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% Pierce Zhang, CMOR220, Fall 2023, Matrix operations and plots
% matrix_ops_plots.m
% Answers to matrix operations and plots competency
% 6 September 2023

% Driver to answer the problems
function matrix_ops_plots
    problem_1
    problem_2
    problem_3
    problem_4
    problem_5
end

% Inputs: none
% Outputs: none
function problem_1()
    % Given predefined matrices A and B as defined below, this function
    % will display the result of adding, subtracting, element-wise
    % multipling and multiplying A * B'.
    A = [2 3 2 ;  3 4 3];
    B = [1 4 1 ;  5 8 5];
    add_A_B = A + B
    sub_B_A = A - B
    elemult_A_B = A .* B
    mult_A_Bprim = A * B'
end

% Inputs: none
% Outputs: none
function problem_2()
    % Given predefined matrices A and B as defined below, this function
    % will display the result of of solving the equations A * x1 = B and x2
    % * A = B^T, where B^T is the transposition of B.
    A = [5 4 3 ; 6 5 4 ; 7 8 7];
    B = [5 ; 6 ; 8];
    x1 = A \ B
    x2 = B' / A
end

% Inputs: none
% Outputs: none
function problem_3()
    % This function will plot sqrt(x), 2*sqrt(x), and 3*sqrt(x) in
    % different styles and colors.
    figure
    hold on

    x = linspace(0, 5, 100);

    y1 = sqrt(x);
    plot(x, y1, 'Color', 'b', 'LineWidth', 2);
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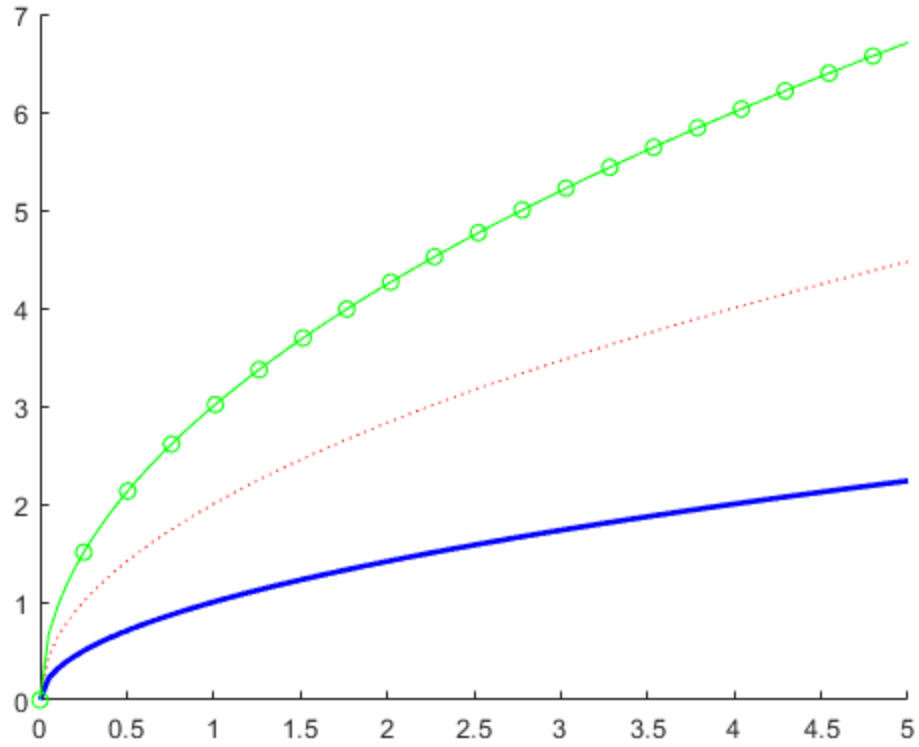
```
    y2 = 2 * sqrt(x);
    plot(x, y2, 'LineStyle', ':', 'Color', 'r');

    y3 = 3 * sqrt(x);
    plot(x, y3, 'Color', 'g', 'Marker', 'o', 'MarkerIndices',1:5:length(x));
end

% Inputs: none
% Outputs: none
function problem_4()
    % This function will draw a pirate face using function graphs on
    % different domains, overlayed in a single window using hold on.
    figure
    hold on
    x1 = linspace( (-5 * pi) / 3 , (5 * pi) / 3 , 100);
    y1 = 1.75*cos(0.7*x1) + 9;

    x2 = linspace(-4, 4, 100);
    y2 = -0.02*x2.^2 + 6.45;

    x3 = linspace(-5.3, -4, 100);
    y3 = -1.1*x3 + 1.7;

    x4 = linspace(4, 5.3, 100);
    y4 = 1.1*x4 + 1.7;

    x5 = linspace(1.55, 2.5, 100);
    y5 = 2*(x5 - 2).^2 + 5;

    x6 = linspace(-2.5, -1.55, 100);
    y6 = 2*(x6 + 2).^2 + 5;

    x7 = linspace(1.55, 2.5, 100);
    y7 = 0.1*x7 + 5.25;

    x8 = linspace(-2.5, -1.55, 100);
    y8 = -0.1*x8 + 5.25;

    x9 = linspace(-3, 1.55, 100);
    y9 = 0.045*(x9 - 1.5).^2 + 5.4;

    x10 = linspace(2.5, 3.15, 100);
    y10 = 0.2*x10.^2 + 4.25;

    x11 = linspace(0, 2, 100);
    y11 = 0.4*(x11 - 0.6).^2 + 1.2;

    x12 = linspace(-2, 0, 100);
    y12 = 0.4*(x12 + 0.6).^2 + 1.2;

    x13 = linspace(-2, 2, 100);
    y13 = -abs(0.8*sin(1.2*x13)) + 2.5;
```

```
    plot(x1,y1)
    plot(x2,y2)
    plot(x3,y3)
    plot(x4,y4)
    plot(x5,y5)
    plot(x6,y6)
    plot(x7,y7)
    plot(x8,y8)
    plot(x9,y9)
    plot(x10,y10)
    plot(x11,y11)
    plot(x12,y12)
    plot(x13,y13)

    x14 = linspace(-3, 3, 100);
    y14 = [];
    for x_i = x14
        y14 = [y14, BrD(x_i)];
    end

    plot(x14, y14)
end

% Inputs: x, in domain R
% Outputs: y, in domain R
function [y] = BrD(x)
    %BrD is a function that plots a key part of your part, but can only take
    %one input at a time and only return one output at a time. As such, a
    %vector input is invalid. Use a loop to plot this over your domain!
    a = eigs(eye(3)*x);
    z = a(randi(3));
    y = (z^2/3+2)+(rand()-0.5)*x*0.35+zeros(1,1)+rand()*1.4-(z~=1.064)-3.5;
end

% Inputs: none
% Outputs: none
function problem_5()
    % This function will display four subfigures of various compositions of
    % elementary functions.
    x = linspace(0, 10, 100);

    figure
    sgtitle("A subfigure array for Problem 5")

    y1 = log(x) .* sin(6 * x);
    subplot(2, 2, 1)
    hold on
    title("Plot of y = ln(x)sin(6x)")
    plot(x, y1)

    y2 = (x / 4) .^ 2 .* cos(2*x);
    subplot(2, 2, 2)
    hold on
    title("Plot of y = ( x / 4 )^2 * cos(2x)")
```

```
    plot(x, y2)

    y3 = 3 * sin(x .^2 / 2);
    subplot(2, 2, 3)
    hold on
    title("Plot of y = 3*sin( x^2 / 2 )")
    plot(x, y3)

    y4 = sin(x) .* cos(x .^ 2);
    subplot(2, 2, 4)
    hold on
    title("Plot of y = sin(x) * cos(x^2)")
    plot(x, y4)
end
```

```
add_A_B =

     3     7     3
     8    12     8


sub_B_A =

     1    -1     1
    -2    -4    -2


elemult_A_B =

     2    12     2
    15    32    15


mult_A_Bprim =

    16    44
    22    62


x1 =

    0.5000
    1.0000
   -0.5000


x2 =

  -17.5000   16.0000   -0.5000
```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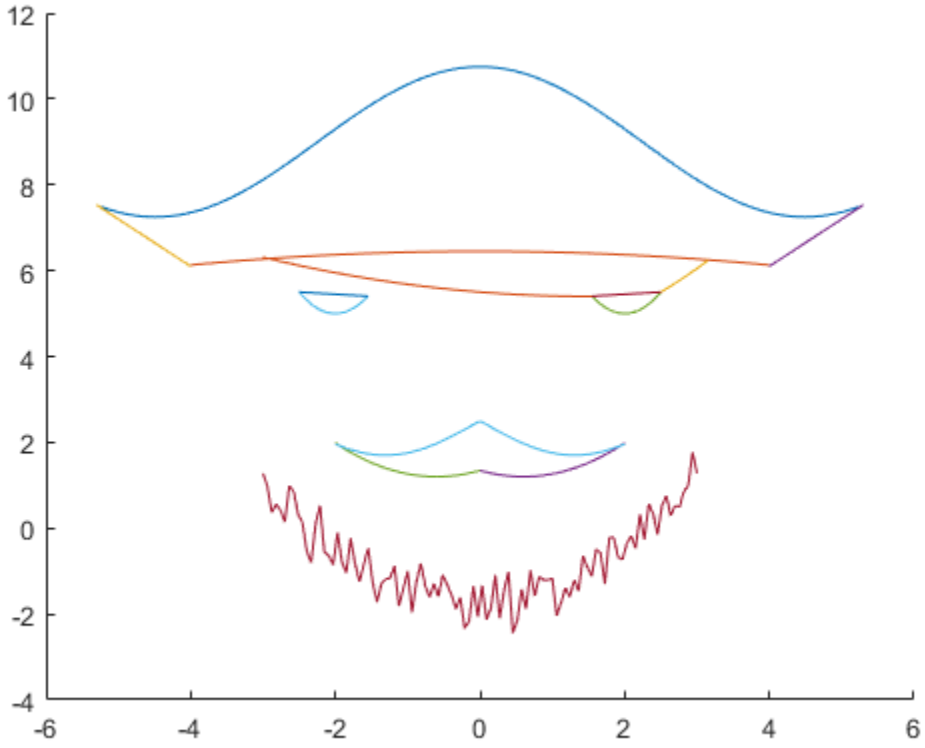
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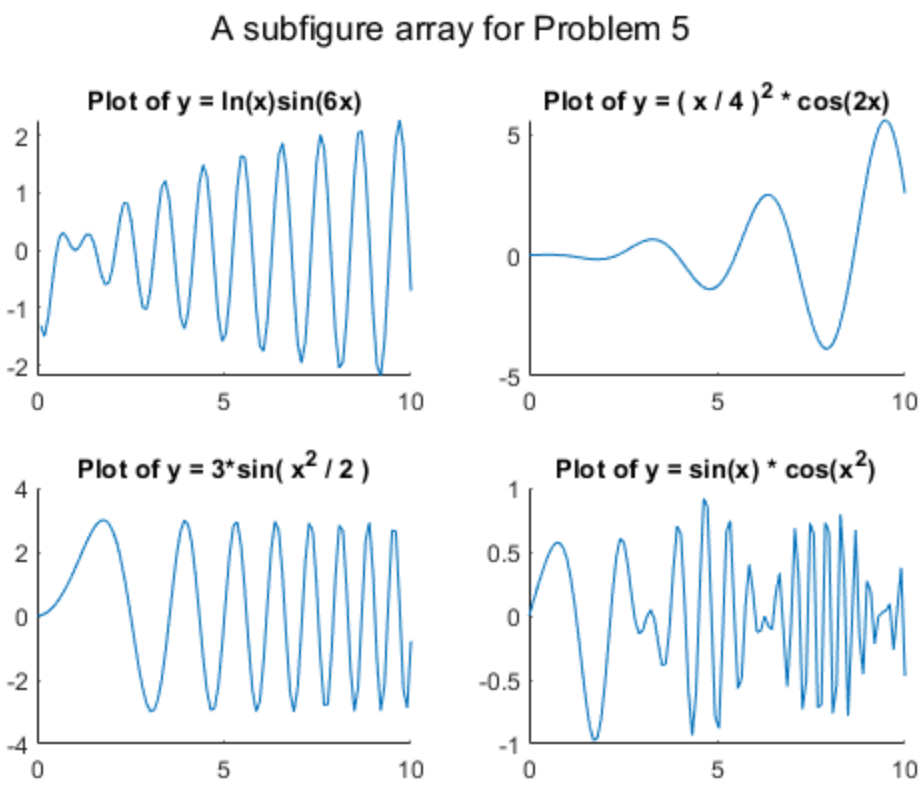

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