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I Sem M. Tech. DS
Computational Linear Algebra-21MA602
Lab exercise-1

1. Consider the matrix

$$A = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

We can see that columns of A are linearly dependent. Hence any column vector can be expressed in terms of the others. The following code express column b in terms of others using 'pinv' command.

```
a=[1; 1 ;0;0];
b=[0; 1 ;1;0];
c=[0; 0 ;1;1];
d=[1; 0 ;0;1];
A=[a b c d];
B=[ a c d];
  coef= pinv(B)*b
      The output would be
coef =

    1.0000
    1.0000
   -1.0000
```

that is b=1*a+1*b-1*c.

Alter the above code suitably to express the remaining 3 vectors in terms of the other.

2. Find the CR decomposition of

A= $\begin{pmatrix} 1 & 3 & 3 \\ 2 & 6 & 3 \\ 3 & 9 & 2 \end{pmatrix}$ using rref command in MATLAB

3. What is the basis of row and column space of A= $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 4 & 6 & 8 \end{pmatrix}$?
4. Program segment to append columns to a given matrix and find its rank.

```
X=[0 9 ]
A=[]
A=[A  randi(X, 3, 1)]
Rank(A)          % ouput is 1
    A=[A randi(X, 3, 1)]
Rank(A)          % ouput is 2
```

.

. . continue…

What do you observe? Why?

Alter the code suitably to append a column each time and find the rank.

5. Program to generate a random integer matrix with given rank :
   R=[0 9]
   A= randi(R, 5, 3)*randi(R, 3, 6) % generates a matrix whose rank is <=3. Mostly 3.
   Alter this to generate a matrix of order 1.
   Use the 'null' command to get the null space of the matrix generated. Verify manually if t is the correct null space of A.

6. If $A = \begin{bmatrix} 1 & 3 & 4 & 7 \\ 2 & 4 & 6 & 10 \\ 3 & 5 & 8 & 13 \\ 4 & 6 & 10 & 16 \end{bmatrix}$

   Is Y= (1, 2, 3, 1)^T in row/ column/left or right null space of A?

Hint: If AY ! = 0 it is not in RNS

IF Y^TA != 0 it is not in LNS

Append Y as last column of A. If rank(A) = 2 then Y is in column space of A.

If rank(A)>2 then it is not.

Append Y as last row of A. If rank(A) = 2 then Y is in row space of A.

If rank(A)>2 then it is not.

Analyze why?

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