

COT4500 – Programming Assignment #1

LU Factorization

Due 03/31/2013

You are tasked implement the **LU Factorization** algorithm presented in chapter 6.5 of the textbook using the C language and compilable by GNU's C compiler. Your Eustis account provides access to the C compiler and should be used to verify your work prior to project submission. The program will compute the lower and upper triangular matrices and the determinant for a given square matrix. The program will display the input and triangular matrices and the determinant of the input matrix as output. If the input matrix is found not to be factorable, the program will display the input matrix and an appropriate message.

The factorization algorithm in the textbook does not incorporate pivoting. As extra credit, you may include pivoting to extend the domain of factorable matrices. Extra credit will add 5 points to the overall grade.

1 Input Specification

The program must accept an input filename from the command line. The input file will contain the data that represents a matrix. The file is formatted as follows:

Field #	Description
1	Number, n , of matrix rows (hence columns)
2 - $(n^2 + 1)$	The matrix elements in natural order. That is, all row 1 elements in column order followed by all row 2 elements and so on.

Each field is separated by one or more **space** characters. **Space** characters are characters for which the C function `isspace` (in header `ctype.h`) returns a non-zero value.

A sample matrix and it's input file representation are,

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

```
4
1 1 0 3
2 1 -1 1
3 -1 -1 2
-1 2 3 -1
```

2 Output Specification

The output must be formatted as follows,

1. Display of the input matrix.
2. If the input matrix can be factored,
 - (a) Display of the input matrix determinant.
 - (b) Display of the L matrix.
 - (c) Display of the U matrix.
3. If the input matrix cannot be factored,
 - (a) Display the string `The matrix cannot be factored`

After each item displayed must be one blank line.

Each $n \times n$ matrix must be displayed as n lines each of n elements. Each item on the line (including the first) is assumed to be a floating point and must be displayed using the C language formatting `%12.5E` as would be used by the `printf` function. This requirement provides consistent column widths among the rows of the matrix and among the matrices. The determinant, if present, must also be displayed with the formatting `%12.5E`.

3 Assignment Grading

Your program will be exercised against a suite of matrices of various sizes. The output of your program will be compared to the expected output. Grading is based on the correctness of the determinant and the matrices L and U and adherence to the output specification.

4 Submission

Sent an email to Frank Plochan (fplochan@gmail.com) with an attachment containing the program and a readme document that explain how to run your program.