Assignment 6: Matlab Basic Operations

Solution

Date Due: March 19, 2015 Instructor: Trani

Problem 1

a) Matlab script

```
%Programmer: Moises Bobadilla
%Date: 03/24/2015
%This program solves basic matrix manipulation problems.

%Definition of Matrices A & B
A = [1 3 5 7; 2 4 6 8; 9 7 5 3; 1 3 2 4];
B = [24 12 23 48];

%Matrix Operations:
C = B*A %multiplies matrix A times B
D = A(2,2:4) %takes values in the second row from second element in second column until row 4
E = 3*B'+5 %Makes matrix B rows-only, then multiplies and adds 3 to each element
F = A(2,:) %displays all the elements in the second row of matrix A
G = A(3,:) + B %takes entire third row of Matrix A and adds it to Matrix B
H = A(:,2) %displays entire 2nd column of Matrix A, whereas Matrix B displays the 2nd Row
I = diag(A)+B' %adds elements in diagonal of Matrix A to B (converted into rows)
J = ones(4,4)+A %creates a matrix of 1s of 4x4 and adds it to Matrix A
x = inv(A)*B' %takes the inverse of Matrix A and multiplies it by B (coverted to rows-only)


```

b) Command Window Output

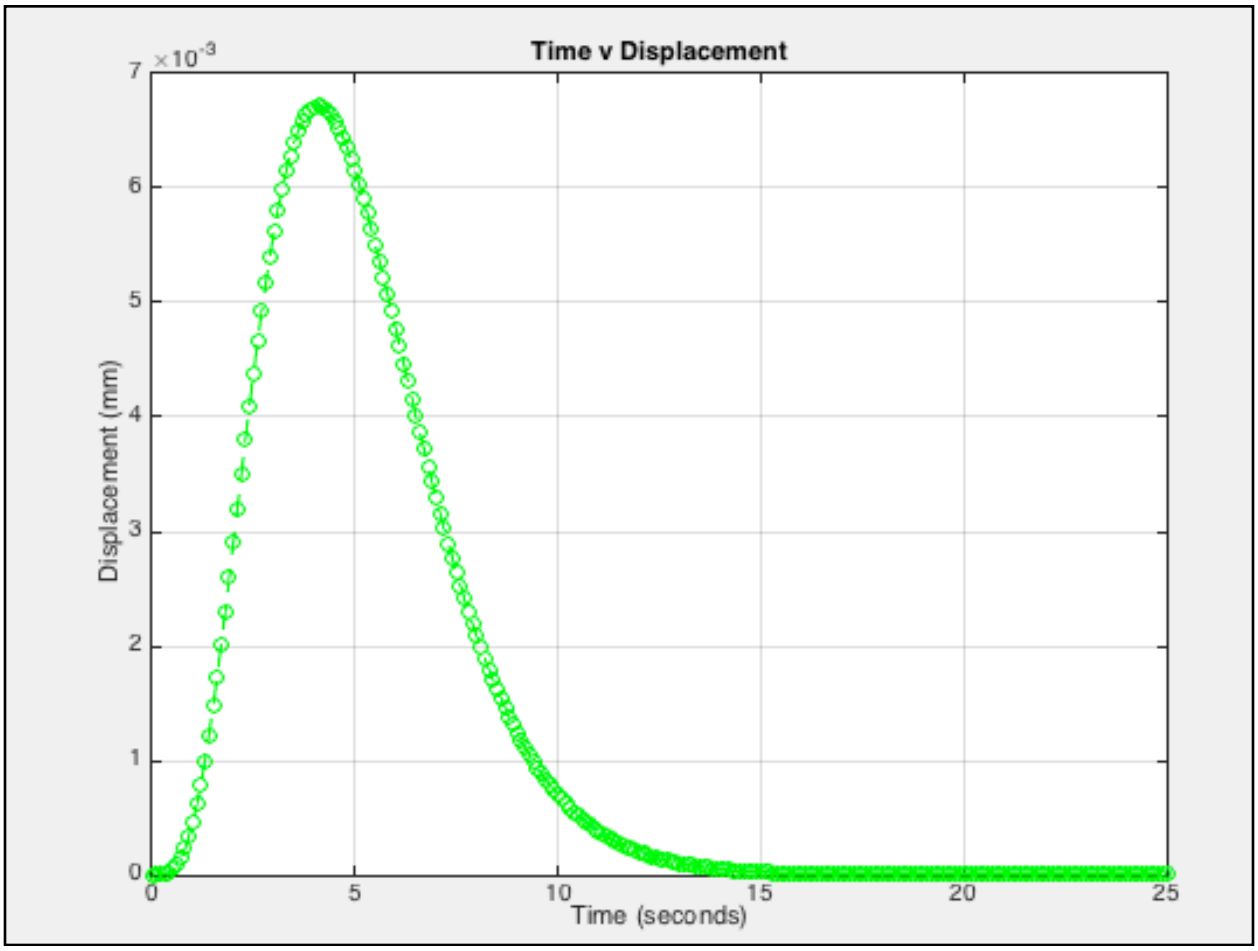
```
>> Problem1

C =

   303   425   403   525


D =

     4     6     8


E =

    77
    41
    74
   149


F =

     2     4     6     8


G =

    33    19    28    51
```

```
H =

     3
     4
     7
     3


I =

    25
    16
    28
    52


J =

     2     4     6     8
     3     5     7     9
    10     8     6     4
     2     4     3     5

Warning: Matrix is close to singular or badly scaled. Results may be inaccurate.
> In Problem1 at 18

x =

   1.0e+16 *

    1.7093
   -1.7093
   -1.7093
    1.7093
```

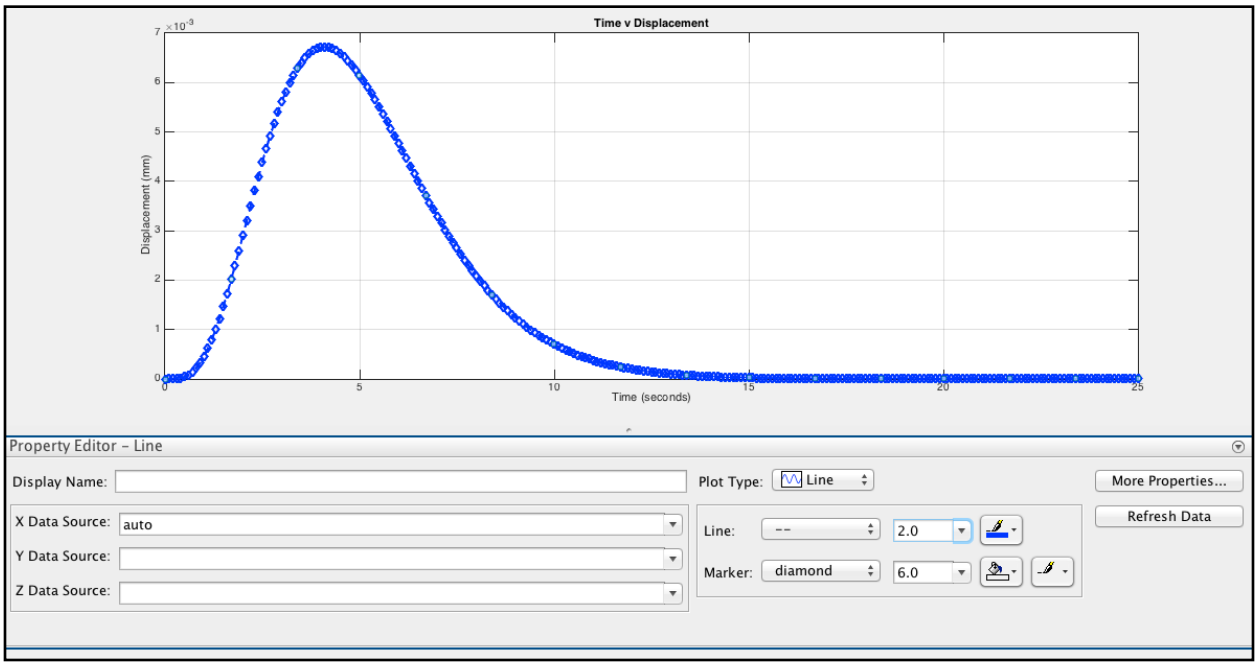
Problem 2

a) Create a matlab script in which the vectors are defined as specified and use the plot command to show output

```
%Programmer: Moises Bobadilla
%Date: 03/24/2015
%This program defines a variable based on an equation and plots results

x=0:.1:25; % creates a vector from 0.1 to 25 at steps of 0.1
y = x.^2.1.*exp(-x).*(1-cos(x/20)); %takes vector x and applies a math formula

%Plot
plot(x,y,'o--b')
title('Time v Displacement')
xlabel('Time (seconds)')
ylabel('Displacement (mm)')
grid
```

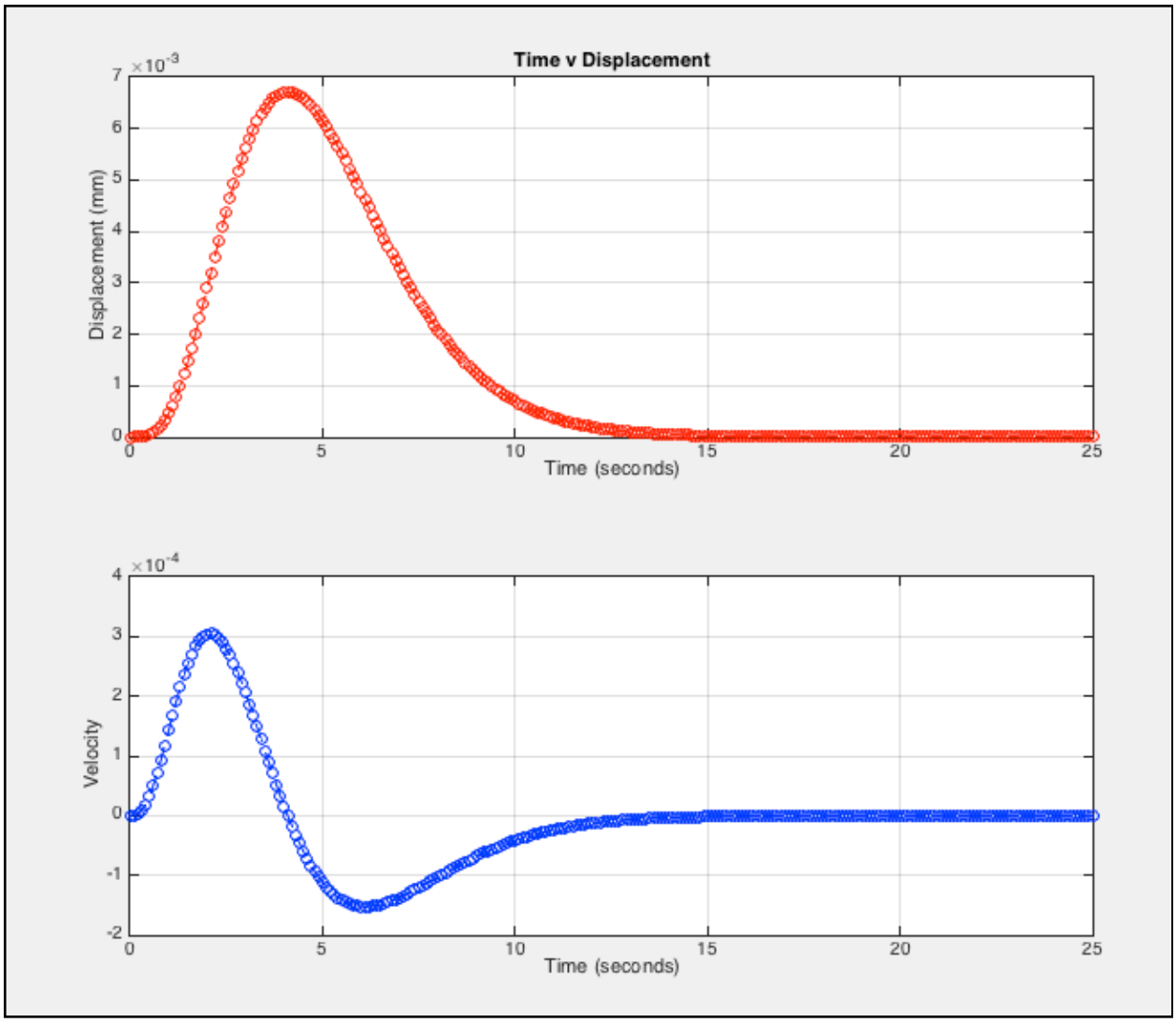


b) Use the 'Tools-Edit Plot' window to change the graph created in part a. Adjust the color to be dark blue and line width to be 2.0, use diamond markers.



c) Create another variable z and use the subplot command

```
%Programmer: Moises Bobadilla
%Date: 03/24/2015
%This program defines a variable based on an equation and plots results

x=0:.1:25; % creates a vector from 0.1 to 25 at steps of 0.1
y = x.^2.1.*exp(-x).*(1-cos(x/20)); %takes vector x and applies a math formula

z = gradient(y);

%Plot
subplot(2,1,1)
plot(x,y,'o--r')
title('Time v Displacement')
xlabel('Time (seconds)')
ylabel('Displacement (mm)')
grid


subplot(2,1,2)
plot(x,z,'o--b')
xlabel('Time (seconds)')
ylabel('Velocity')
grid
```


Time v Displacement
×10^-3
Displacement (mm)
Time (seconds)
×10^-4
Velocity
Time (seconds)

Problem 3

a) Save Autobahn data into a matlab file

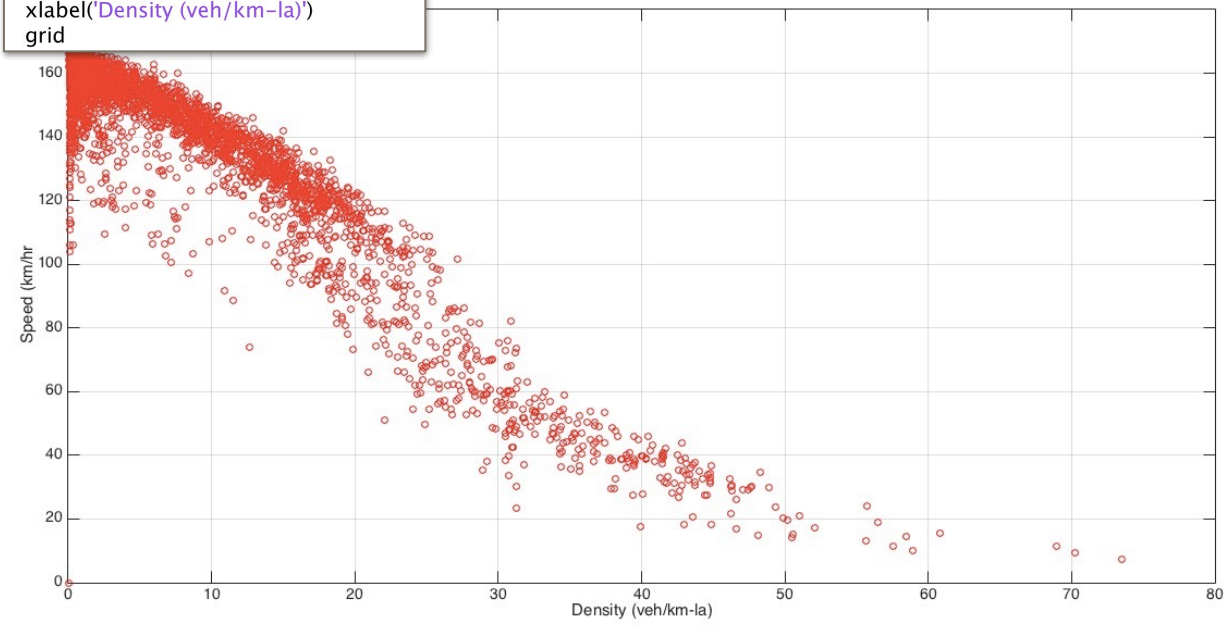
autobahn

3405x2 double

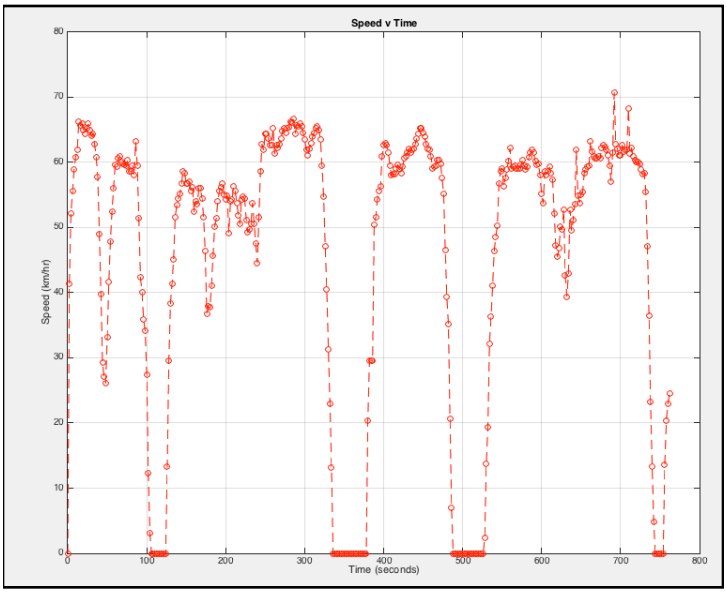
	1	2	3	4
1	0.0800	160		
2	0.0800	152		
3	0	0		
4	0	0		
5	0.0700	162		
6	0	0		
7	0.0800	144		
8	0	0		
9	0.0700	176		
10	0.0900	140		
11	0.0700	162		
12	0	0		
13	0	0		
14	0	0		
15	0.0800	155		
16	0.0700	167		

b), c) & d) Matlab script that reads the data. Create variables Speed and Density, and makes a plot.

```
speed = highwayData_autobahn(:,2);
density = highwayData_autobahn(:,1);

% Make a plot

plot(density,speed,'or')
ylabel('Speed (km/hr')
xlabel('Density (veh/km-la)')
grid
```



e) Perform a linear regression analysis



f) Estimate the traffic speed when 35 vehicles per km are detected

y = -2.3 (35) + 1.5e02

y = 69.5 km/hr

Problem 4

a) & b) Import the data from the 'gps_data_file' file to matlab and plot the speed vs time. Comment on the number of stops the vehicle makes.

```
%Programmer: Moises Bobadilla
%Date: 03/24/2015
%This program uses the 'gps_data.txt' file and perform operations such as
%counting the number of stops and analyzing speed.

%read data in workspace
load gps_data.txt

%assign variables to each column, as described
time = gps_data(:,1);
distance = gps_data(:,2);
speed = gps_data(:,3);
acceleration = gps_data(:,4);

%plot speed v time

plot(time,speed,'o--r')
title('Speed v Time')
xlabel('Time (seconds)')
ylabel('Speed (km/hr)')
grid
```

As it can be observed in the above graph, this vehicle makes a total of **four stops** before reaching its final destination.

c) Estimate the acceleration using the gradient function in matlab and plot this acceleration against the one given in the file. Comment how well these two match.

It can be observed that while the actual values of each of these aren't exactly the same, the general trend is maintained.

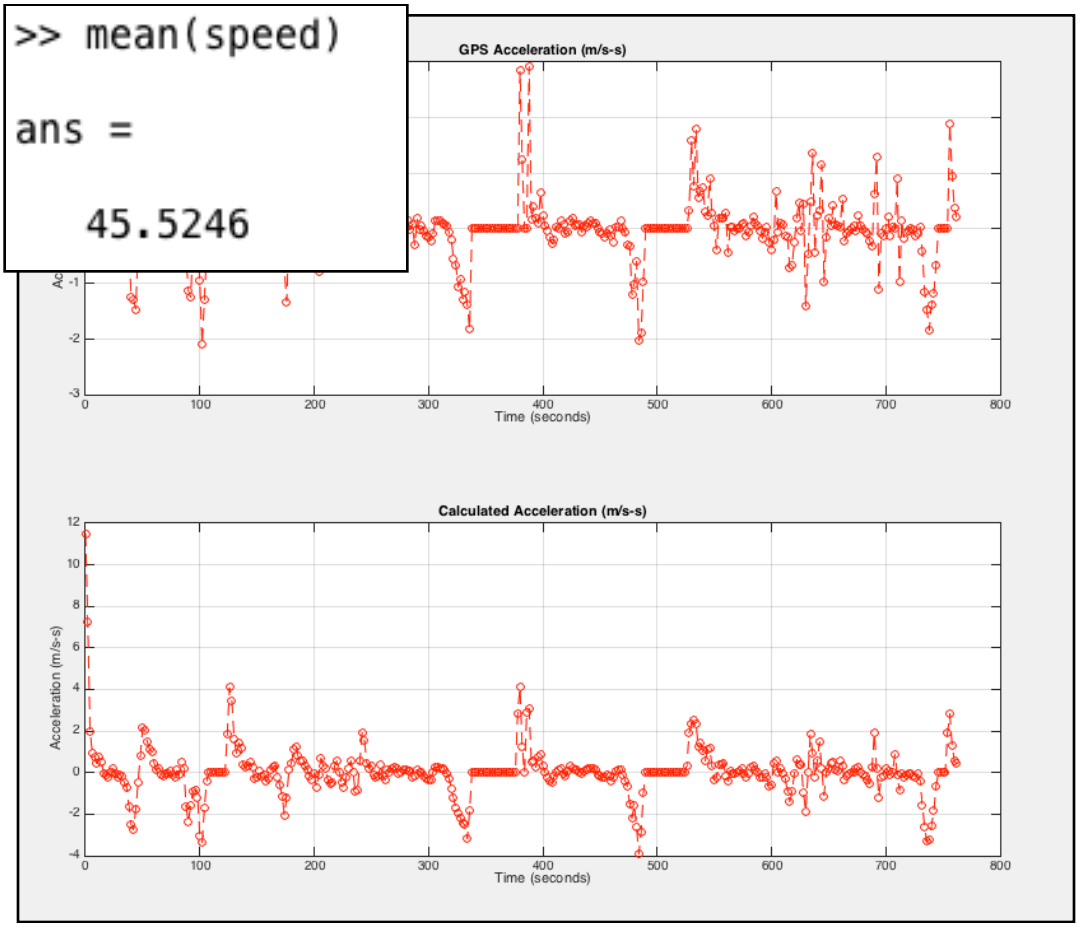
d) Use the max(x) command to detect largest speed during journey

```
>> max(speed)

ans =

   70.7000
```

The maximum speed experienced was approximately **71 km/h**

e) Find the average speed of the car

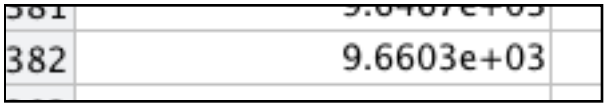
```
>> mean(speed)

ans =

   45.5246
```



The

average speed of this car was **45.5 km/hr.**

f) Find the total distance traveled by the car



The total distance traveled by the car is indicated by the last entry in the distance column **(9,660 meters)**, at which point the driver finished their journey.

g) Find the number of seconds the car is traveling above 40 km/hr.

```
32      %find the instances where the car speeds above 40 km/h
33 -    Above40 = find(speed>40);
34
35      %multiply the number of instances times 2 (time step in time matrix)
36 -    SecondsAbove40 = length(Above40(:,1))*2
37
38
```

```
>> Problem4

SecondsAbove40 =

   564
```

The number of seconds this car remained above 40 km/hr is **564 s.**