xiaoli Yang
Author        : [Student's Name]
Assignment    : Lab [No.]
File Name     : Firstname_Lastname_LAB[No.]_Problem[No.].m
                (eg: Xiaoli_Yang_LAB1_Problem1.m)
Date          : [MM]/[DD]/[YY]
%}

%clear screen
clc

%clear workspace
clear

%display your name
disp('Your Full Name Here');
disp('Starting code: ');

%Start your source code here%

%End your code
disp('Completed');
```

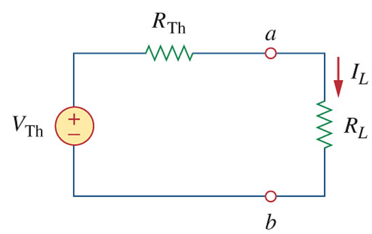
SUBMITTING YOUR LAB:
Submit your lab by uploading .m file using the Brightspace Assignment feature no later than the date specified.

PROBLEM 1 (30 points):

1) (**10 points**) Using what you have learned in the last several labs it is desired to make a plot of the following equation:

$$P = R_L\left(\frac{10}{R_L + 20}\right)^2$$

The equation is derived from the circuit shown below:



The Y axis variable P is power of the resistor R_L which is transferred from a battery modeled as a voltage source V_{TH} equal to 10 V also having and internal heating loss modeled by R_{TH}=20 Ohms .

It is desired to plot the power P on the Y axis in terms of the load resistance R_L on the X axis for the purpose of estimating the value of R_L which results in a maximum value of P. Assume the input R_L, changes from 0 to 40 Ohms with a step size of 0.1 Ohms. Create the plot described above and add a title, the appropriate x and y labels and lastly activate a grid to aid in reading the plot.

2) (**20 points**) Next, use a FOR loop starting at R_L =0 having an ohmic step size of 0.001 ohms to find the value of R_L which makes power P maximum. You will need to include an appropriate IF statement in your code to determine when the maximum value of P is reached and stop the FOR loop using the BREAK command. Lastly, use FPRINTF command to print out the solution found for the value of R_L and the corresponding value of load power P.

PROBLEM 2 (20 points):

The average monthly precipitation (in.) for Boston and Seattle during 2012 are given in the vectors below (data from the U.S. National Oceanic and Atmospheric Administration).

BOS=[2.67 1.00 1.21 3.09 3.43 4.71 3.88 3.08 4.10 2.62 1.01 5.93]

SEA=[6.83 3.63 7.20 2.68 2.05 2.96 1.04 0.00 0.03 6.71 8.28 6.85]

Where the elements in the vectors are in the order of the months (January, February, etc.) Write your program to answer the following:

1) (**10 points**) Calculate the total precipitation for the year in each city using Matlab FOR LOOP. Do NOT use MATLAB's built-in functions sum.
2) (**10 points**) Which months were the precipitation in Boston lower than the precipitation in Seattle? Display the specific months. (HINT: USE IF and FOR)

PROBLEM 3: (25 POINTS)

Consider the equation $y = 2400 - (t - 40)^2$ in meters, where 't' is the time in seconds (from 0 to 100 seconds with a step size of 0.01 seconds). Write a script to do the following:

- Using a WHILE loop to create a plot in a Figure 1 with time t as the variable on the x axis and the y variable on the y axis. Add the title "Y versus Time", the x axis label "Time (sec)" and y axis label "Y (meters)" to the plot.
- Using a WHILE loop structure to find the time t at which y passes through 1600 meters on the way up.
- Using a WHILE loop structure to find the time t at which y passes through 1600 meters on the way down.
- Using a WHILE loop structure to find the time t at which y is at a maximum.
- Using a WHILE loop structure to determine the elapsed time required for y to go from 1000 up to 2000 meters.

  HINT: Solve this problem using the following logic.
  1) Add a variable *etime* and set it equal to zero before the WHILE loop.
  2) Allow the WHILE loop to run until say just past 2300 meters (which is >2000m).
  3) Inside the WHILE loop use an IF statement to determine if the value of y falls between the values of 1000 and 2000 meters. If it does, add 0.01 seconds to the running total variable for the elapsed time *etime* to count how much time is spent between 1000 and 2000 meters.
  4) Use the FPRINTF command to show the result of *etime*.

PROBLEM 4: (25 POINTS)

- Using if-end and while-end statements, perform the following:
  1) Prompt the user to enter numerical grades, one grade at a time (i.e. do not use vectors). Any number of grades can be entered, however, each grade must be non-negative and no larger than 100. Otherwise, the grade is considered invalid and the user should be prompted to re-enter the grade. A grade of 999 indicates the user has finished entering numerical grades.
  2) Compute the number of grades in each grade range using the standard grading policy: A [90 – 100], B [80 – 90), C [70 – 80), D [60 – 70), F [0 – 60).
  3) Compute the minimum grade, maximum grade, and average grade. You are **NOT** allowed to use built-in functions min(), max(), sum(), or mean().