MATLAB ASSIGNMENT

LINEAR ALGEBRA

UE20MA251

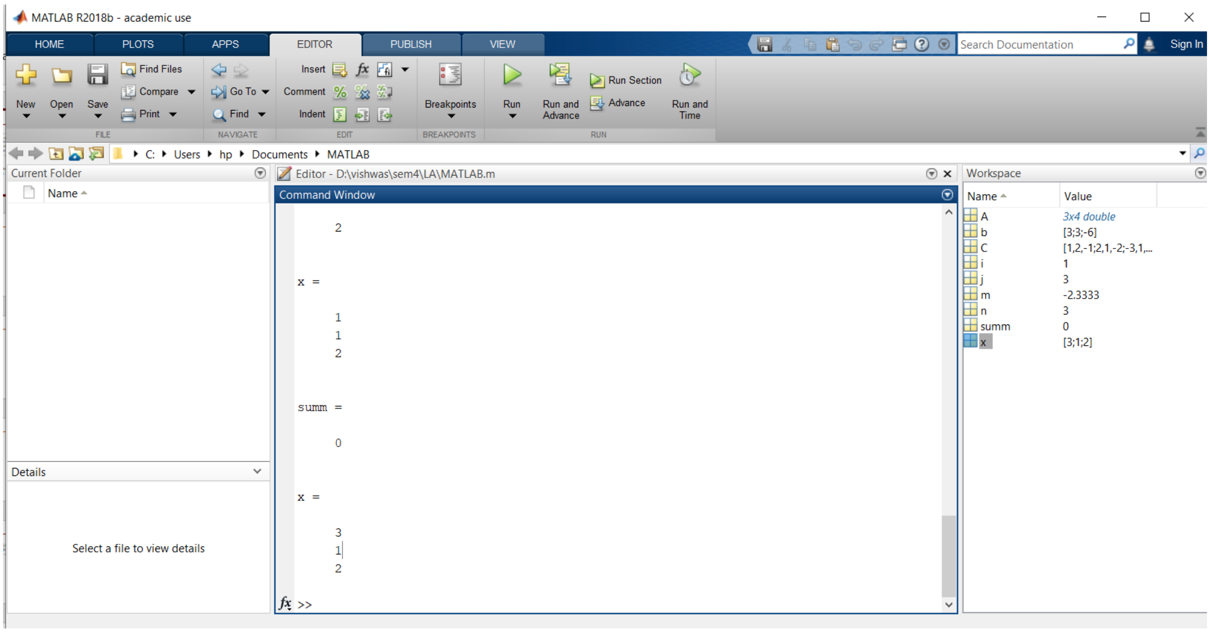
NON IN-BUILT FUNCTION PROGRAMS:

1) GAUSS ELIMINATION METHOD:

I) X+2y-z=3,2x+y-2z=3,-3x+y+z=-6

```
C = [1 2 -1; 2 1 -2; -3 1 1]
b= [3 3 -6]'
A = [C b];
n= size(A,1);
x = zeros(n,1);
for i=1:n-1
for j=i+1:n
m = A(j,i)/A(i,i)
A(j,:) = A(j,:) - m*A(i,:)
end
end
x(n) = A(n,n+1)/A(n,n)
for i=n-1:-1:1
summ = 0
for j=i+1:n
summ = summ + A(i,j)*x(j,:)
x(i,:) = (A(i,n+1) - summ)/A(i,i)
end
end
```

Output:

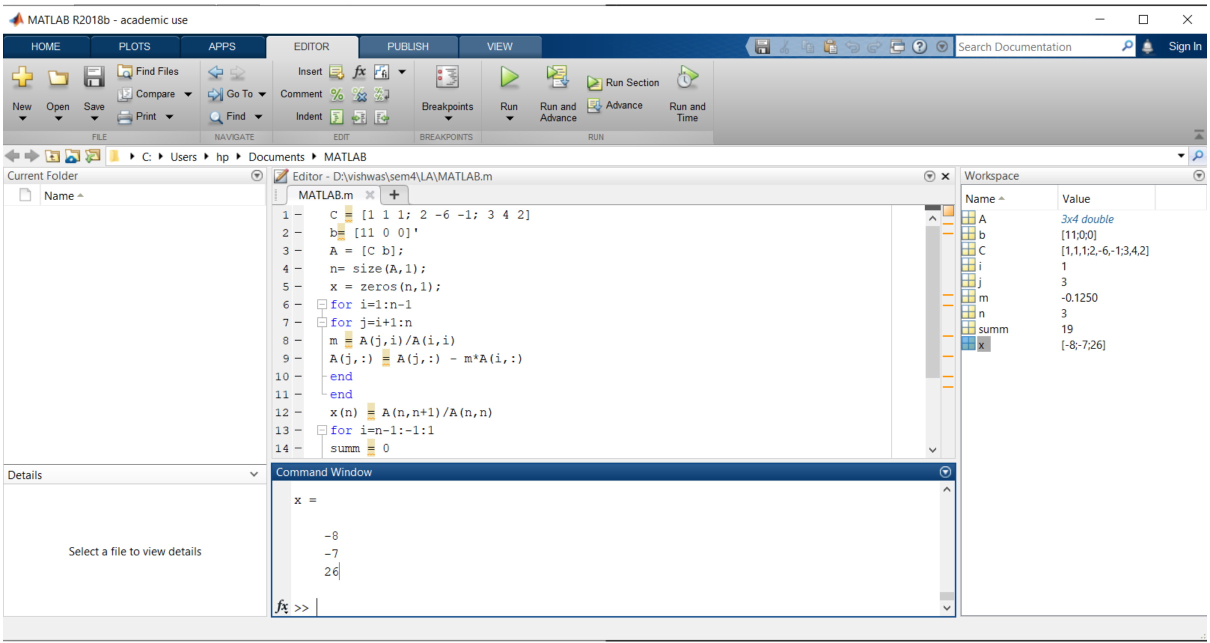


ii) x+y+z=11,2x-6y-1z=0,-3x+4y+2z=-0

```
C = [1 1 1; 2 -6 -1; 3 4 2]
b= [11 0 0]'
A = [C b];
n= size(A,1);
x = zeros(n,1);
for i=1:n-1
for j=i+1:n
m = A(j,i)/A(i,i)
A(j,:) = A(j,:) - m*A(i,:)
end
end
x(n) = A(n,n+1)/A(n,n)
for i=n-1:-1:1
summ = 0
for j=i+1:n
```

summm = summ + A(i,j)*x(j,:)
x(i,:) = (A(i,n+1) - summ)/A(i,i)
end
end

Output :

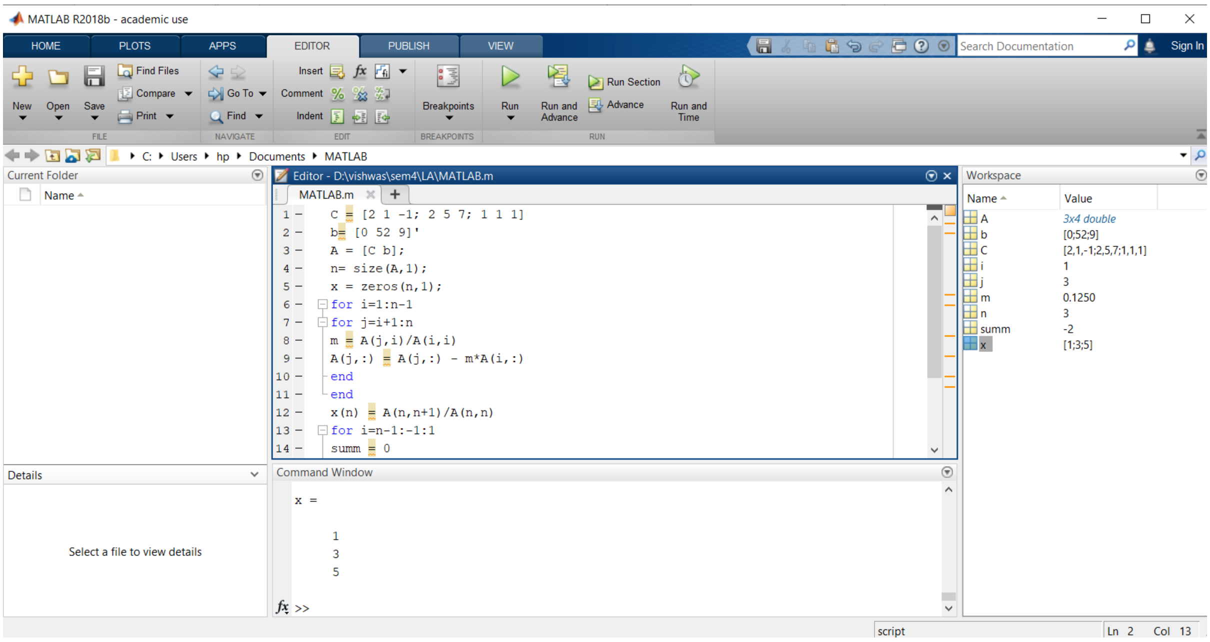


iii) 2x+y-z=0,2x+5y+7z=52,x+y+z=-9

C = [2 1 -1; 2 5 7; 1 1 1
b= [0 52 9]’
A = [C b];
n= size(A,1);
x = zeros(n,1);
for i=1:n-1
for j=i+1:n
m = A(j,i)/A(i,i)
A(j,:) = A(j,:) - m*A(i,:)
end
end
x(n) = A(n,n+1)/A(n,n)
for i=n-1:-1:1
summ = 0

```
for j=i+1:n
summ = summ + A(i,j)*x(j,:)
x(i,:) = (A(i,n+1) - summ)/A(i,i)
end
end
```

Output:



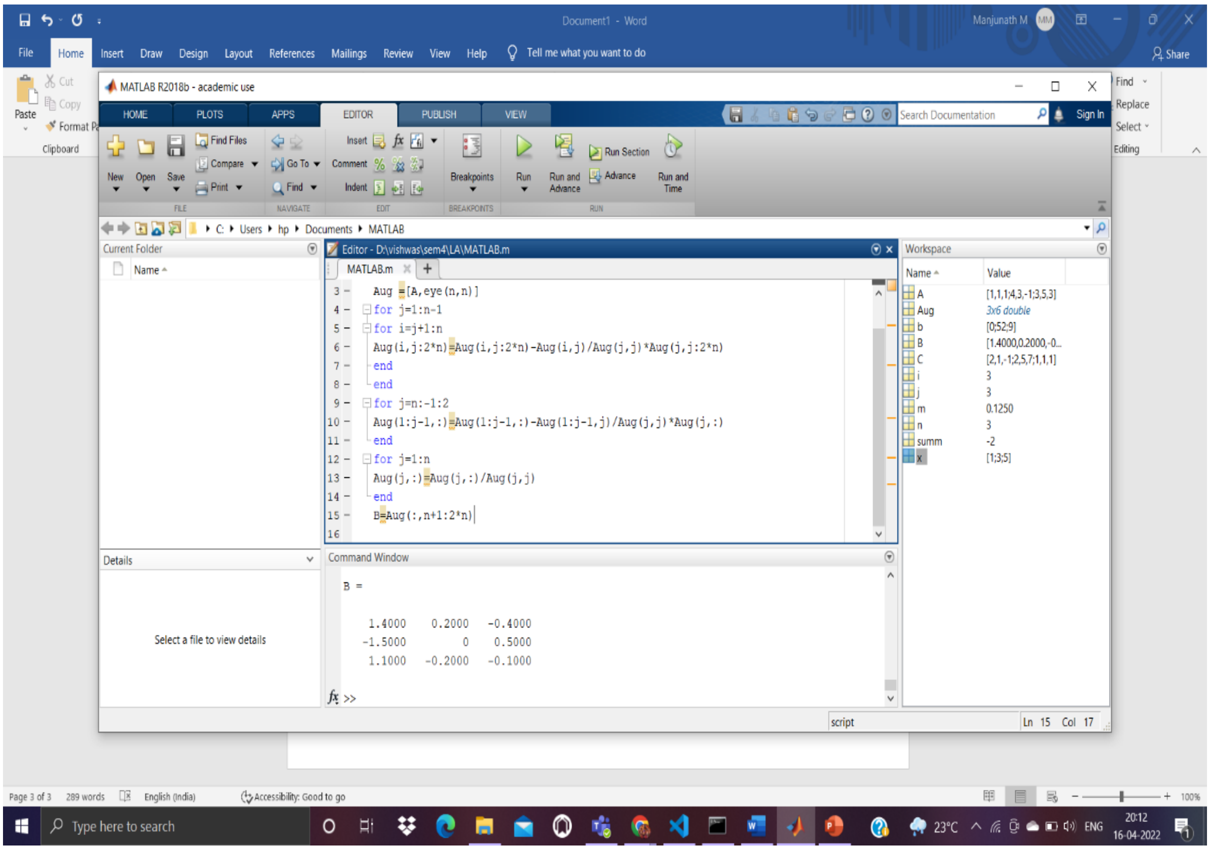
2) Gauss - Jordan Method To find Inverse:

I)Find by Gauss Jordan Method $A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}$

```
A =[1,1,1;4,3,-1;3,5,3];
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:j1,:)=Aug(1:j1,:)Aug(1:j1,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)
```

Output:

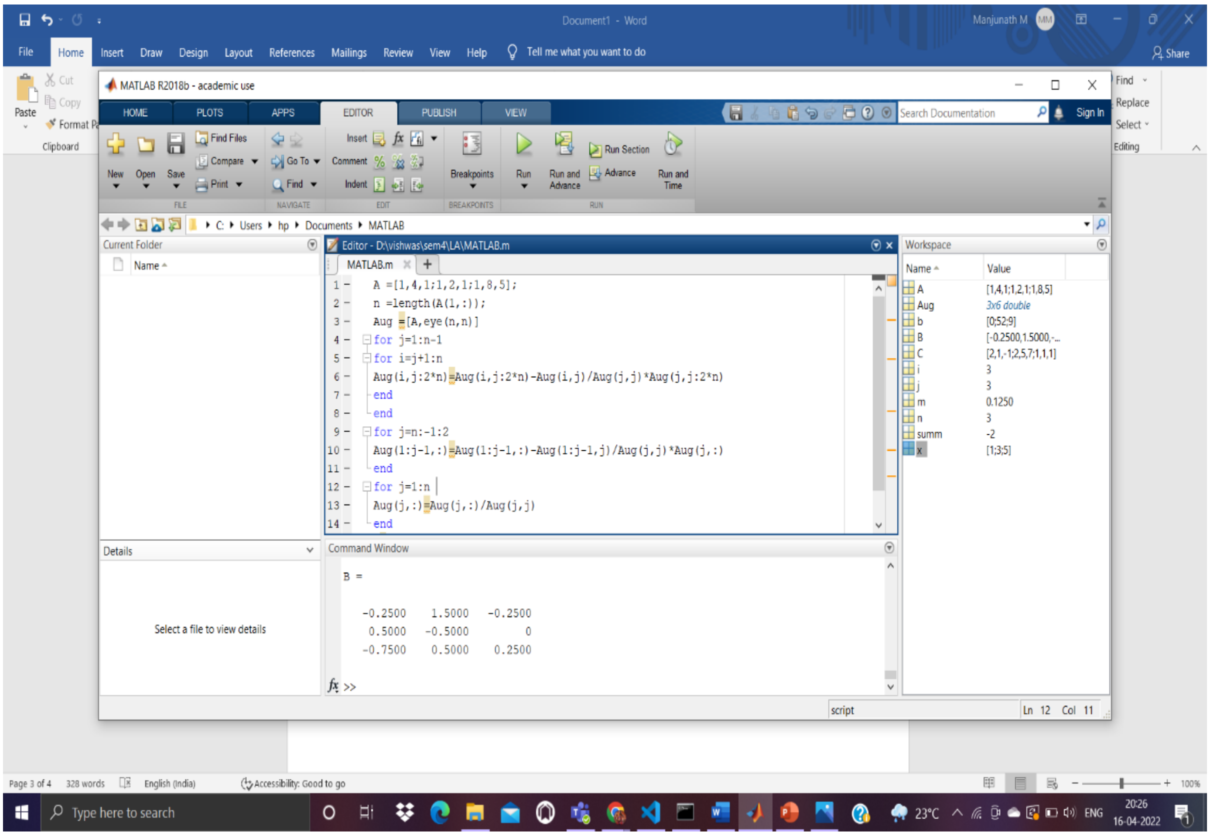


ii)Find by Gauss Jordan Method $A = \begin{bmatrix} 1 & 4 & 1 \\ 1 & 2 & 1 \\ 1 & 8 & 5 \end{bmatrix}$

```
A =[1,4,1;1,2,1;1,8,5];
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:j1,:)=Aug(1:j1,:) Aug(1:j1,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)
```

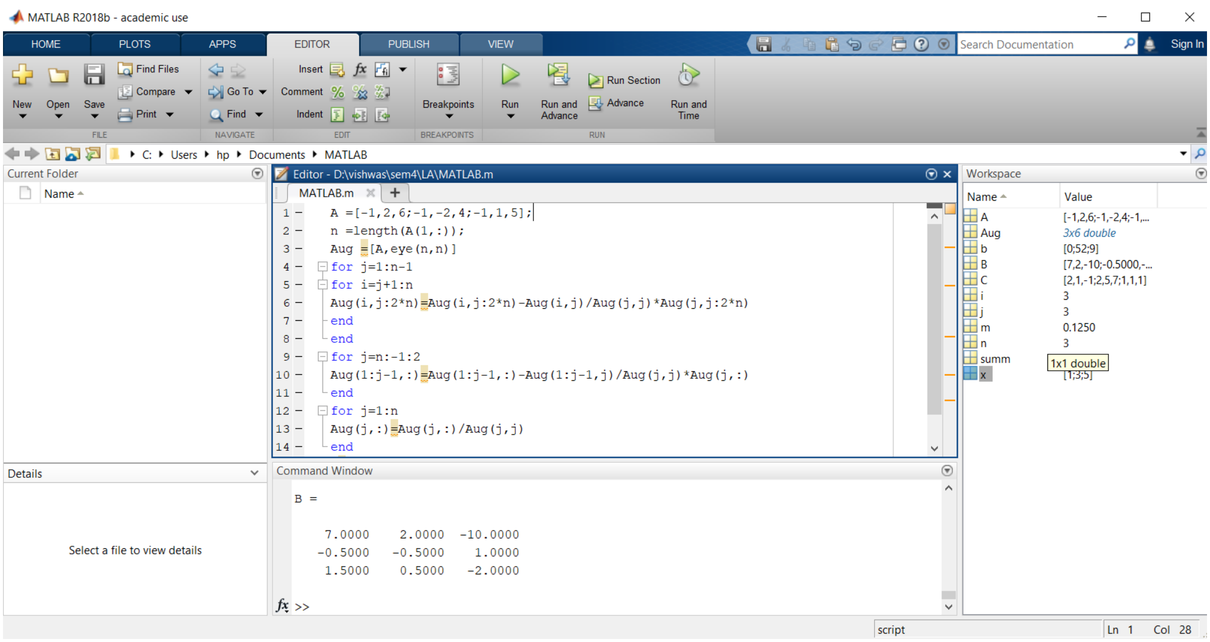
Output:



iii) Find by Gauss Jordan Method $A = \begin{bmatrix} -1 & 2 & 6 \\ -1 & -2 & 4 \\ -1 & 1 & 5 \end{bmatrix}$

```
A =[-1,2,6;-1,-2,4;-1,1,5];
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:j1,:)=Aug(1:j1,:) Aug(1:j1,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)
```

Output:

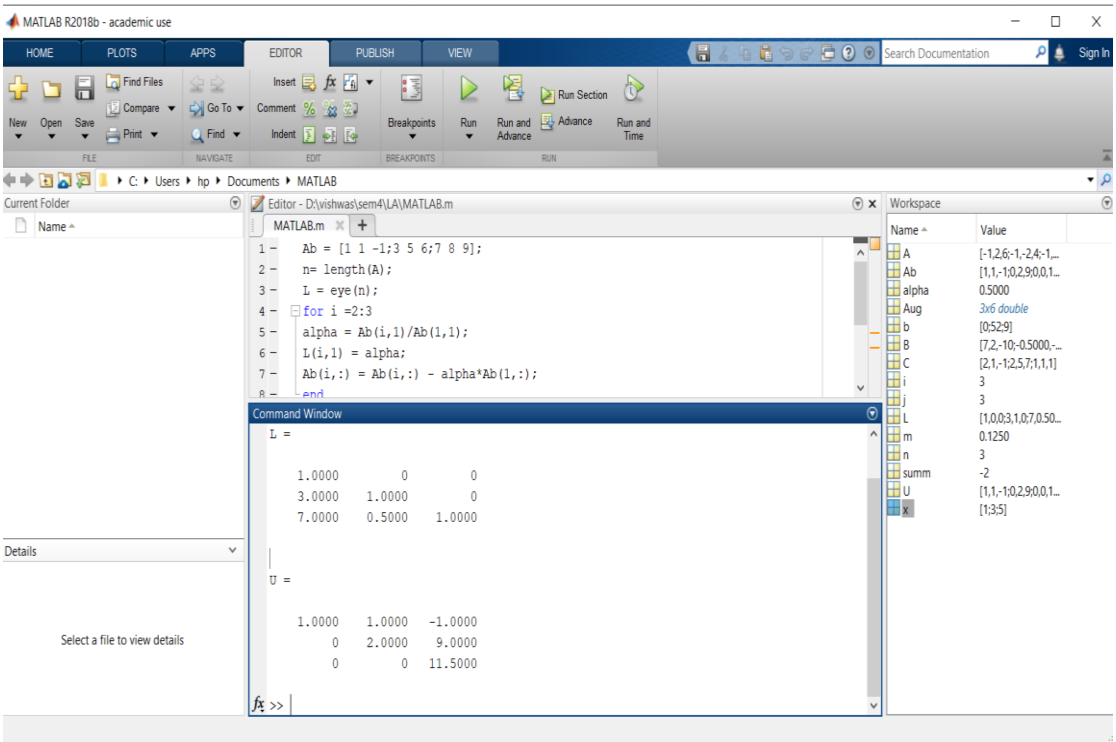


3) **LU Decomposition Method:**

I) $A = \begin{bmatrix} 1 & 1 & -1 \\ 3 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$

```
Ab = [1 1 -1;3 5 6;7 8 9];
n= length(A);
L = eye(n);
for i =2:3
alpha = Ab(i,1)/Ab(1,1);
L(i,1) = alpha;
Ab(i,:) = Ab(i,:) - alpha*Ab(1,:);
end
i=3;
alpha = Ab(i,2)/Ab(2,2);
L(i,2) = alpha
Ab(i,:) = Ab(i,:) - alpha*Ab(2,:);
U = Ab(1:n,1:n)
```

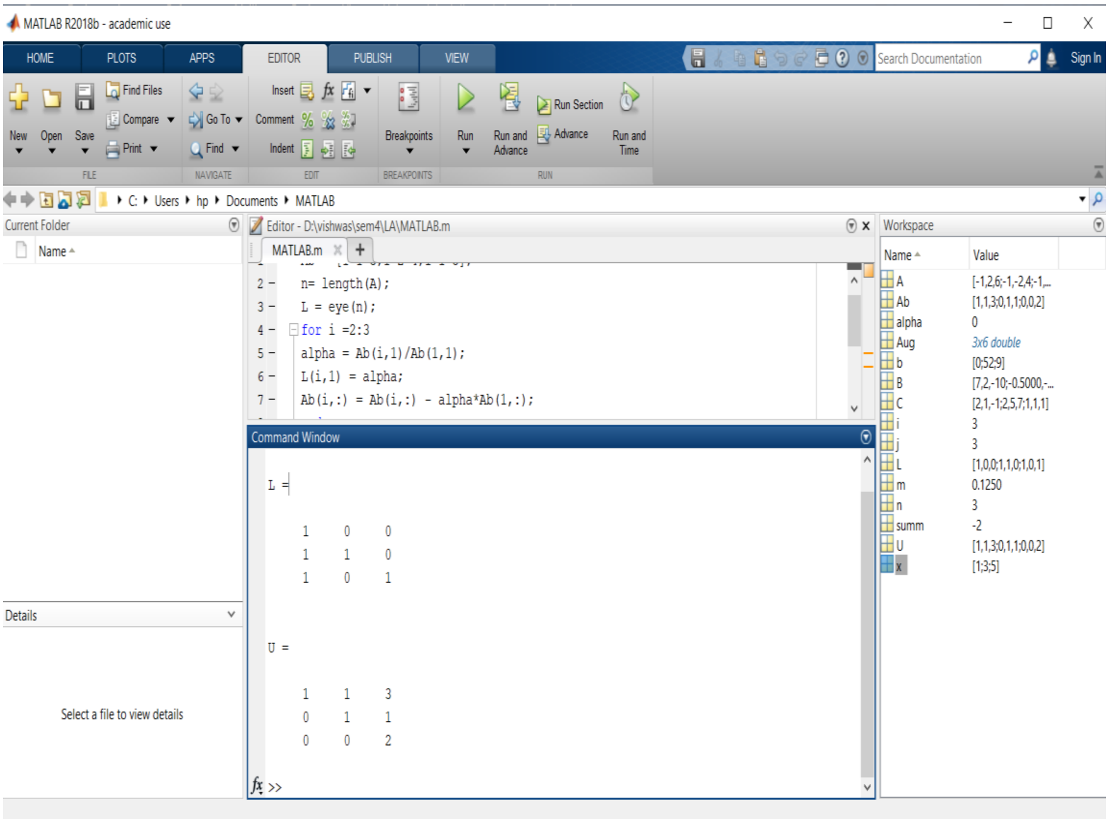
Output:



ii) $A = \begin{bmatrix} -1 & 2 & 6 \\ -1 & -2 & 4 \\ -1 & 1 & 5 \end{bmatrix}$

```
Ab = [1 1 3;1 2 4;1 1 5];
n= length(A);
L = eye(n);
for i =2:3
alpha = Ab(i,1)/Ab(1,1);
L(i,1) = alpha;
Ab(i,:) = Ab(i,:) - alpha*Ab(1,:);
end
i=3;
alpha = Ab(i,2)/Ab(2,2);
L(i,2) = alpha
Ab(i,:) = Ab(i,:) - alpha*Ab(2,:);
U = Ab(1:n,1:n)
```

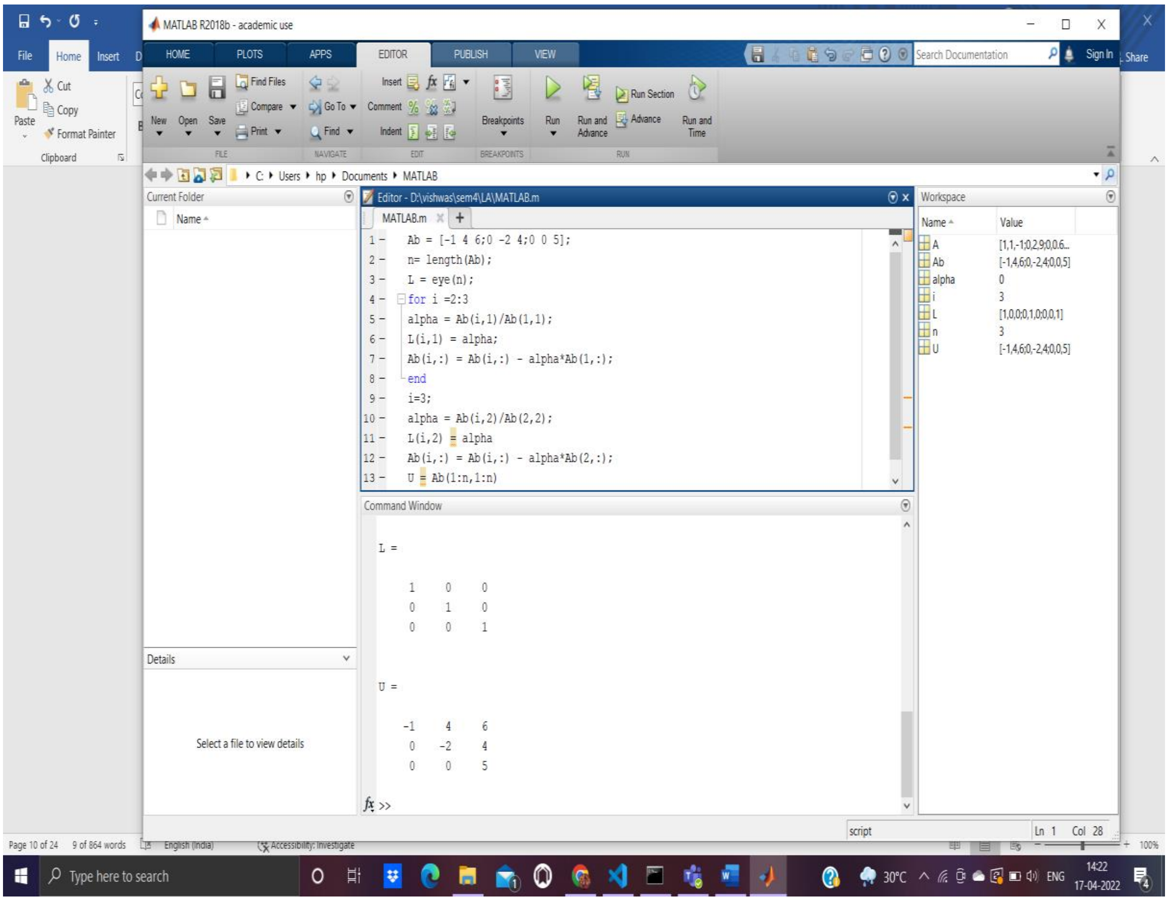
Output:



iii) $A = \begin{bmatrix} -1 & 4 & 6 \\ 0 & -2 & 4 \\ 0 & 0 & 5 \end{bmatrix}$

```
 Ab = [-1 4 6;0 -2 4;0 0 5];
n= length(A);
L = eye(n);
for i =2:3
alpha = Ab(i,1)/Ab(1,1);
L(i,1) = alpha;
Ab(i,:) = Ab(i,:) - alpha*Ab(1,:);
end
i=3;
alpha = Ab(i,2)/Ab(2,2);
L(i,2) = alpha
Ab(i,:) = Ab(i,:) - alpha*Ab(2,:);
U = Ab(1:n,1:n)
```

Output:



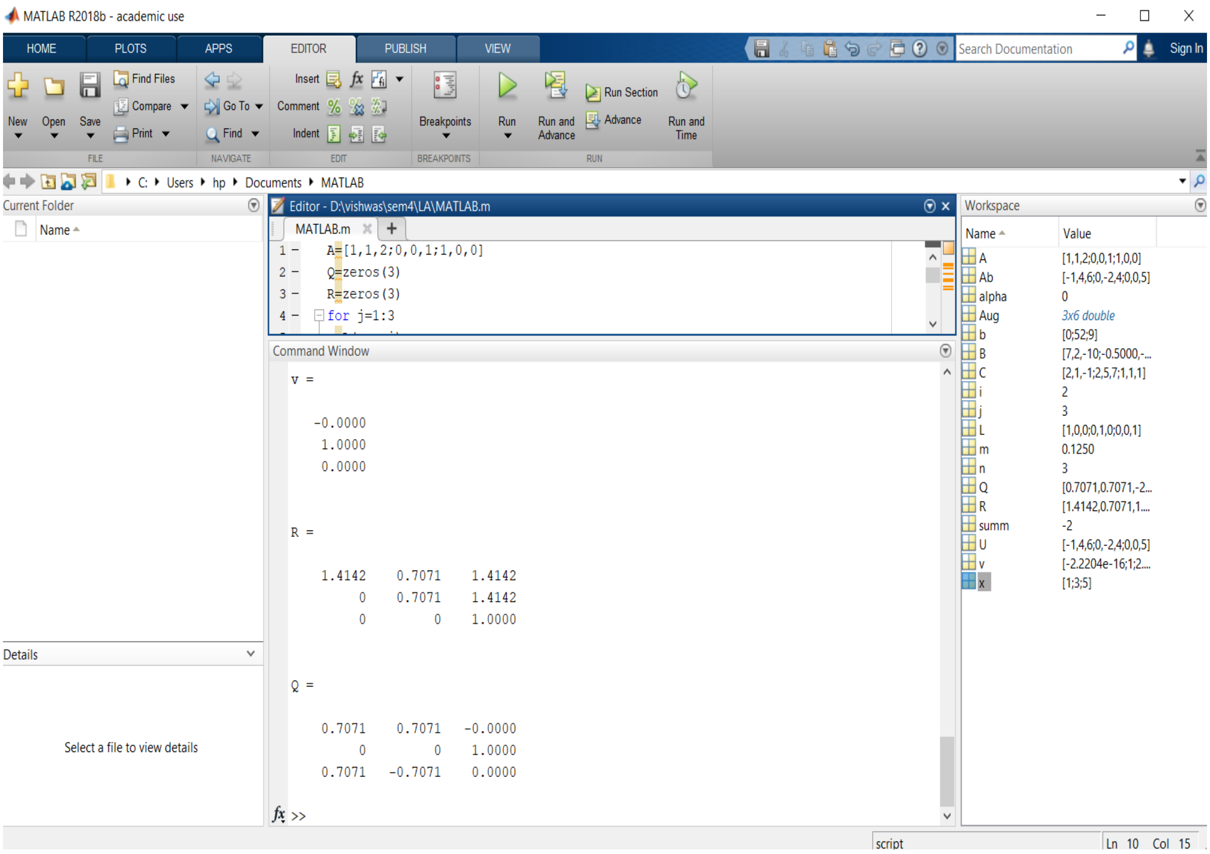
4) Grams- Schmidt Orthogonalization process:

i) Apply the Gram-Schmidt process to the vectors (1,0,1), (1,0,0) and (2,1,0) to produce a set of Orthonormal vectors.

```
A=[1,1,2;0,0,1;1,0,0]
Q=zeros(3)
R=zeros(3)
```

```
for j=1:3
v=A(:  ,  j)
for i=1:j-1
R(i,j)=Q(:,i)'*A(:,j)
v=v-R(i,j)*Q(:,i)
end
R(j,j)=norm(v)
Q(:,j)=v/R(j,j)
end
```

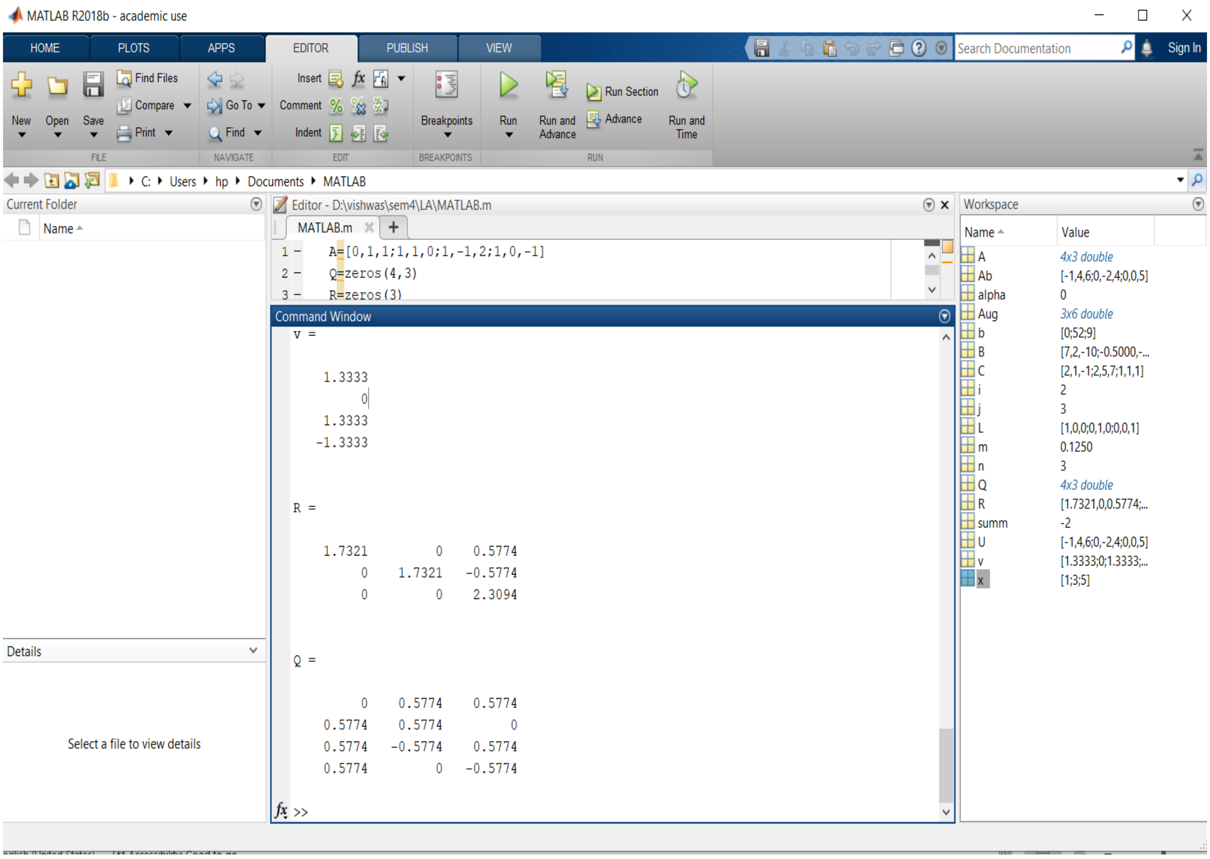
Output:



ii)Apply the Gram-Schmidt process to the vectors a=(0,1,1,1), b=(1,1,-1,0) and c=(1,0,2,-1).

```
A=[0,1,1;1,1,0;1,-1,2;1,0,-1]
Q=zeros(4,3)
R=zeros(3)
for j=1:3
v=A(: , j)
for i=1:j-1
R(i,j)=Q(:,i)'*A(:,j)
v=v-R(i,j)*Q(:,i)
end
R(j,j)=norm(v)
Q(:,j)=v/R(j,j)
end
```

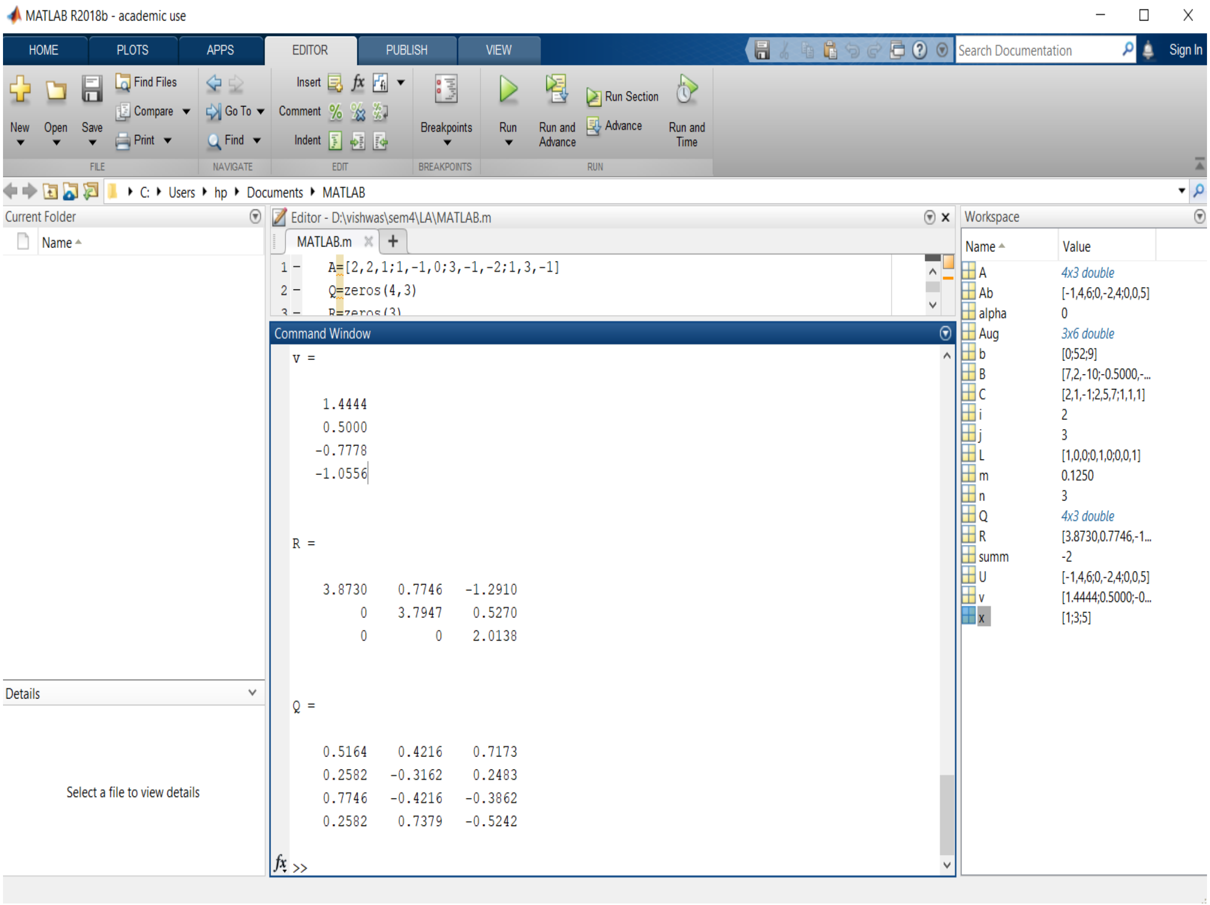
Output:



iii)Apply the Gram-Schmidt process to the vectors a=(0,1,1,1), b=(1,1,-1,0) and c=(1,0,2,-1).

```
A=[2,2,1;1,-1,0;3,-1,-2;1,3,-1]
Q=zeros(4,3)
R=zeros(3)
for j=1:3
v=A(: , j)
for i=1:j-1
R(i,j)=Q(:,i)'*A(:,j)
v=v-R(i,j)*Q(:,i)
end
R(j,j)=norm(v)
Q(:,j)=v/R(j,j)
end
```

Output:



In-Built Functions:

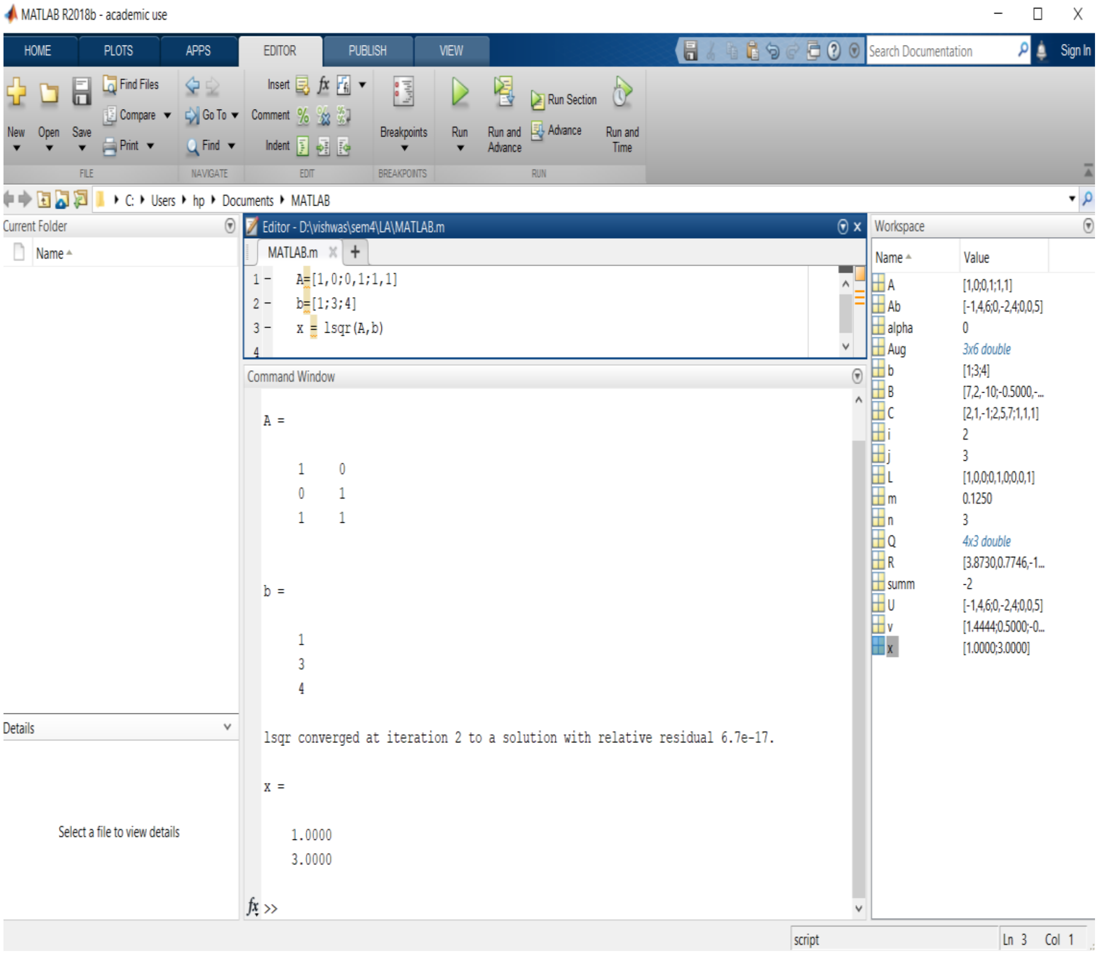
1) **Projection matrices:**

i) Find the projection for the matrix $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$, $b = \begin{bmatrix} 1 \\ 3 \\ 4 \end{bmatrix}$

$u = \begin{bmatrix} u \\ v \end{bmatrix}$

```
A=[1,0;0,1;1,1]
b=[1;3;4]
x = lsqr(A,b)
```

Output:

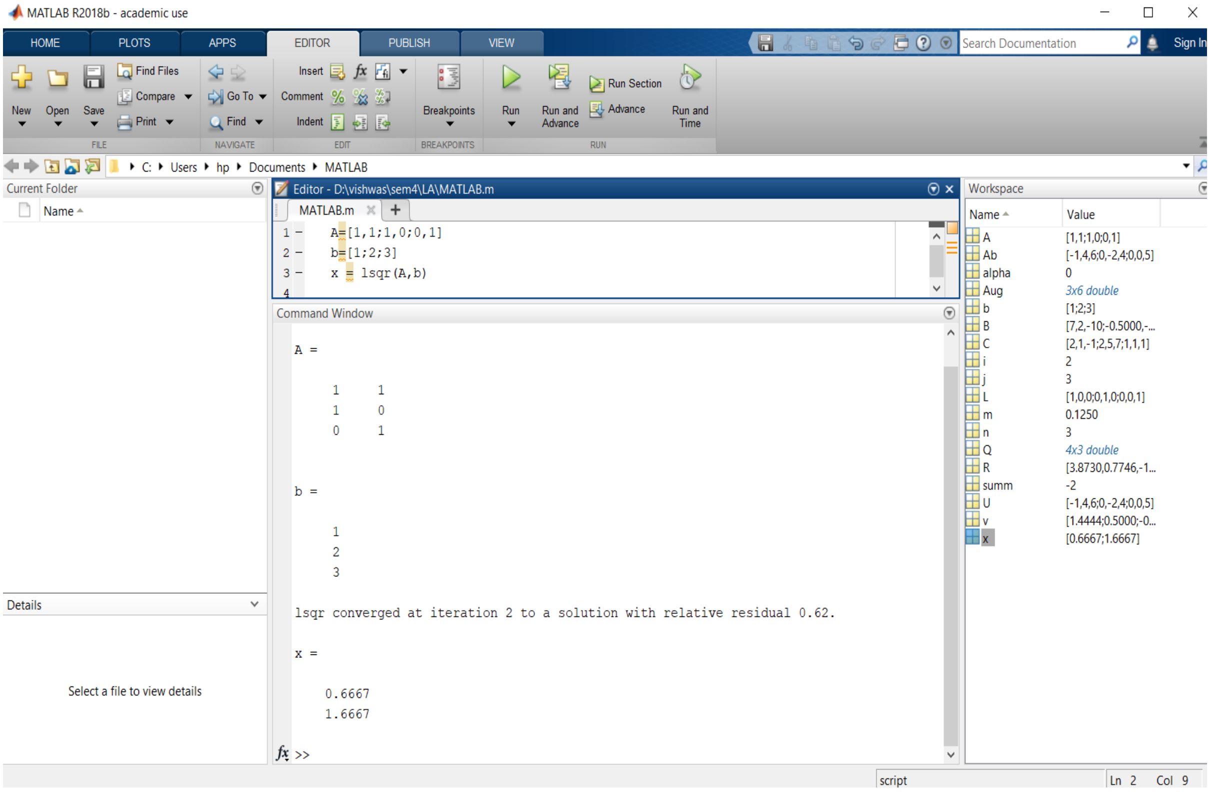


ii)Find the projection for the matrix $A = \begin{bmatrix} 1 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}$, $b = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

$u = \begin{bmatrix} u \\ v \end{bmatrix}$

```
A=[1,1;1,0;0,1]
b=[1;2;3]
x = lsqr(A,b)
```

Output:

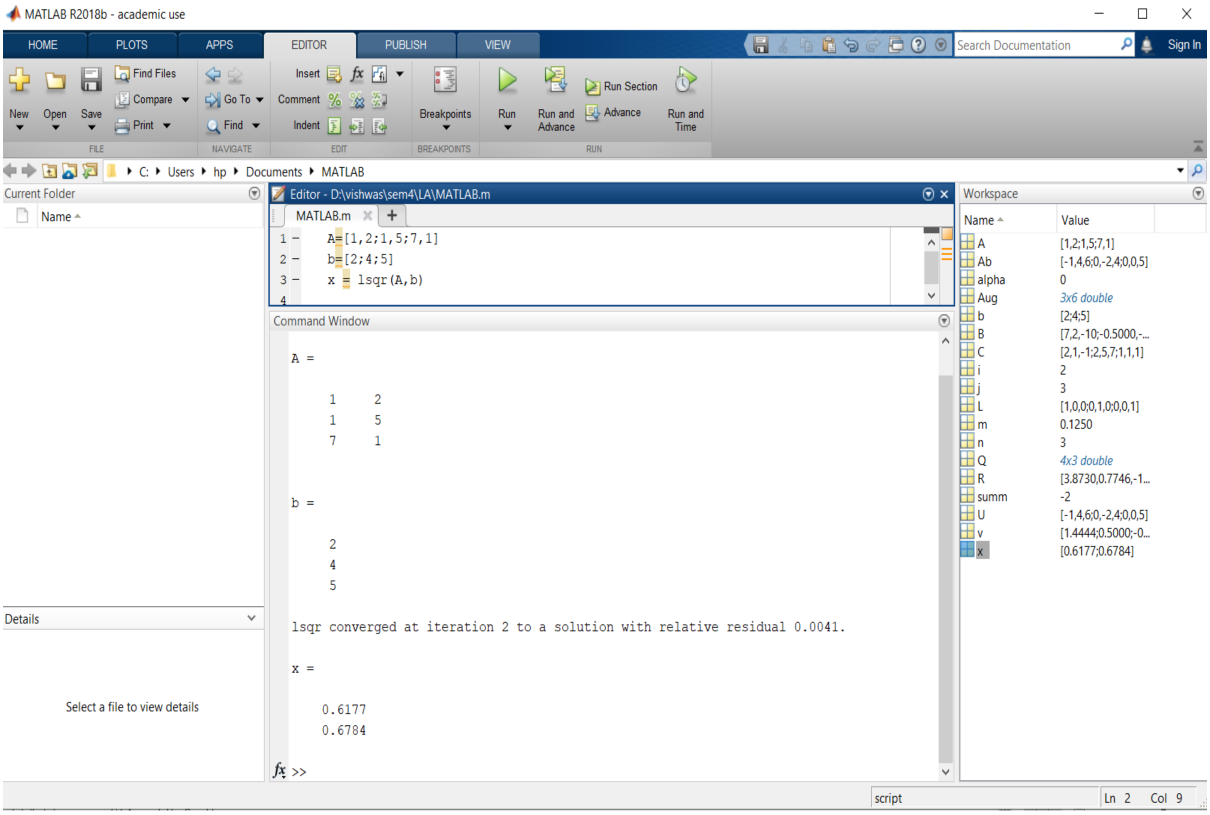


iii) Find the projection for the matrix $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$, $b = \begin{bmatrix} 1 \\ 3 \\ 4 \end{bmatrix}$

$u = \begin{bmatrix} u \\ v \end{bmatrix}$

```
A=[1,2;1,5;7,1]
b=[2;4;5]
x = lsqr(A,b)
```

Output:



2) **least squares:**

i) Let $u = \begin{bmatrix} 1 \\ 7 \end{bmatrix}$ onto $v = \begin{bmatrix} -4 \\ 2 \end{bmatrix}$ and find P, the matrix that will project. any matrix onto the vector v. Use the result to find projv u.

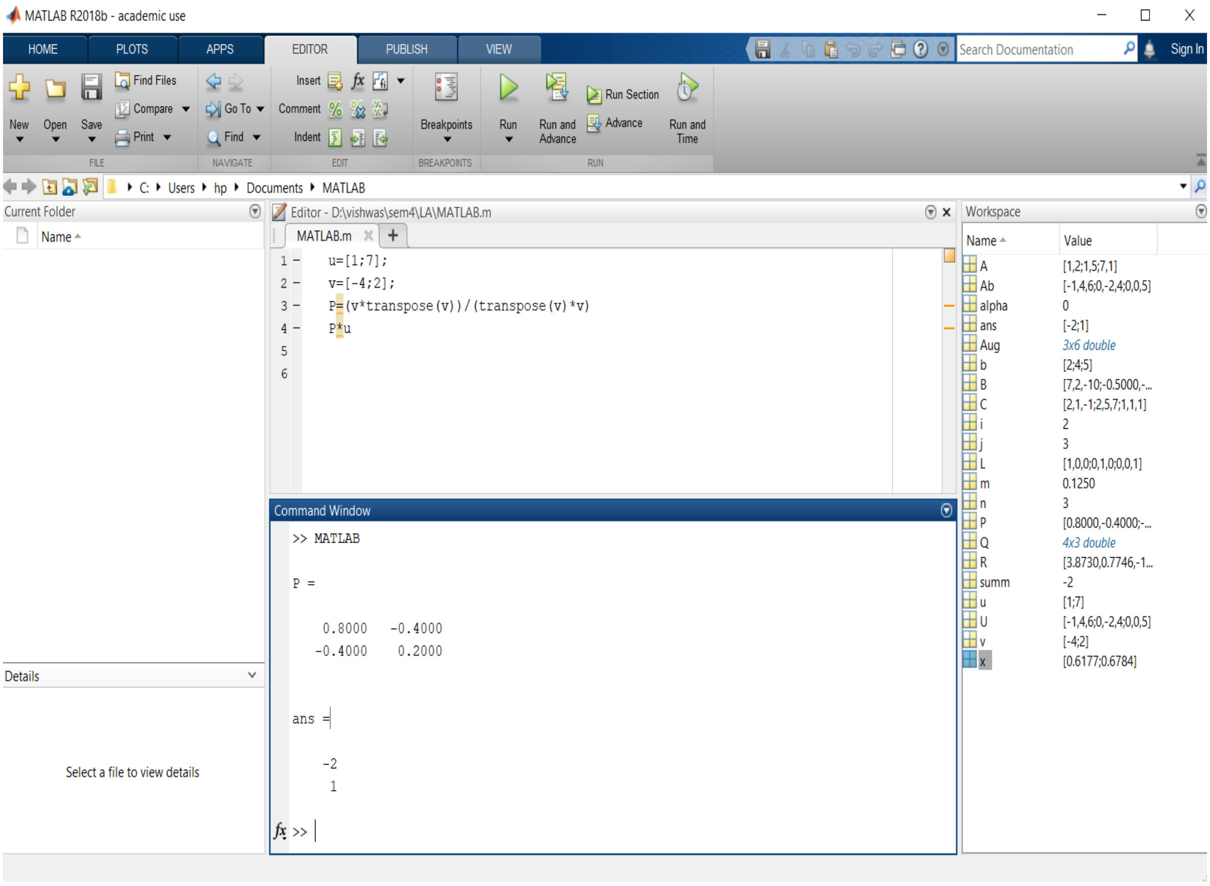
u=[1;7]

v=[-4;2]

P=(v*transpose(v))/(transpose(v)*v)

P*u

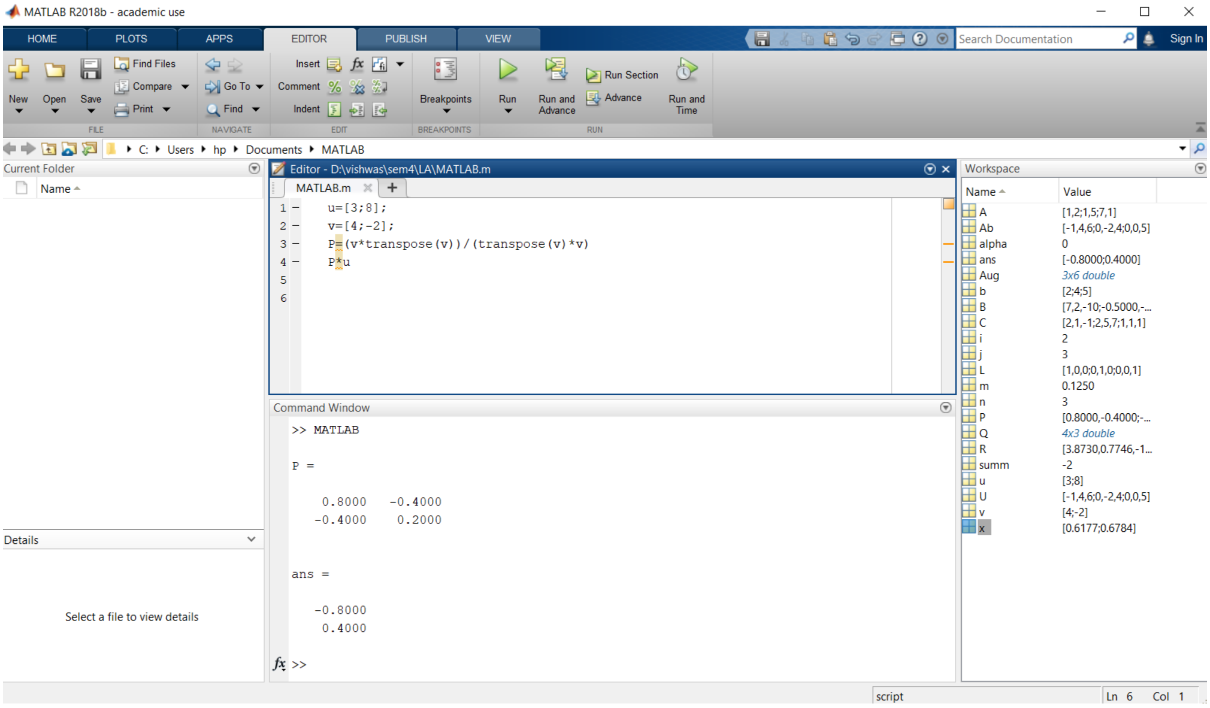
Output:



ii) Let $u = \begin{bmatrix} 3 \\ 8 \end{bmatrix}$ onto $v = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$ and find P, the matrix that will project. any matrix onto the vector v. Use the result to find projv u.

```
u=[3;8];
v=[4;-2];
P=(v*transpose(v))/(transpose(v)*v)
P*u
```

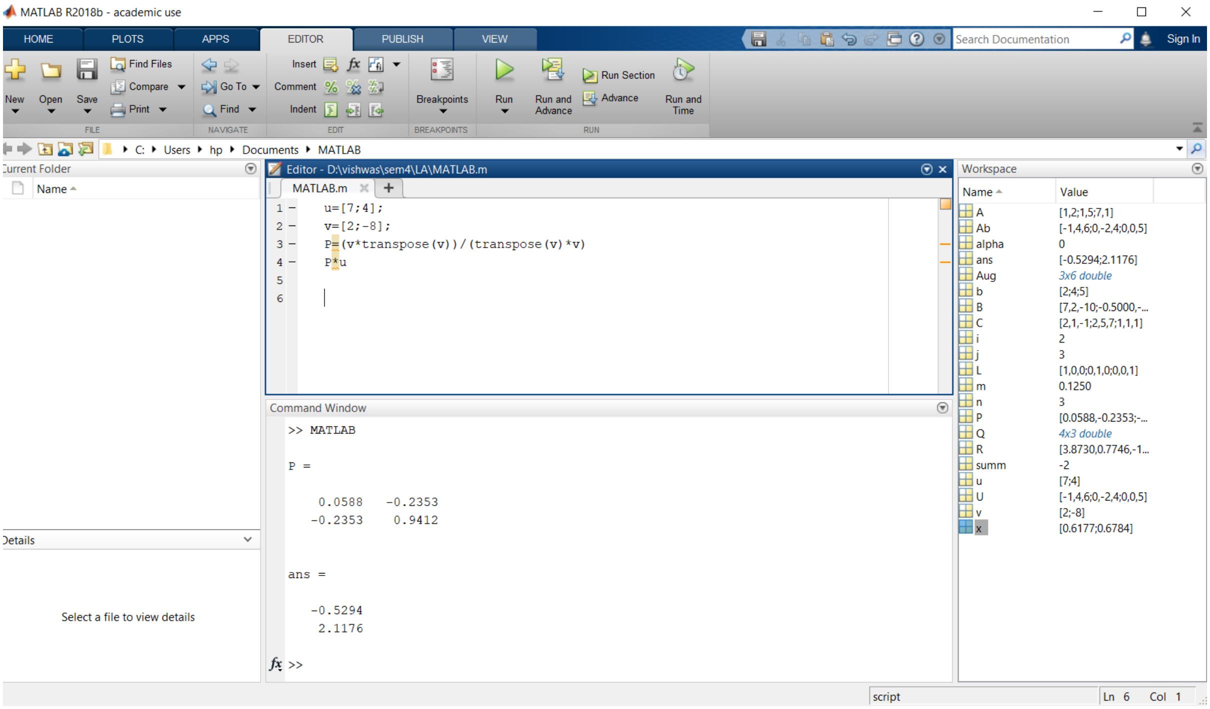
Output:



iii) Let $u = \begin{bmatrix} 7 \\ 4 \end{bmatrix}$ onto $v = \begin{bmatrix} 2 \\ -8 \end{bmatrix}$ and find P, the matrix that will project. any matrix onto the vector v. Use the result to find projv u.

```
u=[7;4];
v=[2;-8];
P=(v*transpose(v))/(transpose(v)*v)
P*u
```

Output:



3) Eigen values and Eigen vectors:

i)Find the eigenvalues and the corresponding eigenvectors of the matrix A=[1,1,3;1,5,1;3,1,1].

Ans: A=[1,1,3;1,5,1;3,1,1]

e=eig(A)

det(A)

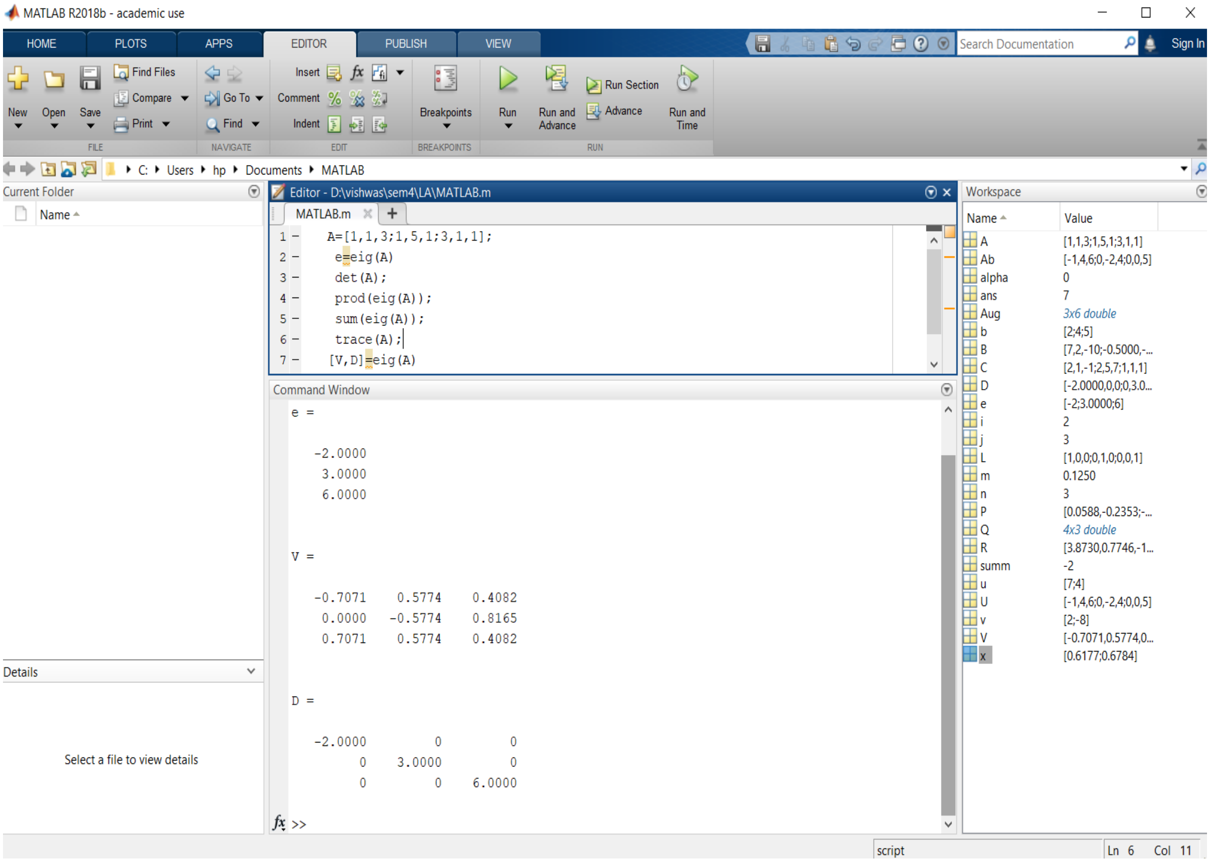
prod(eig(A))

sum(eig(A))

trace(A)

[V,D]=eig(A)

Output:



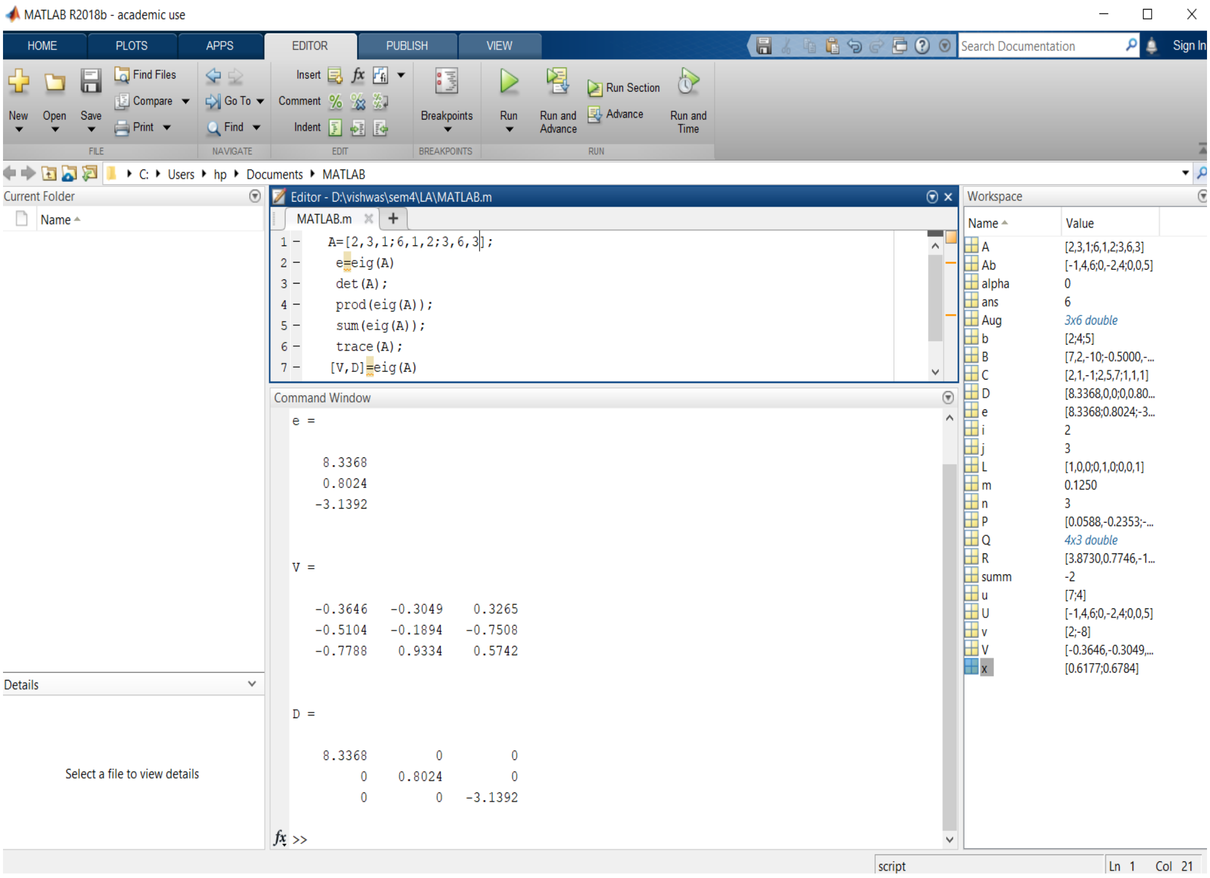
ii) Find the eigenvalues and the corresponding eigenvectors of the matrix

```
A=[2,3,1;6,1,2;3,6,3];
```

Ans:

```
A=[2,3,1;6,1,2;3,6,3];
e=eig(A)
det(A);
prod(eig(A));
sum(eig(A));
trace(A);
[V,D]=eig(A)
```

Output:



iii) Find the eigenvalues and the corresponding eigenvectors of the matrix

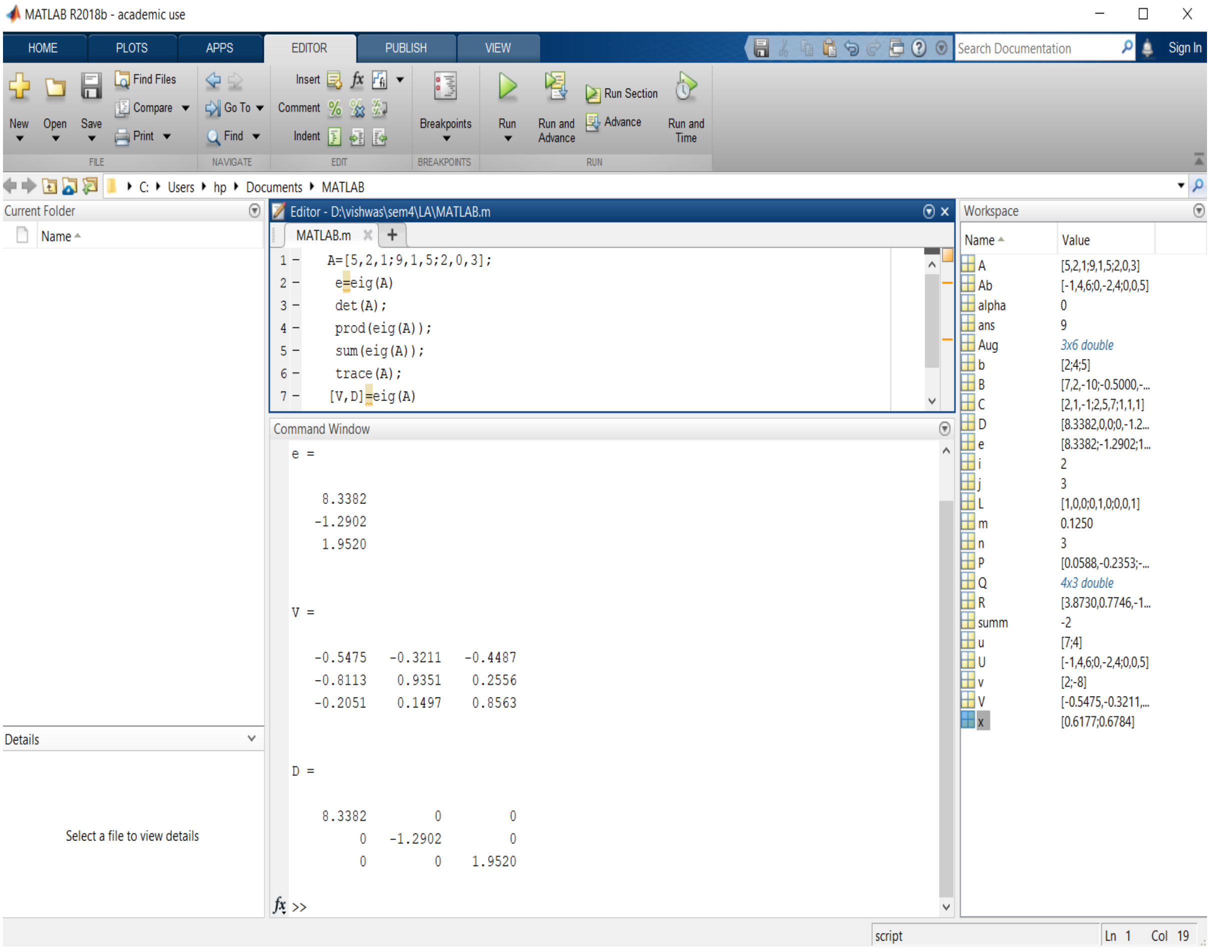
```
A=[5,2,1;9,1,5;2,0,3];
```

Ans:

```
A=[5,2,1;9,1,5;2,0,3];
e=eig(A)
det(A);
prod(eig(A));
sum(eig(A));
```

```
trace(A);
[V,D]=eig(A)
```

Output

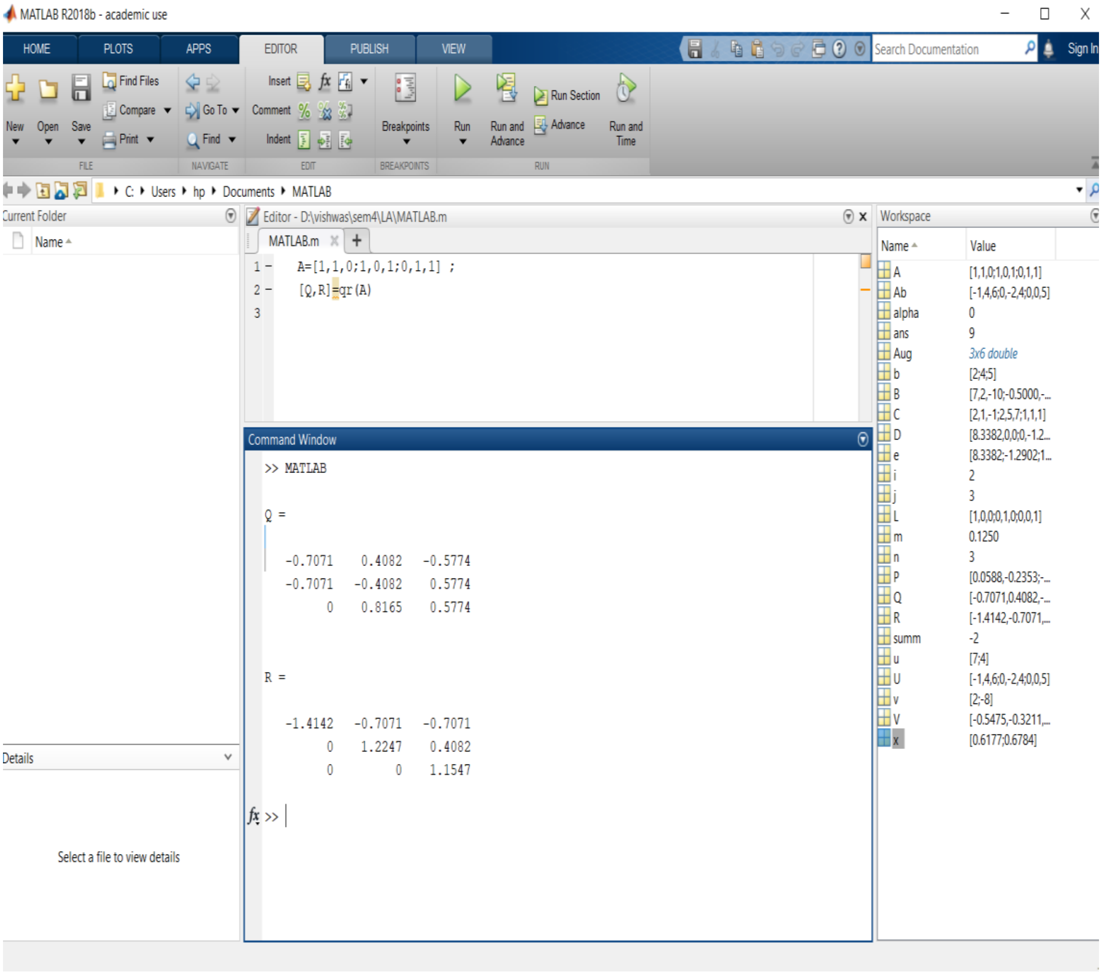


4) **QR Decomposition with Gram-Schmidt:**

i) Find QR factorization of the matrix $A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$

```
A=[1,1,0;1,0,1;0,1,1]
[Q,R]=qr(A)
```

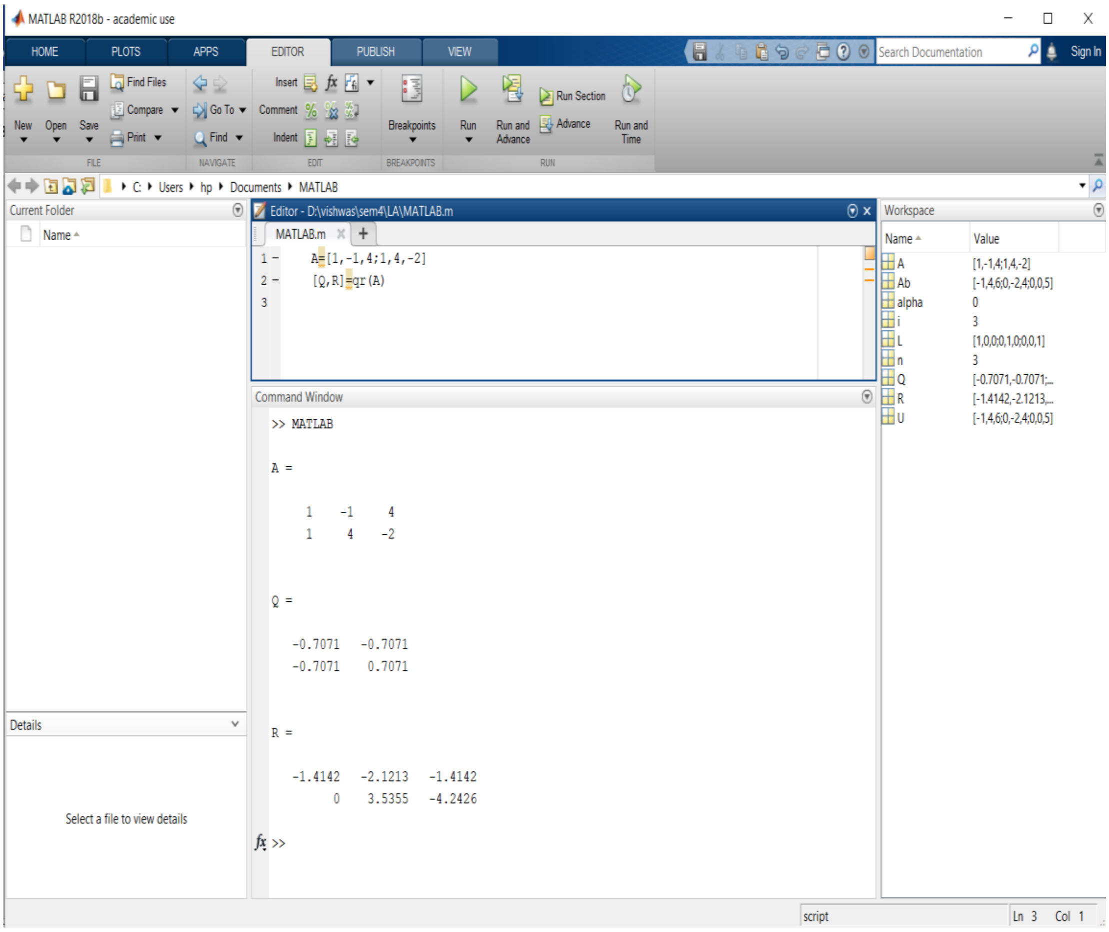
Output:



ii) Find QR factorization of the matrix $A = \begin{bmatrix} 1 & -1 & 4 \\ 1 & 4 & -2 \end{bmatrix}$

```
A=[1,-1,4;1,4,-2]
[Q,R]=qr(A)
```

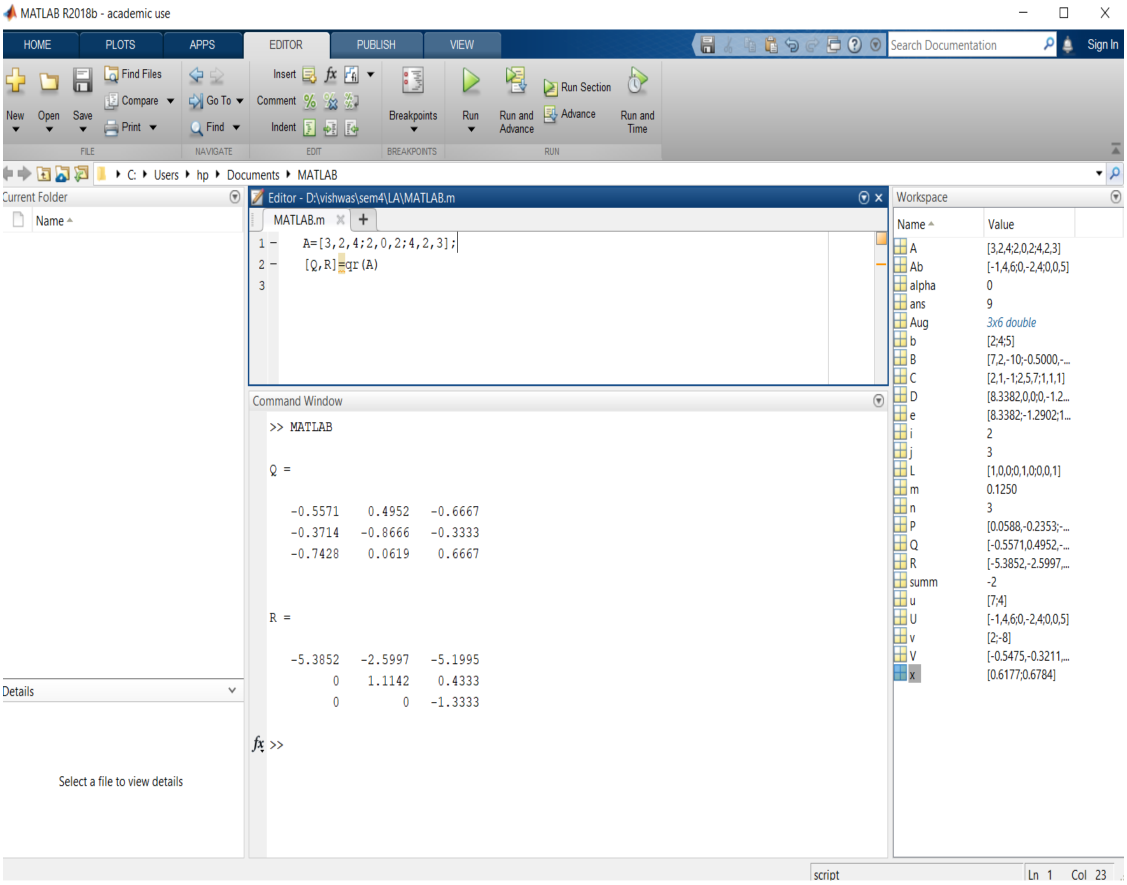
Output:



iii) Find QR factorization of the matrix $A = \begin{bmatrix} 3 & 2 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 3 \end{bmatrix}$

```
A=[3,2,4;2,0,2;4,2,3]
[Q,R]=qr(A)
```

Output:


MATLAB R2018b - academic use
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
Search Documentation
Sign In
Editor - D:\vishwas\sem4\LA\MATLAB.m
MATLAB.m
1 A=[3,2,4;2,0,2;4,2,3];
2 [Q,R]=qr(A)
3
Command Window
>> MATLAB
Q =
-0.5571 0.4952 -0.6667
-0.3714 -0.8666 -0.3333
-0.7428 0.0619 0.6667
R =
-5.3852 -2.5997 -5.1995
0 1.1142 0.4333
0 0 -1.3333
Workspace
Name
Value
A [3,2,4;2,0,2;4,2,3]
Ab [-1,4,6;0,-2,4;0,0,5]
alpha 0
ans 9
Aug 3x6 double
b [2;4;5]
B [7,2,-10;-0.5000,-...
C [2,1,-1;2,5,7;1,1,1]
D [8.3382,0,0;0,-1.2...
e [8.3382;-1.2902;1...
i 2
j 3
L [1,0,0;0,1,0;0,0,1]
m 0.1250
n 3
P [0.0588,-0.2353;-...
Q [-0.5571,0.4952,-...
R [-5.3852,-2.5997,...
summ -2
u [7;4]
U [-1,4,6;0,-2,4;0,0,5]
v [2;-8]
V [-0.5475,-0.3211,...
x [0.6177;0.6784]
Current Folder
Details
Select a file to view details
script
Ln 1 Col 23