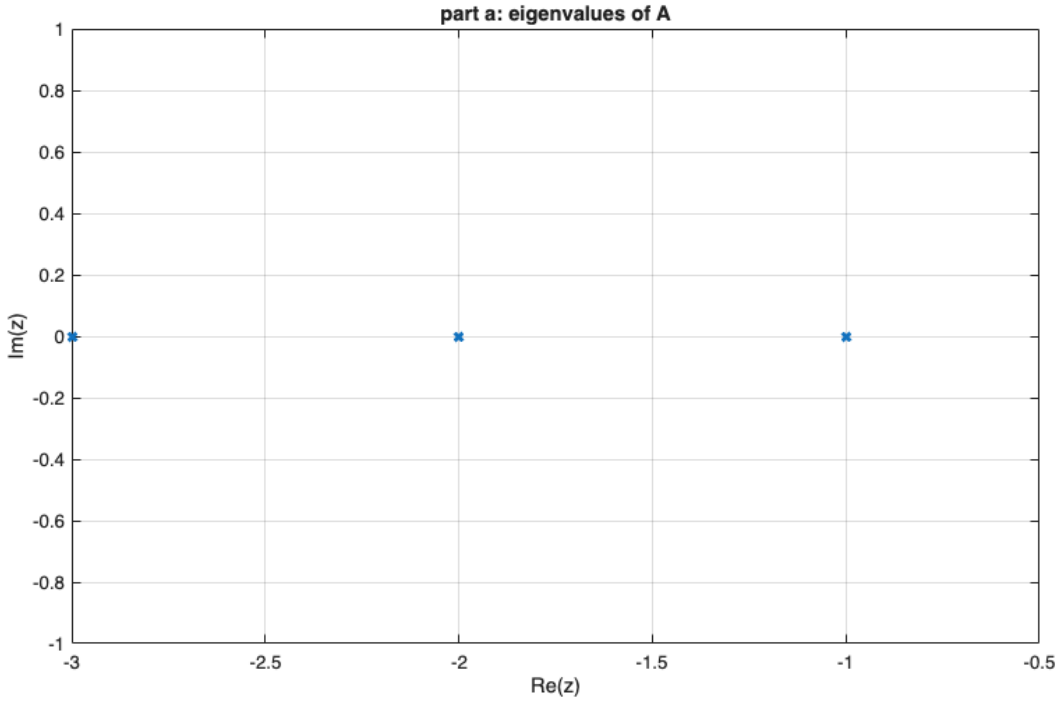
```
%==========Solution to Sim05Q1==========%

clc % clear command window
clear all % remove all variables from workspace
close all % close all figures

%----------Q1a----------%

% define A and b
A = [-6 2 -3; -1 -1 -1; 4 -2 1]
b = [-3; -6; 9]

% (i) compute determinmant of A
det(A)

% (ii) compute A^(-1)
invA = inv(A)

% (iii) verify A^(-1)A = I
% note: a computation A^(-1)A is sufficient for full credit
isapprox(invA*A,eye(3),"tight")

% (iv) solve Ax = b
x = A\b

% (v) find the eigenvalues and eigenvectors of A
[M,D] = eig(A)

% (vi) plot the eigenvalues in the complex plane
eigenvalues = eig(A)
figure % new figure window
plot(real(eigenvalues),imag(eigenvalues),'x','Linewidth',2) % plot
imag(eigenvalues) against real(eigenvalues) and mark points using thick 'x's
grid on
xlabel("Re(z)")
ylabel("Im(z)")
title("part a: eigenvalues of A")

%----------Q1b----------%

% define A and b
A = [8 12 -4; -9 -13 4; -1 -3 0]
b = [-14; 4; 12]

% (i) compute determinmant of A
det(A)

% (ii) compute A^(-1)
invA = inv(A)

% (iii) verify A^(-1)A = I
% note: a computation A^(-1)A is sufficient for full credit
```

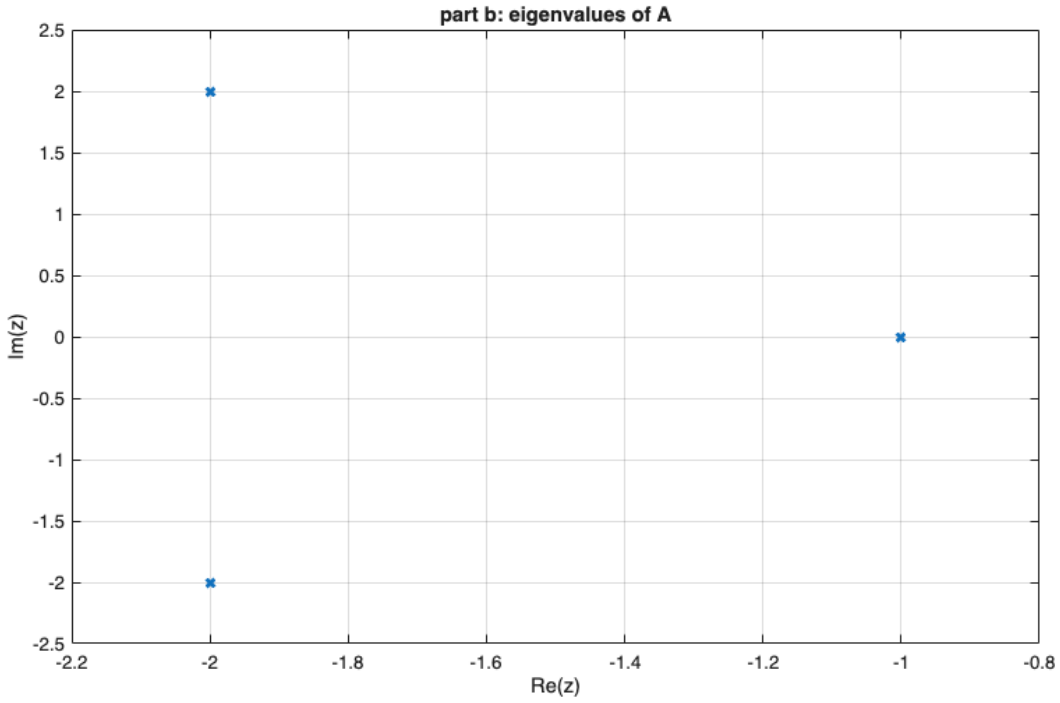
```
isapprox(invA*A,eye(3),"tight")

% (iv) solve Ax = b
x = A\b

% (v) find the eigenvalues and eigenvectors of A
[M,D] = eig(A)

% (vi) plot the eigenvalues in the complex plane
eigenvalues = eig(A)
figure % new figure window
plot(real(eigenvalues),imag(eigenvalues),'x','Linewidth',2) % plot
imag(eigenvalues) against real(eigenvalues) and mark points using thick 'x's
grid on
xlabel("Re(z)")
ylabel("Im(z)")
title("part b: eigenvalues of A")
```

```
A =

    -6     2    -3
    -1    -1    -1
     4    -2     1


b =

    -3
    -6
     9


ans =

    -6


invA =

    0.5000   -0.6667    0.8333
    0.5000   -1.0000    0.5000
   -1.0000    0.6667   -1.3333


ans =

  3×3 logical array

   1   1   1
   1   1   1
   1   1   1
```

```
x =

    10
     9
   -13


M =

   -0.7071    0.5774   -0.4082
   -0.0000    0.5774    0.4082
    0.7071   -0.5774    0.8165


D =

   -3.0000         0         0
         0   -1.0000         0
         0         0   -2.0000


eigenvalues =

   -3.0000
   -1.0000
   -2.0000


A =

     8    12    -4
    -9   -13     4
    -1    -3     0


b =

   -14
     4
    12


ans =

   -8.0000


invA =

   -1.5000   -1.5000    0.5000
    0.5000    0.5000   -0.5000
   -1.7500   -1.5000   -0.5000
```

```
ans =

  3×3 logical array

   1   1   1
   1   1   1
   1   1   1


x =

   21.0000
  -11.0000
   12.5000


M =

   0.6325 + 0.0000i   0.6325 + 0.0000i   0.0000 + 0.0000i
  -0.6325 + 0.0000i  -0.6325 - 0.0000i   0.3162 + 0.0000i
  -0.3162 - 0.3162i  -0.3162 + 0.3162i   0.9487 + 0.0000i


D =

  -2.0000 + 2.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i  -2.0000 - 2.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i   0.0000 + 0.0000i  -1.0000 + 0.0000i


eigenvalues =

  -2.0000 + 2.0000i
  -2.0000 - 2.0000i
  -1.0000 + 0.0000i
```





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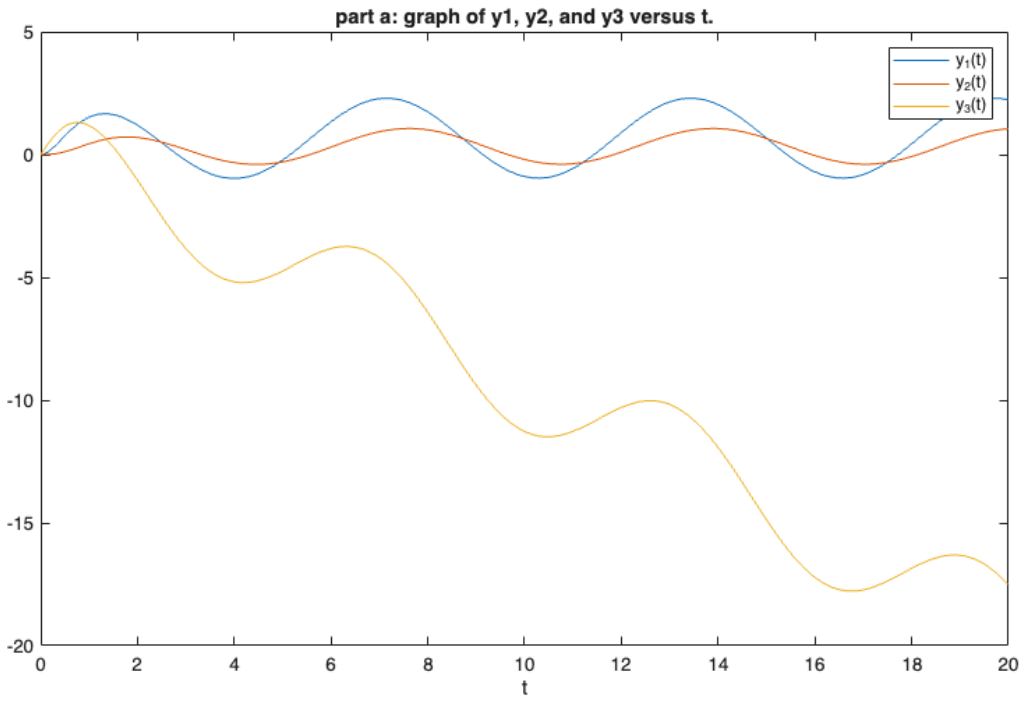
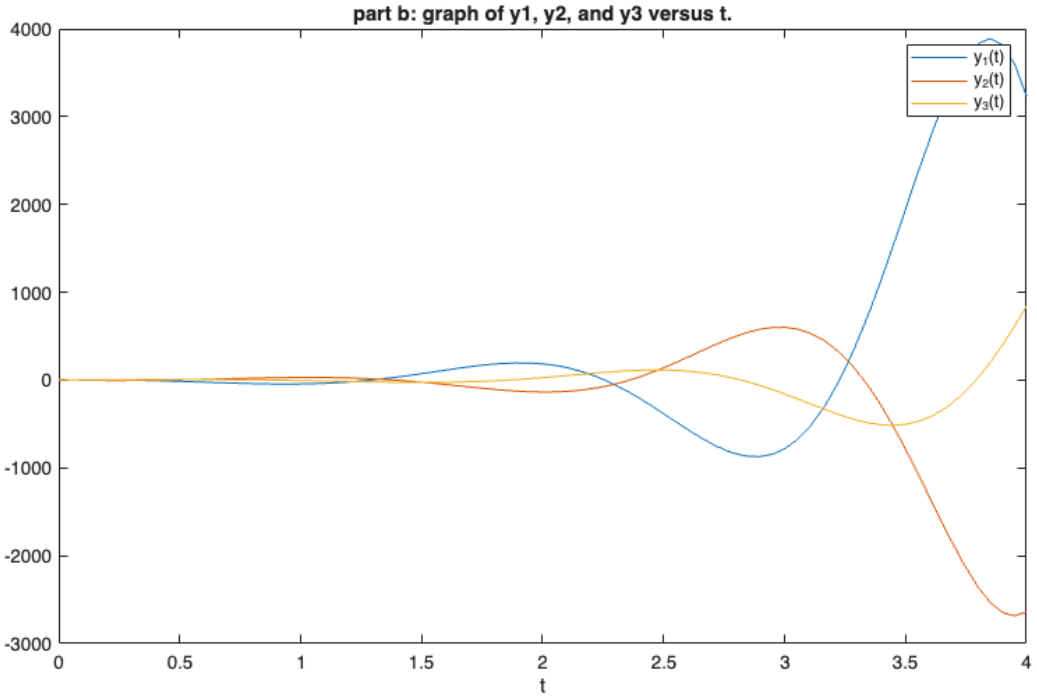
```
%==========Solution to Sim05Q2==========%

clc % clear command window
clear all % remove all variables from workspace
close all % close all figures

%----------Q2a----------%

% define function handle for differential equation y' = f(t,y)
f = @(t,y) [-4.*y(1)+y(2)+3.*y(3)+3.*t; y(1)-2.*y(2);
-2.*y(1)+y(2)+3.*cos(t)]

% define t-domain for the solution y(t)
tspan = [0 20];

% define initial value y(0) = y0
y0 = [0; 0; 0];

% solve the differential equation for y(t)
[t,y] = ode45(f,tspan,y0);

% plot the components of y(t) against t
figure % new figure window
plot(t,y(:,1)) % plot y_1(t) against t
hold on
plot(t,y(:,2)) % plot y_2(t) against t
hold on
plot(t,y(:,3)) % plot y_3(t) against t
hold off
xlabel("t") % label the horizontal axis as t
legend("y_1(t)","y_2(t)","y_3(t)") % label the graphs in the order they were
plotted
title("part a: graph of y1, y2, and y3 versus t.") % indicate that this is
y1, y2, and y3 versus t

%----------Q2b----------%

% define function handle for differential equation y' = f(t,y)
f = @(t,y) [8.*y(1)+12.*y(2)-4.*y(3); -9.*y(1)-13.*y(2)-4.*y(3);
-1.*y(1)-3.*y(2)]

% define t-domain for the solution y(t)
tspan = [0 4];

% define initial value y(0) = y0
y0 = [0; 8; 5];

% solve the differential equation for y(t)
[t,y] = ode45(f,tspan,y0);

% plot the components of y(t) against t
figure % new figure window
```

```
plot(t,y(:,1)) % plot y_1(t) against t
hold on
plot(t,y(:,2)) % plot y_2(t) against t
hold on
plot(t,y(:,3)) % plot y_3(t) against t
hold off
xlabel("t") % label the horizontal axis as t
legend("y_1(t)","y_2(t)","y_3(t)") % label the graphs in the order they were
plotted
title("part b: graph of y1, y2, and y3 versus t.") % indicate that this is
y1, y2, and y3 versus t
```

```
f =

  function_handle with value:

    @(t,y)[-4.*y(1)+y(2)+3.*y(3)+3.*t;y(1)-2.*y(2);-2.*y(1)+y(2)+3.*cos(t)]
```

```
f =

  function_handle with value:

    @(t,y)
[8.*y(1)+12.*y(2)-4.*y(3);-9.*y(1)-13.*y(2)-4.*y(3);-1.*y(1)-3.*y(2)]
```





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