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Lab 1: Exercises 1-3

by: Michelle Pichardo Munoz

```
% Best Practices
close all; % closes all open windows
clear all; % deletes the workspace
```

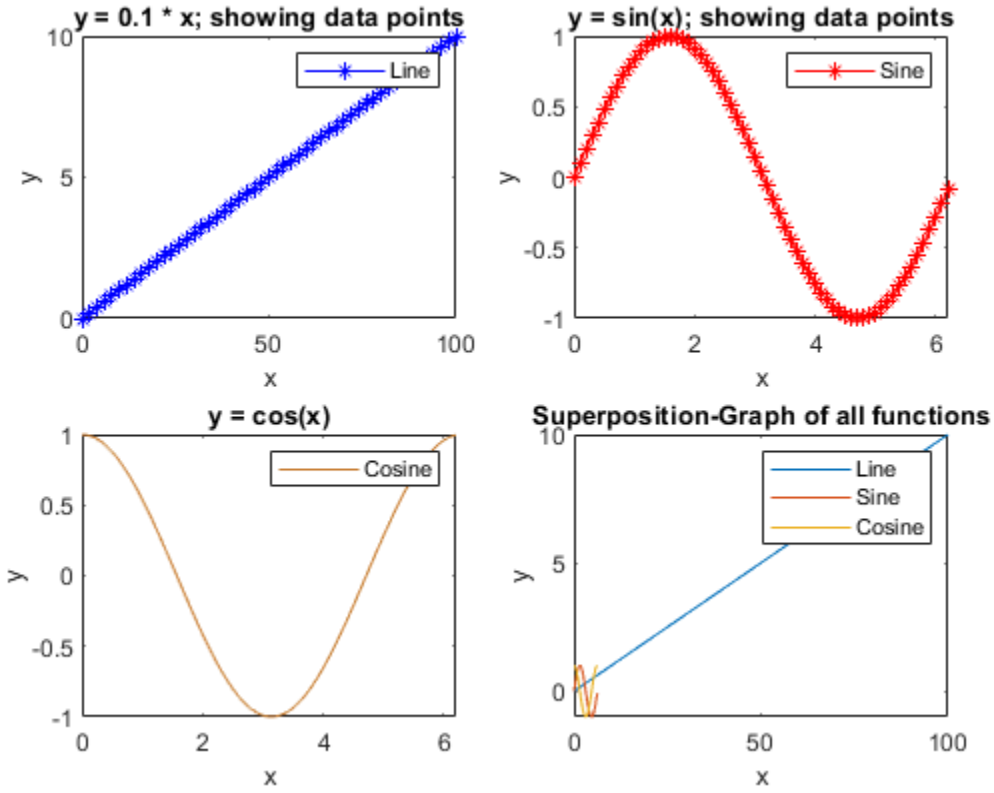
Problem 1 (a-c)

```
% Calculate the following expressions,
%   but I will also assign the answer to a variable
%   a1 = AB + C
%   b1 = Ax + Bu
%   c1 = 1/3*A(x+u)
% Matrix values are given in ECE8_Lab1.pdf
% Note: there is no conflict of dimension

% Steps:
%   - Define Matrix A,B,C,x,u
%   - Dimensions: A,B,C \in R^{3x3}, x,u \in R^{3x1}
%   - Operations: matrix multiplicaton & addition

% Brief notes:
%   Row vectors are seperated by (;)
%   Entries are seperated by (,)
%   Matrix is contained in bracket []
%   ending with (;) stops the output from printing
%       in Command Window

% Define A,B,C,x,u:
A = [8,1,6 ; 3,5,7 ; 4,9,2];
B = [29,44,86 ; 1,66,37 ; 84,78,5];
C = [7,3,9 ; 6,3,5 ; 7,6,5];
x = [2 ; 7 ; 9];
u = [9 ; 38; 45];

% Preform Operations
a1 = A*B + C;
b1 = A*x + B*u;
c1 = (1/3)*A*(x + u*2);
```

Problem 2 (a-c)

```
% For the following functions and given domains,
%  produce 4 figures:
%   - 1 plot for each function defined in a,b,c
%   - 1 plot with with all 4 functions plotted together
%       on the same figure

% Functions given:
% (I redefined the variables)
%   a. ya = 0.1 * xa    where xa = 0:2:100
%   b. yb = sin(xb)     where xb = 0:0.1:2*pi
%   c. yc = cos(xc)     where xc = 0:0.1:2*pi

% Notes:
%   - Plotting a line and 2 trig functions
%   - row vector notation: x = 0:1:5 = start: incriment: stop

% Define variables

% 2.a - Line
xa = 0:2:100;
ya = 0.1 * xa;

% 2.b - sine
xb = 0:0.1:2*pi;
yb = sin(xb);

% 2.c - cosine
xc = 0:0.1:2*pi;
yc = cos(xc);

% Use subplots to create all 4 plots

% Plot 2.a
subplot(2,2,1);
plot(xa,ya,Color='b', Marker='*');
title('y = 0.1 * x; showing data points');
legend('Line');
xlabel('x');
ylabel('y');

% Plot 2.b
subplot(2,2,2);
plot(xb,yb, Color='r',Marker='*');
title('y = sin(x); showing data points');
legend('Sine');
xlabel('x');
ylabel('y');

% Plot 2.c
subplot(2,2,3);
plot(xc,yc, Color=[0.8,0.5,0.2]);
```

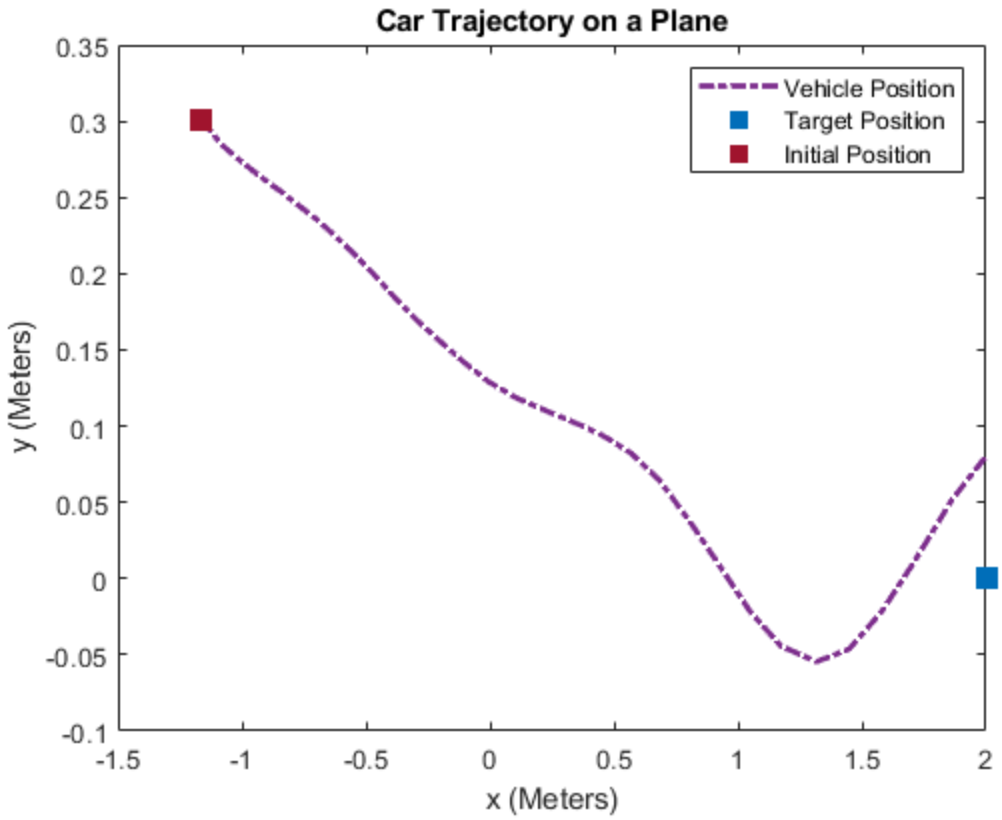
```
title('y = cos(x)');
legend('Cosine')
xlabel('x');
ylabel('y');

% Plot of all functions
subplot(2,2,4);
plot(xa,ya, xb,yb, xc,yc);
title('Superposition-Graph of all functions');
legend('Line', 'Sine', 'Cosine')
xlabel('x');
ylabel('y');

% Notes:
%   - Subplot (# of grid rows, # ''columns, position of plot)
%   - Plot(x,y) takes inputs and outputs then plots them
%       - to plot several we need only put them in pairs
%           - See: Plot of all functions
```



Problem 3 (a-c)

```
% A car that is aware of its position and orientation in the plane (2D)
%  Goal: reach a target point on the plane
%  uses: a wonky controller that under and overshoots its movements

% Code was not working without these lines to clear workspace
```

```
close all; % closes all open windows
clear all; % deletes the workspace

% Load in the variables from the .mat file
load Lab1_Exercise3.mat

% Plot:
%   - Initial position: xv(1),yv(1)
%   - Position of the car: the entire path
%   - Target is present (x,y) = (2,0)
%   - Units: meters
%   - Use hold on and hold off to plot all together

x_target = 2;
y_target = 0;

% Position
plot(xv,yv, Color=[0.4940 0.1840 0.5560],LineWidth=2, LineStyle='-.')
hold on

% Target
plot(x_target,y_target,'s', MarkerSize=10, ...
    Color=[0 0.4470 0.7410], MarkerFaceColor=[0 0.4470 0.7410])
hold on

% Inital Position
plot(xv(1),yv(1), 's', MarkerSize=10, ...
    Color=[0.6350 0.0780 0.1840], MarkerFaceColor=[0.6350 0.0780 0.1840])

% Labels
legend('Vehicle Position','Target Position','Initial Position')
xlabel('x (Meters)')
ylabel('y (Meters)')
title('Car Trajectory on a Plane')

hold off
```



Published with MATLAB® R2022b