Lab 3

MATLAB Functions and Graphing

Objectives:

- Gain familiarity with MATLAB functions
- Learn MATLAB graphing operations and formatting

Files Provided:

- MATLAB3-Plotting_Data.pdf
- datalog1.csv
- datalog2.csv
- datalog3.csv
- datalog4.csv
- datalog5.csv
- datalog6.csv
- datalog7.csv
- readdatalog.m

Assignment:

1. Since the data logs do not contain samples with a fixed sample period, the samples will be weighted based on the amount of time spent in each sample. To facilitate this, write a function that creates a new array from the input file such that each row contains:

    - the time stamp from the data log file (i.e. *time[n]*, the higher time from the sample period)
    - the elapsed time since the previous sample (*time[n]-time[n-1]*
    - the average of continuous readings, which is *(value[n]+value[n-1])/2*, or
      the unmodified discrete value (just the Gear Position)

    The function must accept the file name as input, and it must return the array described above as output. You may assume that the array is correctly formatted and that the file exists (although you are free to implement any form of error detection you wish.)

    Your new array will have one fewer row than the input file since the log file's rows 1 and 2 are used to calculate the first row in the new array for n = 1 , rows 2 and 3 are used for the second row for n = 2, and so on. This array must be returned by the function, but it does not need to be output or captured as a deliverable.

    Hint: When calling the function in the command window or from a script, end the line with a ";" so 100,000's of rows don't print to the command window.)

2. Write a function that calculates the weighted average of the *Fuel Economy* for all samples. The function must accept two inputs, the one-dimensional array of *Fuel Economy* data and the one-dimensional array of Time. (i.e. these are two columns from the array that is returned from the function in part 1, passed separately).

   The function must:
   - Calculate the weighted average of *Fuel Economy*, in which each value of *Fuel Economy* is weighted by the corresponding time.
   - Print a useful, well formatted to the command window stating the weighted average.
   - Return the weighted average.

3. Since the value returned by step 2's function accounts for time spent sitting still at stop lights and stop signs, it may be interesting to see what the vehicle is capable of if traffic is not an issue. Write an improved, separate version of the function from part 2 that also accepts Vehicle Speed as a third one-dimensional array of input, and the Fuel economy value only includes values that do not correspond to a Vehicle Speed of 0.

4. Next, let's graphically show how well the vehicle performed at different speeds.

   a. Create a bar chart that displays the weighted average *Fuel Economy* in 5 mph increments. In other words, the fuel economy from speeds of 0 mph up to but not including 5 mph, 5 mph up to but not including 10 mph, and so on. This bar chart must be appropriately labeled and must be in the upper half of the Figure window (i.e. use subplot(2,1,1)).

      The histogram function will **not** be useful for this. Don't try to use it just because it was demonstrated in the sample file! You will need to use the bar() function, and the values for each bar are basically step 3 with both an upper and lower bound.

   b. Calculate the weighted average fuel economy for each minute of the log file including all values. Display this as a bar chart in the lower left of the Figure window (i.e. use subplot(2,2,3) with appropriate labels.

   c. Calculate the weighted average fuel economy for each minute of the log file excluding samples with a *Vehicle Speed* of 0 mph. Display this as a bar chart in the lower left of the Figure window (i.e. use subplot(2,2,4) with appropriate labels. Note that each bar still covers one minute of real time, but it may show the calculation based on less than a minute of samples.

Deliverables:

Upload an electronic copy of the deliverables to Canvas per the lab submission requirements. Please note: **ALL** deliverables must be present in the single PDF report, and the m-file and the figure window must also be included as separate files with logical names.

- m-files for the three functions from steps 1, 2, and 3
- m-file that generates the figure window of three charts.
- figure window (include in zip file saved as a jpg or bmp, NOT as a fig) generated from each of the 7 sample data logs.

Scoring:
10 points – Compliance with Submission Guidelines
15 points – Part 1
15 points – Part 2
15 points – Part 3
15 points – Part 4a
15 points – Part 4b
15 points – Part 4c