Contents

Problem 1

```
format short;
%part a
A = [2 0 1 0;
     1 5 1 3;
     0 2 -3 5;
     1 2 1 0];
%part b
[P,D] = eig(A)
%part c
disp("With a result from class, we determined that a matrix which is n*n")
disp("and has n distinct eigenvectors, it must be diagonizable. Thus, this")
disp("matrix is diagonizable.")
```

```
P =

   -0.0763    0.1608   -0.2901    0.9287
   -0.8730    0.0273   -0.3537   -0.3566
   -0.3523   -0.9687    0.7326   -0.0661
   -0.3285    0.1873    0.5040    0.0775


D =

    6.6197         0         0         0
         0   -4.0229         0         0
         0         0   -0.5256         0
         0         0         0    1.9288

With a result from class, we determined that a matrix which is n*n
and has n distinct eigenvectors, it must be diagonizable. Thus, this
matrix is diagonizable.
```

Problem 2

```
format rat;
%part a
syms x;
fxgx = (2*x^3 - 4*x^2 + x - 2)*(x^5 -3*x + 1);
answer = int(fxgx, x, 0, 1)
%part b
disp("No they are not orthogonal, the integral should be equal to 0, ")
disp("but it is equal to 629/630, not 0.")
```

```
%part c
h1x = x*sqrt(3) + 1
h2x = x*sqrt(3) - 1
answer = int(h1x*h2x, x, 0, 1)
disp("Thus the answer is 0, and it is orthogonal.")
```

```
answer =

629/630

No they are not orthogonal, the integral should be equal to 0,
but it is equal to 629/630, not 0.

h1x =

3^(1/2)*x + 1


h2x =

3^(1/2)*x - 1


answer =

0

Thus the answer is 0, and it is orthogonal.
```

Problem 3

```
format short;
%part a
u1 = [2; 3; -3; -6];
u2 = [6; -1; 4; 1];
u3 = [0; 5; -3; 6];
u4 = [-4; 5; -2; 4];
%part b
A =[u1, u2, u3, u4]
%part c
v1 = u1;
v2 = u2 - (dot(u2, v1)/dot(v1, v1))*v1;
v3 = u3 - (dot(u3, v1)/dot(v1, v1))*v1 - (dot(u3, v2)/dot(v2, v2))*v2;
v4 = u4 - (dot(u4, v1)/dot(v1, v1))*v1 - (dot(u4, v2)/dot(v2, v2))*v2 - (dot(u4, v3)/dot(v3, v3))*v3;
%part d
w1 = v1/norm(v1);
w2 = v2/norm(v2);
w3 = v3/norm(v3);
w4 = v4/norm(v4);
%part e
Q = [w1 w2 w3 w4]
%part f
R = transpose(Q)*A;
Q*R
```

```
disp("Thus, Q*R = A.")
%part g
[Q1, R1] = qr(A, 0)
```

```
A =

     2     6     0    -4
     3    -1     5     5
    -3     4    -3    -2
    -6     1     6     4


Q =

    0.2626    0.8701    0.2439   -0.3385
    0.3939   -0.0737    0.6843    0.6092
   -0.3939    0.4873   -0.3436    0.6995
   -0.7878    0.0095    0.5952   -0.1580


ans =

    2.0000    6.0000    0.0000   -4.0000
    3.0000   -1.0000    5.0000    5.0000
   -3.0000    4.0000   -3.0000   -2.0000
   -6.0000    1.0000    6.0000    4.0000

Thus, Q*R = A.

Q1 =

   -0.2626    0.8701   -0.2439    0.3385
   -0.3939   -0.0737   -0.6843   -0.6092
    0.3939    0.4873    0.3436   -0.6995
    0.7878    0.0095   -0.5952    0.1580


R1 =

   -7.6158    1.1818    1.5757    1.4444
         0    7.2528   -1.7734   -4.7853
         0         0   -8.0232   -5.5137
         0         0         0   -2.3693
```

Problem 4

```
format rat;
%part a
A = [3 6 -7;
    4 -4 1;
    7 -6 3];
%part b
v1 = [3; 4; -3];
v2 = [-1; 1; 0];
```

```
v3 = [2; 6; -1];
B = [v1 v2 v3];
%part c
C = inv(B)*A*B;
%part d
sev = [17; 17; 17];
values = C* sev
disp("The values vector gives us a way to get the mapped vector by multiplying")
disp("v1-v3 and adding them all up. Thus, the mapped vector is: ")
mappedVector1 = (326*v1)+(-1080*v2)+(-128*v3)
%part e
disp("To verify, since we know C = [17, 17, 17], we must find the vector")
disp("which it yields by multiping 17 with v1-v3, and multiplying the ")
disp("resulting vector by A, which yields the mapped vector.")
v110 = 17 * v1;
v221 = 17 * v2;
v313 = 17* v3;
VBaseB = v110 + v221 + v313;
disp("Now, if we multiply A with VBaseB, we get the same mapped vector")
disp("which we got early. ")
MappedVector2 = A*VBaseB
disp("This we get the same mapped vector and this verifies our previous explanation")
```

```
values =

     326
   -1080
    -128

The values vector gives us a way to get the mapped vector by multiplying
v1-v3 and adding them all up. Thus, the mapped vector is:

mappedVector1 =

    1802
    -544
    -850

To verify, since we know C = [17, 17, 17], we must find the vector
which it yields by multiping 17 with v1-v3, and multiplying the
resulting vector by A, which yields the mapped vector.
Now, if we multiply A with VBaseB, we get the same mapped vector
which we got early.

MappedVector2 =

    1802
    -544
    -850

This we get the same mapped vector and this verifies our previous explanation
```

Problem 5

```
format rat;
%part a
s1 = [5; -2; 1; -5; 0];
s2 = [-3; 1; 6; 4; 2];
s3 = [-6; 1; 0; 4; 2];
S1 = [s1 s2 s3];
rref(S1)
disp("S1 is linearly independent")
s4 = [2; 3; -4; 3; 1];
s5 = [-14; -8; 10; -8; -8];
s6 = [-3; 2; -3; 2; -2];
S2 = [s4 s5 s6];
rref(S2);
disp("S2 is linearly dependent")
%part b
u1 = s1;
u2 = s2;
u3 = s3;
%part c
v1 = u1;
v2 = u2 - (dot(u2, v1)/dot(v1, v1))*v1;
v3 = u3 - (dot(u3, v1)/dot(v1, v1)) * v1 - (dot(u3, v2)/dot(v2, v2))*v2;
%part d
y = [7; -9; 0; 3; 2];
z1 = (dot(y, v1)/dot(v1, v1)) * v1 + (dot(y, v2)/dot(v2, v2))*v2 + (dot(y, v3)/dot(v3, v3))*v3;
z2 = y - z1;
%part f
disp("point in W closest to y is represented by z2: ")
z2
```

```
ans =

       1              0              0
       0              1              0
       0              0              1
       0              0              0
       0              0              0

S1 is linearly independent
S2 is linearly dependent
point in W closest to y is represented by z2:

z2 =

     121/35
    -192/25
    -121/70
    1045/169
    1614/875
```

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