Contents


```
% Zain Bhaila
% Math 240 Fall 2018 Project 3
% Section 0132
clc
```

Problem 0

```
format rat
clock
```

```
ans =

  Columns 1 through 5

    2018           10           29           15            1

  Column 6

    2188/99
```

Problem 1

```
format short

% Problem 1(a)
A = [1 cos(0) cos(0).^2 cos(0).^3 ;  1 cos(0.1) cos(0.1).^2 cos(0.1).^3 ;
    1 cos(0.2) cos(0.2).^2 cos(0.2).^3 ; 1 cos(0.3) cos(0.3).^2 cos(0.3).^3]

% Problem 1(b)
rref(A)
det(A)

% Problem 1(c)
% The rref shows that Ax = 0 has only the trivial solution
% and the detA =/= 0, so A is invertible.

% Problem 1(d)
A = [1 cos(0) cos(0).^2 cos(0).^3 ;  1 cos(1) cos(1).^2 cos(1).^3 ;
```

```
    1 cos(0.2) cos(0.2).^2 cos(0.2).^3 ; 1 cos(0.5) cos(0.5).^2 cos(0.5).^3]
det(A)

% Problem 1(e)
% sin^2 + cos^2 = 1, so since 1 can be written as a linear
% combination of sin^2 and cos^2, the set is linearly dependent
```

```
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


ans =

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


ans =

   6.5176e-11


A =

    1.0000    1.0000    1.0000    1.0000
    1.0000    0.5403    0.2919    0.1577
    1.0000    0.9801    0.9605    0.9414
    1.0000    0.8776    0.7702    0.6759


ans =

   1.7052e-05
```

Problem 2

```
format rat
A = [0 -9 -3 -1 ; 2 -1 -1 -2 ; 1 13 4 2 ; 9 -3 -4 -9 ; 1 -2 -1 -1]

% Problem 2(a)
rank(A)

% Problem 2(b)
% rankA = dimColA = dimRowA = 3
% dimNulA = n - rankA = 4-3 = 1

% Problem 2(c)
```

```
rref(A)
N = [1/3 ; -1/3 ; 0 ; 0] % NulA
C = [0 -9 -1 ; 2 -1 -2 ; 1 13 2 ; 9 -3 -9 ; 1 -2 -1] % ColA
R = [0 2 1 ; -9 -1 -13 ; -3 -1 4 ; -1 -2 2] % RowA
```

```
A =

     0    -9    -3    -1
     2    -1    -1    -2
     1    13     4     2
     9    -3    -4    -9
     1    -2    -1    -1


ans =

     3


ans =

     1     0    -1/3     0
     0     1     1/3     0
     0     0     0       1
     0     0     0       0
     0     0     0       0


N =

     1/3
    -1/3
     0
     0


C =

     0    -9    -1
     2    -1    -2
     1    13     2
     9    -3    -9
     1    -2    -1


R =

     0     2     1
    -9    -1   -13
    -3    -1     4
    -1    -2     2
```

Problem 3

```
% Problem 3(a)
v1 = [2;1;3;1]
v2 = [3;4;7;3]
v3 = [1;-3;8;5]
v4 = [0;5;5;3]
v5 = [-1;2;1;1]

% Problem 3(b)
A = [v1 v2 v3 v4 v5]
rref(A) % columns with pivots form a basis for ColA
B = [v1 v2 v3] % basis for the span

% Problem 3(c)
% basis of W = {p1, p2, p3}, dimW = 3

% Problem 3(d)
% W =/= P3 because W must have 4 linearly independent
% vectors to span P3, and it has 3 since dimW = 3
```

```
v1 =

     2
     1
     3
     1


v2 =

     3
     4
     7
     3


v3 =

     1
    -3
     8
     5


v4 =

     0
     5
     5
     3


v5 =

    -1
     2
```

```
     1
     1


A =

     2     3     1     0    -1
     1     4    -3     5     2
     3     7     8     5     1
     1     3     5     3     1


ans =

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


B =

     2     3     1
     1     4    -3
     3     7     8
     1     3     5
```

Problem 4

```
% Problem 4(a)
v1 = [2;2;-2;3;-12;1]
v2 = [4;1;2;-2;-3;2]
v3 = [0;2;1;-3;-4;0]
v4 = [4;-2;-1;5;0;2]

% Problem 4(b)
A = [v1 v2 v3 v4]
rref(A)
% v4 can be written as a linear combination of the other 3

% Problem 4(c)
% -2/5 * A1 + -4/5 * A2 + 9/5 * A3 = A4
```

```
v1 =

     2
     2
    -2
     3
   -12
     1
```

```
v2 =

     4
     1
     2
    -2
    -3
     2


v3 =

     0
     2
     1
    -3
    -4
     0


v4 =

     4
    -2
    -1
     5
     0
     2


A =

     2          4          0          4
     2          1          2         -2
    -2          2          1         -1
     3         -2         -3          5
   -12         -3         -4          0
     1          2          0          2


ans =

     1          0          0          2/5
     0          1          0          4/5
     0          0          1         -9/5
     0          0          0          0
     0          0          0          0
     0          0          0          0
```

Problem 5

```
% Problem 5(a)
P = [1 0 0 0 ; 1 2 0 0 ; 2 -1 3 0 ; 4 -1 0 1] % B -> e
Q = [1 0 0 0 ; 1 2 0 0 ; 2 -1 3 0 ; 4 -1 0 1] % C -> e
```

```
% Problem 5(b)
R = inv(Q) * P

% Problem 5(c)
x = Q * [0;0;0;1]

% Problem 5(d)
b = [0;3;2;1]
c = R * b
```

```
P =

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


Q =

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


R =

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


x =

     0
     0
     0
     1


b =

     0
     3
     2
     1


c =

     0
     3
     2
```

```
1
```