Problem Solving For Engineering Transfer
ENS 1300 - Spring 2020

Due Date
1 January 2020

Lab 1: Intro to ENS 1300

Last Modified
8 January 2020

ENS 1300 Lab Assignment Proceedures

Course Website

ENS 1300 lab assignments will follow material that can be found on the course website. You should read through the material for each lab carefully before proceeding with the associated assignment, as the instructions and/or examples provided in the assignment pdf documents will be very minimal.

Deliverables

Each ENS 1300 lab assignment will have exactly **one** deliverable. We will use a technique called zipping/archiving to package multiple lab files into a single file. You will complete all work for a lab in a single folder. When ready to submit, you will zip that folder and upload it to the dropbox.

Grading

Grading

Directory Structure (some points)

Create a new directory (aka folder) called `ENS1300`. You will organize and store all files for this course in this directory. In order to avoid losing your work, it would be wise to back up this folder periodically. Create the subdirectories `Templates`, `Examples`, `Projects`, `Labs`, and `Labs/Lab01`. Your directory structure should now look like this:

```
ENS1300
|-- Labs
|    |-- Lab01
|-- Projects
|-- Templates

4 directories, 0 files
```

Now open MATLAB, make `ENS1300/Templates` the working directory, and then create a new script with the following contents:

```
% ----------------------------------------------------------------
% Name:
% Section:
% Assignment:
% Date:
% ----------------------------------------------------------------
clear; close all; clc; format compact; format short;
```

Input your name and section on lines 1 and 2, respectively. Save the script as `ENS1300/Templates/Script.m`. If Foo Bar were in section 2, their script template file for ENS 1300 would look like this:

ENS1300/Templates/ScriptFooBar.m

```
% ------------------------------------------------------------------------
% Name: Foo Bar
% Section: 2
% Assignment:
% Date:
% ------------------------------------------------------------------------
clear; close all; clc; format compact; format short;
```

Now you have a starting point for each script that you will submit for this class. Make a copy of the script template and save it as `ENS1300/Labs/Lab01/lab1_prob1.m`. Foo Bar's directory structure would now look like this:

```
ENS1300
|-- Labs
|   |-- Lab01
|       |-- lab1_prob1.m
|-- Projects
|-- Templates
    |-- Script.m

4 directories, 2 files
```

Archive/Zip/Compress your `ENS1300` directory. Rename and move the zip file to `ENS1300/Labs/Lab01/ENS1300-01.zip`.

Problem 1.1 (some points)

A set of springs have the given loads and stiffnesses shown in Table 1. Copy and paste the data set into the `ENS1300/Labs/Lab01/lab1_prob1.m` script and define it as a matrix called `data`. By using indexing, separate the matrix into column vectors containing spring forces and stiffnesses. Name the two column vectors `springForce` and `springStiffness`, respectively. Using the specified variable names where applicable, complete the following tasks:

	Task	Variable Name(s)
(a)	Fill in the header section.	
(b)	Find the total number of springs.	`numSprings`
(c)	Calculate the deflection of the 15^{th} spring.	`springDeflection`
(d)	Calculate the total potential energy in the springs.	`springEnergy`
(e)	Calculate the average stiffness.	`meanStiffness`
(f)	Calculate the median deflection.	`medianDeflection`

Useful Spring equations:

$$F = kx$$
$$U = \frac{1}{2}kx^2$$

Where:

$$F = \text{Force (N)}$$
$$U = \text{Potential Energy (J)}$$
$$k = \text{Spring Stiffness} \left(\frac{\text{N}}{\text{m}}\right)$$
$$x = \text{Deflection}/(\text{m})$$

Example: The header in Foo Bar's `ENS1300/Labs/Lab01/lab1_prob1.m` file might look something like this:

ENS1300/Templates/lab1_prob1.m

```
% ----------------------------------------------------------------
% Name: Foo Bar
% Section: 2
% Assignment: Lab 1, Problem 1
% Date: 1 January 1983
% Description: Simple spring problem
% ----------------------------------------------------------------
clear; close all; clc; format compact; format short;
```

Table 1: Data for Problem 1.1

Spring Force (N)	Stiffness (N/m)
23	349
19	284
34	325
38	259
40	230
21	359
18	312
32	343
40	353
18	270
30	322
15	272
17	295
23	327
18	283
23	236
33	311
20	317
33	358
29	344
15	206
21	354
24	320
24	217
30	237
28	257
37	214
38	258
25	337
22	327
19	287
33	327
27	252
39	253
31	227
26	282
19	252

Problem 1.2 (some points)

The data in Table 2 gives segments of some traveled path. Make another copy of the script template and save it as `ENS1300/Labs/Lab01/lab1_prob2.m`. In this new script, complete the following tasks:

	Task	Variable Name(s)
(a)	Fill in the header section.	
(b)	Extract the values from Table 2 and define them as a matrix.	`data`
(c)	Using indexing, separate `data` into two column vectors; one for distance and the other for angle.	`distance`, `angle`
(d)	Calculate the horizontal and vertical components for each segment of the path.	`xDist`, `yDist`
(e)	Sum the horizontal components.	`xTot`
(f)	Sum the vertical components.	`yTot`
(g)	Calculate the magnitude of the resultant distance.	`resMag`
(h)	Calculate the angle (CCW from +x) of the resultant distance vector.	`resAng`

Table 2: Data for Problem 1.2

Distance (ft)	Angle (CCW from +x)
19	281
33	274
30	233
34	162
27	204

Problem 1.3 (some points)

Consider the following equation:

$$A = \frac{e^{-c/(2x)}}{\ln(y)\sqrt{dz}}$$

Where:

$$\begin{aligned}
c &= 2 \\
d &= 4 \\
x &= \text{a row vector of values from 1 to 10 in increments of 1} \\
y &= \text{a row vector of values from 0.1 to 0.55 in increments of 0.05} \\
z &= \text{a row vector of 10 equally spaced values in the range 18 to 45, inclusive.}
\end{aligned}$$

Write a script that will:

	Task	Variable Name(s)
(a)	Correctly initialize given variables.	`c`, `d`, `x`, `y`
(b)	Calculate A.	`A`
(c)	Calculate average value of A.	`meanA`

Problem 1.4 (some points)

Consider the following equation:

$$A = \frac{e^{-c/(2x)}}{\ln(y)\sqrt{dz}}$$

Where:

$$\begin{aligned}
c &= 2 \\
d &= 4 \\
x &= \text{a row vector of values from 1 to 10 in increments of 1} \\
y &= \text{a row vector of values from 0.1 to 0.55 in increments of 0.05} \\
z &= \text{a row vector of 10 equally spaced values in the range 18 to 45, inclusive.}
\end{aligned}$$

Write a script that will:

	Task	**Variable Name(s)**
(a)	Correctly initialize given variables.	`c`, `d`, `x`, `y`
(b)	Calculate A.	`A`
(c)	Calculate average value of A.	`meanA`