Department of Computer Science and Engineering

Scilab

LINEAR ALGEBRA AND ITS APPLICATIONS -UE19MA251

Session: Jan-May 2021

NAME OF THE STUDENT : Trisha Jain

SRN : PES1UG19CS542

BRANCH : COMPUETR SCIENCE AND ENGINEERING

SEMESTER & SECTION : IV

INDEX

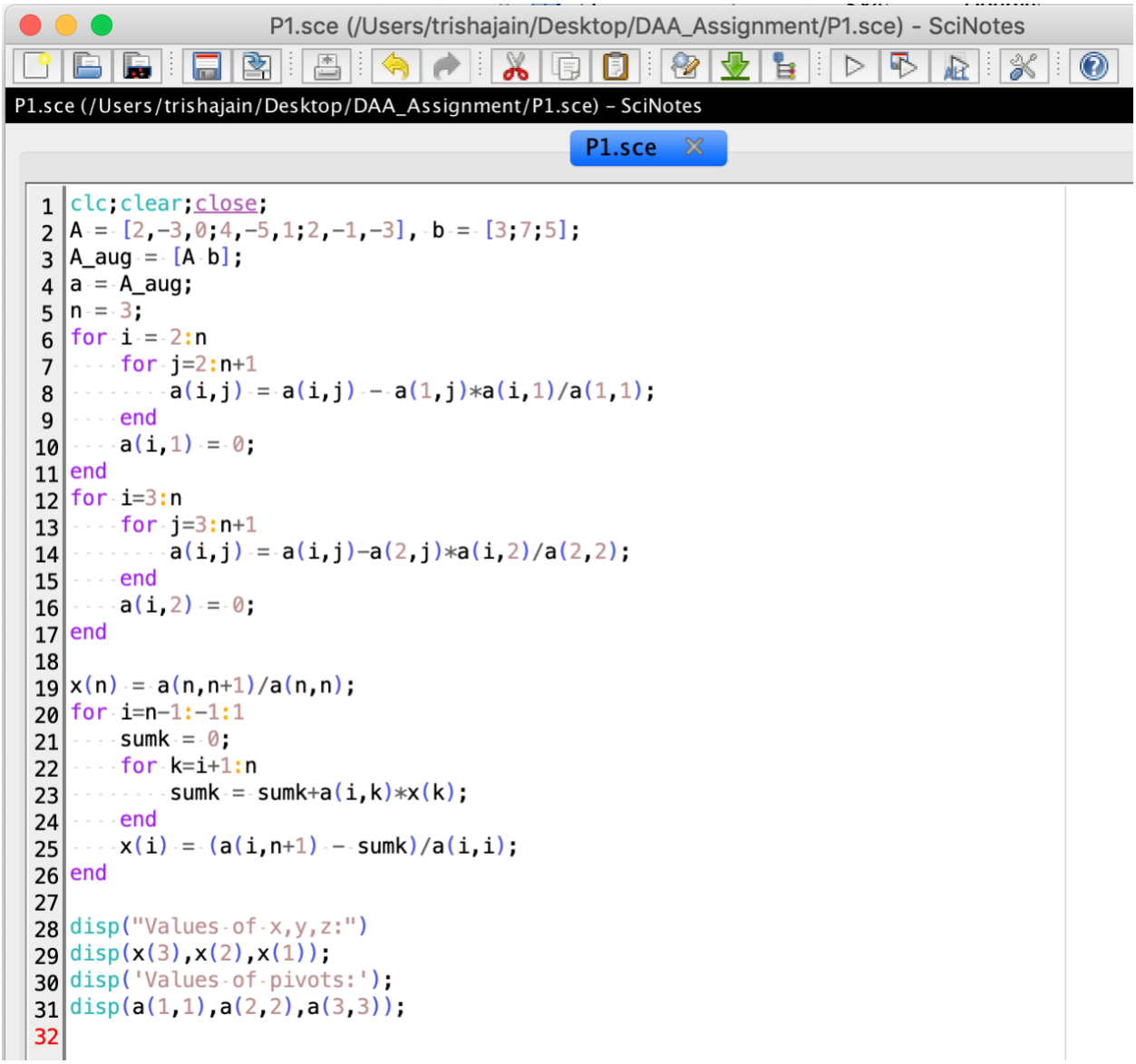
15-16	**Find the line of best fit Ax=b for the following system** $Ax=\begin{pmatrix}1 & -1\\ 1 & 0\\ 1 & 1\end{pmatrix}\begin{pmatrix}C\\ D\end{pmatrix}$, $b=\begin{pmatrix}4\\ 5\\ 9\end{pmatrix}$
17-18	**Apply the Gram – Schmidt process to the following set of vectors and find the orthogonal matrix: (1, 0, 1) , (1, 1, 0) , (2, 1, 1)**
19-20	**Find the Eigen values and the corresponding Eigen vectors of the following matrix:** $\begin{pmatrix}2 & 2 & 1\\ 1 & 3 & 1\\ 1 & 2 & 2\end{pmatrix}$

Topic : Gaussian Elimination

Q1) Solve the following system of equations by Gaussian Elimination. Identify the pivots.

$2x - 3y = 3$, $4x - 5y + z = 7$, $2x - y - 3z = 5$

A) Scilab Code :-



Console Screenshot :-

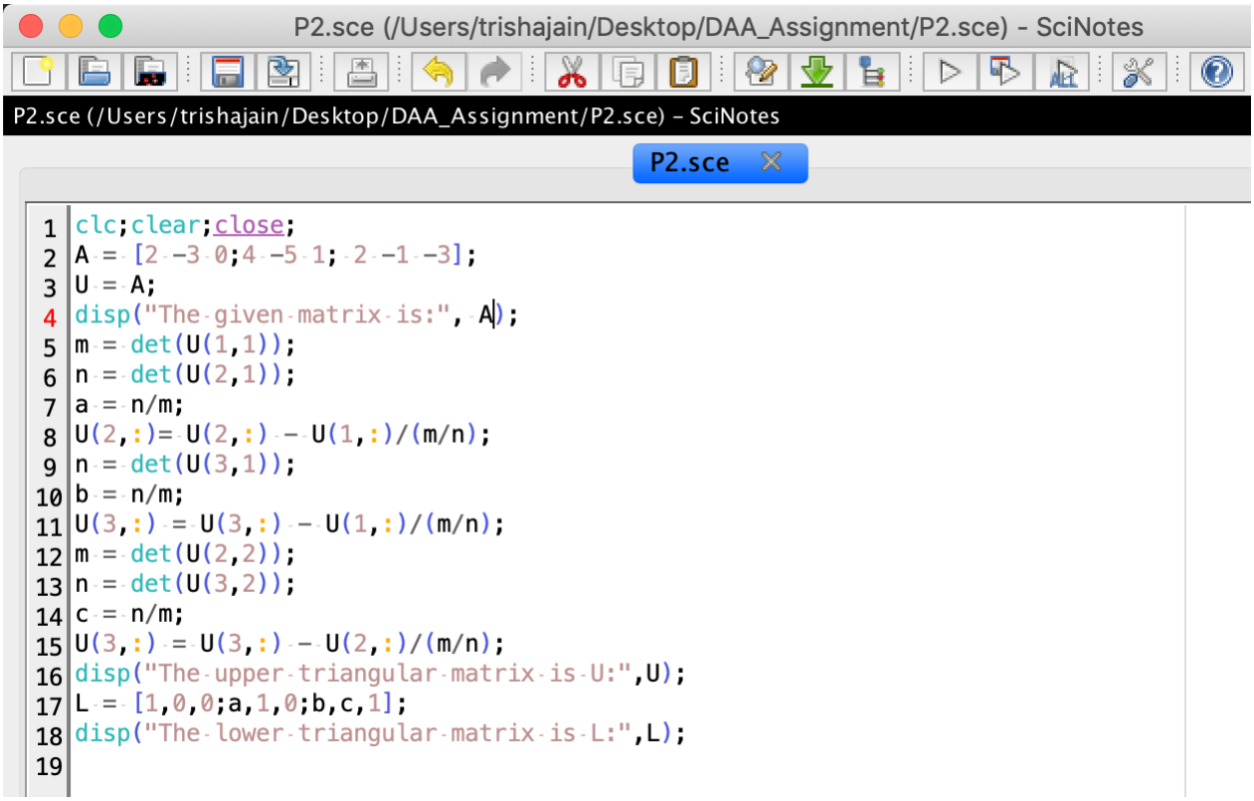
```
  "Values of x,y,z:"
   0.
   1.
   3.
  "Values of pivots:"
   2.
   1.
  -5.
--> |
```

Topic: LU decomposition of a matrix

Q2) Solve the system of equations by decomposing A as a product A = LU

2x – 3y = 3, 4x – 5y + z = 7, 2x – y – 3z = 5

A) Scilab Code :-




```
clc;clear;close;
A = [2 -3 0;4 -5 1; 2 -1 -3];
U = A;
disp("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("The upper triangular matrix is U:",U);
L = [1,0,0;a,1,0;b,c,1];
disp("The lower triangular matrix is L:",L);

```

Console Screenshot :-

```
"The given matrix is:"

 2.  -3.   0.
 4.  -5.   1.
 2.  -1.  -3.

"The upper triangular matrix is U:"

 2.  -3.   0.
 0.   1.   1.
 0.   0.  -5.

"The lower triangular matrix is L:"

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

Topic: The Gauss - Jordan method of calculating A^{-1}

Q3) Find the inverse of the following matrix:

$$\begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$$

A) Scilab code :-

P3.sce (/Users/trishajain/Desktop/DAA_Assignment/P3.sce) - SciNotes

P3.sce (/Users/trishajain/Desktop/DAA_Assignment/P3.sce) - SciNotes

P3.sce

```
clc;clear;close;
A = [1 0 0;1 1 1;0 0 1];
n = length(A(1,:));
Aug = [A,eye(n,n)];
//Forward Elimination
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
//Backward Elimination
for j = n:-1:2
    Aug(1:j-1,:) = Aug(1:j-1,:)-Aug(1:j-1,j)/Aug(j,j)*Aug(j,:);
end
//Diagonal Normalization
for j=1:n
    Aug(j,:) = Aug(j,:)/Aug(j,j);
end
B = Aug(:,n+1:2*n);
disp("The inverse of A is:");
disp(B);

```

Console Screenshot :-

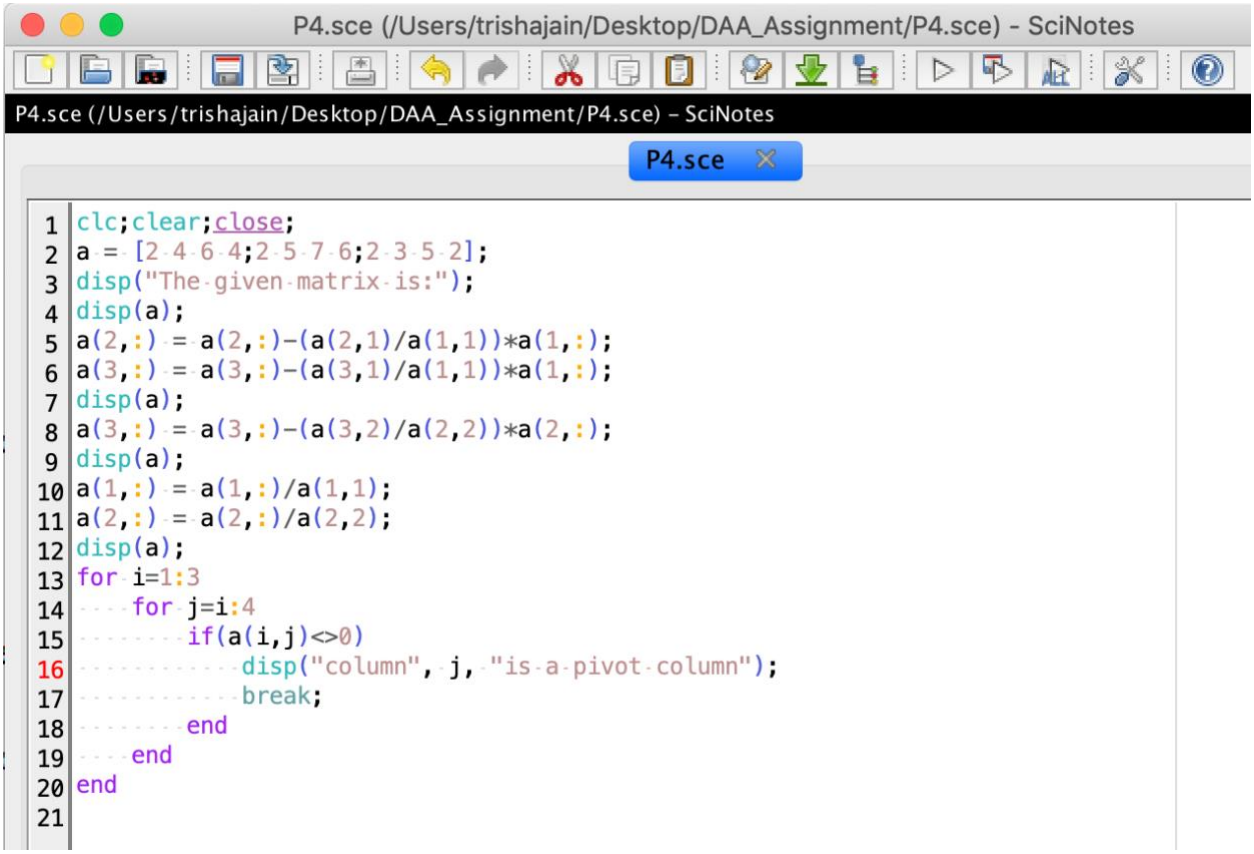
```
"The inverse of A is:"

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

Topic: Span of the Column Space of A

Q4) Identify the columns that span the column space of A in the following case

$$A=\begin{pmatrix} 2 & 4 & 6 & 4 \\ 2 & 5 & 7 & 6 \\ 2 & 3 & 5 & 2 \end{pmatrix}$$

A) Scilab Code :-




```
clc;clear;close;
a = [2 4 6 4;2 5 7 6;2 3 5 2];
disp("The given matrix is:");
disp(a);
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("column", j, "is a pivot column");
            break;
        end
    end
end
```

Console Screenshot :-

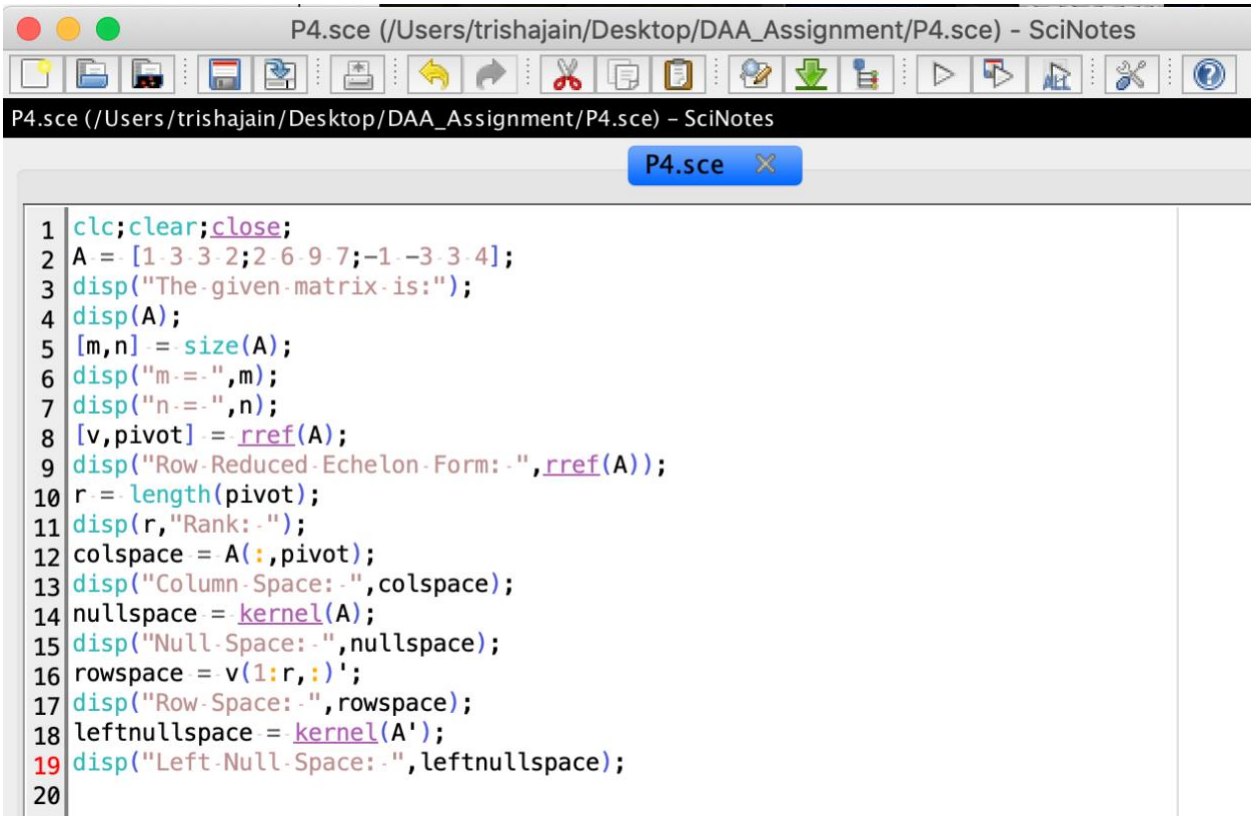
```
"The given matrix is:"

 2.   4.   6.   4.
 2.   5.   7.   6.
 2.   3.   5.   2.

 2.   4.   6.   4.
 0.   1.   1.   2.
 0.  -1.  -1.  -2.

 2.   4.   6.   4.
 0.   1.   1.   2.
 0.   0.   0.   0.

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

"column"

 1.

"is a pivot column"

"column"

 2.

"is a pivot column"
```

Topic: The Four Fundamental Subspaces

Q5) Find the four fundamental subspaces of :-

$$A=\begin{pmatrix} 1 & 3 & 3 & 2 \\ 2 & 6 & 9 & 7 \\ -1 & -3 & 3 & 4 \end{pmatrix}$$

A) Scilab Code :-



Console Screenshot :-

```
"The given matrix is:"

 1.   3.   3.   2.
 2.   6.   9.   7.
-1.  -3.   3.   4.

"m = "

 3.

"n = "

 4.

"Row Reduced Echelon Form: "

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

 2.

"Rank: "

"Column Space: "

 1.   3.
 2.   9.
-1.   3.

"Null Space: "

-0.2016536   0.9295686
 0.287881   -0.2449115
-0.6619896  -0.194834
 0.6619896   0.194834

"Row Space: "

 1.   0.
 3.   0.
 0.   1.
-1.   1.
```

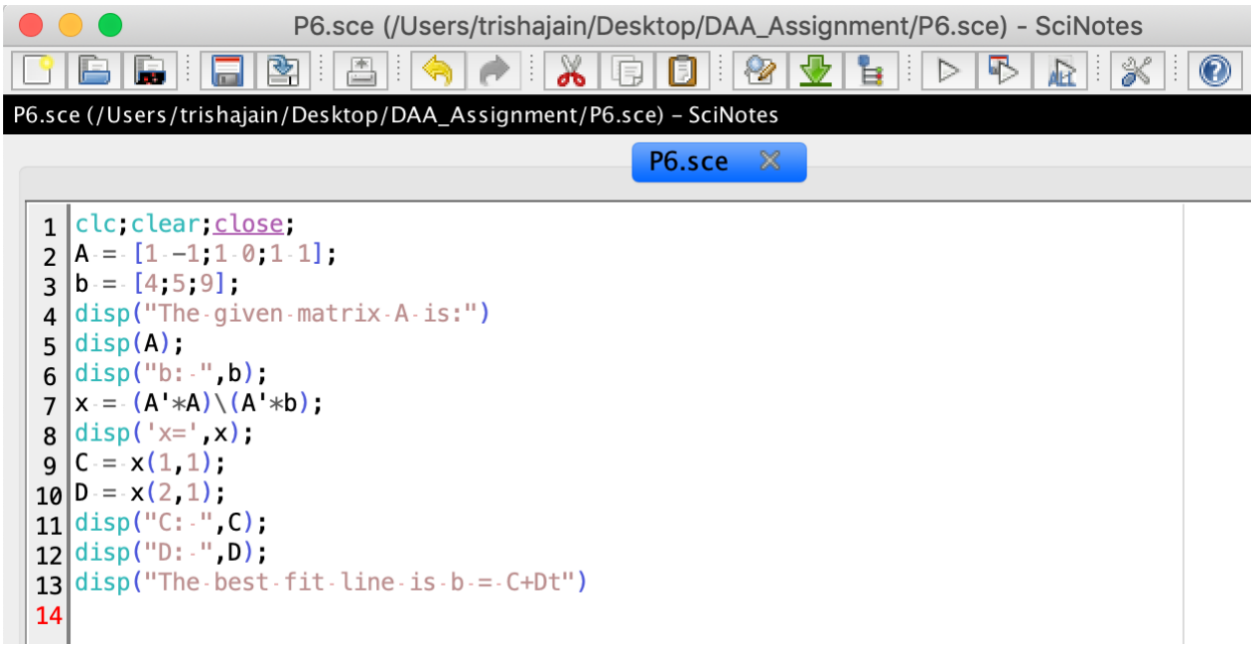
```
"Left Null Space: "

 0.9128709
-0.3651484
 0.1825742
```

Topic: Projections by Least Squares

Q6) Find the line of best fit Ax=b for the following system

$$Ax=\begin{pmatrix}1 & -1\\ 1 & 0\\ 1 & 1\end{pmatrix}\begin{pmatrix}C\\ D\end{pmatrix}, b=\begin{pmatrix}4\\ 5\\ 9\end{pmatrix}$$

A) Scilab Code :-



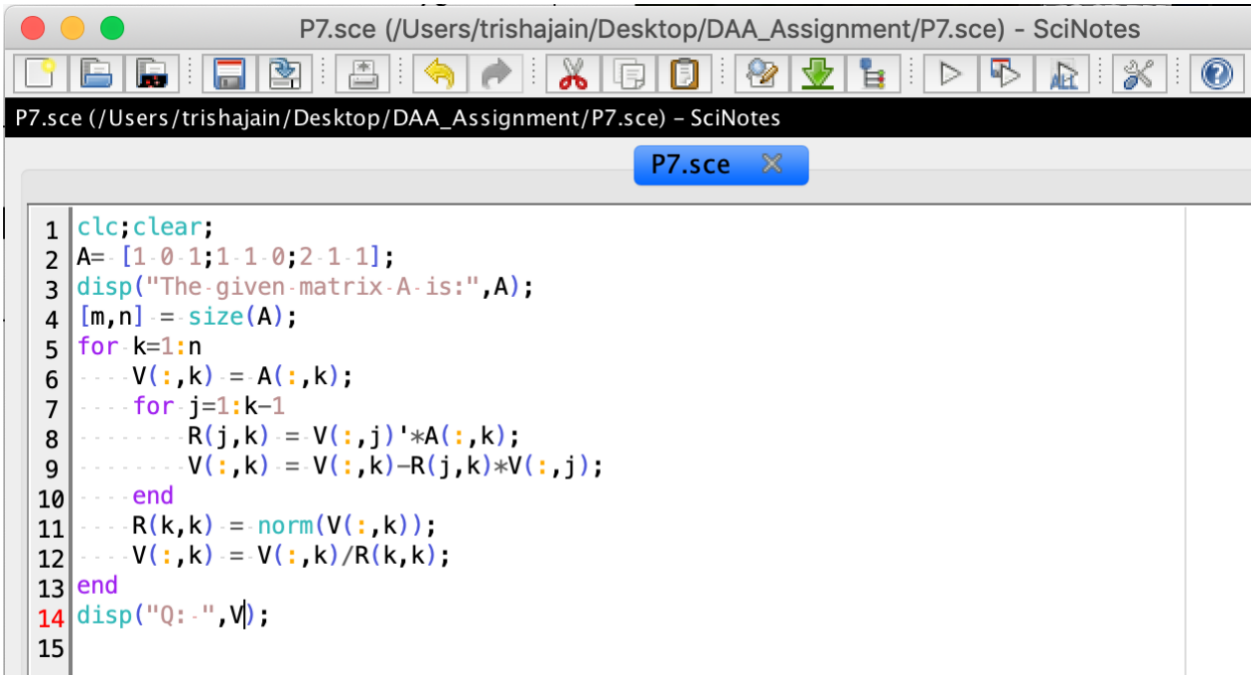
Console Screenshot :-

```
"The given matrix A is:"

 1.  -1.
 1.   0.
 1.   1.

"b: "

 4.
 5.
 9.

"x="

 6.
 2.5

"C: "

 6.

"D: "

 2.5

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

Topic: The Gram- Schmidt Orthogonalization

Q7) Apply the Gram – Schmidt process to the following set of vectors and find the orthogonal matrix: (1, 0, 1) , (1, 1, 0) , (2, 1, 1)

A) Scilab Code :-



Console Screenshot :-

```
"The given matrix A is:"

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

"Q: "

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

Topic: Eigen values and Eigen vectors of a given square matrix

Q8) Find the Eigen values and the corresponding Eigen vectors of the following matrix:

$$\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$$

A) Scilab Code :-

P8.sce (/Users/trishajain/Desktop/DAA_Assignment/P8.sce) - SciNotes

P8.sce (/Users/trishajain/Desktop/DAA_Assignment/P8.sce) – SciNotes

P8.sce

```
clc;clear;close;
A = [2 2 1;1 3 1;1 2 2];
disp("The given matrix A is: ",A)
lam = poly(0,"lam");
charMat = A-lam*eye(3,3);
disp("The Characteristic Matrix is: ",charMat);
charPoly = poly(A,"lam");
disp("The Characteristic Polynomial is:",charPoly);
lam = spec(A);
disp("Eigen Values: ",lam);
function[x,lam] = eigenvectors(A)
    [n,m] = size(A);
    lam = spec(A)';
    x = [];
    for k=1:3
        B = A-lam(k)*eye(3,3);
        C = B(1:n-1,1:n-1);
        b = -B(1:n-1,n);
        y = C\b;
        y = [y;1];
        y = y/norm(y);
        x = [x y];
    end
endfunction
[x,lam] = eigenvectors(A);
disp("Eigen Vectors of A: ",x);
```

Console Screenshot :-

```
"The given matrix A is: "

 2.   2.   1.
 1.   3.   1.
 1.   2.   2.

"The Characteristic Matrix is: "

2 -lam  2       1
1       3 -lam  1
1       2       2 -lam

"The Characteristic Polynomial is:"

-5 +11lam -7lam² +lam³

"Eigen  Values: "

 1. + 0.i
 5. + 0.i
 1. + 0.i

"Eigen Vectors of A: "

 0.          0.5773503   0.
-0.4472136   0.5773503  -0.4472136
 0.8944272   0.5773503   0.8944272
```