



Department of Computer Science and Engineering
Scilab

LINEAR ALGEBRA AND ITS APPLICATIONS -UE19MA251

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BRANCH : COMPUETR SCIENCE AND ENGINEERING

SEMESTER & SECTION : IV

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8-9	Find the inverse of the following matrix: $\begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$
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12-14	Find the four fundamental subspaces of :- $A = \begin{pmatrix} 1 & 3 & 3 & 2 \\ 2 & 6 & 9 & 7 \\ -1 & -3 & 3 & 4 \end{pmatrix}$

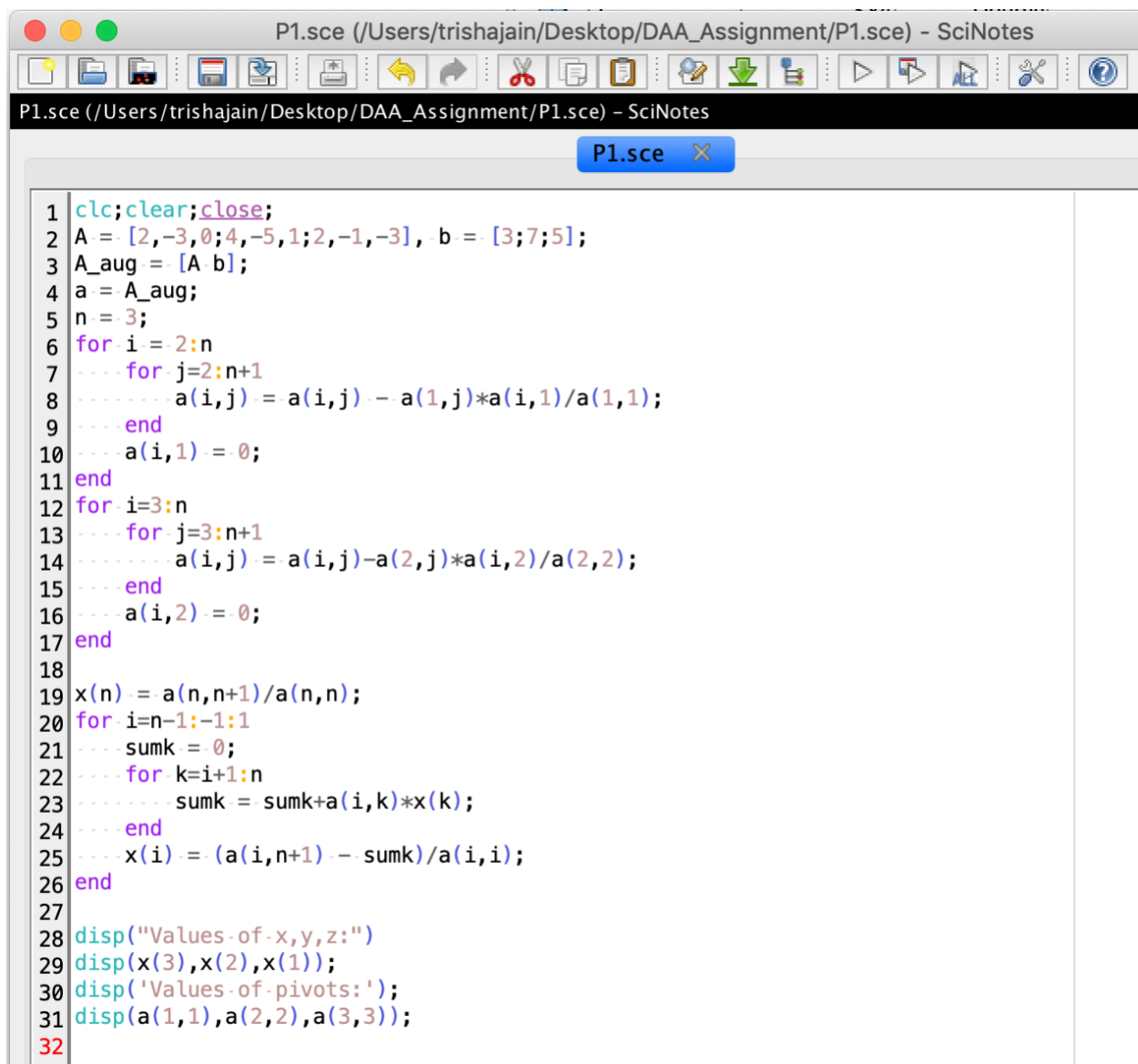
15-16	<p>Find the line of best fit $Ax=b$ for the following system</p> $Ax = \begin{pmatrix} 1 & -1 \\ 1 & 0 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} C \\ D \end{pmatrix}, b = \begin{pmatrix} 4 \\ 5 \\ 9 \end{pmatrix}$
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19-20	<p>Find the Eigen values and the corresponding Eigen vectors of the following matrix:</p> $\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$

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 :-



```

P1.sce (/Users/trishajain/Desktop/DAA_Assignment/P1.sce) - SciNotes
P1.sce (/Users/trishajain/Desktop/DAA_Assignment/P1.sce) - SciNotes
P1.sce

1 clc;clear;close;
2 A = [2,-3,0;4,-5,1;2,-1,-3], b = [3;7;5];
3 A_aug = [A b];
4 a = A_aug;
5 n = 3;
6 for i = 2:n
7     for j = 2:n+1
8         a(i,j) = a(i,j) - a(1,j)*a(i,1)/a(1,1);
9     end
10    a(i,1) = 0;
11 end
12 for i = 3:n
13     for j = 3:n+1
14         a(i,j) = a(i,j) - a(2,j)*a(i,2)/a(2,2);
15     end
16    a(i,2) = 0;
17 end
18
19 x(n) = a(n,n+1)/a(n,n);
20 for i = n-1:-1:1
21     sumk = 0;
22     for k = i+1:n
23         sumk = sumk + a(i,k)*x(k);
24     end
25     x(i) = (a(i,n+1) - sumk)/a(i,i);
26 end
27
28 disp("Values of x,y,z:")
29 disp(x(3),x(2),x(1));
30 disp('Values of pivots:');
31 disp(a(1,1),a(2,2),a(3,3));
32

```

Console Screenshot :-

"Values of x,y,z:"

0.

1.

3.

"Values of pivots:"

2.

1.

-5.

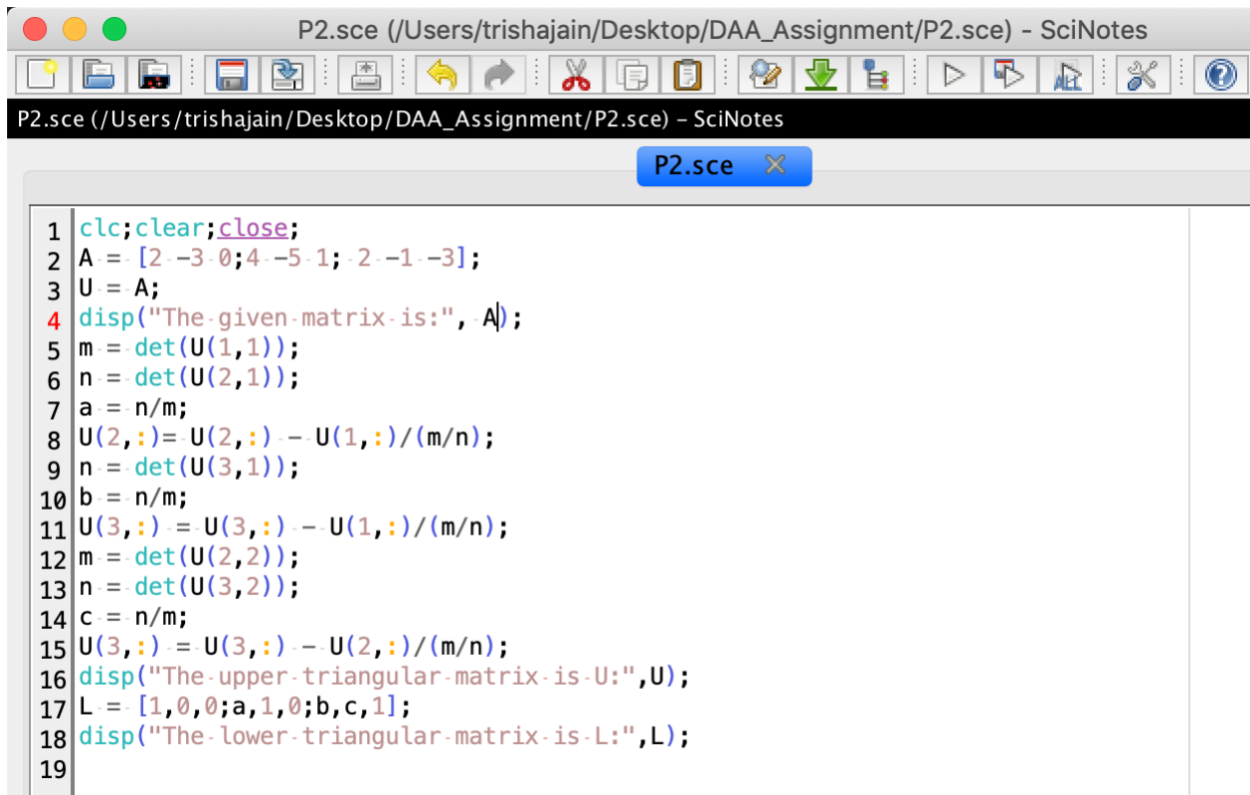
--> |

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 :-



```

P2.sce (/Users/trishajain/Desktop/DAA_Assignment/P2.sce) - SciNotes
P2.sce (/Users/trishajain/Desktop/DAA_Assignment/P2.sce) - SciNotes
P2.sce X

1  clc;clear;close;
2  A = [2 -3 0; 4 -5 1; 2 -1 -3];
3  U = A;
4  disp("The-given-matrix-is:", A);
5  m = det(U(1,1));
6  n = det(U(2,1));
7  a = n/m;
8  U(2,:) = U(2,:) - U(1,:)/(m/n);
9  n = det(U(3,1));
10 b = n/m;
11 U(3,:) = U(3,:) - U(1,:)/(m/n);
12 m = det(U(2,2));
13 n = det(U(3,2));
14 c = n/m;
15 U(3,:) = U(3,:) - U(2,:)/(m/n);
16 disp("The-upper-triangular-matrix-is-U:",U);
17 L = [1,0,0;a,1,0;b,c,1];
18 disp("The-lower-triangular-matrix-is-L:",L);
19

```

Console Screenshot :-

"The given matrix is:"

$$\begin{bmatrix} 2. & -3. & 0. \\ 4. & -5. & 1. \\ 2. & -1. & -3. \end{bmatrix}$$

"The upper triangular matrix is U:"

$$\begin{bmatrix} 2. & -3. & 0. \\ 0. & 1. & 1. \\ 0. & 0. & -5. \end{bmatrix}$$

"The lower triangular matrix is L:"

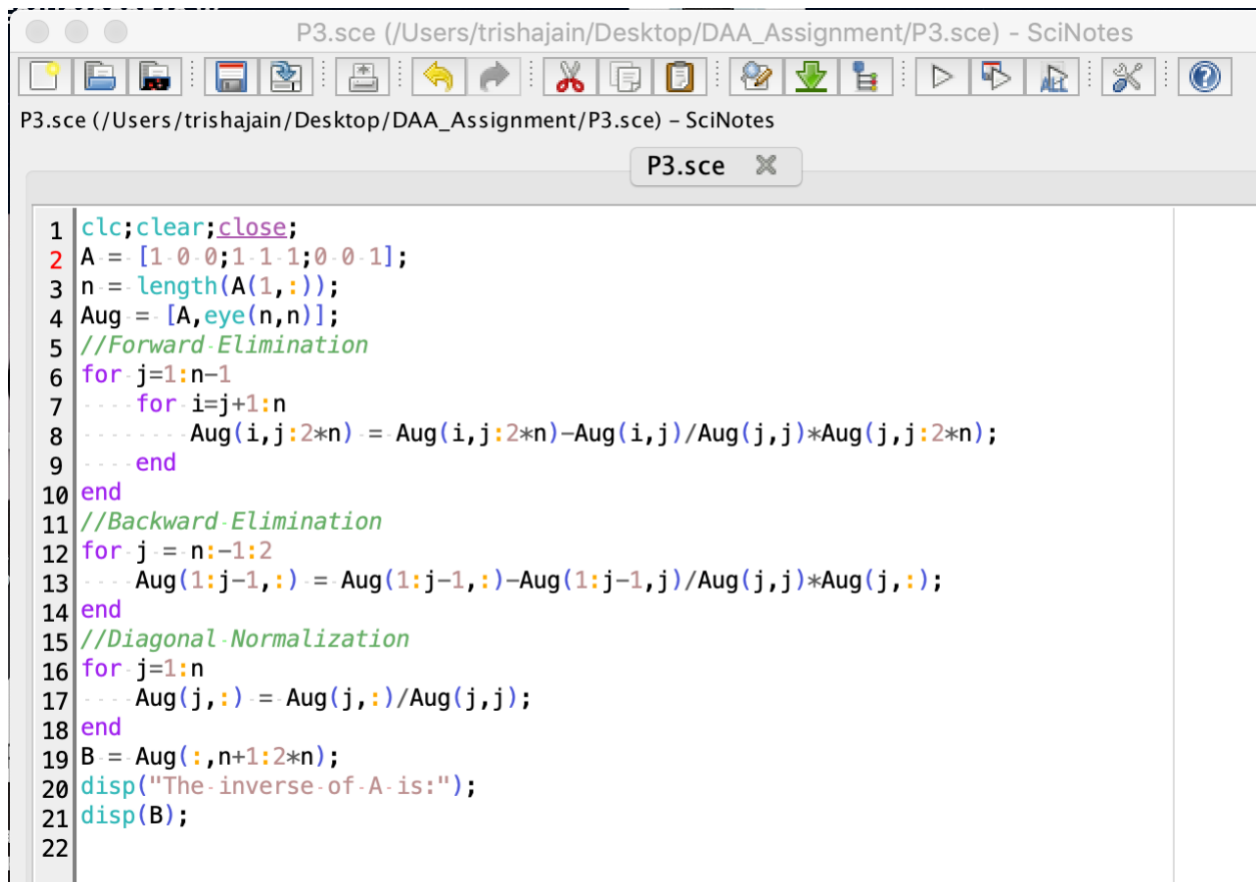
$$\begin{bmatrix} 1. & 0. & 0. \\ 2. & 1. & 0. \\ 1. & 2. & 1. \end{bmatrix}$$

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 X

1 clc;clear;close;
2 A = [1 0 0;1 1 1;0 0 1];
3 n = length(A(1,:));
4 Aug = [A,eye(n,n)];
5 //Forward-Elimination
6 for j=1:n-1
7     for i=j+1:n
8         Aug(i,j:2*n) = Aug(i,j:2*n)-Aug(i,j)/Aug(j,j)*Aug(j,j:2*n);
9     end
10 end
11 //Backward-Elimination
12 for j = n:-1:2
13     Aug(1:j-1,:) = Aug(1:j-1,:)-Aug(1:j-1,j)/Aug(j,j)*Aug(j,:);
14 end
15 //Diagonal-Normalization
16 for j=1:n
17     Aug(j,:) = Aug(j, :)/Aug(j,j);
18 end
19 B = Aug(:,n+1:2*n);
20 disp("The inverse of A is:");
21 disp(B);
22

```


Console Screenshot :-

"The inverse of A is:"

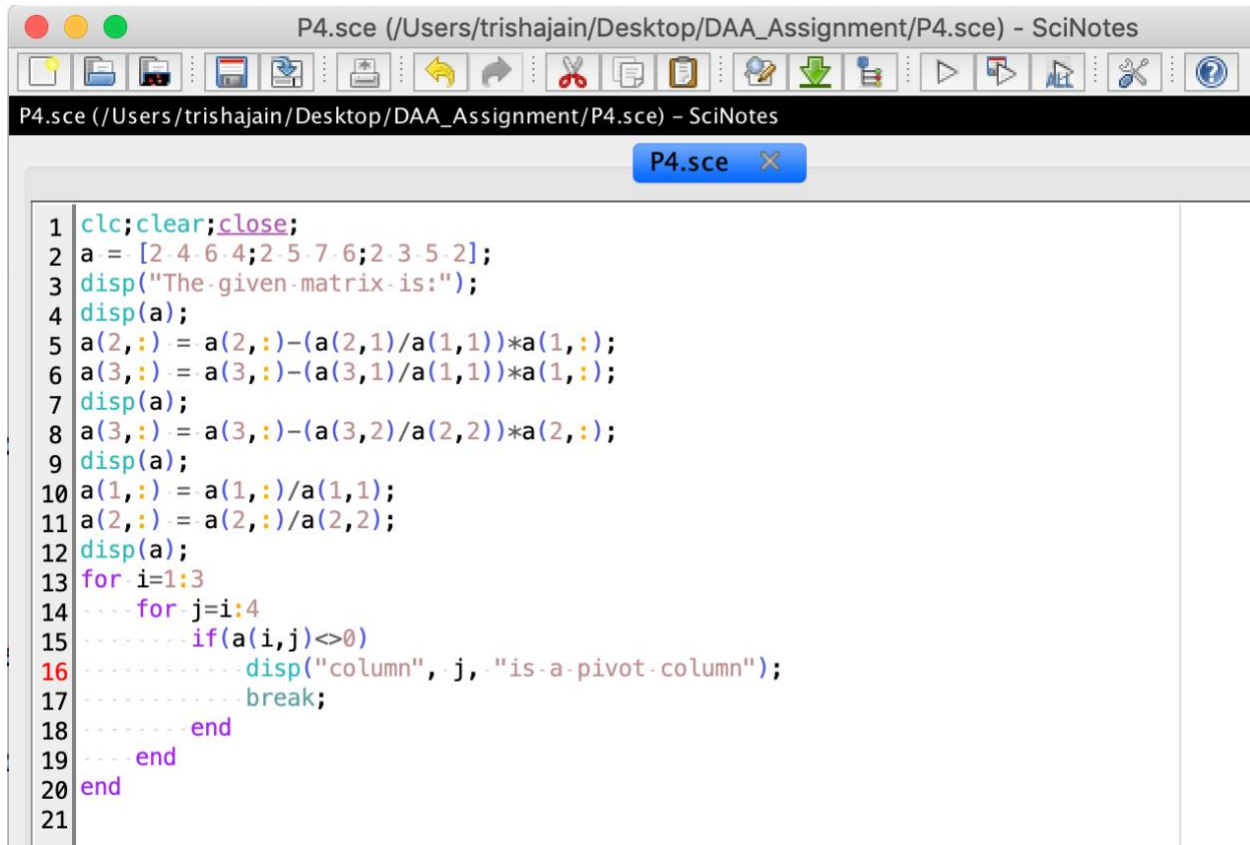
1.	0.	0.
-1.	1.	-1.
0.	0.	1.

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 :-



The screenshot shows a Scilab editor window titled "P4.sce (/Users/trishajain/Desktop/DAA_Assignment/P4.sce) - SciNotes". The code in the editor is as follows:

```

1  clc;clear;close;
2  a = [2 4 6 4;2 5 7 6;2 3 5 2];
3  disp("The-given-matrix-is:");
4  disp(a);
5  a(2,:) = a(2, :)-(a(2,1)/a(1,1))*a(1, :);
6  a(3,:) = a(3, :)-(a(3,1)/a(1,1))*a(1, :);
7  disp(a);
8  a(3,:) = a(3, :)-(a(3,2)/a(2,2))*a(2, :);
9  disp(a);
10 a(1,:) = a(1, :)/a(1,1);
11 a(2,:) = a(2, :)/a(2,2);
12 disp(a);
13 for i=1:3
14     for j=i:4
15         if(a(i,j)<>0)
16             disp("column", j, "is-a-pivot-column");
17             break;
18         end
19     end
20 end
21

```

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.

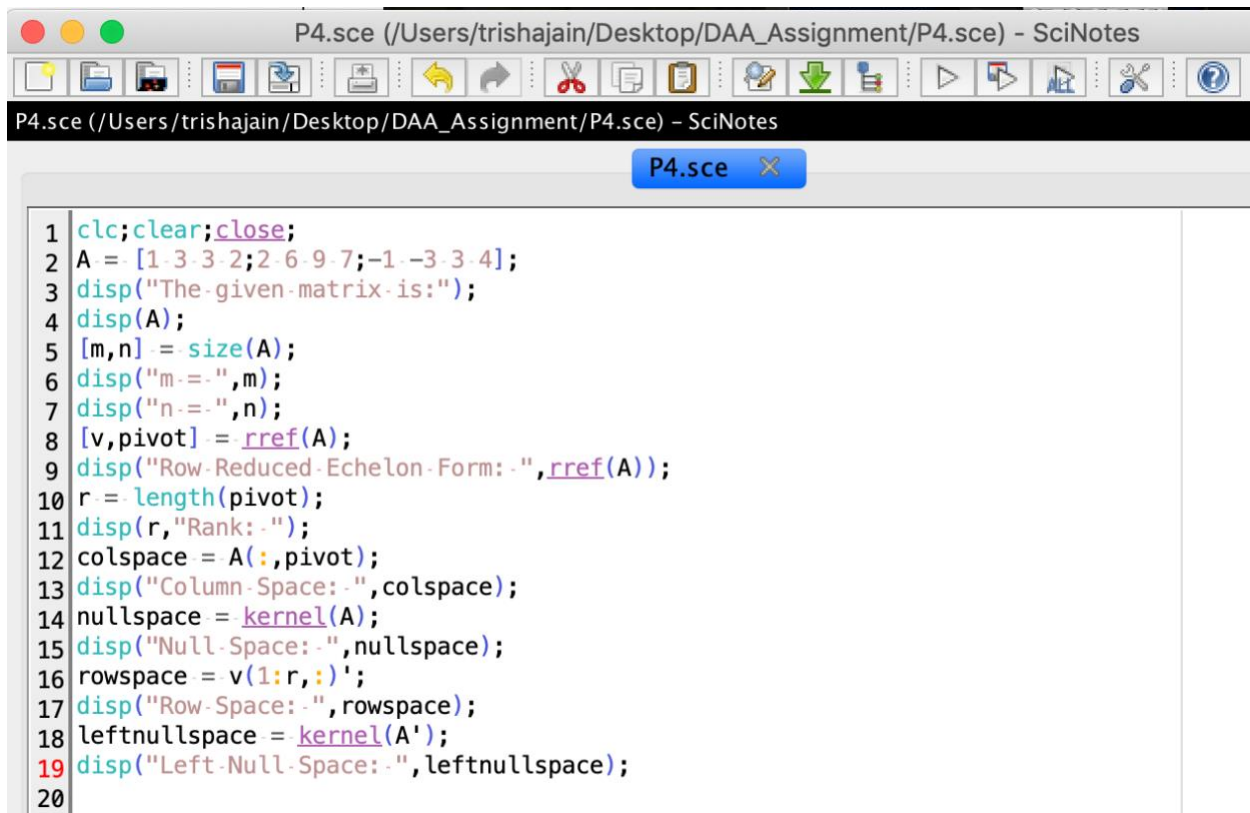
"is a pivot column"

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 :-



```

1  clc;clear;close;
2  A = [1 3 3 2;2 6 9 7;-1 -3 3 4];
3  disp("The-given-matrix-is:");
4  disp(A);
5  [m,n] = size(A);
6  disp("m=-",m);
7  disp("n=-",n);
8  [v,pivot] = rref(A);
9  disp("Row-Reduced-Echelon-Form:-",rref(A));
10 r = length(pivot);
11 disp(r,"Rank:-");
12 colspace = A(:,pivot);
13 disp("Column-Space:-",colspace);
14 nullspace = kernel(A);
15 disp("Null-Space:-",nullspace);
16 rowspace = v(1:r,:);
17 disp("Row-Space:-",rowspace);
18 leftnullspace = kernel(A');
19 disp("Left-Null-Space:-",leftnullspace);
20

```

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: "

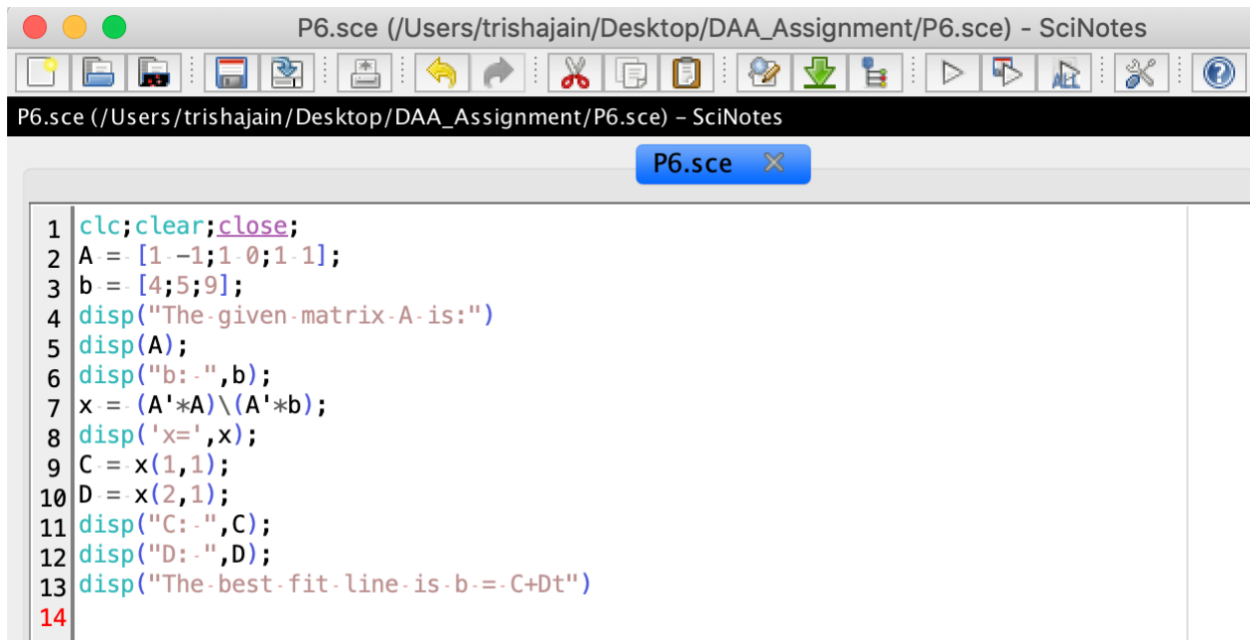
0.9128709
-0.3651484
0.1825742

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 :-



```

1 clc;clear;close;
2 A = [1 -1;1 0;1 1];
3 b = [4;5;9];
4 disp("The-given-matrix-A-is:")
5 disp(A);
6 disp("b:-",b);
7 x = (A'*A)\(A'*b);
8 disp('x=',x);
9 C = x(1,1);
10 D = x(2,1);
11 disp("C:-",C);
12 disp("D:-",D);
13 disp("The-best-fit-line-is-b=-C+Dt")
14

```

Console Screenshot :-

"The given matrix A is:"

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

"b: "

4.
5.
9.

"x="

6.
2.5

"C: "

6.

"D: "

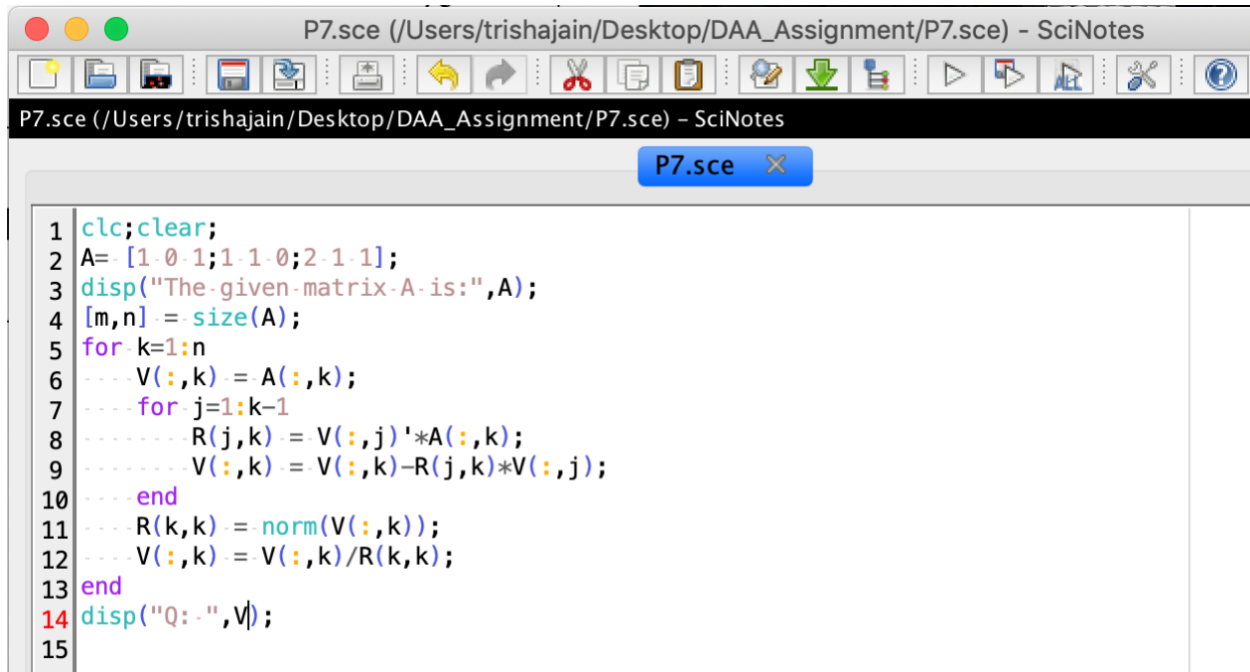
2.5

"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 :-



```

1  clc;clear;
2  A= [1-0-1;1-1-0;2-1-1];
3  disp("The-given-matrix-A-is:",A);
4  [m,n]= size(A);
5  for k=1:n
6  ----V(:,k)=- A(:,k);
7  ----for j=1:k-1
8  ----- R(j,k) = V(:,j)'*A(:,k);
9  ----- V(:,k) = V(:,k)-R(j,k)*V(:,j);
10 ----end
11 ----R(k,k)=-norm(V(:,k));
12 ----V(:,k)=- V(:,k)/R(k,k);
13 end
14 disp("Q:-",V);
15

```

Console Screenshot :-

"The given matrix A is:"

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

"Q: "

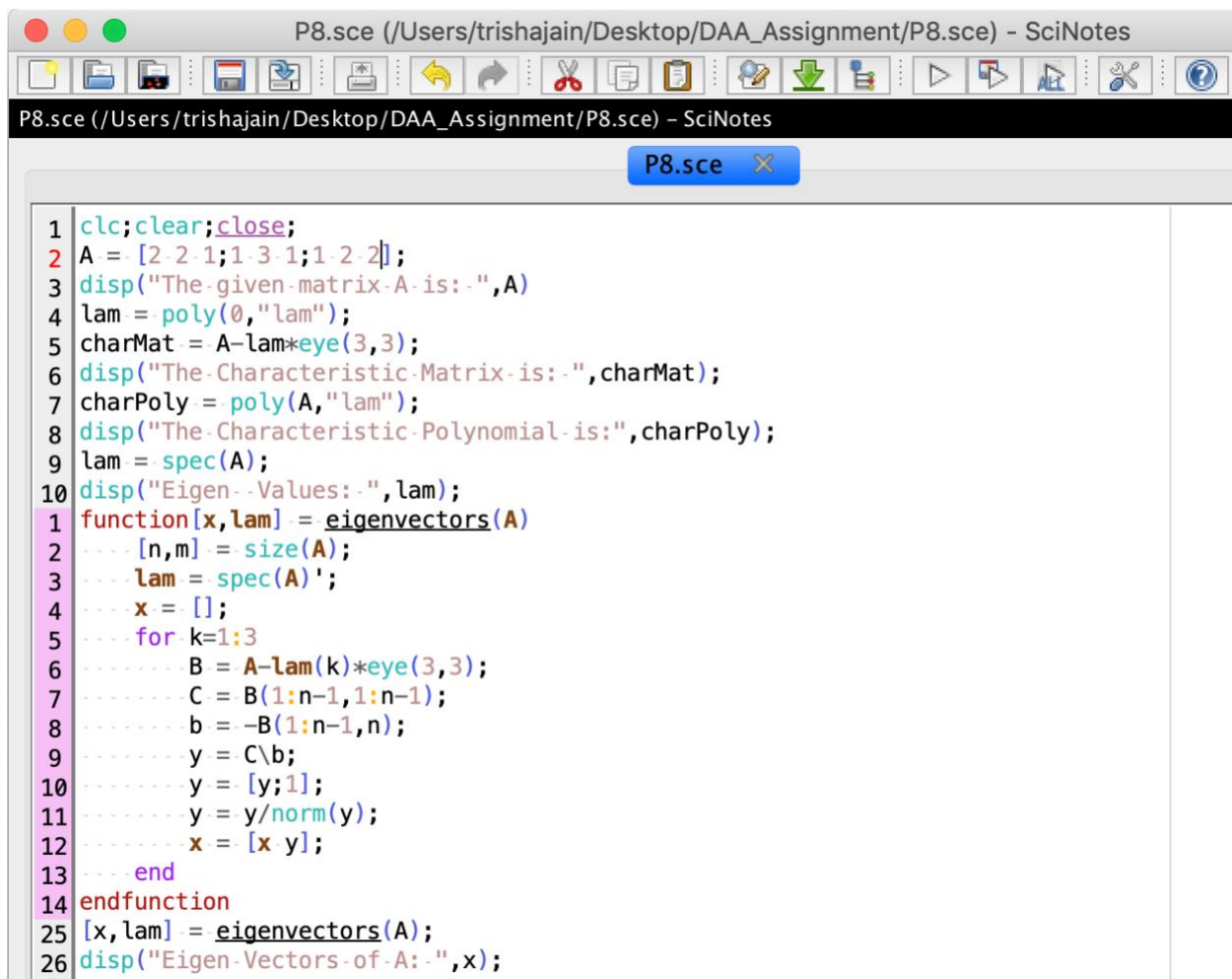
0.4082483	-0.7071068	-0.842701
0.4082483	0.7071068	0.2407717
0.8164966	-3.140D-16	-0.4815434

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 X

1 clc;clear;close;
2 A = [2 2 1;1 3 1;1 2 2];
3 disp("The given matrix A is:-",A)
4 lam = poly(0,"lam");
5 charMat = A-lam*eye(3,3);
6 disp("The Characteristic Matrix is:-",charMat);
7 charPoly = poly(A,"lam");
8 disp("The Characteristic Polynomial is:-",charPoly);
9 lam = spec(A);
10 disp("Eigen-Values:-",lam);
11 function [x,lam] = eigenvectors(A)
12     [n,m] = size(A);
13     lam = spec(A)';
14     x = [];
15     for k=1:3
16         B = A-lam(k)*eye(3,3);
17         C = B(1:n-1,1:n-1);
18         b = -B(1:n-1,n);
19         y = C\b;
20         y = [y;1];
21         y = y/norm(y);
22         x = [x y];
23     end
24 endfunction
25 [x,lam] = eigenvectors(A);
26 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:"

$-5 + 11\lambda - 7\lambda^2 + \lambda^3$

"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