```
%%Math 240 Matlab Project 3
% Spring 2020
%
% Section [0342]
%
% Author: [May Kyaw]
% Problem 1
```

(a)

```
clear
clc
close all
v1 = [-6 4 -9 4]'
v2 = [8 -3 7 -3]'
v3 = [-9 5 -8 3]'
x = [4 7 -8 3]'
A = [v1 v2 v3 x]
% x is in H = Span{v1,v2,v3}
%show that the vector equation x1v1+x2v2+x3v3=x has a solution
%The augumented matrix [v1 v2 v3 x] in rref
disp('A = ');
disp(A);
fprintf('Row Reduced form : \n');
disp(rref(A));
%The first three columns show that B is a basis for H
% Since this system has a solution, x is in H
%The solution allows us to find the B-coordinate vector for x: since
%x=x1v1+x2v2+x3v3=3v1+5v2+2v3
%xß=[3 5 2]
fprintf('xß=[3 5 2] \n');
```

```
v1 =

    -6
     4
    -9
     4


v2 =

     8
    -3
     7
    -3


v3 =

    -9
     5
```

```
      -8
       3


x =

       4
       7
      -8
       3


A =

      -6               8              -9               4
       4              -3               5               7
      -9               7              -8              -8
       4              -3               3               3

A =
      -6               8              -9               4
       4              -3               5               7
      -9               7              -8              -8
       4              -3               3               3

Row Reduced form :
       1               0               0               3
       0               1               0               5
       0               0               1               2
       0               0               0               0

xß=[3 5 2]
```

Problem 2 (a)

```
format short
t = [0 0.1 0.2 0.3];
f = @(t) [1 cos(t) cos(t)^2 cos(t)^3];
%when plugging in the t it gives you the four linear equations
%for the four unknown eqations

%Defining what the coeffcient matrix A is for the linear system
A = zeros(4);
for i=1:4
A(i,:)=f(t(i));
end
fprintf('\nA = \n');
disp(A);
```

```
A =
    1.0000    1.0000    1.0000    1.0000
    1.0000    0.9950    0.9900    0.9851
    1.0000    0.9801    0.9605    0.9414
```

```
    1.0000    0.9553    0.9127    0.8719
```

(b)

```
%Prints out rref(A)
fprintf('Row Reduced form : \n');
disp(rref(A));
%Prints out det(A)
fprintf('det(A) = ');
disp(det(A));
```

```
Row Reduced form :
     1     0     0     0
     0     1     0     0
     0     0     1     0
     0     0     0     1

det(A) =    6.5176e-11
```

(c) From the example we are able to see that det(A) is pretty close to zero

```
%but is not zero. That rref(A) contains all of its diagonal 1 as it is
 a
%full rank matrix so because of all of these reasons A is invertible.
```

(d)

```
t = [0 0.2 0.5 1];
f = @(t) [1 cos(t) cos(t)^2 cos(t)^3];
%Plugging in the new values of t into the equation

%Defining what the coeffcient matrix A is for the linear system
A = zeros(4);
for i=1:4
A(i,:)=f(t(i));
end
fprintf('\nA = \n');
disp(A);

%Prints out rref(A)
fprintf('Row Reduced form : \n');
disp(rref(A));
%Prints out det(A)
fprintf('det(A) = ');
disp(det(A));
```

```
A =
    1.0000    1.0000    1.0000    1.0000
    1.0000    0.9801    0.9605    0.9414
    1.0000    0.8776    0.7702    0.6759
    1.0000    0.5403    0.2919    0.1577
```

```
Row Reduced form :
     1     0     0     0
     0     1     0     0
     0     0     1     0
     0     0     0     1

det(A) =    1.7052e-05
```

(e)

```
%We know that 1=1(sin^2t)+1(cos^2t) vt
%then 1 is expressed as {(sin^2t),(cos^2t)} and because the set of the
%function is {1,(sin^2t),(cos^2t)} it is linearly dependent
%also since
%sin^2t+cos^2t=1
%1-sin^2t-cos^2t=0
%{1,(sin^2t),(cos^2t)} would be a linearly dependent function
```

Problem 3 (a)

```
%1=1
%cost=cost
%cos2t= -1+2cos^2t
%cos3t= -3cost+4cos^3t
%cos4t= 1-8cos^2t+8cos^4t
%cos5t= 5cost-20cos^3t+16cos^6t
%cos6t= -1+18cos^2t-48cos^4t+32cos^6t
A=[1 0 -1 0 1 0 -1;0 1 0 -3 0 5 0;0 0 2 0 -8 0 18;0 0 0 4 0 -20 0;0 0
 0 0 8 0 -48;0 0 0 0 0 16 0;0 0 0 0 0 0 32]
fprintf('Row Reduced form : \n');
disp(rref(A));
fprintf('Rank of A\n')
rank(A)
%So C would be considered to be linearly independent
fprintf('C is linearly independent\n')
```

```
A =

     1     0    -1     0     1     0    -1
     0     1     0    -3     0     5     0
     0     0     2     0    -8     0    18
     0     0     0     4     0   -20     0
     0     0     0     0     8     0   -48
     0     0     0     0     0    16     0
     0     0     0     0     0     0    32

Row Reduced form :
     1     0     0     0     0     0     0
     0     1     0     0     0     0     0
     0     0     1     0     0     0     0
     0     0     0     1     0     0     0
     0     0     0     0     1     0     0
     0     0     0     0     0     1     0
```

```
     0     0     0     0     0     0     1

Rank of A

ans =

     7

C is linearly independent
```

(b)

```
%Since dim H = 7 because B is a basis of H.
%C is a linearly independent set
%the vectors in C lie in H because of the trigonometric identities.
%So becuase of the Basis Theorem, C is basis for H.
```

Problem 4 (a)

```
format rat
A=[-2 2 1 8 2;1 -10 22 11 11;1 -4 7 1 3;-2 -4 16 18 10]
fprintf('Rank of A\n')
rank(A)
```

```
A =

      -2              2              1              8              2

       1            -10             22             11             11

       1             -4              7              1              3

      -2             -4             16             18             10


Rank of A

ans =

       2
```

(b)

```
%A is a m x n matrix where the m=4 and the n=5
%When using the rank nullity theorem
%rank(A)+dim(Nul A)=n
%dim(Nul A)=4 - rank(A)=5-2=3
%dim(Col A)= rank(A) = 2
%dim(Row A)= rank(A) = 2

fprintf('dim(Nul A): %d\n', size(A,2) - rank(A))
fprintf('dim(Col A): %d\n', rank(A))
fprintf('dim(Row A): %d\n', rank(A))
```

```
dim(Nul A): 3
dim(Col A): 2
dim(Row A): 2
```

(c)

```
fprintf('\nRREF of A\n')
rref(A)

%(i) Null(A)
%A=[1 0 -3 -17/3 -7/3;0 1 -5/2 -5/3 -4/3]
%B=[c1;c2;c3;c4;c5]
%A*B= [0;0;0;0]
%c1=(17s/3)+(3t)+(7u/3)
%c2=(5s/3)+(5t/2)+(4u/3)
%c3=t
%c4=s
%c5=u
%Null(A)={3,5/2,1,0,0}, {17/3,5/3,0,1,0},{7/3,4/3,0,0,1}
fprintf('\n Null(A)={3,5/2,1,0,0}, {17/3,5/3,0,1,0},{7/3,4/3,0,0,1}
 \n')
%(ii) Col(A)
fprintf('\n Col(A) \n')
A=[-2 2 1 8 2;1 -10 22 11 11]
%(iii) Row(A)
fprintf('\n Row(A) \n')
A=[-2 1 1 -2;2 -10 -4 -4]
```

```
RREF of A

ans =

       1              0              -3             -17/3          -7/3

       0              1              -5/2            -5/3          -4/3

       0              0               0               0              0

       0              0               0               0              0


 Null(A)={3,5/2,1,0,0}, {17/3,5/3,0,1,0},{7/3,4/3,0,0,1}

 Col(A)

A =

      -2              2               1               8              2

       1            -10              22              11             11
```

```
 Row(A)

A =

      -2             1              1              -2
       2           -10             -4              -4
```

Problem 5 (a)

```
v1 = [4 3 7 3]'
v2 = [2 1 1 -1]'
v3 = [1 1 3 2]'
v4 = [-3 5 8 1]'
v5 = [5 3 5 0]'


v1 =

       4
       3
       7
       3


v2 =

       2
       1
       1
      -1


v3 =

       1
       1
       3
       2


v4 =

      -3
       5
       8
       1


v5 =

       5
       3
```

```
        5
        0
```

(b)

```
A = [v1 v2 v3 v4 v5];
disp('A = ');
disp(A);
fprintf('\nRREF of A\n')
rref(A)
C = colspace(sym(A));
disp('Basis = ');
disp(double(C));
```

```
A =
        4              2              1             -3              5

        3              1              1              5              3

        7              1              3              8              5

        3             -1              2              1              0



RREF of A

ans =

        1              0              1/2            0              1/2

        0              1             -1/2            0              3/2

        0              0              0              1              0

        0              0              0              0              0


Basis =
        1              0              0
        0              1              0
        0              0              1
       -3/23         -50/23          33/23
```

(c)

```
%This displays that [v1 v2 v3 v4 v5] is not linearly independet set
%Since we only have three non zero pivot. So dimension of W = 3.
%And we can choose last three column of A for basis for W as follow.
 \{t^2, -3+2t, -2+t\}
%Because these are linearly independent.
```

(d)

```
%W does not euqal P3
%dimW=3 and dimp3=4
%3<4
%so W does not euqal P3
```

Problem 6 (a)

```
M = 4;
A = zeros(2, 3, M);
A(:, :, 1) = [2 -3 4; -2 1 2];
A(:, :, 2) = [0 -4 0; -3 2 1];
A(:, :, 3) = [2 0 4; 5 -2 -1];
A(:, :, 4) = [1 -12 2; 3 2 -2];

N = 6;
E = zeros(2, 3, N);
E(:, :, 1) = [1 0 0; 0 0 0]; E(:, :, 2) = [0 1 0; 0 0 0];
E(:, :, 3) = [0 0 1; 0 0 0]; E(:, :, 4) = [0 0 0; 1 0 0];
E(:, :, 5) = [0 0 0; 0 1 0]; E(:, :, 5) = [0 0 0; 0 0 1];
```

(a)

```
v = zeros(2*3, M);
for i = 1:1:M
T = A(:, :, i); T = T'; T = T(:);
v(:, i) = T;
end
disp('v1 ='), disp(v(:,1))
disp('v2 ='), disp(v(:,2))
disp('v3 ='), disp(v(:,3))
disp('v4 ='), disp(v(:,4))

v1 =
       2
      -3
       4
      -2
       1
       2

v2 =
       0
      -4
       0
      -3
       2
       1

v3 =
       2
       0
       4
       5
      -2
      -1
```

```
v4 =
     1
   -12
     2
     3
     2
    -2
```

(b)

```
rref_v = rref(v);
disp('RREF of v ='), disp(rref_v)
fprintf('Column 4 (v4) can be written as linear combination of other
 three columns.\n')
fprintf('v4 = -2*v1 + (9/2)*v2 + (5/2)*v3 so the vectors v1, v2, v3
 and v4 are linearly dependent.\n')
```

```
RREF of v =
       1              0              0              -2
       0              1              0               9/2
       0              0              1               5/2
       0              0              0               0
       0              0              0               0
       0              0              0               0

Column 4 (v4) can be written as linear combination of other three
 columns.
v4 = -2*v1 + (9/2)*v2 + (5/2)*v3 so the vectors v1, v2, v3 and v4 are
 linearly dependent.
```

(c)

```
fprintf('Thus, A4 = -2*A1 + (9/2)*A2 + (5/2)*A3, same as the
 relationship between coordinate vectors.\n')
disp('A4 ='), disp(A(:, :, 4))
T = -2*A(:, :, 1) + 9/2*A(:, :, 2) + 5/2*A(:, :, 3);
disp('-2*A1 + (9/2)*A2 + (5/2)*A3 ='), disp(T)
```

```
Thus, A4 = -2*A1 + (9/2)*A2 + (5/2)*A3, same as the relationship
 between coordinate vectors.
A4 =
       1            -12              2
       3              2             -2

-2*A1 + (9/2)*A2 + (5/2)*A3 =
       1            -12              2
       3              2             -2
```

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