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6.3.1 LU factorization (Gaussian elimination) 6.3.1 LU factorization (Gaussian elimination)

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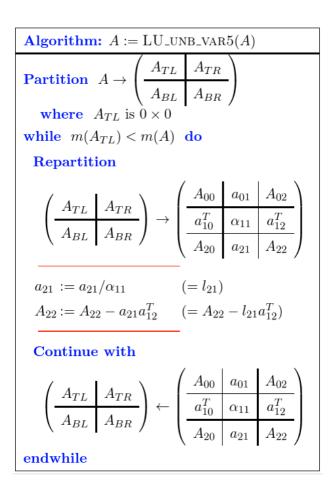
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Homework 6.3.1.1

1 point possible (graded)



Implement the above LU factorization algorithm.

```
• [ A out ] = LU unb var5( A )
```

You can check that they compute the right answers with the following script:

test LU unb var5.m (In LAFF-2.0xM/Programming/Week06/)

Unfortunately, PictureFLAME may not work for this problem, since a zero may be encountered on the diagonal causing a divide by zero.

This script exercises the functions by factoring the matrix

```
A = [
    2
                   2
              1
        -1
   -2
                  -1
        -1
             5
                  4
                  -8
   -4
        1
             -3
```

by calling

```
LU = LU_unb_var5(A)
```

Next, it extracts the unit lower triangular matrix and upper triangular matrix:

```
L = tril(LU, -1) + eye(size(A))
U = triu( LU )
```

and checks if the correct factors were computed:

which should yield a 4×4 zero matrix.



Here is our implementations of the function:

LU unb var5.m

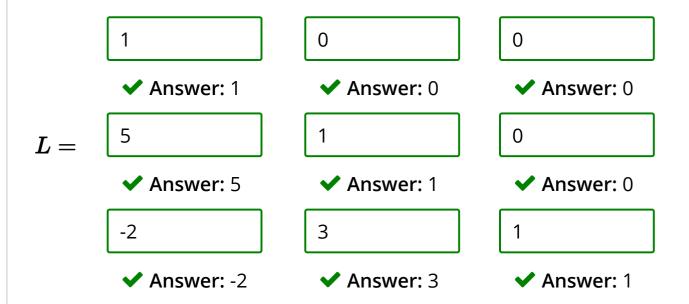
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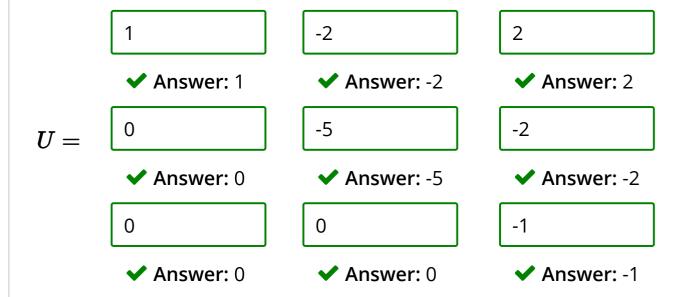
• Answers are displayed within the problem

Homework 6.3.1.2

18/18 points (graded)

What is the LU factorization of $\begin{bmatrix} 1 & -2 & 2 \\ 5 & -15 & 8 \\ -2 & -11 & -11 \end{bmatrix}$?





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Answer:

$$\begin{pmatrix} 1 & -2 & 2 \\ 5 & -15 & 8 \\ -2 & -11 & -11 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 5 & 1 & 0 \\ -2 & 3 & 1 \end{pmatrix} \begin{pmatrix} 1 & -2 & 2 \\ 0 & -5 & -2 \\ 0 & 0 & -1 \end{pmatrix}.$$

Here are the details when executing the algorithm:

Iteration	Before	After
1	$ \begin{array}{ c c c c c } \hline 1 & -2 & 2 \\ 5 & -15 & 8 \\ -2 & -11 & -11 \end{array} $	
2	$ \left(\begin{array}{c c c} 1 & -2 & 2 \\ \hline 5 & -5 & -2 \\ \hline -2 & -15 & -7 \end{array}\right) $	$ \begin{pmatrix} 1 & -2 & 2 \\ 5 & -5 & -2 \\ -2 & 3 & -1 \end{pmatrix} $
3	$ \left(\begin{array}{c ccc} 1 & -2 & 2 \\ 5 & -5 & -2 \\ \hline -2 & 3 & -1 \end{array}\right) $	$ \left(\begin{array}{c cc c} 1 & -2 & 2 \\ 5 & -5 & -2 \\ \hline -2 & 3 & -1 \end{array}\right) $

The unit lower triangular matrix L and upper triangular matrix U can then be read off as:

$$L = \begin{pmatrix} 1 & 0 & 0 \\ 5 & 1 & 0 \\ -2 & 3 & 1 \end{pmatrix} \qquad \begin{pmatrix} 1 & -2 & 2 \\ 0 & -5 & -2 \\ 0 & 0 & -1 \end{pmatrix}$$

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Answers are displayed within the problem

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