Universidad Industrial de Santander, Colombia
Numerical Analysis, 2020-1
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Lab 5. LU Factorization

Name: _____

1 Instructions

- Make a **pdf** report including the solution to each point of the practice with name *Lab5_name_lastname.pdf*.
- Send the report and all created files in a rar or zip file with name *Lab5_name_lastname.rar* in the Moodle.
- You are allowed to use internet, notes, and .m files that you have created before.

2 Purposes

- To understand the LU Factorization method.
- To implement the LU Factorization method in Matlab.
- To interpret the LU Factorization method.
- To propose problems in which the LU Factorization method can be used.

3 Practice

3.1 Understanding

Answer with your own words the following questions:

- (0.2 points) What is LU factorization?

  Es un metodo directo para la solución de sistemas de ecuaciones lineales.

- (0.2 points) How to calculate the LU factorization?

  El metodo consiste en factorizar la matrix en el producto de dos matrices, una triangular inferior y la otra triangular inferior,

- (0.2 points) What applications does the LU factorization method have?

Como se dijo anteriormente, se usa para la resolución de susteams de ecuacuines lineales, adicionalmente también se usa para calcular la matriz inversa de una matriz A.

3.2 Implementing

- (1.0 points) Create a Matlab function called *my_lu_name_lastname()* to find the LU factorization of a matrix. The arguments of the function must be: the matrix. For instance,

```
A= []
[ L,U ] =my_lu_name_lastname(A);
```

- Find the triangular factorization $\mathbf{A} = \mathbf{LU}$ for the following matrix by using the created LU function

$$\mathbf{A} = \begin{bmatrix} 1 & 1 & 0 & 4 \\ 2 & -1 & 5 & 0 \\ 5 & 2 & 1 & 2 \\ -3 & 0 & 2 & 6 \end{bmatrix} \tag{1}$$

- Use the created LU function to solve the system $\mathbf{Ax} = \mathbf{b}$, where

$$\mathbf{A} = \begin{bmatrix} 1 & 2 & -3 & 4 \\ 4 & 8 & 12 & -8 \\ 2 & 3 & 2 & 1 \\ -3 & -1 & 1 & -4 \end{bmatrix}, \tag{2}$$

and

$$\mathbf{b} = \begin{bmatrix} 3 \\ 60 \\ 1 \\ 5 \end{bmatrix}. \tag{3}$$

- (1.0 points) Compare the results with the LU decomposition obtained by the MATLAB command lu(). Discuss about what you observe.

3.3 Interpreting

Sophia sells pictures at the Eiffel tower. She prices the pictures according to size: miniature pictures cost $10, normal size pictures cost $15, and huge picture cost $40. She usually sells as many miniature pictures as normal size and huge pictures combined. She also sells twice as many normal size pictures as huge. The fixed cost of her pictures is $300. How many of each size pictures must she sell to cover the fixed cost?.

- (0.4 points) Formulate a linear system of equations $\mathbf{Ax} = \mathbf{b}$ to model the problem.

- (0.3 points) Make a script named *run_4a_name_lastname.m* to find the LU factorization of the matrix $\mathbf{A}$.

- (0.3 points) Answer the question by using the found LU factorization.

3.4 Proposing

- (2.0 points)Propose an application problem in which the LU factorization can be used. The problem should include at least 3 variables. Solve the proposed problem using the created LU function.