T.C.

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EEE247

Programming-2

LABORATORY SHEETS

Experiments 1 to 10

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EEE247 LABORATORY EXPERIMENT – 1

1) Let the variable A be a row matrix (2, 4, 0, -1, 3), and B be a column matrix whose five elements are 2, 5, 8, 3, -5, in that order. Calculate the quantity A * (B+1).

2) Set up the vector and calculate the magnitude of this vector, (0,1,2,...,50)

3) Evaluate the following MATLAB expressions by hand and use MATLAB to check the answers

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) round(6 / 9 + 3 * 2)
g) floor(6 / 9 + 3 * 2)
h) ceil(6 / 9 + 3 * 2)

4) Create a vector x with the elements...

a) 2, 4, 6, 8
b) 10, 8, 6, 4, 2, 0, -2, -4
c) 1, 1/2, 1/3, 1/4, 1/5
d) 0, 1/2, 2/3, 3/4, 4/5

5) Given the array A = [2 4 1 ; 6 7 2 ; 3 5 9], provide the commands needed to

a) assign the first row of A to a vector called x_1
b) assign the last 2 rows of A to an array called y
c) compute the sum over the columns of A
d) compute the sum over the rows of A
e) compute the standard error of the mean of each column of A (NB. the standard error of the mean is defined as the standard deviation divided by the square root of the number of elements used to compute the mean.)

6) Let x = [3 2 6 8]' and y = [4 1 3 5]' (NB. x and y should be column vectors).

a) Add the sum of the elements in x to y
b) Raise each element of x to the power specified by the corresponding element in y.
c) Divide each element of y by the corresponding element in x
d) Multiply each element in x by the corresponding element in y, calling the result "z".
e) Add up the elements in z and assign the result to a variable called "w".
f) Compute x'*y - w and interpret the result

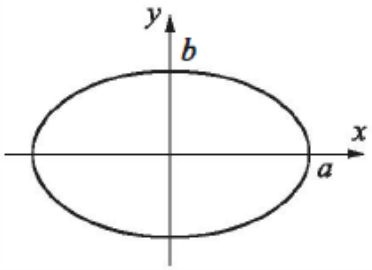
EEE247 LABORATORY EXPERIMENT – 2

1)

The circumference of an ellipse can be approximated by:

$$C = \pi[3(a+b) - \sqrt{(3a+b)(a+3b)}]$$

Calculate the circumference of an ellipse with $a = 16$ in. and $b = 11$ in.



2) Given a vector, t, of length n, write down the MATLAB expressions that will correctly compute the following:

a) $\ln(2 + t + t^2)$
b) $e^t(1 + \cos(3t))$
c) $\cos^2(t) + \sin^2(t)$
d) $\tan^{-1}(t)$
e) $\cot(t)$
f) $\sec^2(t) + \cot(t) - 1$

Test that your solution works for t = 1:0.2:2 and plot all functions.

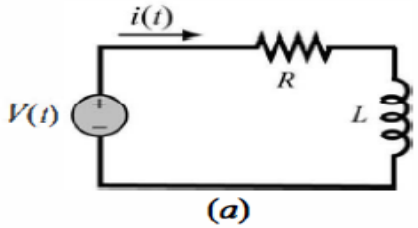
3) Plot the expression (determined in modeling the growth of the US population)

$$P(t) = 197{,}273{,}000/(1 + e^{-0.0313(t - 1913.25)})$$

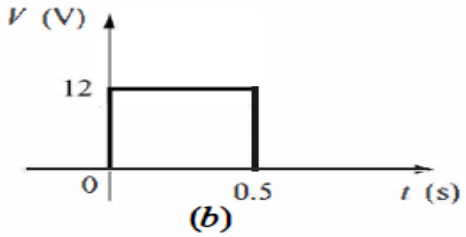
where t is the date, in years AD, using t = 1790 to 2000. What population is predicted in the year 2020?

4)

A resistor, $R = 4\ \Omega$, and an inductor, $L = 1.3$ H, are connected in a circuit to a voltage source as shown in Figure (*a*) (an *RL* circuit). When the voltage



(*a*)



(*b*)

source applies a rectangular voltage pulse with an amplitude of $V = 12$ V and a duration of 0.5 s, as shown in Figure (*b*), the current $i(t)$ in the circuit as a function of time is given by:

$$i(t) = \frac{V}{R}(1 - e^{(-Rt)/L}) \quad \text{for} \quad 0 \le t \le 0.5 \text{ s}$$

$$i(t) = e^{-(Rt)/L}\frac{V}{R}(e^{(0.5R)/L} - 1) \quad \text{for} \quad 0.5 \le t \text{ s}$$

Make a plot of the current as a function of time for $0 \le t \le 2$ s.

EEE247 LABORATORY EXPERIMENT – 3

1) Given x = [3 15 9 12 -1 0 -12 9 6 1], provide the command(s) that will

a) set the values of x that are positive to zero
b) set values that are multiples of 3 to 3 (rem will help here)
c) multiply the values of x that are even by 5
d) extract the values of x that are greater than 10 into a vector called y
e) set the values in x that are less than the mean to zero
f) set the values in x that are above the mean to their difference from the mean

2) Create the vector x = randperm(35) and then evaluate the following function using only logical indexing:

y(x)= 2 if x < 6
y(x)= x - 4 if 6 <= x < 20
y(x)= 36 - x if 20 <= x <= 35

You can check your answer by plotting y vs. x with symbols. The curve should a triangular shape, always above zero and with a maximum of 16. It might also be useful to try setting x to 1:35. Using multiple steps (or a simple mfile) is recommended for solving this problem.

3) Write a script that asks for a temperature (in degrees Fahrenheit) and computes the equivalent temperature in degrees Celcius. The script should keep running until no number is provided to convert. [NB. the function isempty will be useful here.]

4) Given a year between 1982 and 2048, inclusive, the date for any Easter Sunday can be computed from the set of relations

A = Year modulus 19
B = Year modulus 4
C = Year modulus 7
D = (19*A + 24) modulus 30
E = (2*B + 4*C + 6*D + 5) modulus 7
Easter Sundy is then Sunday, March (22 + D + E). Note that (22+D+E) could be greater than 30, giving a date that is really in April!

Design a MATLAB program that when given the year, returns the day of the week on which Easter Sunday falls, the month in which Easter Sunday falls, and the date of the month on which Easter Sunday falls. If the year lies outside the permissible range, the day of the week should return the phrase “Error!!!”, the month should return a phrase indicating that the year is not in the acceptable range, and the date of the month should return the offending year.

EEE247 LABORATORY EXPERIMENT – 4

1) Write a function to do the following:

a) A function that returns area of a triangle. Function will take height and base lengths as input.
b) A function that returns maximum value in a vector. Function will accept this vector as input.
c) A function for converting cartesian coordinates to polar coordinates. Cartesian coordinates are inputs to the function.
d) A function that outputs first N prime numbers. N is input to the function.

2) Write the function [x,y] = getCircle(center,r) to get the x and y coordinates of a circle. The circle should be centered at center (2-element vector containing the x and y values of the center) and have radius r. Return x and y such that plot(x,y) will plot the circle.

Recall that for a circle at the origin (0,0), the following is true:

$x(t) = \cos(t)$ and $y(t) = \sin(t)$ for t on the range $[0, 2\pi]$.

Now, you just have to figure out how to scale and translate it. Plot the circle using this function.

3) Write a function to dynamically plot a sinusoidal signal. Plot must change dynamically (sinusoidal signal value will change with the time) with respect to time. Use sin or cos functions to generate signal and pause() to create animation.

EEE247 LABORATORY EXPERIMENT – 5

1. Information about GUIDE

We will use GUIDE (GUI Development Environment, an interactive GUI construction kit) for this experiment. This approach starts with a figure that you populate with components from within a graphic layout editor. GUIDE creates an associated code file containing callbacks for the GUI and its components. GUIDE saves both the figure (as a FIG-file) and the code file. Opening either one also opens the other to run the GUI.

Start GUIDE by typing `guide` at the MATLAB prompt.

To add functionality to your buttons, add commands to the 'Callback' functions in the MATLAB file. For example, when the user clicks the ADD button, the `add_Callback` function will be called and executed. All the data for the GUI is stored in the handles, so use `set` and `get` to get data and change it if necessary. Any time you change the handles, save it using guidata.

```
guidata(hObject, handles);
```

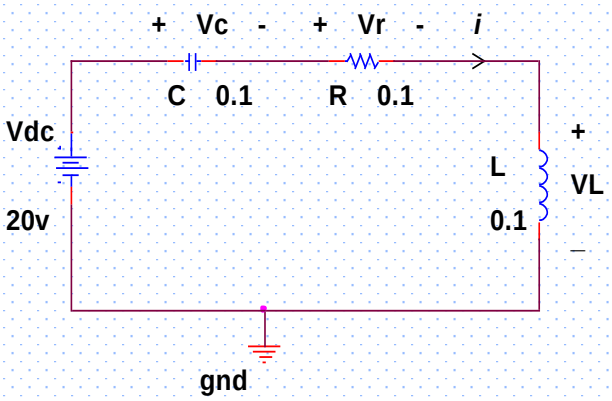
2. GUI Experiments

1) Write a GUI program that reads two numbers from two edit boxes and adds them if the user clicks the add button. Summation of two numbers has to be displayed in a static text box.

2) Write a GUI program that plots a function (hardcoded into script) when the user clicks the plot button. There also must be a push button for toggling grid on and off.

3. Simulink Experiment

1) Plot Vc, Vr, Vl and i versus time by using Simulink Environment.



$$Vdc - Ri - Vc = L\frac{di}{dt}$$

$$V_L = L\frac{di}{dt}$$

$$Vr = Ri$$

$$V_c = \frac{1}{C}\int i\ dt \qquad i = C\frac{dVc}{dt}$$

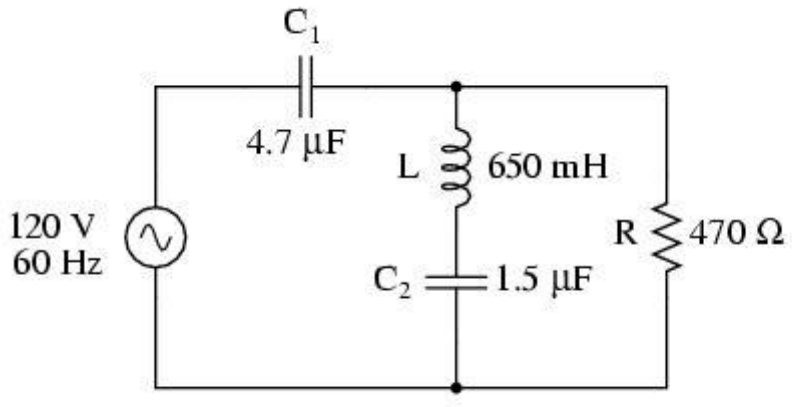
EEE247 LABORATORY EXPERIMENT – 6

1. Usage of basic I/O blocks and running simulations.

-Create a sine wave with amplitude of 10 and frequency of 60 Hertz using signal generator block.
-Run the simulation for 5 seconds.
-Observe the resulting signal using "Scope" block.
-Add "To Workspace" block to your design and change save format to 2D-array.
-Open simulation parameter settings to do the followings;
    -In the solver options, by using variable-step solver change the max step size to 1e-4.
    -In data import/export part, remove the tick next to the data point limit.
-Run the simulation again and observe the sine wave using Scope.
-Go to command window and plot the generated sine wave that To Workspace block provided.
-Compare two graphs.

-Create the variables in the command window as:
t = [0:0.0001:5];
sig = sin(t);
-Plot the sine wave.
-Create a structure array with the variables above. (How to: explained in From Workspace block.)
-Go to your Simulink design and add "From Workspace" block and a Scope.
-Change the settings of "From Workspace" block to get the structure array created in the workspace.
-Run the simulations for 5 seconds and observe the signal in the Scope. Compare it to the graph you previously plotted.

2. RLC Circuit Implementation



-Create the RLC circuit above in Simulink and observe the voltage and current across each component.

EEE 247 LABORATORY EXPERIMENT - 7

1- Perform the following operations.
   a. Create an Excel file named exampleFile.xlsx
   b. Read numeric data from the Excel file.
   c. Read all data from the Excel file.
   d. Read a specific range of data from the Excel file in the previous example.
   e. Read the second column from the Excel file in the first example.
   f. Read the first row from the Excel file in the first example.

exampleFile.xlsx:

First	Second	Third
1	2	3
4	5	x
7	8	9

2- Perform the following operations.
   a. Open the badpoem.txt file, read the first line, and then close the file
   b. Open the badpoem.txt file, read all the lines, and close the file.

3- Create a sample text file that contains floating point numbers.

4- By following the steps written below, build the table you see on the right.
   a. Create a vector 'x' from 0 to 1 in steps of 0.1.
   b. Create another vector containing exponential values of all elements of x.
   c. Combine these two vectors.
   d. Create a sample text file that contains these two vectors.
   e. Close the file.
   f. Examine the contents of the file with the type command.

x	exp(x)
0.00	1.00000000
0.10	1.10517092
0.20	1.22140276
0.30	1.34985881
0.40	1.49182470
0.50	1.64872127
0.60	1.82211880
0.70	2.01375271
0.80	2.22554093
0.90	2.45960311
1.00	2.71828183

EEE247 LABORATORY EXPERIMENT – 8

1) The number of faculty members in each department at a certain College of Engineering is:

   ME 22
   BM 45
   CE 23
   EE 33

   Experiment with at least 3 different plot types to graphically depict this information. Make sure that you have appropriate titles, labels, and legends on your plots. Which type(s) work best, and why?

2) Plot Sinc function, where Sinc (x) = sin(x) / x , and $-6\pi \leq x \leq 6\pi$. (x vector has 160 linearly spaced points in the range).

3) Generate a grid of equally spaced x values over the interval $0 \leq x \leq 5$ and make line plots of the functions x, x^3, e^x all on the same graph (using hold on and hold off). After you plot the first function, you should dock the Figure window. (Try docking it and undocking it so that you know how to.)

4) Use the **cylinder** function to create *x*, *y*, and *z* matrices and pass them to the **surf** function to get a surface plot. Experiment with different arguments to **cylinder**.

EEE 247 LABORATORY EXPERIMENT - 9

1. Perform the following operations.

   a.
      i. Create a symbolic function f with variables x and y by using *syms*.
      ii. Assign *x^2*y expression* to f.
      iii. Find the value of f at (3,2).
      iv. Calculate f for multiple values of x and y.
      v. Find the derivative of f(x,y) with respect to x.

   b.
      i. Create a symbolic function f and assign sin(x)^2 + cos(y)^2 expression to f.
      ii. *Differantiate symbolic expression f with respect to x.*
      iii. *Differantiate symbolic expression f with respect to y.*
      iv. *Take second derivative of the symbolic expression f with respect to a variable y.*

2. $ax^2 + bx + c = 0$ Solve the equation using the *solve* utility in MATLAB.

   the solutions of the quadratic equation are:
   $$x = -\frac{1}{2a}(b \pm \sqrt{b^2 - 4ac})$$

3. 4x-2y3z=1
   x+3y-4z=-7
   3x+y+2z=5
   Solve this system of equations using the *solve* utility in Matlab.

4. $\frac{d^3y}{dx^3} = ax^2$ Solve the equation by using *dslove* utility in Matlab.

5. $\frac{df}{dt}$=3f + 4g , $\frac{dg}{dt} = -4f + 3g$ f(0)=0 , g(0)=1. Solve this system of differantial equations using the *dsolve* utility in Matlab.

6. Do the following operations according to the given matrices Ma and Mb.
   a. Find the sum and multiplication of M_a and M_b.
   b. Find the determinant of Ma.
   c. Find the inverse of Ma.

$$M_a = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$$
$$M_b = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}$$

EEE242 LABORATORY EXPERIMENT – 10

1. Header of the Stack class is given below. Implement the class Stack and use it in the main program provided.

```
// Stack class declaration

const int SIZE = 5;

class Stack
{
     private:
          int s_array[SIZE];
          int top; // Top of Stack

     public:
          Stack(); // Default Constructor
          void push(int);
          int pop();
          int isempty() const;
          int isfull() const;
};
```