ENGR 132 Exam Practice
Importing and Plotting Data

Problems

Practice 1.

You have an Excel spreadsheet saved in Comma Separated Values (CSV) format and named **car_data.csv**. The file has 3 columns of data as shown below:

Column A: Year (with each year from 2000 through 2015)
Column B: Annual car production at Ford (millions)
Column C: Annual car production at Mercedes (millions)
Column D: Total annual car production (millions)

	A	B	C	D
1		Cars Produced (Millions)		
2	Year	Ford	Mercedes	Total
3	2000	8	7.5	15.5
4	2001	8.1	7.6	15.7
	⋮	⋮	⋮	⋮
17	2014	5.6	5.5	11.1
18	2015	6.5	6.2	12.7

On the answer sheet, write MATLAB code to perform the following tasks.

1) Load the data file to the variable **`all_data`**.
2) Copy the corresponding columns of data to variables **`year`**, **`Ford_qty`**, **`Mercedes_qty`**, and **`total_qty`**.
3) Plot the data using three different figure windows. Note: Only format the plot in the third figure window for technical presentation.
    a. Create a figure window (Figure 1) with one plot showing the total annual car production versus time.
    b. Create a second figure window (Figure 2) with two plots in a 2-row, 1-column display.
        i. Plot Ford's annual car production versus time on the top plot.
        ii. Plot Mercedes's annual car production versus time on the bottom plot.
    c. Create a third figure window (Figure 3) with two datasets showing Ford's and Mercedes's annual car production versus time in a single plot. Format this plot for technical presentation.

Solution

Practice 2.

Ball bearings are hardened through a process of heating and then rapid cooling by submersion in a water bath. The temperature of the ball as a function of time can be estimated using the following equation:

$$T = (T_i - T_w)\, e^{-t/\alpha} + T_w$$

Where: T = temperature of the ball at time t (in degrees Celsius)

T_i = initial temperature of the ball (in degrees Celsius)

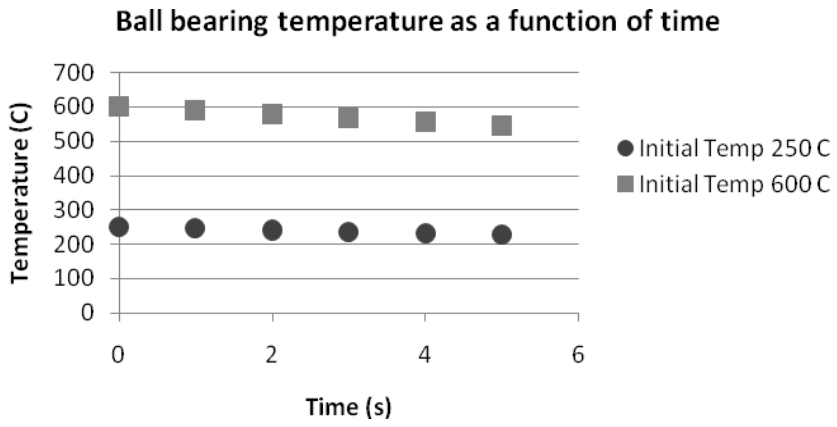
T_w = temperature of the water bath (in degrees Celsius)

t = time (seconds)

α = time constant (seconds)

The following Excel spreadsheet was created to compute T, the ball temperature as a function of time, for two different initial ball temperatures. Excel was also used to create the plot shown.

	A	B	C
1	**Temperature of water (Tw, C):**	25	
2	**Time constant (α, sec):**	50	
3			
4		**Initial Ball Temperature (C)**	
5	**Time (t, sec)**	**250**	**600**
6	**0**	250.0	600.0
7	**1**	245.5	588.6
8	**2**	241.2	577.5
9	**3**	236.9	566.5
10	**4**	232.7	555.8
11	**5**	228.6	545.3



Write a MATLAB script to replicate the analysis and plot as shown above. Use the MATLAB script below as a guide. Note that two variables have been created for you, but others still need to be created to complete the calculations. Adequately comment your code. You do not need to worry about replicating the location of the legend. More space is provided than may be necessary to complete the task.

```
% --- INPUTS ---
T_water = 25  % water temperature (deg C)
ball_initT = [250,600]   % 1st and 2nd initial ball temperature (deg C)
```

Solution

Practice 3.

The input and calculations section of a MATLAB script are shown below. In the Outputs section, write the necessary MATLAB code to complete the following actions:

A. On the same plot, plot the populations of Rabbits versus Time and Wolves versus Time. Plot the rabbit population using blue circles as data markers. Plot the wolf population using red x's as data markers. Include appropriate formatting for technical presentation.

B. Use the fprintf command to output the maximum rabbit and maximum wolf populations. Format the output with no digits after the decimal place. Be sure to include appropriate text in the fprintf command, don't just output a number devoid of context! *(Note: These maximum values are already calculated in the CALCULATIONS section of the script)*

```
%% INPUTS
Time = [0:17];  % Months
Rabbits = [27 25 44 77 96 124 176 244 297 341 352 331 249 155 51 17 5 0];
Wolves =  [7 7 9 13 13 13 13 17 19 28 35 43 45 63 64 65 64 60];

%% CALCULATIONS
```

```
% Calculate maximum rabbit population and maximum wolf population
maxRabbits = max(Rabbits);
maxWolves = max(Wolves);

%% OUPUTS


% Plot populations on same graph


% Display peak values
```

Solution

Practice 4.

An engineering firm has an employee database containing three columns. Column one is a list of employee ID numbers. Column two is a list of employee salaries. Column three is a list of hours that each employee has worked so far this week. The database has been saved as a csv file called '*employeedata.csv*'. The file has no headers or labels.

As a project manager, you want to make a list of all employee ID numbers who have recorded more than 40 hours of work.

Using the provided comments as a guide, write MATLAB code to perform the following:

A. Load the data file, *'employeedata.csv'*.

B. Find the number of employees in the database.

Solution

Practice 5.

Please note that this problem is taken directly from a homework problem with minor variations. You are given the file **`tires.txt`** that contains the following data.

```
Car    New Material  Old Material
1      4.35                4.19
2      5                   4.62
3      4.21                4.04
4      5.03                4.72
5      5.71                5.52
6      4.61                4.26
7      4.7                 4.27
8      6.03                6.24
9      3.8                 3.46
10     4.7                 4.5
```

Complete the following steps needed to plot these data points in MATLAB.

A. As the very first step, delete the _____ from the data file to avoid errors when importing the data. File is then saved under the same filename **tires.txt**

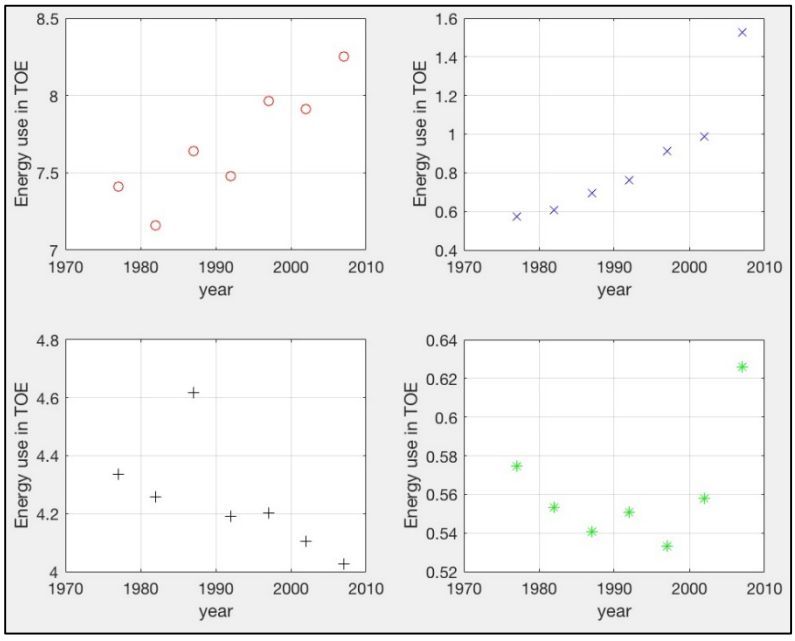
B. Complete the following code based on the comments below:

```
% --- INPUTS ---
% Load the data into MyData
MyData = _____;
% Save the column containing car numbers
car=MyData(________);
% Save all rows from New Material column into NewTires
NewTires=MyData(______);

% The following section creates a complete engineering graph
% Create a plot of car on x-axis and NewTires on y-axis with a
% circle for a marker
plot(__________, _________, ________)
% Add the graph title Tread Depth of Tires with New Material (mm)

% Create labels for x-axis as Cars and y-axis as Tread Depth (mm)


% Make sure the grid lines are visible
```

Solution

Practice 6.

The subplot at the right shows energy use per capita in tons of oil equivalent (TOE) from 1977 to 2007 for four countries: Angola, Canada, China, and Germany. The programmer forgot to label the subplots.



Part 1: Select the appropriate code to make the lower left plot active.

A. `subplot(2,2,2)`
B. `subplot(2,2,3)`
C. `subplot(2,1)`
D. `subplot(1,2)`

Part 2: Select the code to assign an appropriate title linking the active plot to Germany.

A. `title='Energy use per capita in TOE over 1977-2007 in Germany'`
B. `title='Energy use in Germany over 1977-2007'`

C. `title('Energy use per capita in TOE over 1977-2007 in Germany')`

D. `title('Energy use in Germany over 1977-2007')`

Solution

Solutions

Practice Solution 1

```
% ENGR 132 Spring 2017, Exam 1
%% Initialization
all_data = csvread('car_data.csv',2,0)
year = all_data(:,1);
Ford_qty = all_data(:,2);
Mercedes_qty = all_data(:,3);
total_qty = all_data(:,4);

%% Figure Displays
% Step C1: Figure 1
figure(1)
plot(year,total_qty,'*')

% Step C2: Figure 2
figure(2)
subplot(2,1,1)
plot(year,Ford_qty,'o')
subplot(2,1,2)
plot(year,Mercedes_qty,'o')


% Step C3: Figure 3
figure(3)
plot(year,Ford_qty,'bo')
hold on
plot(year,Mercedes_qty,'k^')
title('Cars Produced by Manufacturer, 2000-2015')
xlabel('Year')
ylabel('Qty of Cars [million]')
legend('Ford','Mercedes')
grid on
```

Practice Solution 2

```
% --- INPUTS ---
T_water = 25  % water temperature (deg C)
ball_initT = [250,600]    % 1st and 2nd initial ball temperature (deg C)
time_constant = 50    % alpha, time constant (s)
time_s = 0:1:5     % time (s)

% --- CALCULATIONS ---
% ball temperature for first initial ball temperature (C)
```

```
11  ballT250 = (ball_initT(1) - T_water)*exp(-time_s/time_constant)+T_water
12  % ball temperature for second initial ball temperature (C)
13  ballT600 = (ball_initT(2) - T_water)*exp(-time_s/time_constant)+T_water
14
15  % --- OUTPUT ---
16  % create a plot suitable for technical presentation of temperature as a function
17  % of time that includes two lines with different line colors, data markers, and
18  % line styles for initial ball temperatures of 250 and 600 C
19  plot(time_s,ballT250,'ro-')  % plots first ball temp as function of time
20  hold on                      % adds second plot to same figure
21  plot(time_s,ballT600,'bd-')  % plots second ball temp as function of time
22  xlabel('Time (s)')           % adds label to x-axis
23  ylabel('Temperature (C)')    % adds label to y-axis
24  title('Ball bearing temperature as a function of time')  % adds plot title
25  legend('Initial Temp 250 C', 'Initial Temp 600 C')
        % adds legend to plot to identify what each line represents
```

Practice Solution 3

```
%% INPUTS
Time = [0:17];  % Months
Rabbits = [27 25 44 77 96 124 176 244 297 341 352 331 249 155 51 17 5 0];
Wolves =  [7 7 9 13 13 13 13 17 19 28 35 43 45 63 64 65 64 60];

%% CALCULATIONS
% Calculate maximum rabbit population and maximum wolf population
maxRabbits = max(Rabbits);
maxWolves = max(Wolves);

%% OUPUTS
% Plot populations on same graph
plot(Time,Rabbits,'bo');
hold on;
plot(Time,Wolves,'rx');
%ALTERNATE: plot(Time,Rabbits,'bo',Time,Wolves,'rx');
title('Wolf and Rabbit Population Statistics');
ylabel('Population');
xlabel('Time [Months]');
grid on
legend('Rabbit Population','Wolf Population')

% Display peak values
fprintf('Peak rabbit population was %.0f.\n',maxRabbits);
fprintf('Peak wolf population was %.0f.\n',maxWolves);
% SINGLE LINE ALTERNATE:
fprintf('Peak rabbit population was %.0f. Peak wolf population was %.0f.\n',
maxRabbits,maxWolves);
```

Practice Solution 4

```
%% INPUTS
% Load data
data = csvread('employeedata.csv');

%% CALCULATIONS
% Get number of employees
nRows = size(data,1);
```

Practice Solution 5

A. Response: remove first line or header line or the text or anything similar

B.

```
% --- INPUTS ---
% Load the data into MyData
MyData = load('tires.txt');
% Save the column containing car numbers
car=MyData(:, 1);
% Save all rows from New Material column into NewTires
NewTires=MyData(:, 2);

% The following section creates a complete engineering graph
% Create a plot of car on x-axis and NewTires on y-axis with a
% circle for a marker
plot(car, NewTires, '-o')
% Add the graph title Tread Depth of Tires with New Material (mm)
title('Tread Depth of Tires with New Material (mm)')
% Create labels for x-axis as Cars and y-axis as Tread Depth (mm)
xlabel('Car')
ylabel('Tread Depth (mm)')
% Make sure the grid lines are visible
grid on
```

Practice Solution 6

Part 1: B

Part 2: C