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ROLL NO:- 21/610

SUBJECT :- MATHEMATICS

COURSE:-B.SC(HONS)

ELECTRONICS

PRACTICAL:-5

AIM:- To verify LU decomposition method

APPARATUS:- a computer system with Scilab software 6.1.1

WHAT IS LU DECOMPOSITION?

The LU decomposition method of a matrix is the factorization of given square matrix into two triangular matrices, one upper triangular matrix and one lower triangular matrix, such that the product of these two matrices gives the original matrix.

ALGORITHM:-

1. Start
2. Compose elements of augmented matrix into matrix A and B
3. Convert the matrix into L and U.
4. Display the matrix L and U.
5. Find the elements of Y by using $LY=B$.
6. Find the elements of X by using $UX=Y$.
7. Stop

QUESTIONS TO BE SOLVED.

1) $2x+3y+3z=5$

$x-2y+z=-4$

$3x-y-2z=3$

2) $x-y+2z=7$

$3x+4y-5z=-5$

$2x-y+3z=12$

3) $x+y-z=4$

$x-2y+3z=-6$

$2x+3y+z=7$

Q

Equation is Given as

$$x + y - z = 4$$

$$x - 2y + 3z = -6$$

$$2x + 3y + z = 7$$

$$\begin{bmatrix} 1 & 1 & -1 \\ 1 & -2 & 3 \\ 2 & 3 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ -6 \\ 7 \end{bmatrix}$$

FOR UPPER TRIANGULAR MATRIX

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

$$R_2 \rightarrow R_2 - R_1$$

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

$$R_3 \rightarrow R_3 - 2R_1$$

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

$$R_3 \rightarrow R_3 + \frac{1}{3}R_2$$

$$\begin{bmatrix} 1 & 1 & -1 \\ 0 & -3 & 4 \\ 0 & 0 & 13/3 \end{bmatrix}$$

= Upper triangular Matrix (U)

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LOWER TRIANGULAR MATRIX.

2022.03.08 20:47

$$L = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 2 & -1/3 & 1 \end{bmatrix}$$

$$\text{As } LY = B \quad \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 2 & -1/3 & 1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 4 \\ -6 \\ 7 \end{bmatrix}$$

on solving we get

$$\boxed{y_1 = 4}$$

$$y_1 + y_2 = -6$$

$$4 + y_2 = -6$$

$$\boxed{y_2 = -10}$$

$$2y_1 - \frac{1}{3}y_2 + y_3 = 7$$

$$2(4) - \frac{1}{3}(-10) + y_3 = 7$$

$$y_3 = 7 - 8 + \frac{10}{3}$$

$$\boxed{y_3 = \frac{-13}{3}}$$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 4 \\ -10 \\ -13/3 \end{bmatrix}$$

$UX = Y$ for values of x_1, x_2 and x_3

$$\begin{bmatrix} 1 & 1 & -1 \\ 0 & -3 & 4 \\ 0 & 0 & 13/3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 4 \\ -10 \\ -13/3 \end{bmatrix}$$

On solving above Matrix we get.

$$\frac{13}{3}x_3 = \frac{-13}{3}$$

$$-3x_2 + 4x_3 = -10$$

$$-3x_2 + 4(-1) = -10$$

$$-3x_2 = -6$$

$$x_2 = 2$$

$$x_1 + x_2 - x_3 = 4$$

$$x_1 + 2 + 1 = 4$$

$$x_1 = 1$$

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$$

So the values of x_1, x_2, x_3 are 1, 2, -1 respectively

PROGRAMS IN SCILAB

```

ludcom.sce (C:\Users\91875\ludcom.sce) - SciNotes
File Edit Format Options Window Execute ?
ludcom.sce (C:\Users\91875\ludcom.sce) - SciNotes
5_6330208549313971046.sce x matrix.sce x lu decomp.sce x scl1.sce x ludcom.sce x

1 clc
2 a=input("enter a matrix a:")
3 b=input("enetr a matrix b:")
4 [l,u,p]=lu(a);
5 disp(l,"lower triangular matrix")
6 disp(u,"upper triangular matrix")
7 disp(p,"permuted matrix")
8 c=p*b
9 disp(c,"c matrix is")
10 y=inv(l)*c
11 disp("y1,y2,y3",y)
12 x=inv(u)*y
13 disp("x1,x2,x3",x)
14

Scilab 6.1.1 Console
File Edit Control Applications ?
Scilab 6.1.1 Console
enter a matrix a : [1,-1,2;3,4,-5;2,-1,3]
enetr a matrix b : [7;-5;12]

1. 0. 0.
0.6666667 1. 0.
0.3333333 0.6666666 1.

"lower triangular matrix"

3. 4. -5.
0. -3.6666667 6.3333333
0. 0. -0.3666666

"upper triangular matrix"

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

"permuted matrix"

-5.
12.
7.

"c matrix is"

"y1,y2,y3"

-5.
15.3333333
-1.0909091

"x1,x2,x3"

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```

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ludcom.sce (C:\Users\91875\ludcom.sce) - SciNotes
File Edit Format Options Window Execute ?
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14

Scilab 6.1.1 Console
File Edit Control Applications ?
Scilab 6.1.1 Console
enter a matrix a : [2,3,2;1,-2,1;3,-1,-2]
enetr a matrix b : [5;-4;3]

1. 0. 0.
0.6666667 1. 0.
0.3333333 -0.4545455 1.

"lower triangular matrix"

3. -1. -2.
0. 3.6666667 4.3333333
0. 0. 3.6666666

"upper triangular matrix"

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

"permuted matrix"

3.
5.
-4.

"c matrix is"

"y1,y2,y3"

3.
3.
-3.6666666

"x1,x2,x3"

1.

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```
i_6330208549313971046.sce  matrix.sce  lu decom.sce  scli.sce  ludecom.sce

1  clc
2  a=input("enter a matrix a :")
3  b=input("enetr a matrix b :")
4  [l,u,p]=lu(a);
5  disp(l,"lower triangular matrix")
6  disp(u,"upper triangular matrix")
7  disp(p,"permuted matrix")
8  c=p*b
9  disp(c,"c matrix is")
10 y=inv(l)*c
11 disp("y1,y2,y3",y)
12 x=inv(u)*y
13 disp("x1,x2,x3",x)
14
```

"lower triangular matrix"

```
2.   3.   1.
0.  -3.5  2.5
0.   0.  -1.8571429
```

"upper triangular matrix"

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

"permuted matrix"

```
7.
-6.
4.
```

"c matrix is"

"y1,y2,y3"

```
7.
-9.5
1.8571429
```

"x1,x2,x3"

```
1.0000000
2.0000000
-1.
```

RESULTS:

The theoretically solution and scilab software solution has same results so the LU decomposition method is verified

