Department of Computer Scince and Engineering

Scilab

LINEAR ALGEBRA AND ITS APPLICATIONS -UE19MA251

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BRANCH : COMPUETR SCIENCE AND ENGINEERING

SEMESTER & SECTION : IV

Gaussian Elimination

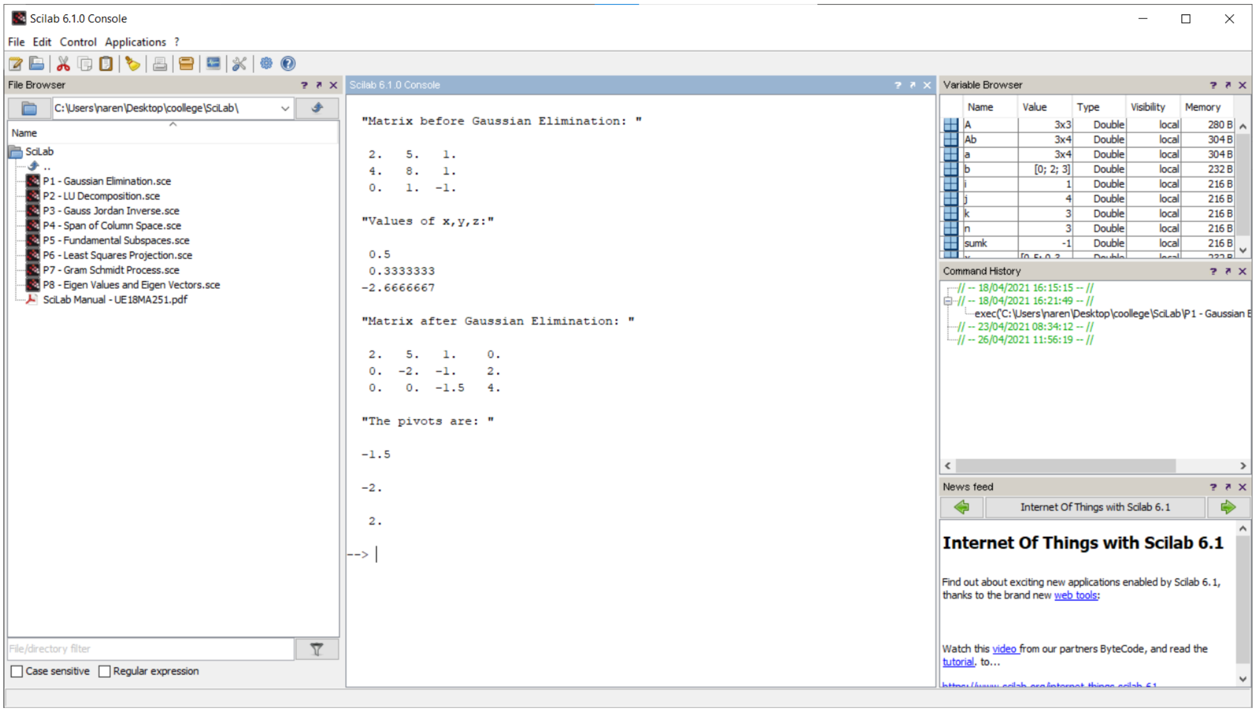
1. Solve the system of equations by Gaussian Elimination. Identify the pivots
$2x + 5y + z = 0$, $4x + 8y + z = 2$, $y - z = 3$

```
clc;clear;
A = [2,5,1;4,8,1;0,1,-1], b = [0;2;3];
disp("Matrix before Gaussian Elimination: ")
disp(A);
Ab = [A b];
a = Ab;
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("Values of x,y,z:")
disp(x);
disp("Matrix after Gaussian Elimination: ")
```

```
disp(a);
disp("The pivots are: ");
disp(a(3,3),a(2,2),a(1,1));
```



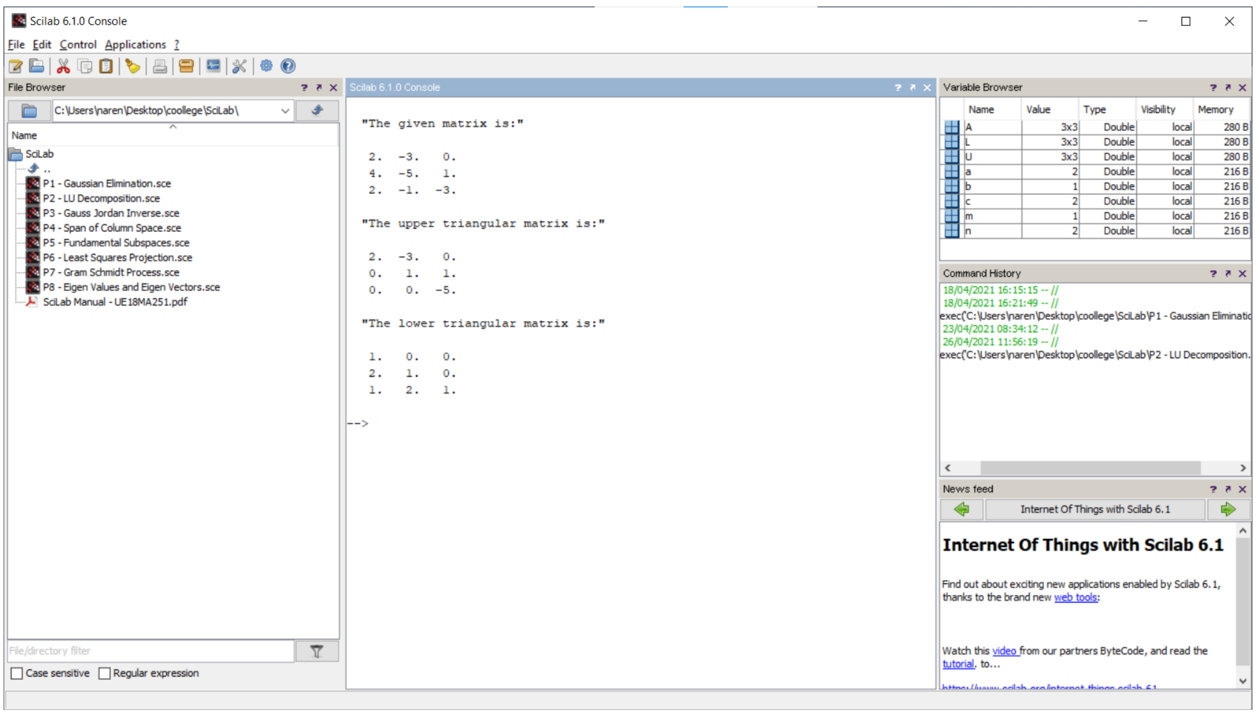
LU decomposition of a matrix

1. Factorize the Matrix as A = LU

$$A = \begin{pmatrix} 2 & -3 & 0 \\ 4 & -5 & 1 \\ 2 & -1 & -3 \end{pmatrix}$$

```
clear;clc;;
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);
L = [1,0,0;a,1,0;b,c,1];
disp("The lower triangular matrix is:",L);
```



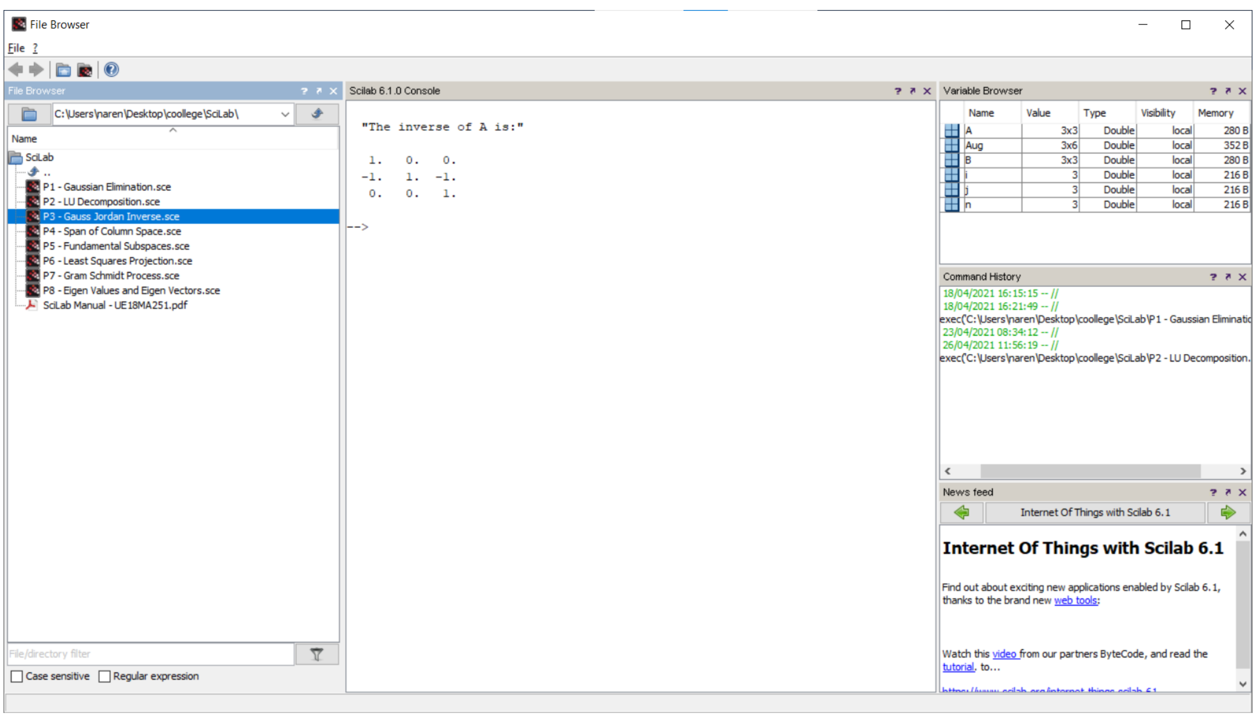
The Gauss - Jordan method of calculating A^{-1}

1. Find the inverse of the matrix A:

(1 0 0
 1 1 1
 0 0 1)

```
clc;clear;
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);
```



Span of the Column Space of A

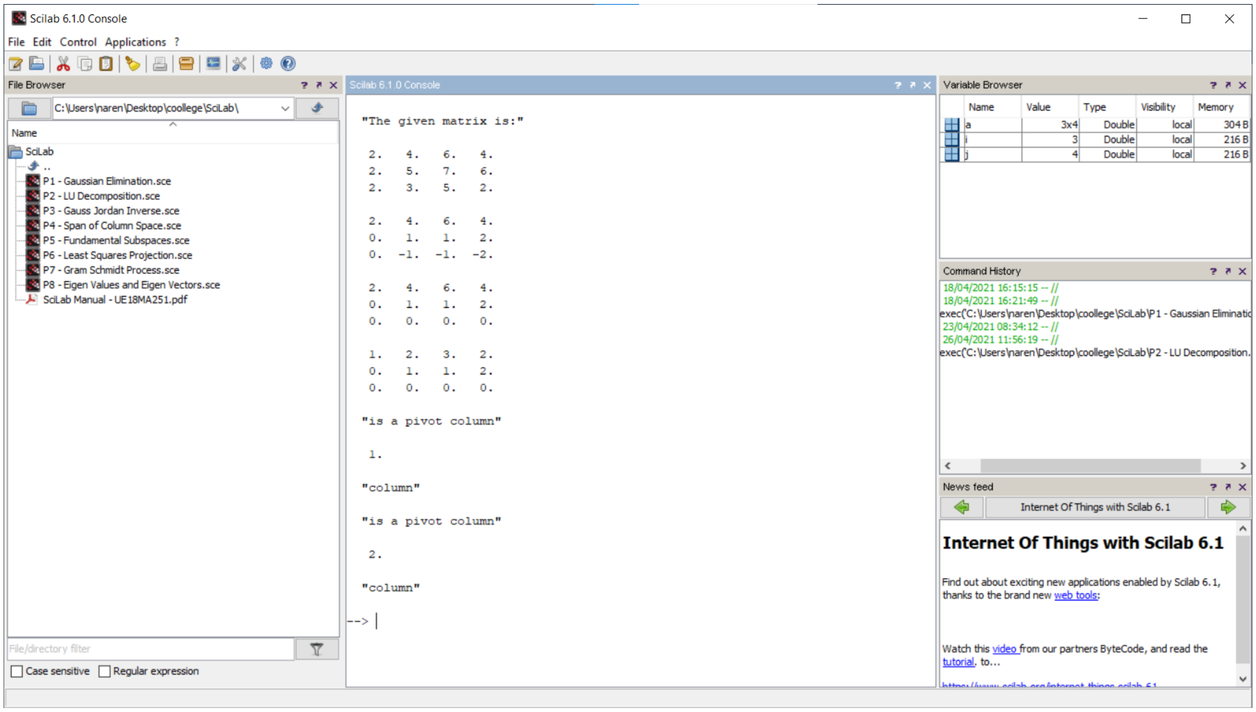
Identify the columns that span the column space of A

A=(2 4 6 4

2 5 7 6

2 3 5 2)

```
clc;clear;
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("is a pivot column",j,"column");
         break;
      end
   end
end
```



The Four Fundamental Subspaces

Find the four fundamental subspaces of

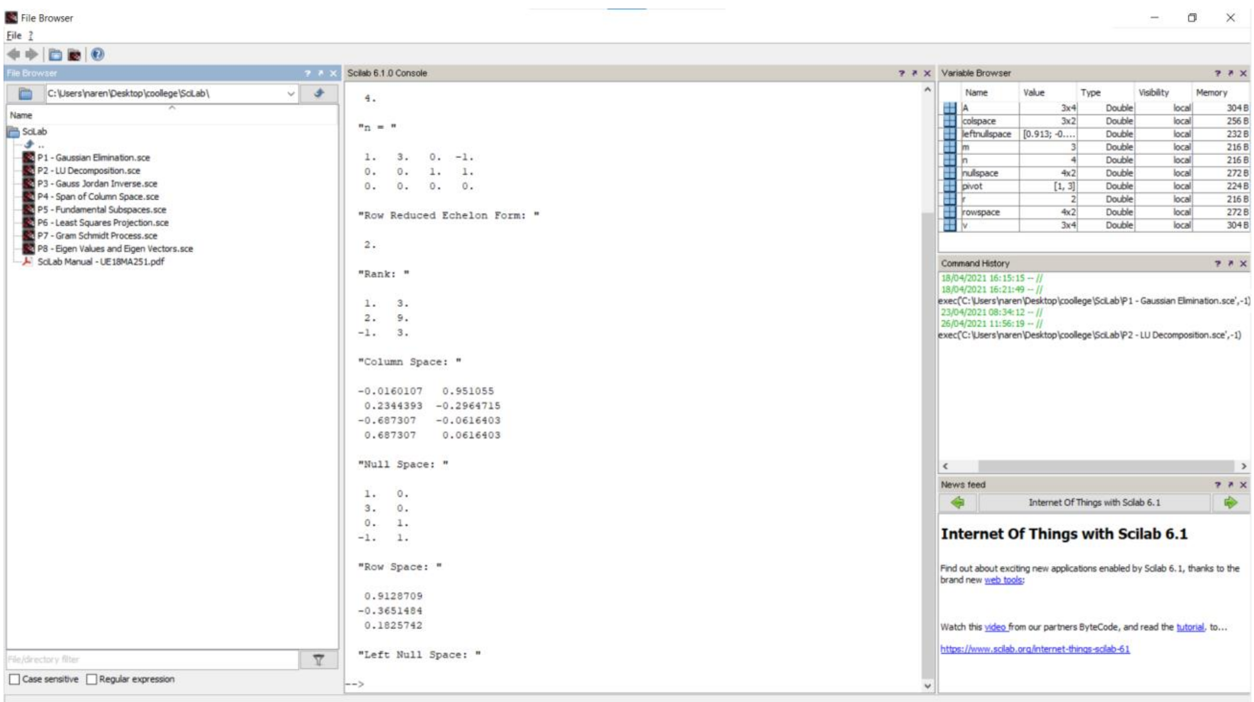
A=(1 3 3 2

2 6 9 7

−1 − 3 3 4)

```
clc;clear;
A = [1 3 3 2;2 6 9 7;-1 -3 3 4];
disp("The given matrix is:");
disp(A);
[m,n] = size(A);
disp(m,"m = ");
disp(n,"n = ");
[v,pivot] = rref(A);
disp(rref(A),"Row Reduced Echelon Form: ");
r = length(pivot);
disp(r,"Rank: ");
colspace = A(:,pivot);
```

```
disp(colspace,"Column Space: ");
nullspace = kernel(A);
disp(nullspace,"Null Space: ");
rowspace = v(1:r,:)';
disp(rowspace,"Row Space: ");
leftnullspace = kernel(A');
disp(leftnullspace,"Left Null Space: ");
```



Projections by Least Squares

1. Solve Ax = b by least squares where

A=(

1 0

0 1

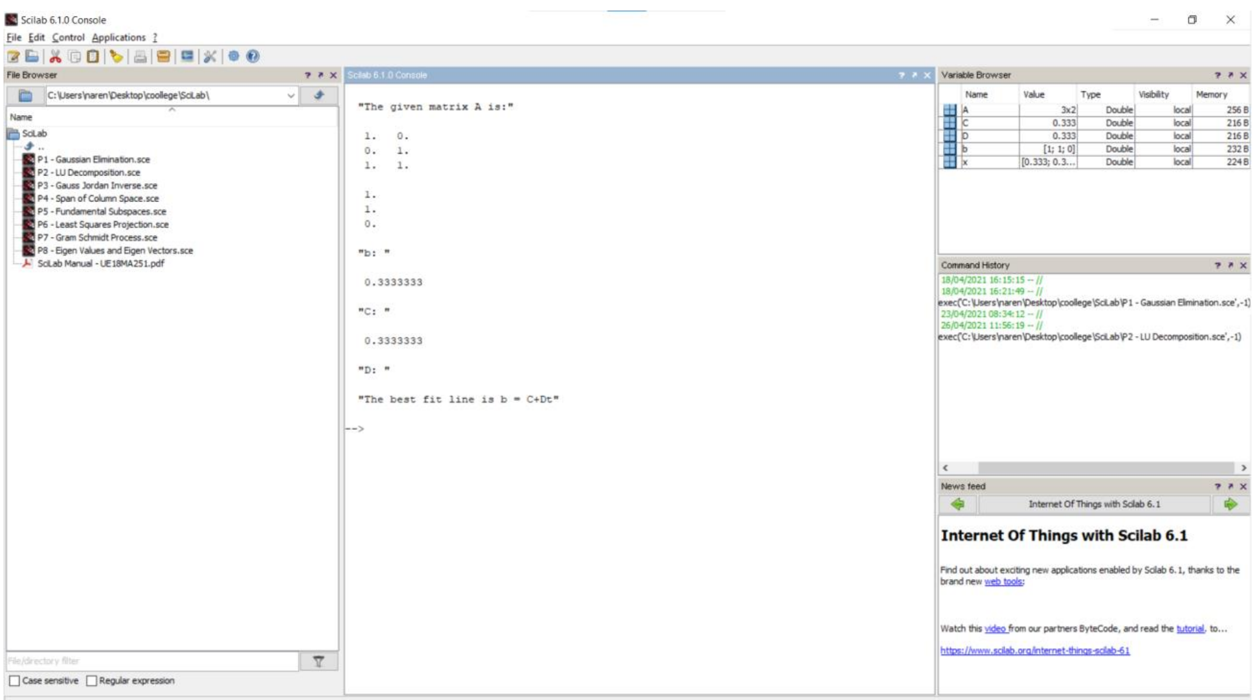
1 1)

b=(1

1

0)

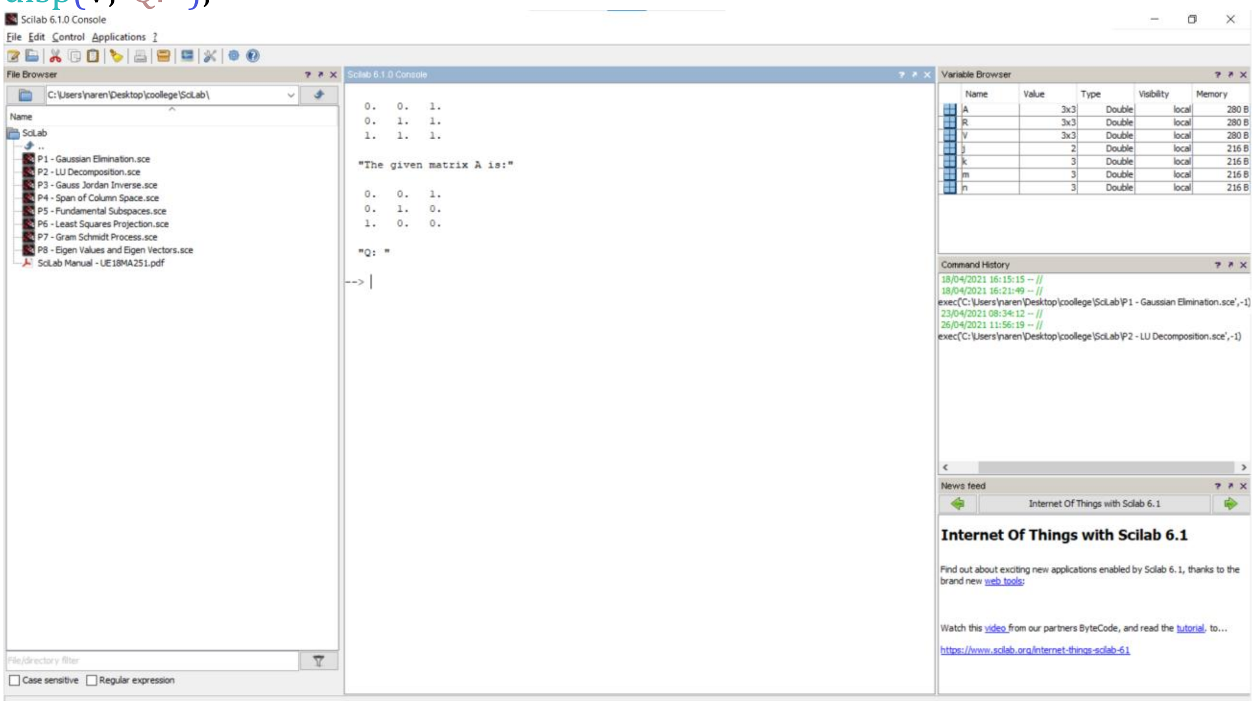
```
clc;clear;
A = [1 0;0 1;1 1];
b = [1;1;0];
disp("The given matrix A is:")
disp(A);
disp(b, "b: ");
x = (A'*A)\(A'*b)
C = x(1,1);
D = x(2,1);
disp(C,"C: ");
disp(D,"D: ");
disp("The best fit line is b = C+Dt")
```



The Gram- Schmidt Orthogonalization

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

```
clc;clear;
A= [0 0 1;0 1 1;1 1 1];
disp(A, "The given matrix A is:");
[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: ");
```



Eigen values and Eigen vectors of a given square matrix

Find the Eigen values and the corresponding Eigen vectors of the matrix A

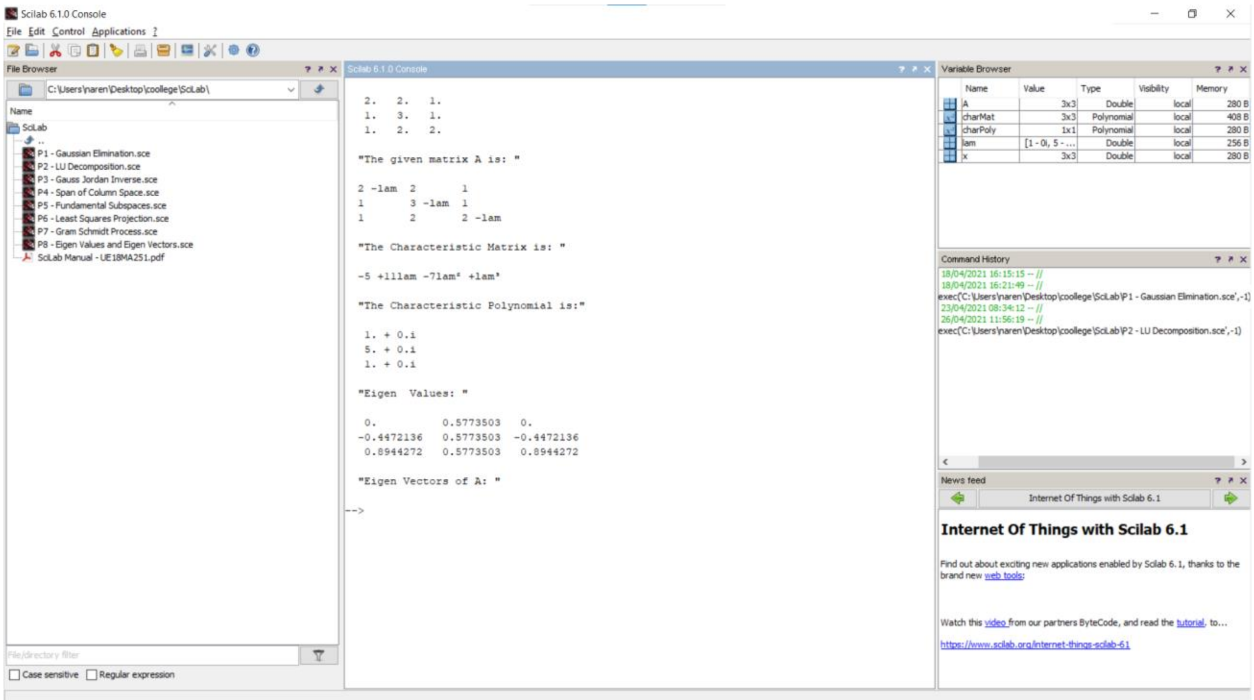
A= (

2 2 1

1 3 1

1 2 2)

```
clc;clear;
A = [2 2 1;1 3 1;1 2 2];
disp(A,"The given matrix A is: ")
lam = poly(0,"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,"Eigen  Values: ");
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(x,"Eigen Vectors of A: ");
```


Scilab 6.1.0 Console
File Edit Control Applications ?
File Browser
Scilab 6.1.0 Console
2. 2. 1.
1. 3. 1.
1. 2. 2.
"The given matrix A is: "
2 -lam 2 1
1 3 -lam 1
1 2 2 -lam
"The Characteristic Matrix is: "
-5 +11lam -7lam² +lam³
"The Characteristic Polynomial is:"
1. + 0.i
5. + 0.i
1. + 0.i
"Eigen Values: "
0. 0.5773503 0.
-0.4472136 0.5773503 -0.4472136
0.8944272 0.5773503 0.8944272
"Eigen Vectors of A: "
-->
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