PES University, Bangalore

(Established under Karnataka Act No. 16 of 2013)

APRIL 2021: IN SEMESTER ASSESSMENT (ISA) B.TECH. IV SEMESTER

UE19MA251- LINEAR ALGEBRA

Mathematics Lab

Session: Jan-May 2021

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SRN : **PES2UG19CS412**

Branch : **Computer Science & Engineering**

Semester & Section : **Semester IV Section G (Batch G1)**

FOR OFFICE USE ONLY:

Marks : /05

Name of the Course Instructor : **Prof. SATYAVANI N L**

Signature of the Course Instructor : ______________________________

PES UNIVERSITY

ELECTRONIC CITY CAMPUS

(Established under Karnataka Act no. 16 of 2013)

Hosur Road, Near Electronic City,Bangalore-100

SCI LAB

Subject: LINEAR ALGEBRA AND ITS APPLICATIONS

Subject Code: UE19MA251

Name:Suhan.B.Revankar

SRN :PES2UG19CS412

Section: G (batch G1)

Branch: CSE

Marks awarded:

Name of the faculty: Prof.Satyavani N L.

Class Number	Topic
1	Gaussian Elimination
2	The LU Decomposition
3	Inverse of a Matrix by the Gauss- Jordan Method
4	The Span of Column Space of a Matrix
5	The Four Fundamental Subspaces
6	Projections by Least Squares
7	The Gram-Schmidt Orthogonalization
8	Eigen values and Eigen Vectors of a Matrix
9-10	In Semester Assessment

1) Solve the system of equations 2x+5y+z=4 , 4x+8y+z=2 and y-z=3

Using guassian elimination. Also identify the pivotes.

```
clc;clear;close;
A=[2,5,1;4,8,1;0,1,-1], b= [0;2;3]
A_aug=[A b]
a=A_aug
n=3;

for i=2:n
    for j=2:n+1
        a(i,j)=a(i,j)-a(1,j)*a(i,1)/a(1,1);
end
a(i,1)=0;
end
for i=3:n
    for j=3:n+1
        a(i,j)=a(i,j)-a(2,j)*a(i,2)/a(2,2);
    end
    a(i,2)=0;
end
x(n)=a(n,n+1)/a(n,n);for i=n-1:-1:1
    sumk=0;
    for k=i+1:n
        sumk=sumk+a(i,k)*x(k);
    end
    x(i)=(a(i,n+1)-sumk)/a(i,i);
end
disp(x(3),x(2),x(1),'The value of x,y,z are');
disp(a(1,1),a(2,2),a(3,3),'The pivots are');
```

```
-2.6666667

 0.3333333

 0.5000000

"The value of x,y,z are"

 2.

-2.

-1.5

"The pivots are"

-->
```

2) Find the triangular factors L and U for the matrix $A=\begin{pmatrix} 2 & 3 & 1 \\ 4 & 7 & 5 \\ 1 & -2 & 2 \end{pmatrix}$

```
A=[2,3,1; 4,7,5;1,-2,2];
U=A;
disp(A, 'The given matrix is A=')
m=det(U(1,1));
n=det(U(2,1));
a=n/m;
U(2,:)=U(2,:)-U(1,:)/(m/n);
n=det(U(3,1));
b=n/m;
U(3,:)=U(3,:)-U(1,:)/(m/n);
m=det(U(2,2));
n=det(U(3,2));
c=n/m;
U(3,:)=U(3,:)-U(2,:)/(m/n);
disp(U, 'The upper triangular matrix is U=')
L=[1,0,0;a,1,0;b,c,1];
disp(L, 'The lower triangular matrix is L=')
```

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

 "The given matrix is A="

  2.   3.   1.
  0.   1.   3.
  0.   0.   12.

 "The upper triangular matrix is U="

  1.    0.    0.
  2.    1.    0.
  0.5  -3.5   1.

 "The lower triangular matrix is L="

-->
```

3) Find the inverse of the matrix $A = \begin{pmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{pmatrix}$

```
clc;clear;
A=[1 1 1; 4 -2 -1; 7 -3 3];
n= length (A(1,:));
Aug=[A,eye(n,n)];

for j=1:n-1
    for i=j+1:n
Aug(i,j:2*n)=Aug(i,j:2*n)-Aug(i,j)/Aug(j,j)*Aug(j,j:2*n);
end
end

for j=n:-1:2
Aug(1:j -1,:)=Aug(1:j -1,:)-Aug(1:j -1,j)/Aug(j,j)*Aug(j,:);
end

for j=1:n
Aug(j,:)=Aug(j,:)/Aug(j,j);
end
B=Aug(:,n+1:2*n);
disp(B, 'The inverse of A is');

```

```
  0.3461538   0.2307692  -0.0384615
  0.7307692   0.1538462  -0.1923077
 -0.0769231  -0.3846154   0.2307692

 "The inverse of A is"

-->
```

4) identify the column that area in the column space of A where $A=\begin{bmatrix} 2 & 4 & 7 & -1 \\ 6 & 5 & 2 & 9 \\ 3 & 5 & 6 & -4 \end{bmatrix}$

```
clc;clear;close;
disp('The given matrix is ')
a=[2 4 7 -1;6 5 2 9;3 5 6 -4]
a(2,:)=a(2,:)-a(2,1)/(a(1,1))*a(1,:)
a(3,:)=a(3,:)-a(3,1)/(a(1,1))*a(1,:)
disp(a)
a(3,:)=a(3,:)-a(3,2)/(a(2,2))*a(2,:)
disp(a)
a(1,:)=a(1,:)/a(1,1)
a(2,:)=a(2,:)/a(2,2)
disp(a)
for i=1:3
    for j=i:4
        if(a(i,j)<>0)
            disp('is a pivot column',j,'column')
            break
          end
end
end
```

```
"The given matrix is "

 2.    4.    7.    -1.
 0.   -7.   -19.    12.
 0.   -1.   -4.5   -2.5

 2.    4.    7.            -1.
 0.   -7.   -19.            12.
 0.    0.   -1.7857143   -4.2142857

 1.    2.    3.5          -0.5
 0.    1.    2.7142857   -1.7142857
 0.    0.   -1.7857143   -4.2142857

"is a pivot column"

 1.

"column"

"is a pivot column"

 2.

"column"

"is a pivot column"

 3.

"column"
```

5)find the four fundamental subspace of $A=\begin{bmatrix} 2 & 1 & 0 \\ 3 & 0 & 1 \\ 0 & 5 & 0 \end{bmatrix}$

```
clear;
close;
clc;
A=[2 1 0;3 0 1;0 5 0];
disp(A, 'A=');
[m,n]=size(A);
disp(m, 'm=');
disp(n, 'n=');
[v,pivot]=rref(A);
disp(rref(A));
disp(v);
r=length(pivot);
disp(r, 'rank=')
cs=A(:,pivot);
disp(cs, 'Column space=');
ns=kernel(A);
disp(ns, 'Null space=');
rs=v(1:r,:)';
disp(rs,'Row space=');
lns=kernel(A');
disp(lns, 'Left Null Space=');
```

```
 2.   1.   0.
 3.   0.   1.
 0.   5.   0.

"A="

 3.

"m="

 3.

"n="

 1.   0.   0.
 0.   1.   0.
 0.   0.   1.

 1.   0.   0.
 0.   1.   0.
 0.   0.   1.

 3.

"rank="

 2.   1.   0.
 3.   0.   1.
 0.   5.   0.
```

```
"Column space="

  []

"Null space="

 1.   0.   0.
 0.   1.   0.
 0.   0.   1.

"Row space="

  []

"Left Null Space="
```

6) find the solution x=(C,D) of the system Ax=b and the line of best fit C+Dt=b given

A = [1 0
0 1
1 1]

```
clear;close;clc;
A=[1 0;0 1;1 1];
disp(A,'A=');
b=[1;2;3];
disp(b,'b=');
x=(A'*A)\(A'*b);
disp(x,'x=');;
C=x(1,1);
D=x(2,1);
disp(C,'C=');
disp(D,'D=');
disp('The line of best fit is b=C+Dt');
//end

```

```
  1.   0.
  0.   1.
  1.   1.

 "A="

  1.
  2.
  3.

 "b="

  1.
  2.

 "x="

  1.

 "C="

  2.

 "D="

 "The line of best fit is b=C+Dt"

-->
```

7) Apply the Gram-Schmidt process to the vector (1,0,1),(1,1,0) and (2,1,1) to produce the set oforthonormal vectors.

```
clear;close;clc;
A=[1 0 1;1 1 0;2 1 1];

disp(A,'A=');
[m,n]=size(A);
for k=1:n
    V(:,k)=A(:,k);
    for j=1:k-1
    R(j,k)=V(:,j)'*A(:,k);

            V(:,k)=V(:,k)-R(j,k)*V(:,j);
    end
    R(k,k)=norm(V(:,k));
    V(:,k)=V(:,k)/R(k,k);
end
disp(V,'Q=');
```

```
  1.   0.   1.
  1.   1.   0.
  2.   1.   1.

 "A="

  0.4082483  -0.7071068  -0.842701
  0.4082483   0.7071068   0.2407717
  0.8164966  -3.140D-16  -0.4815434

 "Q="

-->
```

8)find the eigen values and the corresponding eigen vector of $A = \begin{bmatrix} 3 & -2 & 5 \\ -2 & 3 & 6 \\ 5 & 6 & 4 \end{bmatrix}$

```
clc;close;clear;
A=[3,-2,5;-2,3,6;5,6,4]
lam=poly(0,'lam')
lam=lam
charMat=A-lam*eye(3,3)
disp(charMat,'The characteristic Matrix is')
charPoly=poly(A,'lam')
disp(charPoly,'the characteristic polynomial is')
lam=spec(A)
disp(lam,'the eigen values of A are')
function[x,lam]=eigenvectors(A)
[n,m]=size(A);
lam=spec(A)';
 x=[];
for k=1:3
    B=A-lam(k)*eye(3,3);//characteristic matrix
    C=B(1:n-1,1:n-1);//coeff matrix for the reduced system
    b=-B(1:n-1,n);//RHS vector for the reduced system
    y=C\b;//solution for the reduced system
    y=[y;1];//complete eigen vector
    y=y/norm(y);//make unit eigen vector
    x=[x y];
end
endfunction
//End of function
get f('eigenvectors')
[x,lam]= eigenvectors(A)
disp(x,'The eigen vectors of A are');
```

```
The characteristic Matrix is

   3 - lam    - 2           5

 - 2          3 - lam       6

   5          6             4 - lam

the characteristic polynomial is

                           2     3
   283 - 321am - 10lam + lam

the eigen values of A are

 - 5.4409348
   4.9650189
   10.475916

The eigen vectors of A are

 - 0.5135977    0.7711676    0.3761887
 - 0.5746266  - 0.6347298    0.5166454
   0.6371983    0.0491799    0.7691291
```