MATLAB Assignment 4

● Graded

Student

Miles Levine

View or edit group

Total Points

48 / 48 pts

Question 1

Question 1

5 / 5 pts

✔ **+ 5 pts** Correct

+ 2 pts Part b is correct

– 1 pt Matrix P is not displayed

+ 3 pts Part c is correct

+ 0 pts No Justification for part c or incorrect justification

+ 0 pts Incorrect

Question 2

Question 2

8 / 8 pts

✔ **+ 8 pts** Correct

+ 3 pts a) Correct

+ 2 pts b) Correct

+ 3 pts c) Correct

+ 0 pts c) Incorrect: both h_1, h_2 should be *non-constant* **polynomial**. Note: sine and cosine functions are NOT polynomials.

+ 0 pts c) Incorrect: The inner product of your functions is NOT 0. *In particular, your mistake might be that you need to integrate from 0 to 1, not from -1 to 1 or any other intervals!*

+ 0 pts Incorrect interpretation of the term "inner product" for this question.
In particular, the inner product in parts (b) and (c) should still be the integral form, not the "dot product" of the coefficients

Question 3

Question 3

11 / 11 pts

✔ **+ 11 pts** Correct

– 0.5 pts Not in format short

+ 6 pts (c) Correct

+ 2 pts (d) Correct

+ 2 pts (f) Correct

+ 1 pt (g) Correct

Question 4

Question 4

12 / 12 pts

✔ **+ 12 pts** Correct

+ 6 pts Part c is correct

– 3 pts Missing inverse in part c / incorrect product

+ 0 pts Part C is incorrect

+ 4 pts Part d is correct

– 2 pts Incorrectly interpretation of part d, saying it is the mapped vector and not its coordinates or talking about the wrong coordinates

+ 0 pts Part d is incorrect / no justification

+ 2 pts Part e is correct

+ 0 pts Incorrect

Question 5

Question 5

12 / 12 pts

✔ **+ 12 pts** Correct

+ 4 pts a) Correct.

+ 0 pts a) Incorrect. The rest was graded assuming your result from a)

+ 3 pts c) Correct Gram-Schmidt.

+ 1 pt c) Partially correct.

+ 4 pts e) Correct orthogonal decomposition

+ 0 pts e) Incorrect. *In particular, your mistake might be you only projected* $\mathbf{y}$ *to one or two of the orthogonal vectors from the Gram-Schmidt. But* W *is the span of all orthogonal vectors.*

+ 0 pts e) Incorrect. *In particular, your mistake might be you used* u_j*'s instead of* v_j*'s for your projection.*

+ 1 pt f) Correct point chosen

+ 0 pts Incorrect: each vector given must be a column vector, not a row vector.

+ 0 pts Incorrect: should use S_1, the linearly independent set.

Question assigned to the following page: 1

Contents


```
%Miles Levine
%Section 0412
%Matlab Project 4
```

Problem 1

```
format short;
%%a
A = [2 0 1 0; 1 5 1 3; 0 2 -3 5; 1 2 1 0]

%%b
[P D] = eig(A)

%%c
disp("Matrix A is diagonalizable because there exists 4 e' values");
disp(" and they correspond to the 4 columms that matrix A has");
```

```
A =

     2     0     1     0
     1     5     1     3
     0     2    -3     5
     1     2     1     0


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

Matrix A is diagonalizable because there exists 4 e' values
 and they correspond to the 4 columms that matrix A has
```

Questions assigned to the following page: 2 and 3

Problem 2

```
format rat
%%a
syms x;
F = 2*x^3 - 4*x^2 + x - 2

G = x^5 - 3*x + 1
inner_product = int(F * G,x,0,1)

%%b
disp("both functions are not orthogonal since the inner product is 1.");
disp("for both functions to be orthogonal, inner product must equal 0");
%%c
H1 = (x-1)^2
H2 = (.25-x)
innerProduct = int(H1 * H2,x,0,1)
```

```
F =

2*x^3 - 4*x^2 + x - 2


G =

x^5 - 3*x + 1


inner_product =

629/630

both functions are not orthogonal since the inner product is 1.
for both functions to be orthogonal, inner product must equal 0

H1 =

(x - 1)^2


H2 =

1/4 - x


innerProduct =

0
```

Problem 3

```
format short;
%%a
```

Question assigned to the following page: 3

```
u1 = [2;3;-3;-6]
u2 = [6; -1; 4; 1]
u3 = [0;5;-3;6]
u4 = [-4; 5; -2; 4]

%%b
A = [u1, u2, u3, u4]
%%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
Gs_v3 = dot(u4,v3)/dot(v3,v3)*v3;
v4 = u4 - dot(u4,v1)/dot(v1,v1)*v1 - dot(u4,v2)/dot(v2,v2)*v2 - Gs_v3


%%d
w1 = v1/norm(v1)
w2 = v2/norm(v2)
w3 = v3/norm(v3)
w4 = v4/norm(v4)
%%e
Q = [w1, w2, w3, w4]
%%f
R = Q' * A
disp("R is a triangle matrix therefor A = QR");
%%g
[Q1,R1] = qr(A,0)
```

```
u1 =

     2
     3
    -3
    -6


u2 =

     6
    -1
     4
     1


u3 =

     0
     5
    -3
     6


u4 =

    -4
     5
    -2
```

Question assigned to the following page: 3

```
     4


A =

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


v1 =

     2
     3
    -3
    -6


v2 =

    6.3103
   -0.5345
    3.5345
    0.0690


v3 =

    1.9567
    5.4900
   -2.7565
    4.7755


v4 =

   -0.8019
    1.4435
    1.6573
   -0.3742


w1 =

    0.2626
    0.3939
   -0.3939
   -0.7878


w2 =

    0.8701
   -0.0737
    0.4873
    0.0095
```

Questions assigned to the following page: 3 and 4

```
w3 =

    0.2439
    0.6843
   -0.3436
    0.5952


w4 =

   -0.3385
    0.6092
    0.6995
   -0.1580


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


R =

    7.6158   -1.1818   -1.5757   -1.4444
    0.0000    7.2528   -1.7734   -4.7853
    0.0000   -0.0000    8.0232    5.5137
   -0.0000    0.0000   -0.0000    2.3693

R is a triangle matrix therefor A = QR

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;
%%a
A = [3 6 -7; 4 -4 1; 7 -6 3]

%%b
```

Question assigned to the following page: 4

```
v1 = [3;4;-3]
v2 = [-1;1;0]
v3 = [2;6;-1]
Pb = [v1,v2,v3]
%%c
%inverse of A*v1,  A*v2,  A*v3
C = [Pb\(A*v1), Pb\(A*v2), Pb\(A*v3)]


%%d

v = [17;17;17] %is in the b coordinate
disp("C*v =");
disp(C*v);
%%e
disp("u1 represents the linear combination vector");
u1 = Pb*(C*v)
disp("u2 represents the mapped vector");
u2 = A*(Pb*v)
disp("Both vectors are the same");
```

```
A =

       3              6             -7
       4             -4              1
       7             -6              3


v1 =

       3
       4
      -3


v2 =

      -1
       1
       0


v3 =

       2
       6
      -1


Pb =

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


C =
```

Questions assigned to the following page: 4 and 5

```
      49/17         109/17         168/17
    -657/17          64/17        -487/17
      57/17        -106/17         -79/17


v =

      17
      17
      17

C*v =
     326
   -1080
    -128

u1 represents the linear combination vector

u1 =

    1802
    -544
    -850

u2 represents the mapped vector

u2 =

    1802
    -544
    -850

Both vectors are the same
```

Problem 5

```
format rat;
x1 = [5;-2;1;-5;0];
x2 = [-3;1;6;4;2];
x3 = [-6;1;0;4;2];
S1 = [x1, x2, x3]
y1 = [2;3;-4;3;1];
y2 = [-14;-8;10;-8;-8];
y3 = [-3;2;-3;2;-2];
S2 = [y1,y2,y3]
%%a
rref_S1 = rref(S1)
rref_S2 = rref(S2)

disp("pivit in every column shows that S1 is linearly independent");
disp("S2 is linearly dependent ");
%%b
u1 = x1;
u2 = x2;
u3 = x3;
%%c
```

Question assigned to the following page: 5

```
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
%%d
y = [7;-9;0;3;2]
%%e
% use Gram Schmidt
Gs_v1 = dot(y,v1)/dot(v1,v1)*v1;
Gs_v2 = dot(y,v2)/dot(v2,v2)*v2;
Gs_v3 = dot(y,v3)/dot(v3,v3)*v3;
z1 = Gs_v1 + Gs_v2 + Gs_v3
z2 = y - z1
%%f
disp("z1 would be the closest point in W that is");
disp("closest to y since it is LLS" );
disp(z1);
```

```
S1 =

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


S2 =

       2           -14            -3
       3            -8             2
      -4            10            -3
       3            -8             2
       1            -8            -2


rref_S1 =

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


rref_S2 =

       1             0             2
       0             1           1/2
       0             0             0
       0             0             0
       0             0             0

pivit in every column shows that S1 is linearly independent
S2 is linearly dependent

v1 =
```

Question assigned to the following page: 5

```
       5
      -2
       1
      -5
       0


v2 =

      -2/11
      -7/55
     361/55
      13/11
       2


v3 =

   -1229/994
   -1229/1420
    -975/2669
    -446/463
     533/333


y =

       7
      -9
       0
       3
       2


z1 =

     124/35
     -33/25
     121/70
   -5571/1750
     136/875


z2 =

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

z1 would be the closest point in W that is
closest to y since it is LLS
     124/35
     -33/25
     121/70
   -5571/1750
```

Question assigned to the following page: 5

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