Assignment 1

E33 Abdule33 260677463

Question 1 $A = \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 4 & 9 & 14 & 8 & 8 \\ 2 & 6 & 12 & 12 & 21 \\ 4 & 10 & 20 & 17 & 32 \\ 8 & 17 & 30 & 18 & 34 \end{bmatrix}$ final answer

Find LU such that $A = LU$

1. Doolittle –

Row 1

$u_{1i} = a_{1i}$

steps

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 4 & 9 & 14 & 8 & 8 \\ 2 & 6 & 12 & 12 & 21 \\ 4 & 10 & 20 & 17 & 32 \\ 8 & 17 & 30 & 18 & 34 \end{bmatrix}$

Column 1

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 9 & 14 & 8 & 8 \\ 1 & 6 & 12 & 12 & 21 \\ 2 & 10 & 20 & 17 & 32 \\ 4 & 17 & 30 & 18 & 34 \end{bmatrix}$

Row 2

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 6 & 12 & 12 & 21 \\ 2 & 10 & 20 & 17 & 32 \\ 4 & 17 & 30 & 18 & 34 \end{bmatrix}$

Column 2

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 12 & 12 & 21 \\ 2 & 2 & 20 & 17 & 32 \\ 4 & 7 & 30 & 18 & 34 \end{bmatrix}$

Row 3

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 20 & 17 & 32 \\ 4 & 7 & 30 & 18 & 34 \end{bmatrix}$

Column 3

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 17 & 32 \\ 4 & 1 & 2 & 18 & 34 \end{bmatrix}$

Row 4

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 1 & 2 \\ 4 & 1 & 2 & 18 & 34 \end{bmatrix}$

Column 4

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 1 & 2 \\ 4 & 1 & 2 & 2 & 34 \end{bmatrix}$

(5)

$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 1 & 2 \\ 4 & 1 & 2 & 2 & 4 \end{bmatrix}$ ✓

$U = \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 0 & 1 & 2 & 4 & 6 \\ 0 & 0 & 2 & 2 & 8 \\ 0 & 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 0 & 4 \end{bmatrix}$

$L = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 2 & 1 & 0 & 0 & 0 \\ 1 & 2 & 1 & 0 & 0 \\ 2 & 2 & 2 & 1 & 0 \\ 4 & 1 & 2 & 2 & 1 \end{bmatrix}$

$$A = \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 4 & 9 & 14 & 8 & 8 \\ 2 & 6 & 12 & 12 & 21 \\ 4 & 10 & 20 & 17 & 32 \\ 8 & 17 & 30 & 18 & 34 \end{bmatrix}$$ final answer → $$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 1 & 2 \\ 4 & 1 & 2 & 2 & 4 \end{bmatrix}$$ → U, same as 1.

L ↙

Question 1: find LU such that A = LU

2. Gaussian –

steps ↓

$$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 9 & 14 & 8 & 8 \\ 1 & 6 & 12 & 12 & 21 \\ 2 & 10 & 20 & 17 & 32 \\ 4 & 17 & 30 & 18 & 34 \end{bmatrix} \rightarrow \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 6 & 10 & 20 \\ 2 & 2 & 8 & 13 & 30 \\ 4 & 1 & 6 & 10 & 30 \end{bmatrix}$$

$$L = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 2 & 1 & 0 & 0 & 0 \\ 1 & 2 & 1 & 0 & 0 \\ 2 & 2 & 2 & 1 & 0 \\ 4 & 1 & 2 & 2 & 1 \end{bmatrix}$$

$$U = \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 0 & 1 & 2 & 4 & 6 \\ 0 & 0 & 2 & 2 & 8 \\ 0 & 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 0 & 4 \end{bmatrix}$$

$$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 9 & 2 & 4 & 6 \\ 1 & 3 & 6 & 10 & 29 \\ 2 & 20 & 8 & 13 & 30 \\ 4 & 1 & 6 & 10 & 30 \end{bmatrix} \rightarrow \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 4 & 5 & 18 \\ 4 & 1 & 4 & 6 & 24 \end{bmatrix}$$

$$\begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 5 & 18 \\ 4 & 1 & 2 & 6 & 24 \end{bmatrix} \rightarrow \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 1 & 2 \\ 4 & 1 & 2 & 2 & 8 \end{bmatrix} \rightarrow \begin{bmatrix} 2 & 4 & 6 & 2 & 1 \\ 2 & 1 & 2 & 4 & 6 \\ 1 & 2 & 2 & 2 & 8 \\ 2 & 2 & 2 & 1 & 2 \\ 4 & 1 & 2 & 2 & 4 \end{bmatrix}$$ ✓

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3. Both methods solve system by decomposing A into L, U
Both methods use forward/backward subs after decomp to solve the linear system.

However, the gaussian version can be used on non-square matrices while the doolittle algorithm can't be.
The gaussian version uses a pivot to form submatrices while the doolittle algorithm uses a set of equations to get the coefficients.