Assignment 7: Basic Matlab Operations

Date Due: March 31, 2023 Instructor: Trani

Problem 1

Use Matlab to solve this problem.

a) Create a new Matlab script to plot the horizontal building displacement (y) of a building during an small earthquake.

$$y = 1.5 + t^{1.2}e^{-t}$$

where:

t = time in seconds

y =horizontal displacement of the building in centimeters

In your script create a time vector (t) from 0 to 20 seconds at steps of 0.02 seconds and plot using the building horizontal displacement (y-axis) against time (time in x-axis). Label the plot accordingly. Add a grid to the plot using the 'grid' attribute of the plot.

b) Modify the script created in part (a) and using the interactive 'Tools-Edit Plot' adjust the color of the line to be dark blue and the line width to be 1.5. Use "circle" markers in the modified plot.

c) Modify the script created in part (a) creating another variable z.

$z = gradient(y)$ % the Matlab function gradient takes the first derivative of the values of vector (x)

Using the "subplot" command create a new figure with two plots. Plot the values of time vs. y in the upper part of the window and time vs. z in the lower part of the same window. Change the line colors to distinguish the two views.

d) Verify that the "gradient" function is working. For example, verify that the slope at the peak displacement is zero.

e) Find the peak value of displacement and the time when it happens. Write Matlab code to do this.

Problem 2

Use the **dams_2023.xlsx** file to work on the problem. For each problem show the Matlab code used to execute the task.

a) Use the Matlab wizard to read the all data. Let Matlab create the code to read the data. Save the file.

b) Create variables for each column of data provided. Label the variables according to the headers in the Excel file.

c) Plot the dam surface area (acres) in the x-axis versus the normal storage area (acre-ft) in the y-axis.

d) Perform a simple linear regression analysis using the Basic Fitting tools available in the plot window (under tools). State the linear equation that represents the best fit to the data.

e) Create a histogram of the heights of dams. Look at the histogram and find the most frequent height of dams based on your plot.

f) Use the string comparison command (strcmp) to find the dams in the state of California. Create a variable with the names of the dams in California. Show me the name of the first 20 dams listed in your answer.

g) Find the number of dams in the state of Virginia.

Problem 3

Use the GPS data collected in Arizona to do this problem. A sample of the data is shown below.

Time (s)	Speed (km/h)
0	0.00
2	9.50
4	22.00
6	35.00
8	48.00

a) Read the data using Matlab.

b) Plot the car speed (in y-axis) vs. time (x- axis). Observe the plot and comment on the number of stops.

c) Convert the speed data into units of meters per second. Create a new variable to store the speed values in m/s.

d) Convert the speed data into units of miles per hour.

e) Estimate the acceleration of the car as a function of time. Use the Matlab "gradient(x)" function to find the acceleration using the speed vector created in part (b). Plot the calculated acceleration vs. time recorded by the GPS data logger unit.

f) Use the Max(x) command in Matlab to detect the largest speed during the journey. Find the time when the maximum speed is recorded. Display the maximum speed and the time in the Command window (use the DISP command).

g) Find the average speed in miles per hour of the car for the complete profile. Use the Matlab function MEAN(x) to get the average speed.

h) Find the number of seconds the car is traveling below 15 mph. Use the Matlab FIND function to do this part.

Problem 4

Use Matlab to solve each problem.

Task 1

Solve the system of linear equations:

$$3x_1 + 4x_2 + x_3 + 6x_4 = 25$$

$$2x_1 + 9x_2 + 7x_3 + 13x_4 = 36$$

$$6x_1 + 5x_2 + 3x_3 + x_4 = 21$$

$$3x_1 + 8x_2 + 9x_3 + 3x_4 = 13$$

Task 2

Define two matrices:

```
C = [ 5    2    1    6
      2    9    7   13
      6    5    3    1
      7    8    9    3];
```

And

```
D = [1 5 2 6]'
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a) Evaluate E = C * D
b) Find the determinant of C
c) Find the inverse matrix of C
d) Evaluate F = (C+25)/3
e) Evaluate G = diag(C)
f) Evaluate S=inv(C)*D
g) Evaluate T = ones(4,4) + C
h) Find all values in the first row of matrix C
i) Find all values of the last column of matrix C