ENGR 16200
HW 2 MATLAB PROGRAMMING PROBLEMS

Individual Assignment: See the course syllabus for a definition of what this constitutes.

Note: Failure to submit any programming assignments with a correct filename may result in no points earned. Use the Gradescope programming assignment output to verify that the autograder found your submission.

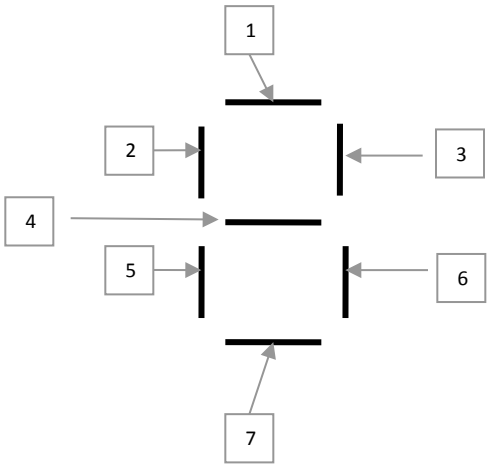
Note: For this and all subsequent programming assignments, final program outputs should exactly match the given examples' output in terms of text and values.

Programming Problem 1 (of 2)

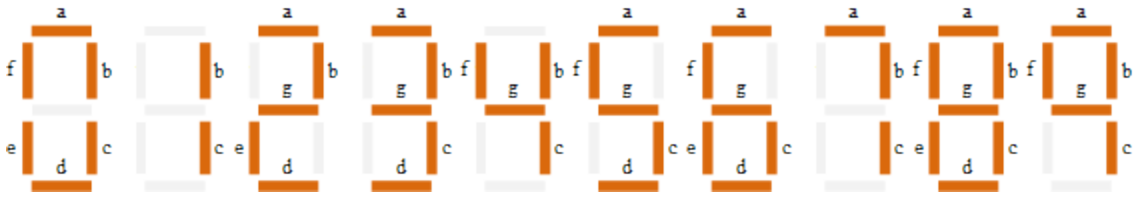
Learning Objectives: Create and implement user-defined functions in MATLAB; apply course code standard.

Background:

7 segment LCD displays are used in a variety of applications: gas station pumps (to display the amount of fuel dispensed and the corresponding cost), alarm clocks (to display the hours and minutes), etc. Each segment can be turned on or left off in order to create a reasonably good depiction of the numerals 0 through 9. The figure below shows a labeling scheme for the individual segments.



To display a certain numeral, a "code" in the form of a seven element array is sent to a computer that runs the display system. The code operates on a binary system, where 0 indicates that a given segment is off and 1 indicates that the segment is on. For example, the display will be blank if all seven segments are off, i.e. 0 0 0 0 0 0 0, and the number 8 (shown above) would be indicated by having all segments on, i.e. 1 1 1 1 1 1 1. Note, these 0's and 1's do not indicate the binary representation of the one-digit numeral; rather, they indicate the state of each segment in the order shown above. The standard representation for each one-digit numeral is shown below:



(The small letters represent a different system for labelling the segments; you should not use these letters when developing your program.)

Instructions:

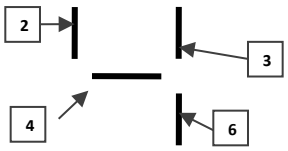
Part A: Write a MATLAB function called `HW2_Prob1_function_`*`login`*`.m` (where *`login`* is your user name) that accepts as input a single one-digit numeral, and returns an array of the appropriate output values for the segments of the LCD, where 0 corresponds to "off" and 1 corresponds to "on." You do not need to implement any error checking on this function; you may assume that the input is always a one-digit numeral. Note that this function should not output any information to the screen. Instead, you should assume that the output of this function will always be assigned to a variable. As an example:

```
>> code4 = HW2_Prob1_function_login(4)

code4 =

     0   1   1   1   0   1   0
```

These output values correspond to:



(To be clear: the above example simply illustrates how your function should operate. Do not worry about matching the formatting of this output.)

Part B: You are interning at a company that makes electronic displays for various retail stores. Your supervisor wants you to write a MATLAB program called `HW2_Prob1_script_`*`login`*`.m` (where *`login`* is your user name) that accepts as input a price value less than $100.00 and outputs all of the codes necessary to represent the digits of this price. The output should be in the form of an array, where the first row of the array corresponds to the code needed to display the tens digit, the second row corresponds to the code for the ones digit, etc. You do not need to include codes for the dollar sign or the decimal point, just the numerical digits. You may assume that the user will enter the price as a floating point number (so no dollar sign) that always has exactly two digits after the decimal point (so a price of $1.50 would be entered as 1.50, not 1.5 or 1.500). Your program should check to make sure that the price is greater than $0.00 and less than $100.00; an appropriate error message should be displayed if this is not true, and the program should terminate. If the price is less than $10.00, your program

output should include the code for a blank display as its first row. If the price is less than $1.00, your program output should have the code for 0 as its second row.

Save these two files and submit them to the appropriate programming dropbox on Gradescope. Also, create a flowchart of the relevant algorithm for Part B this problem, and include this flowchart in your PDF submission of the written portion of this assignment. (Be sure to include a flowchart for the user-defined function in your overall flowchart.) Please note that the PDF for the written portion of the assignment will be submitted to its own dropbox -- do not submit this PDF to the programming dropbox or vice versa.

Examples: (User inputs in bold)

Example #1:

```
Enter the price to be displayed: 40.40
The codes to use are:
     0     1     1     1     0     1     0
     1     1     1     0     1     1     1
     0     1     1     1     0     1     0
     1     1     1     0     1     1     1
```

Example #2:

```
Enter the price to be displayed: 120.21
Invalid price.
```

Important Information:

You may find it helpful to use the MATLAB function `str2num()` for this problem. This function accepts a string (or individual character) representing a number and returns the actual numerical value. For example:

```
>> digit = str2num('1') % ‘1’ is a string
digit =
    1  % The variable digit is a number
```

Using this function is not mandatory but may help you avoid certain errors.

Programming Problem 2 (of 2)

Learning Objectives: Practice using matrices and plotting functions in MATLAB; apply course code standard.

Background:

Innovative Aviation of America, Inc. has created a new design for general aviation aircraft, but they need to do some computations in order to verify the design's performance. They need your expertise in aeronautics and MATLAB to construct a program that will compute and plot various drag forces for different aircraft speed (V). Using your notes from AAE 251, you determined that the equations you need to estimate the relevant drag forces are as follows:

To calculate the coefficient of lift: $Cl = L \ / \ (0.5 * \rho * V^2 * S)$	To calculate the parasitic drag force: $D0 = 0.5 * \rho * V^2 * S * Cd0$
To calculate the induced drag force: $Di = Cl^2 * 0.5 * \rho * V^2 * S / (\pi * e * AR)$	To calculate the total drag force: $D = D0 + Di$

You are given the following values:

Aspect Ratio: AR = 3	Efficiency Factor: e = 0.9	Density (slugs/ft^3): ρ = 1.066*10^(-3)
Parasitic Drag Coefficient: Cd0 = 0.018	Surface Area (ft^2): S = 610	Lift Generated (lb): L = 1000

Since this is a general aviation aircraft that flies at low speeds, you need only consider speeds from 100 ft/s to 350 ft/s with increments of 5 ft/s. The aircraft is flying at constant altitude and level flight. Therefore, since temperature and air pressure are constant, you can assume density and lift are not changing. No values should be taken as input.

Instructions:

Write a program that that will create a single graph showing the following: parasitic drag force versus speed, induced drag force versus speed, and total drag force versus speed. Thus, your graph should contain three distinct plot lines that are readily identifiable. The three lines should be different colors, have different line styles, and use different markers. (You are free to make these choices as you wish, but none of the colors, line styles, or markers can be repeated in your graph.) Your graph should include an appropriate title, axis labels (with units), and a legend. You must save your graph and copy it into your PDF submission of the written portion of this assignment.

Save this program as `HW2_Prob2_login.m` and submit it to the appropriate programming dropbox on Gradescope. Also, create a flowchart of the relevant algorithm for this problem, and include this flowchart in your PDF submission of the written portion of this assignment. Please note that the PDF for the written portion of the assignment will be submitted to its own dropbox – do not submit this PDF to the programming box or vice versa.