Contents

Problem 1

```
format rat;
A = [3 -8 22 -8 2;
     6 -8 -2 -8 44;
     -3 3 15 3 -27;
     -1 1 6 1 -9;
     0 5 -7 5 25;
     4 2 -3 2 66];
% Part a
rref(A)
disp("Basis of Col(A): {(3, 6, -3, -1, 0, 4), (-8, -8, 3, 1, 5, 2), ")
disp("(22, -2, 15, 6, -7, -3)}")
disp("Basis of Ker(A): {(0, -1, 0, 1, 0), (-14, -5, 0, 0, 1)}")
% Part b
disp("There are infinite solutions, as the fourth column (x4) is a free")
disp("variable")
disp("Parametric Vector Form: x4(0, -1, 0, 1, 0) + (-14, -5, 0, 0, 1)")
```

```
ans =

       1              0              0              0             14
       0              1              0              1              5
       0              0              1              0              0
       0              0              0              0              0
       0              0              0              0              0
       0              0              0              0              0

Basis of Col(A): {(3, 6, -3, -1, 0, 4), (-8, -8, 3, 1, 5, 2),
(22, -2, 15, 6, -7, -3)}
Basis of Ker(A): {(0, -1, 0, 1, 0), (-14, -5, 0, 0, 1)}
There are infinite solutions, as the fourth column (x4) is a free
variable
Parametric Vector Form: x4(0, -1, 0, 1, 0) + (-14, -5, 0, 0, 1)
```

Problem 2

```
format rat;

A = [5 -3 6 7,
     0 0 0 1,
     7 -5 3 -7,
     4 0 3 -7];
rref(A)
```

```
%part a
disp("Basis of Row Space: {[1 0 0 0], [0 1 0 0], [0 0 1 0], [0 0 0 1]}")
%part b
disp("Basis of col space: {(5, 0, 7, 4), (-3, 0, -5, 0), (6, 0, 3, 3), ")
disp("(7, 1, -7, -7)}")
%part c
disp("Yes dim(col(A)) = dim(row(A))")
%part d
disp("No row(A) does not equal col(A) as row(A) represents the standard")
disp("basis while col(A) is just the original matrix.")
```

```
ans =

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

Basis of Row Space: {[1 0 0 0], [0 1 0 0], [0 0 1 0], [0 0 0 1]}
Basis of col space: {(5, 0, 7, 4), (-3, 0, -5, 0), (6, 0, 3, 3),
(7, 1, -7, -7)}
Yes dim(col(A)) = dim(row(A))
No row(A) does not equal col(A) as row(A) represents the standard
basis while col(A) is just the original matrix.
```

Problem 3

```
format rat;
% part a
B = [4 2 4 -8;
     1 6 3 6;
     -5 4 0 7;
     5 -7 1 7]
v = [2; -30; 13; -10];
disp("What I do here is just put the coefficents/values of vector v")
disp("and multiply them in order according to the matrix B, which")
disp("gets you the u below")
u = [80; -199; -200; 163]
%part b
BsolutionV = [4 2 4 -8 2;
     1 6 3 6 -30;
     -5 4 0 7 13;
     5 -7 1 7 -10]
rref(BsolutionV)
disp("I set up the matrix as an augmented matrix where v is the solution")
disp("which will allow us to get the answer for the coefficients of the")
disp("vectors in B that produce the vector v, our final answer is the W")
disp("below: ")
W = [-958/91; -1783/273; 1231/118; -305/158]
```

```
B =

       4             2             4            -8
       1             6             3             6
```

```
      -5              4              0              7
       5             -7              1              7
```

What I do here is just put the coefficents/values of vector v
and multiply them in order according to the matrix B, which
gets you the u below

```
u =

      80
    -199
    -200
     163


BsolutionV =

       4              2              4             -8              2
       1              6              3              6            -30
      -5              4              0              7             13
       5             -7              1              7            -10


ans =

       1              0              0              0          -958/91
       0              1              0              0         -1783/273
       0              0              1              0          1231/118
       0              0              0              1          -305/158
```

I set up the matrix as an augmented matrix where v is the solution
which will allow us to get the answer for the coefficients of the
vectors in B that produce the vector v, our final answer is the W
below:

```
W =

    -958/91
   -1783/273
    1231/118
    -305/158
```

Problem 4

```
format rat;
%part a
v1 = [7; -3; 1; 7; 2];
v2 = [9; -3; -9; -5; -6];
v3 = [1, -1, 3, 4, 3];
v4 = [5; -3; -1; 0; 1];
%part b
A = [7 9 1 5;
     -3 -3 -1 -3;
     1 -9 3 -1;
     7 -5 4 0;
     2 -6 3 1]
```

```
%part c
rref(A)
disp("Basis is {(1, x, x^2, -1 + x + 3x^2)}")
%part d
disp("It is linearly dependent because there are free variables.")
disp("v4 can be written as a linear combination of v1, v2, v3")
```

```
A =

       7             9             1             5
      -3            -3            -1            -3
       1            -9             3            -1
       7            -5             4             0
       2            -6             3             1


ans =

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

Basis is {(1, x, x^2, -1 + x + 3x^2)}
It is linearly dependent because there are free variables.
v4 can be written as a linear combination of v1, v2, v3
```

Problem 5

```
format short;
%part a
A = [1 cos(0.1) (cos(0.1))^2 (cos(0.1))^3 (cos(0.1))^4;
     1 cos(0.2) (cos(0.2))^2 (cos(0.2))^3 (cos(0.2))^4;
     1 cos(0.3) (cos(0.3))^2 (cos(0.3))^3 (cos(0.3))^4;
     1 cos(0.4) (cos(0.4))^2 (cos(0.4))^3 (cos(0.4))^4;
     1 cos(0.5) (cos(0.5))^2 (cos(0.5))^3 (cos(0.5))^4];
%part b
rref(A)
disp("As we can see there is a pivot in every row and column")
disp("and there are no free variables. This means that one vector")
disp("cannot be written as a linear combination of another, thus")
disp("meaning that we only have a trivial solution.")
%part c
u1 = [1; 0; -1; 0; 1];
u2 = [0; 1; 0; -3; 0];
u3 = [0; 0; 2; 0; -8];
u4 = [0; 0; 0; 4; 0];
u5 = [0; 0; 0; 0; 8];
%part d
B = [1 0 0 0 0;
     0 1 0 0 0;
     -1 0 2 0 0;
     0 -3 0 4 0;
     1 0 -8 0 8]
```

```
rref(B)
disp("Yes, C is linearly independent because it has a pivot/row in")
disp("every column/no free variables and one vector is not a linear")
disp("combination of another.")
%part e
disp("C is a basis for D because the rref of C is the standard basis")
disp("with a pivot in every row/column, meaning it must be a basis, it")
disp("is also the same matrix in rref as B.")
```

```
ans =

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

As we can see there is a pivot in every row and column
and there are no free variables. This means that one vector
cannot be written as a linear combination of another, thus
meaning that we only have a trivial solution.

B =

     1     0     0     0     0
     0     1     0     0     0
    -1     0     2     0     0
     0    -3     0     4     0
     1     0    -8     0     8


ans =

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

Yes, C is linearly independent because it has a pivot/row in
every column/no free variables and one vector is not a linear
combination of another.
C is a basis for D because the rref of C is the standard basis
with a pivot in every row/column, meaning it must be a basis, it
is also the same matrix in rref as B.
```

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