Assignment 5: Basic Matlab Operations Solution

Date Due: October 11, 2013 Instructor: Trani

Problem 1

Use Matlab to solve this problem. Use the Command Window and define two matrices, A and B, in Matlab. Use (;) to separate the rows in the matrix and use square parenthesis to define the numerical values inside the matrix.

$$A = \begin{bmatrix} 7 & 8 & 1 \\ 4 & 6 & 1 \\ 9 & 8 & 6 \end{bmatrix}$$

and $B = \begin{bmatrix} 13 & 12 & 5 \end{bmatrix}$

Perform the following matrix operations. In one line comment on the results obtained after each operation.

a) $C = B \times A$

b) $D = A(1,:)$

c) $E = 2 * B'$

d) $F = A \times B$

e) $G = A(3,:) + B$

f) $H = A(:,1)$ compare with part (b). Comment.

g) $I = diag(A) + B'$

h) $J = ones(3,3) + A$

i) $x = inv(A) * B'$

Answer:

a) C = [184 216 55];

If use cross() function, it will be an error.

b) D = [7 8 1];

c) E = [26; 24; 10];

d) F = error, Inner matrix dimensions must agree.

e) G = [22 20 11];

f) H = [7; 4; 9]; Comment: part (b) got the first row of Matrix A, while part (f) got the first column of Matrix A.

g) I = [20; 18; 11];

h) J = [8 9 2; 5 7 2; 10 9 7];

i) x = [-1.9630; 3.4444; -0.8148].

Comment:

The Matlab can easily do matrix calculation. But the calculation should obey the matrix calculation rules, such as when doing matrix multiply matrix, the inner matrix dimensions must agree.

Problem 2

Use Matlab to solve this problem.

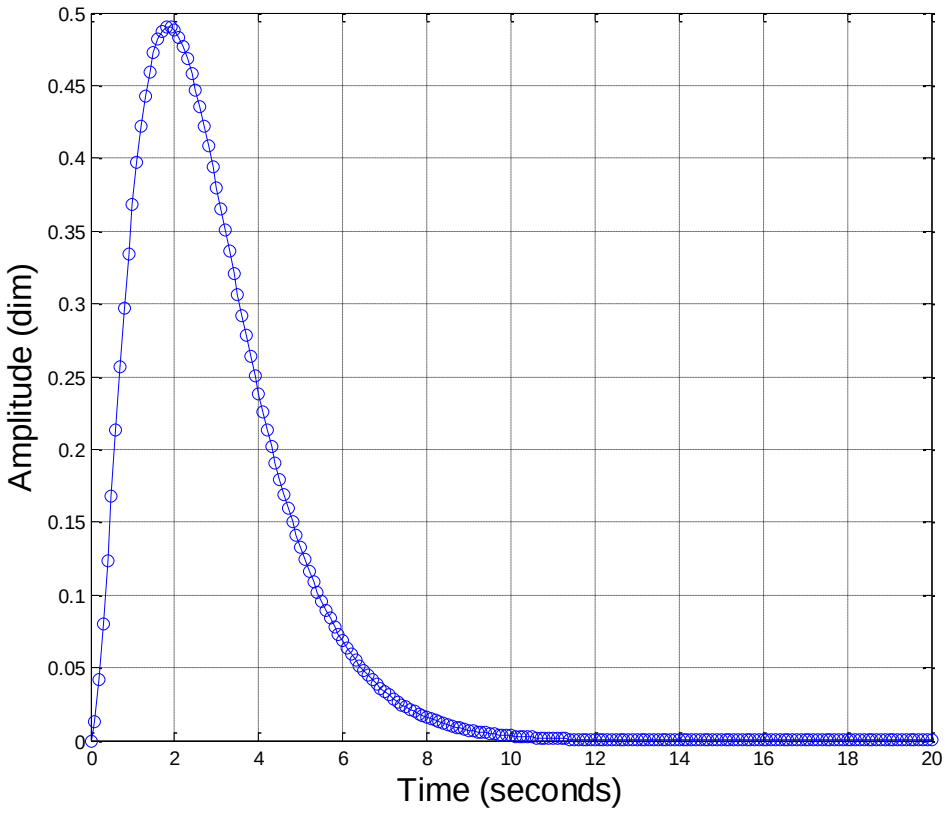
a) Create a new Matlab script and define two vectors as follows:

$$x = 0:0.1:20$$

$$y = x.\text{^}1.85.*\exp(-x)$$

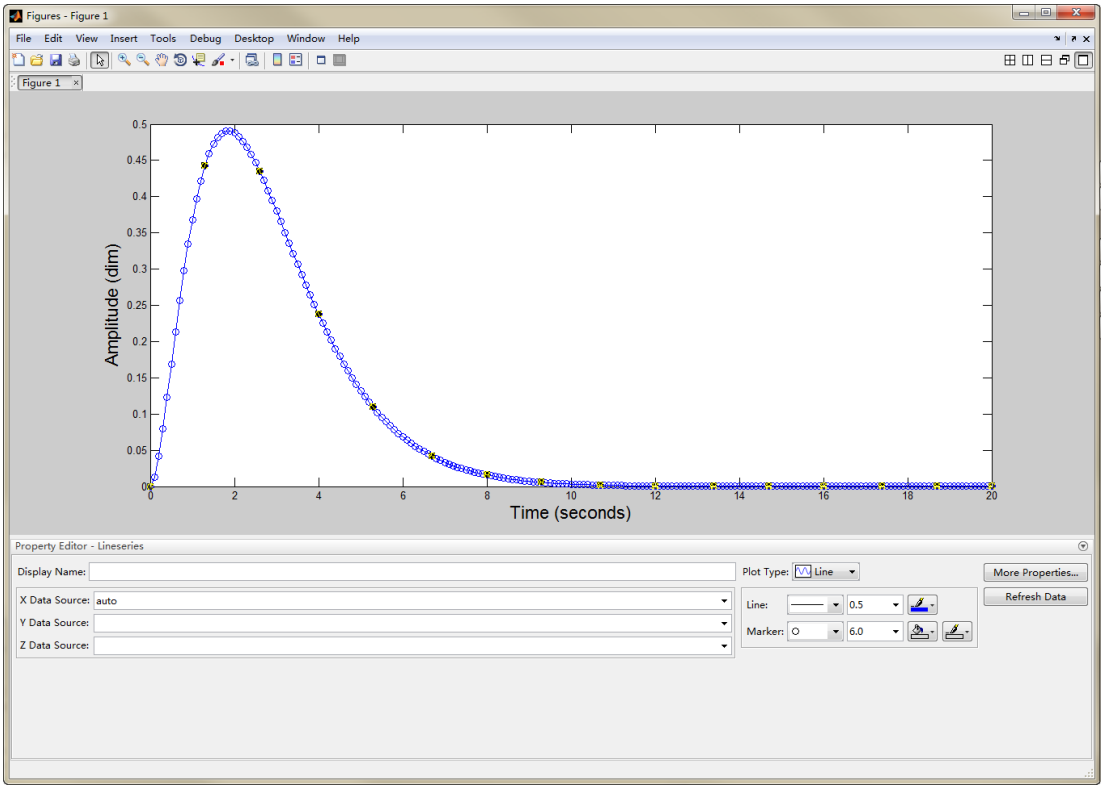
In your script make a simple plot using the "plot" function in Matlab. Label the x-axis as 'Time (seconds)' and the y axis as 'Amplitude (dim)'. Add a grid to the plot using the 'grid' attribute of the plot.

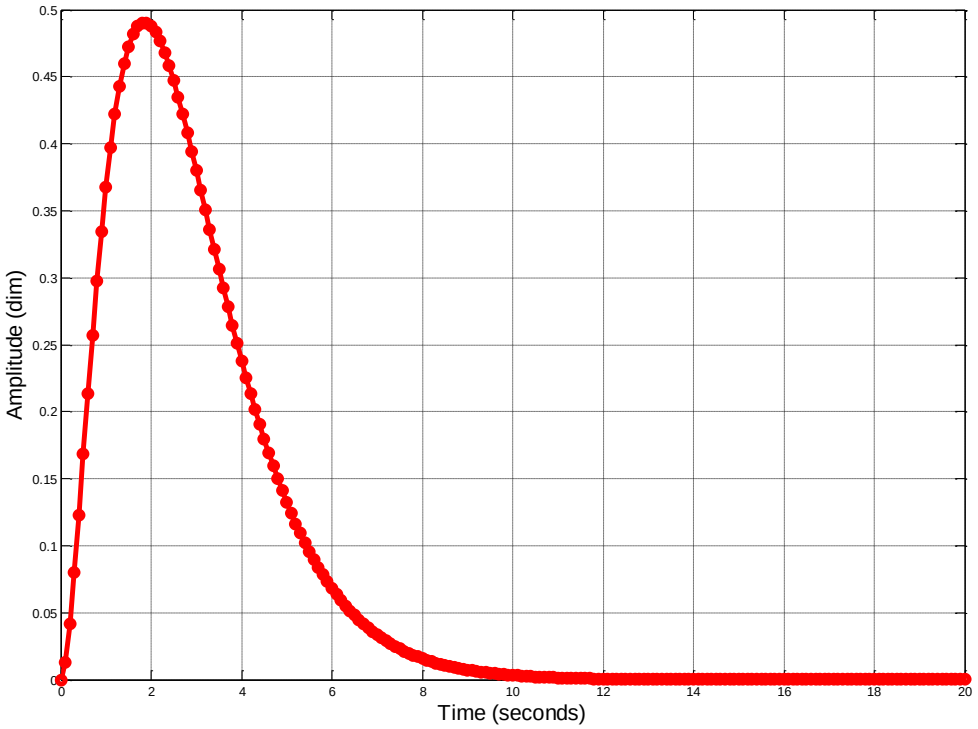
Answer:



b) Modify the script created in part (a) and using the interactive 'Tools-Edit Plot' adjust the color of the line to be red and the line width to be 4.0.

Answer:

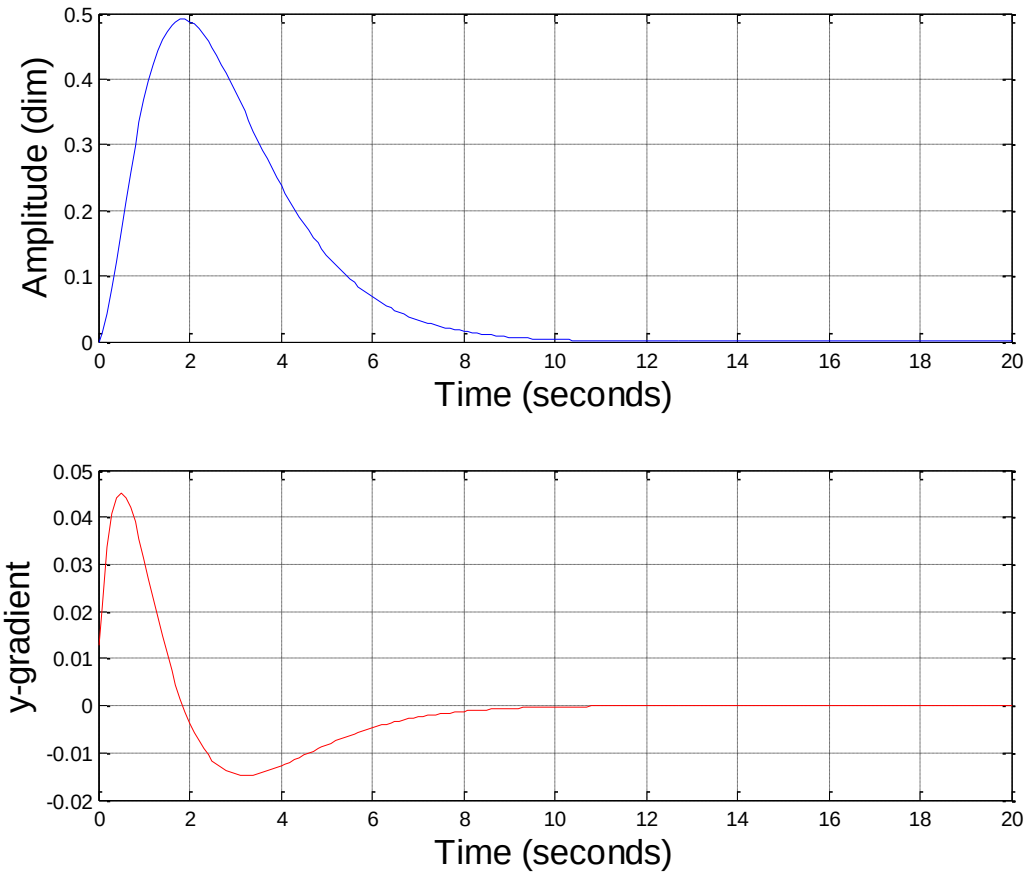




c) Modify the script created in part (a) creating another variable z.

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

Using the "subplot" command create a new figure with two plots. Plot the values of x vs. y in the upper part of the window and x 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. Verify a few numbers by hand if necessary.

Answer:

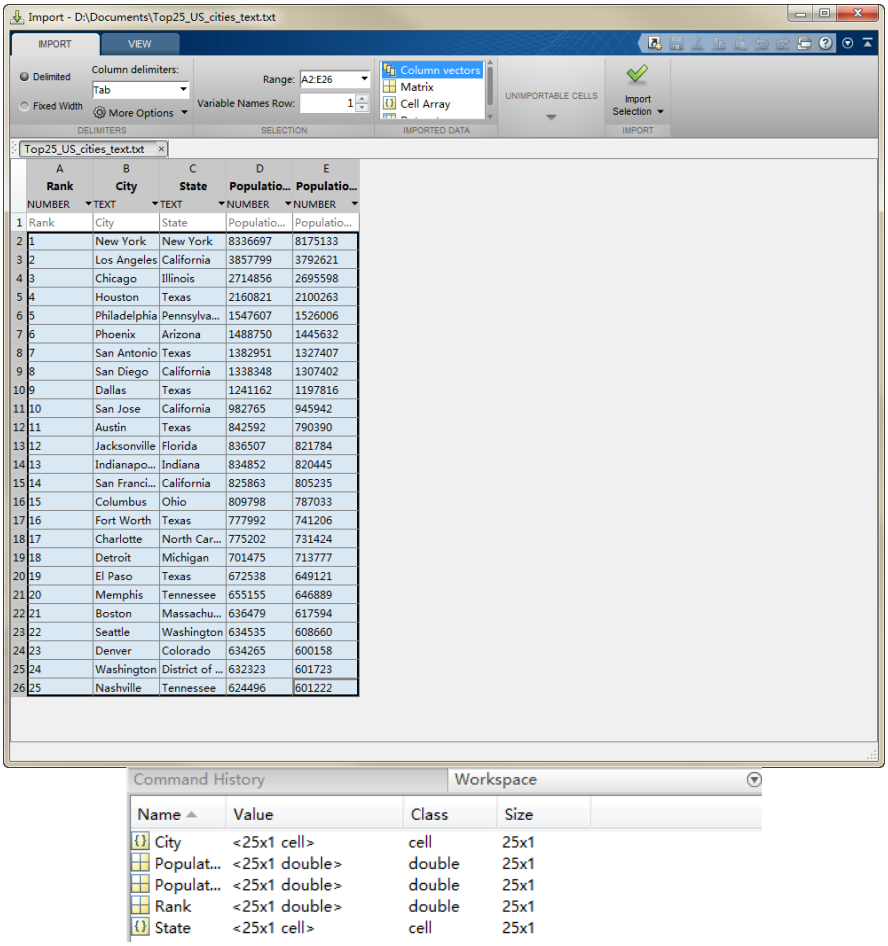
The gradient near x = 1.8 is close to 0. And obviously, the gradient at x = 1.8 is close to 0.

Problem 3

Use Matlab to solve this problem. A companion file provided in the assignment contains the population of the top 25 cities in the US.

Rank	City	State	Population in 2012	Population in 2010
1	New York	New York	8336697	8175133
2	Los Angeles	California	3857799	3792621
3	Chicago	Illinois	2714856	2695598
4	Houston	Texas	2160821	2100263
5	Philadelphia	Pennsylvania	1547607	1526006
6	Phoenix	Arizona	1488750	1445632
7	San Antonio	Texas	1382951	1327407
8	San Diego	California	1338348	1307402
9	Dallas	Texas	1241162	1197816
10	San Jose	California	982765	945942
11	Austin	Texas	842592	790390

a) Crete a Matlab script and read the data using the Import Wizard in Matlab.



b) Create variables for each column of data provided. For example, Column 1 is the “Rank” variables, and so on.

c) Create a new variable in the scrip to estimate the change in population between the years 2012 and 2010.

diff_Pop <25x1 double>

	1	2
1	161564	
2	65178	
3	19258	
4	60558	
5	21601	
6	43118	
7	55544	
8	30946	
9	43346	
10	36823	
11	52202	
12	14723	
13	14407	
14	20628	
15	22765	
16	36786	
17	43778	
18	-12302	
19	23417	
20	8266	
21	18885	
22	25875	
23	34107	
24	30600	
25	23274	

d) Find the percent change (%) of the population between the two years.

Per_Pop <25x1 double>

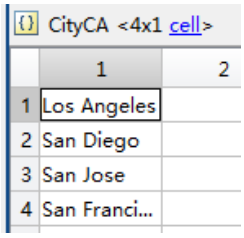
	1	2
1	1.0198	
2	1.0172	
3	1.0071	
4	1.0288	
5	1.0142	
6	1.0298	
7	1.0418	
8	1.0237	
9	1.0362	
10	1.0389	
11	1.0660	
12	1.0179	
13	1.0176	
14	1.0256	
15	1.0289	
16	1.0496	
17	1.0599	
18	0.9828	
19	1.0361	
20	1.0128	
21	1.0306	
22	1.0425	
23	1.0568	
24	1.0509	
25	1.0387	

e) Find the name of the city with the highest population change using the Matlab “max” function (e.g.,, max(x) finds the highest value of vector x)

Answer:

Austin, (change = 106.6%) had the highest percent change; while New York had the highest change in absolute value of population (change = 161564).

f) Find the names of the top 25 cities located in the state of California. Show the code to do this search. I suggest you use the "find" function in Matlab as demonstrated in class.



Problem 4

Data collected by a Global Positioning System (GPS) recording unit inside a car is presented in the accompanying file (GPS Data). Create a Matlab script that performs the following steps:

a) Import the data into Matlab using the "load" command.

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

c) Estimate the acceleration of the car as a function of time (use the Matlab "gradient" function - see Problem 2). In your script find the largest deceleration the vehicle makes and the time where that acceleration is recorded. Comment on the driving behavior of the person driving the vehicle.

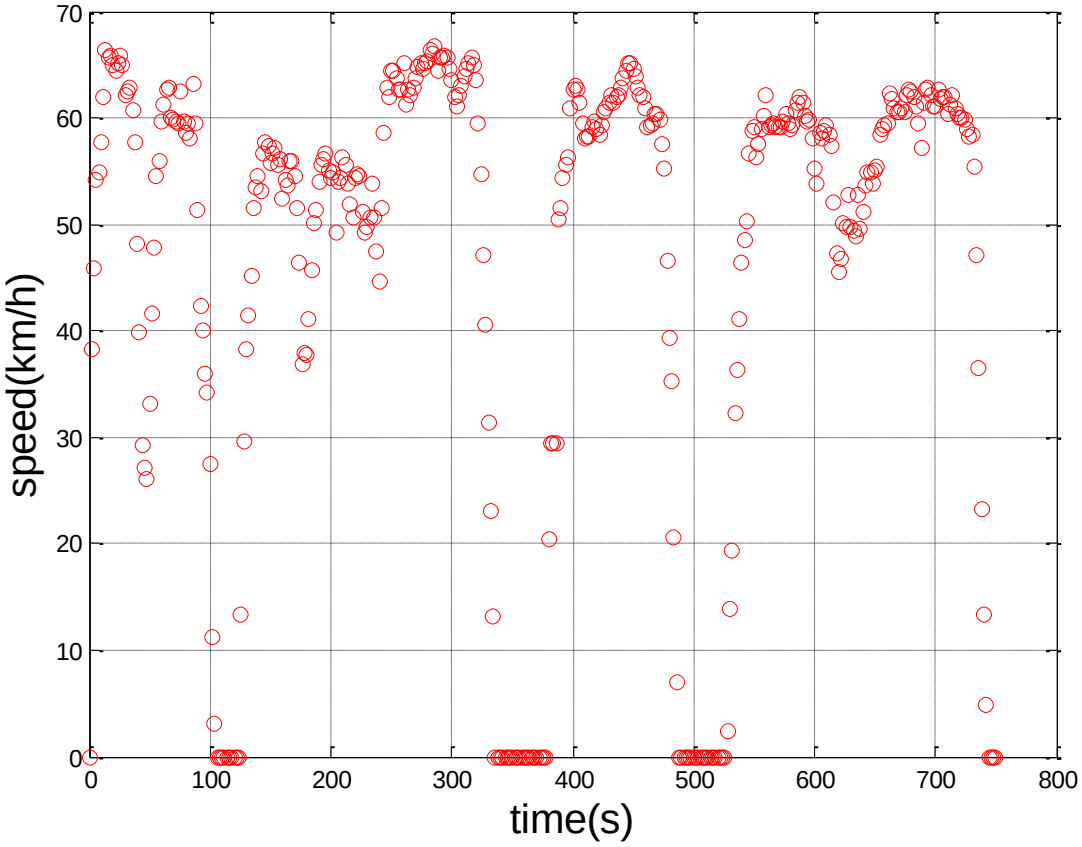
d) Find the average speed of the car for the complete profile. Use the Matlab function MEAN(x) to get the average speed.

e) Find the number of seconds the car spends at a red traffic light.

Answer:

a)

b)



Comment:

The car makes **4** stops, which are around 100s, 340s, 490s and 750s.

c)

The largest deceleration is made at **484 s**, which equal to **-14.1 m/s^2.**

Comment:

The vehicle may travel in an urban area, where it hit the red light for several times. So the vehicle has to accelerate and decelerate frequently.

d)

The average speed is **45.98 km/h**.

e)

The car spends **114 s** at a red traffic light.