Métodos para resolución de sistemas de ecuaciones lineales *LU*

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Contents

1 Metodo Lu

1.1 Caso de matrices de 2×2

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} = \begin{pmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{pmatrix} \cdot \begin{pmatrix} 1 & u_{12} \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} \\ l_{21} & l_{22} \end{pmatrix}$$

$$\begin{aligned} a_{11} &= l_{11} \\ a_{21} &= l_{21} \\ a_{12} &= l_{11} u_{12} \\ a_{22} &= l_{21} u_{12} + l_{22} \end{aligned}$$

$$\begin{aligned} l_{11} &= a_{11} \\ l_{21} &= a_{21} \\ u_{12} &= \frac{a_{12}}{l_{11}} \\ l_{22} &= a_{22} - l_{21} u_{12} \end{aligned}$$

1.2 Caso de matrices de 3×3

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix} \cdot \begin{pmatrix} 1 & u_{12} & u_{13} \\ 0 & 1 & u_{23} \\ 0 & 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} \\ l_{21} & l_{22} & u_{23} \\ l_{31} & l_{32} & l_{33} \end{pmatrix}$$

$$\begin{aligned} a_{11} &= l_{11} \\ a_{21} &= l_{21} \\ a_{31} &= l_{31} \\ a_{12} &= l_{11} u_{12} \\ a_{22} &= l_{21} u_{12} + l_{22} \\ a_{32} &= l_{31} u_{12} + l_{32} \\ a_{13} &= l_{11} u_{13} \\ a_{23} &= l_{21} u_{13} + l_{22} u_{23} \\ a_{33} &= l_{31} u_{13} + l_{32} u_{23} + l_{33} \end{aligned}$$

$$\begin{aligned} l_{11} &= a_{11} \\ l_{21} &= a_{21} \\ l_{31} &= a_{31} \\ u_{12} &= \frac{a_{12}}{l_{11}} \\ l_{22} &= a_{22} - l_{21} u_{12} \\ l_{32} &= a_{32} - l_{31} u_{12} \\ u_{13} &= \frac{a_{13}}{l_{11}} \\ u_{23} &= \frac{a_{23} - l_{21} u_{13}}{l_{22}} \\ l_{33} &= a_{33} - l_{31} u_{13} - l_{32} u_{23} \end{aligned}$$

1.3 Caso de matrices de 4×4

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} \end{pmatrix} \cdot \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} \\ 0 & 1 & u_{23} & u_{24} \\ 0 & 0 & 1 & u_{34} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} & u_{14} \\ l_{21} & l_{22} & u_{23} & u_{24} \\ l_{31} & l_{32} & l_{33} & u_{34} \\ l_{41} & l_{42} & l_{43} & l_{44} \end{pmatrix}$$

$$\begin{aligned} a_{11} &= l_{11} \\ a_{21} &= l_{21} \\ a_{31} &= l_{31} \\ a_{41} &= l_{41} \\ a_{12} &= l_{11} u_{12} \\ a_{22} &= l_{21} u_{12} + l_{22} \end{aligned}$$

$$\begin{aligned} a_{32} &= l_{31} u_{12} + l_{32} \\ a_{42} &= l_{41} u_{12} + l_{42} \\ a_{13} &= l_{11} u_{13} \\ a_{23} &= l_{21} u_{13} + l_{22} u_{23} \\ a_{33} &= l_{31} u_{13} + l_{32} u_{23} + l_{33} \\ a_{43} &= l_{41} u_{13} + l_{42} u_{23} + l_{43} \\ a_{14} &= l_{11} u_{14} \end{aligned}$$

$$a_{24} = l_{21}u_{14} + l_{22}u_{24}$$
$$a_{34} = l_{31}u_{14} + l_{32}u_{24} + l_{33}u_{34}$$
$$a_{44} = l_{41}u_{14} + l_{42}u_{24} + l_{43}u_{34} + l_{44}$$

$$l_{11} = a_{11}$$
$$l_{21} = a_{21}$$
$$l_{31} = a_{31}$$
$$l_{41} = a_{41}$$
$$u_{12} = \frac{a_{12}}{l_{11}}$$
$$l_{22} = a_{22} - l_{21}u_{12}$$
$$l_{32} = a_{32} - l_{31}u_{12}$$
$$l_{42} = a_{42} - l_{41}u_{12}$$
$$u_{13} = \frac{a_{13}}{l_{11}}$$
$$u_{23} = \frac{a_{23} - l_{21}u_{13}}{l_{22}}$$
$$l_{33} = a_{33} - l_{31}u_{13} - l_{32}u_{23}$$
$$l_{43} = a_{43} - l_{41}u_{13} - l_{42}u_{23}$$
$$u_{14} = \frac{a_{14}}{l_{11}}$$
$$u_{24} = \frac{a_{24} - l_{21}u_{14}}{l_{22}}$$
$$u_{34} = \frac{a_{34} - l_{31}u_{14} - l_{32}u_{24}}{l_{33}}$$
$$l_{44} = a_{44} - l_{41}u_{14} - l_{42}u_{24} - l_{43}u_{34}$$

1.4 Caso de matrices de 5×5

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} \end{pmatrix} \cdot \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} & u_{15} \\ 0 & 1 & u_{23} & u_{24} & u_{25} \\ 0 & 0 & 1 & u_{34} & u_{35} \\ 0 & 0 & 0 & 1 & u_{45} \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ l_{21} & l_{22} & u_{23} & u_{24} & u_{25} \\ l_{31} & l_{32} & l_{33} & u_{34} & u_{35} \\ l_{41} & l_{42} & l_{43} & l_{44} & u_{45} \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} \end{pmatrix}$$

$$a_{11} = l_{11}$$
$$a_{21} = l_{21}$$
$$a_{31} = l_{31}$$
$$a_{41} = l_{41}$$
$$a_{51} = l_{51}$$
$$a_{12} = l_{11}u_{12}$$
$$a_{22} = l_{21}u_{12} + l_{22}$$
$$a_{32} = l_{31}u_{12} + l_{32}$$
$$a_{42} = l_{41}u_{12} + l_{42}$$
$$a_{52} = l_{51}u_{12} + l_{52}$$
$$a_{13} = l_{11}u_{13}$$
$$a_{23} = l_{21}u_{13} + l_{22}u_{23}$$
$$a_{33} = l_{31}u_{13} + l_{32}u_{23} + l_{33}$$
$$a_{43} = l_{41}u_{13} + l_{42}u_{23} + l_{43}$$
$$a_{53} = l_{51}u_{13} + l_{52}u_{23} + l_{53}$$
$$a_{14} = l_{11}u_{14}$$
$$a_{24} = l_{21}u_{14} + l_{22}u_{24}$$
$$a_{34} = l_{31}u_{14} + l_{32}u_{24} + l_{33}u_{34}$$
$$a_{44} = l_{41}u_{14} + l_{42}u_{24} + l_{43}u_{34} + l_{44}$$
$$a_{54} = l_{51}u_{14} + l_{52}u_{24} + l_{53}u_{34} + l_{54}$$
$$a_{15} = l_{11}u_{15}$$
$$a_{25} = l_{21}u_{15} + l_{22}u_{25}$$
$$a_{35} = l_{31}u_{15} + l_{32}u_{25} + l_{33}u_{35}$$
$$a_{45} = l_{41}u_{15} + l_{42}u_{25} + l_{43}u_{35} + l_{44}u_{45}$$
$$a_{55} = l_{51}u_{15} + l_{52}u_{25} + l_{53}u_{35} + l_{54}u_{45} + l_{55}$$

$$l_{11} = a_{11}$$
$$l_{21} = a_{21}$$
$$l_{31} = a_{31}$$
$$l_{41} = a_{41}$$
$$l_{51} = a_{51}$$
$$u_{12} = \frac{a_{12}}{l_{11}}$$
$$l_{22} = a_{22} - l_{21}u_{12}$$
$$l_{32} = a_{32} - l_{31}u_{12}$$
$$l_{42} = a_{42} - l_{41}u_{12}$$
$$l_{52} = a_{52} - l_{51}u_{12}$$
$$u_{13} = \frac{a_{13}}{l_{11}}$$
$$u_{23} = \frac{a_{23} - l_{21}u_{13}}{l_{22}}$$
$$l_{33} = a_{33} - l_{31}u_{13} - l_{32}u_{23}$$
$$l_{43} = a_{43} - l_{41}u_{13} - l_{42}u_{23}$$
$$l_{53} = a_{53} - l_{51}u_{13} - l_{52}u_{23}$$
$$u_{14} = \frac{a_{14}}{l_{11}}$$
$$u_{24} = \frac{a_{24} - l_{21}u_{14}}{l_{22}}$$
$$u_{34} = \frac{a_{34} - l_{31}u_{14} - l_{32}u_{24}}{l_{33}}$$
$$l_{44} = a_{44} - l_{41}u_{14} - l_{42}u_{24} - l_{43}u_{34}$$
$$l_{54} = a_{54} - l_{51}u_{14} - l_{52}u_{24} - l_{53}u_{34}$$
$$u_{15} = \frac{a_{15}}{l_{11}}$$
$$u_{25} = \frac{a_{25} - l_{21}u_{15}}{l_{22}}$$
$$u_{35} = \frac{a_{35} - l_{31}u_{15} - l_{32}u_{25}}{l_{33}}$$
$$u_{45} = \frac{a_{45} - l_{41}u_{15} - l_{42}u_{25} - l_{43}u_{35}}{l_{44}}$$
$$l_{55} = a_{55} - l_{51}u_{15} - l_{52}u_{25} - l_{53}u_{35} - l_{54}u_{45}$$

1.5 Caso de matrices de 6×6

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} & 0 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} & 0 \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & l_{66} \end{pmatrix} \cdot \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & 1 & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & 1 & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & 1 & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & 1 & u_{56} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ l_{21} & l_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ l_{31} & l_{32} & l_{33} & u_{34} & u_{35} & u_{36} \\ l_{41} & l_{42} & l_{43} & l_{44} & u_{45} & u_{46} \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} & u_{56} \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & l_{66} \end{pmatrix}$$

$$a_{11} = l_{11}$$
$$a_{21} = l_{21}$$
$$a_{31} = l_{31}$$
$$a_{41} = l_{41}$$
$$a_{51} = l_{51}$$
$$a_{61} = l_{61}$$
$$a_{12} = l_{11}u_{12}$$
$$a_{22} = l_{21}u_{12} + l_{22}$$
$$a_{32} = l_{31}u_{12} + l_{32}$$
$$a_{42} = l_{41}u_{12} + l_{42}$$
$$a_{52} = l_{51}u_{12} + l_{52}$$
$$a_{62} = l_{61}u_{12} + l_{62}$$
$$a_{13} = l_{11}u_{13}$$
$$a_{23} = l_{21}u_{13} + l_{22}u_{23}$$
$$a_{33} = l_{31}u_{13} + l_{32}u_{23} + l_{33}$$
$$a_{43} = l_{41}u_{13} + l_{42}u_{23} + l_{43}$$
$$a_{53} = l_{51}u_{13} + l_{52}u_{23} + l_{53}$$
$$a_{63} = l_{61}u_{13} + l_{62}u_{23} + l_{63}$$
$$a_{14} = l_{11}u_{14}$$
$$a_{24} = l_{21}u_{14} + l_{22}u_{24}$$
$$a_{34} = l_{31}u_{14} + l_{32}u_{24} + l_{33}u_{34}$$
$$a_{44} = l_{41}u_{14} + l_{42}u_{24} + l_{43}u_{34} + l_{44}$$
$$a_{54} = l_{51}u_{14} + l_{52}u_{24} + l_{53}u_{34} + l_{54}$$
$$a_{64} = l_{61}u_{14} + l_{62}u_{24} + l_{63}u_{34} + l_{64}$$
$$a_{15} = l_{11}u_{15}$$
$$a_{25} = l_{21}u_{15} + l_{22}u_{25}$$
$$a_{35} = l_{31}u_{15} + l_{32}u_{25} + l_{33}u_{35}$$
$$a_{45} = l_{41}u_{15} + l_{42}u_{25} + l_{43}u_{35} + l_{44}u_{45}$$
$$a_{55} = l_{51}u_{15} + l_{52}u_{25} + l_{53}u_{35} + l_{54}u_{45} + l_{55}$$
$$a_{65} = l_{61}u_{15} + l_{62}u_{25} + l_{63}u_{35} + l_{64}u_{45} + l_{65}$$
$$a_{16} = l_{11}u_{16}$$
$$a_{26} = l_{21}u_{16} + l_{22}u_{26}$$
$$a_{36} = l_{31}u_{16} + l_{32}u_{26} + l_{33}u_{36}$$

$$a_{46} = l_{41}u_{16} + l_{42}u_{26} + l_{43}u_{36} + l_{44}u_{46}$$
$$a_{56} = l_{51}u_{16} + l_{52}u_{26} + l_{53}u_{36} + l_{54}u_{46} + l_{55}u_{56}$$
$$a_{66} = l_{61}u_{16} + l_{62}u_{26} + l_{63}u_{36} + l_{64}u_{46} + l_{65}u_{56} + l_{66}$$

$$l_{11} = a_{11}$$
$$l_{21} = a_{21}$$
$$l_{31} = a_{31}$$
$$l_{41} = a_{41}$$
$$l_{51} = a_{51}$$
$$l_{61} = a_{61}$$
$$u_{12} = \frac{a_{12}}{l_{11}}$$
$$l_{22} = a_{22} - l_{21}u_{12}$$
$$l_{32} = a_{32} - l_{31}u_{12}$$
$$l_{42} = a_{42} - l_{41}u_{12}$$
$$l_{52} = a_{52} - l_{51}u_{12}$$
$$l_{62} = a_{62} - l_{61}u_{12}$$
$$u_{13} = \frac{a_{13}}{l_{11}}$$
$$u_{23} = \frac{a_{23} - l_{21}u_{13}}{l_{22}}$$
$$l_{33} = a_{33} - l_{31}u_{13} - l_{32}u_{23}$$
$$l_{43} = a_{43} - l_{41}u_{13} - l_{42}u_{23}$$
$$l_{53} = a_{53} - l_{51}u_{13} - l_{52}u_{23}$$
$$l_{63} = a_{63} - l_{61}u_{13} - l_{62}u_{23}$$
$$u_{14} = \frac{a_{14}}{l_{11}}$$
$$u_{24} = \frac{a_{24} - l_{21}u_{14}}{l_{22}}$$
$$u_{34} = \frac{a_{34} - l_{31}u_{14} - l_{32}u_{24}}{l_{33}}$$
$$l_{44} = a_{44} - l_{41}u_{14} - l_{42}u_{24} - l_{43}u_{34}$$
$$l_{54} = a_{54} - l_{51}u_{14} - l_{52}u_{24} - l_{53}u_{34}$$
$$l_{64} = a_{64} - l_{61}u_{14} - l_{62}u_{24} - l_{63}u_{34}$$
$$u_{15} = \frac{a_{15}}{l_{11}}$$
$$u_{25} = \frac{a_{25} - l_{21}u_{15}}{l_{22}}$$
$$u_{35} = \frac{a_{35} - l_{31}u_{15} - l_{32}u_{25}}{l_{33}}$$
$$u_{45} = \frac{a_{45} - l_{41}u_{15} - l_{42}u_{25} - l_{43}u_{35}}{l_{44}}$$
$$l_{55} = a_{55} - l_{51}u_{15} - l_{52}u_{25} - l_{53}u_{35} - l_{54}u_{45}$$
$$l_{65} = a_{65} - l_{61}u_{15} - l_{62}u_{25} - l_{63}u_{35} - l_{64}u_{45}$$
$$u_{16} = \frac{a_{16}}{l_{11}}$$
$$u_{26} = \frac{a_{26} - l_{21}u_{16}}{l_{22}}$$
$$u_{36} = \frac{a_{36} - l_{31}u_{16} - l_{32}u_{26}}{l_{33}}$$
$$u_{46} = \frac{a_{46} - l_{41}u_{16} - l_{42}u_{26} - l_{43}u_{36}}{l_{44}}$$
$$u_{56} = \frac{a_{56} - l_{51}u_{16} - l_{52}u_{26} - l_{53}u_{36} - l_{54}u_{46}}{l_{55}}$$
$$l_{66} = a_{66} - l_{61}u_{16} - l_{62}u_{26} - l_{63}u_{36} - l_{64}u_{46} - l_{65}u_{56}$$

2 Metodo lU

2.1 Caso de matrices de 2×2

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ l_{21} & 1 \end{pmatrix} \cdot \begin{pmatrix} u_{11} & u_{12} \\ 0 & u_{22} \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} \\ l_{21} & u_{22} \end{pmatrix}$$

$$\begin{aligned} a_{11} &= u_{11} \\ a_{21} &= l_{21} u_{11} \\ a_{12} &= u_{12} \\ a_{22} &= l_{21} u_{12} + u_{22} \end{aligned}$$

$$\begin{aligned} u_{11} &= a_{11} \\ l_{21} &= \frac{a_{21}}{u_{11}} \\ u_{12} &= a_{12} \\ u_{22} &= a_{22} - l_{21} u_{12} \end{aligned}$$

2.2 Caso de matrices de 3×3

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{pmatrix} \cdot \begin{pmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} \\ l_{21} & u_{22} & u_{23} \\ l_{31} & l_{32} & u_{33} \end{pmatrix}$$

$$\begin{aligned} a_{11} &= u_{11} \\ a_{21} &= l_{21} u_{11} \\ a_{31} &= l_{31} u_{11} \\ a_{12} &= u_{12} \\ a_{22} &= l_{21} u_{12} + u_{22} \\ a_{32} &= l_{31} u_{12} + l_{32} u_{22} \\ a_{13} &= u_{13} \\ a_{23} &= l_{21} u_{13} + u_{23} \\ a_{33} &= l_{31} u_{13} + l_{32} u_{23} + u_{33} \end{aligned}$$

$$\begin{aligned} u_{11} &= a_{11} \\ l_{21} &= \frac{a_{21}}{u_{11}} \\ l_{31} &= \frac{a_{31}}{u_{11}} \\ u_{12} &= a_{12} \\ u_{22} &= a_{22} - l_{21} u_{12} \\ l_{32} &= \frac{a_{32} - l_{31} u_{12}}{u_{22}} \\ u_{13} &= a_{13} \\ u_{23} &= a_{23} - l_{21} u_{13} \\ u_{33} &= a_{33} - l_{31} u_{13} - l_{32} u_{23} \end{aligned}$$

2.3 Caso de matrices de 4×4

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 \\ l_{41} & l_{42} & l_{43} & 1 \end{pmatrix} \cdot \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} \\ 0 & u_{22} & u_{23} & u_{24} \\ 0 & 0 & u_{33} & u_{34} \\ 0 & 0 & 0 & u_{44} \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} \\ l_{21} & u_{22} & u_{23} & u_{24} \\ l_{31} & l_{32} & u_{33} & u_{34} \\ l_{41} & l_{42} & l_{43} & u_{44} \end{pmatrix}$$

$$\begin{aligned} a_{11} &= u_{11} \\ a_{21} &= l_{21} u_{11} \\ a_{31} &= l_{31} u_{11} \\ a_{41} &= l_{41} u_{11} \\ a_{12} &= u_{12} \\ a_{22} &= l_{21} u_{12} + u_{22} \end{aligned}$$

$$\begin{aligned} a_{32} &= l_{31} u_{12} + l_{32} u_{22} \\ a_{42} &= l_{41} u_{12} + l_{42} u_{22} \\ a_{13} &= u_{13} \\ a_{23} &= l_{21} u_{13} + u_{23} \\ a_{33} &= l_{31} u_{13} + l_{32} u_{23} + u_{33} \\ a_{43} &= l_{41} u_{13} + l_{42} u_{23} + l_{43} u_{33} \\ a_{14} &= u_{14} \\ a_{24} &= l_{21} u_{14} + u_{24} \end{aligned}$$

$$a_{34} = l_{31}u_{14} + l_{32}u_{24} + u_{34}$$
$$a_{44} = l_{41}u_{14} + l_{42}u_{24} + l_{43}u_{34} + u_{44}$$

$$u_{11} = a_{11}$$
$$l_{21} = \frac{a_{21}}{u_{11}}$$
$$l_{31} = \frac{a_{31}}{u_{11}}$$
$$l_{41} = \frac{a_{41}}{u_{11}}$$
$$u_{12} = a_{12}$$
$$u_{22} = a_{22} - l_{21}u_{12}$$
$$l_{32} = \frac{a_{32} - l_{31}u_{12}}{u_{22}}$$
$$l_{42} = \frac{a_{42} - l_{41}u_{12}}{u_{22}}$$
$$u_{13} = a_{13}$$
$$u_{23} = a_{23} - l_{21}u_{13}$$
$$u_{33} = a_{33} - l_{31}u_{13} - l_{32}u_{23}$$
$$l_{43} = \frac{a_{43} - l_{41}u_{13} - l_{42}u_{23}}{u_{33}}$$
$$u_{14} = a_{14}$$
$$u_{24} = a_{24} - l_{21}u_{14}$$
$$u_{34} = a_{34} - l_{31}u_{14} - l_{32}u_{24}$$
$$u_{44} = a_{44} - l_{41}u_{14} - l_{42}u_{24} - l_{43}u_{34}$$

2.4 Caso de matrices de 5×5

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & 1 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & 1 \end{pmatrix} \cdot \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} \\ 0 & 0 & u_{33} & u_{34} & u_{35} \\ 0 & 0 & 0 & u_{44} & u_{45} \\ 0 & 0 & 0 & 0 & u_{55} \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ l_{21} & u_{22} & u_{23} & u_{24} & u_{25} \\ l_{31} & l_{32} & u_{33} & u_{34} & u_{35} \\ l_{41} & l_{42} & l_{43} & u_{44} & u_{45} \\ l_{51} & l_{52} & l_{53} & l_{54} & u_{55} \end{pmatrix}$$

$$a_{11} = u_{11}$$
$$a_{21} = l_{21}u_{11}$$
$$a_{31} = l_{31}u_{11}$$
$$a_{41} = l_{41}u_{11}$$
$$a_{51} = l_{51}u_{11}$$
$$a_{12} = u_{12}$$
$$a_{22} = l_{21}u_{12} + u_{22}$$
$$a_{32} = l_{31}u_{12} + l_{32}u_{22}$$
$$a_{42} = l_{41}u_{12} + l_{42}u_{22}$$
$$a_{52} = l_{51}u_{12} + l_{52}u_{22}$$
$$a_{13} = u_{13}$$
$$a_{23} = l_{21}u_{13} + u_{23}$$
$$a_{33} = l_{31}u_{13} + l_{32}u_{23} + u_{33}$$
$$a_{43} = l_{41}u_{13} + l_{42}u_{23} + l_{43}u_{33}$$
$$a_{53} = l_{51}u_{13} + l_{52}u_{23} + l_{53}u_{33}$$
$$a_{14} = u_{14}$$
$$a_{24} = l_{21}u_{14} + u_{24}$$
$$a_{34} = l_{31}u_{14} + l_{32}u_{24} + u_{34}$$
$$a_{44} = l_{41}u_{14} + l_{42}u_{24} + l_{43}u_{34} + u_{44}$$
$$a_{54} = l_{51}u_{14} + l_{52}u_{24} + l_{53}u_{34} + l_{54}u_{44}$$
$$a_{15} = u_{15}$$
$$a_{25} = l_{21}u_{15} + u_{25}$$
$$a_{35} = l_{31}u_{15} + l_{32}u_{25} + u_{35}$$
$$a_{45} = l_{41}u_{15} + l_{42}u_{25} + l_{43}u_{35} + u_{45}$$
$$a_{55} = l_{51}u_{15} + l_{52}u_{25} + l_{53}u_{35} + l_{54}u_{45} + u_{55}$$

$$u_{11} = a_{11}$$
$$l_{21} = \frac{a_{21}}{u_{11}}$$
$$l_{31} = \frac{a_{31}}{u_{11}}$$
$$l_{41} = \frac{a_{41}}{u_{11}}$$
$$l_{51} = \frac{a_{51}}{u_{11}}$$
$$u_{12} = a_{12}$$
$$u_{22} = a_{22} - l_{21}u_{12}$$
$$l_{32} = \frac{a_{32} - l_{31}u_{12}}{u_{22}}$$
$$l_{42} = \frac{a_{42} - l_{41}u_{12}}{u_{22}}$$
$$l_{52} = \frac{a_{52} - l_{51}u_{12}}{u_{22}}$$
$$u_{13} = a_{13}$$
$$u_{23} = a_{23} - l_{21}u_{13}$$
$$u_{33} = a_{33} - l_{31}u_{13} - l_{32}u_{23}$$
$$l_{43} = \frac{a_{43} - l_{41}u_{13} - l_{42}u_{23}}{u_{33}}$$
$$l_{53} = \frac{a_{53} - l_{51}u_{13} - l_{52}u_{23}}{u_{33}}$$
$$u_{14} = a_{14}$$
$$u_{24} = a_{24} - l_{21}u_{14}$$
$$u_{34} = a_{34} - l_{31}u_{14} - l_{32}u_{24}$$
$$u_{44} = a_{44} - l_{41}u_{14} - l_{42}u_{24} - l_{43}u_{34}$$
$$l_{54} = \frac{a_{54} - l_{51}u_{14} - l_{52}u_{24} - l_{53}u_{34}}{u_{44}}$$
$$u_{15} = a_{15}$$
$$u_{25} = a_{25} - l_{21}u_{15}$$
$$u_{35} = a_{35} - l_{31}u_{15} - l_{32}u_{25}$$
$$u_{45} = a_{45} - l_{41}u_{15} - l_{42}u_{25} - l_{43}u_{35}$$
$$u_{55} = a_{55} - l_{51}u_{15} - l_{52}u_{25} - l_{53}u_{35} - l_{54}u_{45}$$

2.5 Caso de matrices de 6×6

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & 1 & 0 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & 1 & 0 \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & 1 \end{pmatrix} \cdot \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & u_{33} & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & u_{44} & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & u_{55} & u_{56} \\ 0 & 0 & 0 & 0 & 0 & u_{66} \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ l_{21} & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ l_{31} & l_{32} & u_{33} & u_{34} & u_{35} & u_{36} \\ l_{41} & l_{42} & l_{43} & u_{44} & u_{45} & u_{46} \\ l_{51} & l_{52} & l_{53} & l_{54} & u_{55} & u_{56} \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & u_{66} \end{pmatrix}$$

$$a_{11} = u_{11}$$
$$a_{21} = l_{21}u_{11}$$
$$a_{31} = l_{31}u_{11}$$
$$a_{41} = l_{41}u_{11}$$
$$a_{51} = l_{51}u_{11}$$
$$a_{61} = l_{61}u_{11}$$
$$a_{12} = u_{12}$$
$$a_{22} = l_{21}u_{12} + u_{22}$$
$$a_{32} = l_{31}u_{12} + l_{32}u_{22}$$
$$a_{42} = l_{41}u_{12} + l_{42}u_{22}$$
$$a_{52} = l_{51}u_{12} + l_{52}u_{22}$$
$$a_{62} = l_{61}u_{12} + l_{62}u_{22}$$
$$a_{13} = u_{13}$$
$$a_{23} = l_{21}u_{13} + u_{23}$$
$$a_{33} = l_{31}u_{13} + l_{32}u_{23} + u_{33}$$
$$a_{43} = l_{41}u_{13} + l_{42}u_{23} + l_{43}u_{33}$$
$$a_{53} = l_{51}u_{13} + l_{52}u_{23} + l_{53}u_{33}$$
$$a_{63} = l_{61}u_{13} + l_{62}u_{23} + l_{63}u_{33}$$
$$a_{14} = u_{14}$$
$$a_{24} = l_{21}u_{14} + u_{24}$$
$$a_{34} = l_{31}u_{14} + l_{32}u_{24} + u_{34}$$
$$a_{44} = l_{41}u_{14} + l_{42}u_{24} + l_{43}u_{34} + u_{44}$$
$$a_{54} = l_{51}u_{14} + l_{52}u_{24} + l_{53}u_{34} + l_{54}u_{44}$$
$$a_{64} = l_{61}u_{14} + l_{62}u_{24} + l_{63}u_{34} + l_{64}u_{44}$$
$$a_{15} = u_{15}$$
$$a_{25} = l_{21}u_{15} + u_{25}$$
$$a_{35} = l_{31}u_{15} + l_{32}u_{25} + u_{35}$$
$$a_{45} = l_{41}u_{15} + l_{42}u_{25} + l_{43}u_{35} + u_{45}$$
$$a_{55} = l_{51}u_{15} + l_{52}u_{25} + l_{53}u_{35} + l_{54}u_{45} + u_{55}$$
$$a_{65} = l_{61}u_{15} + l_{62}u_{25} + l_{63}u_{35} + l_{64}u_{45} + l_{65}u_{55}$$
$$a_{16} = u_{16}$$
$$a_{26} = l_{21}u_{16} + u_{26}$$
$$a_{36} = l_{31}u_{16} + l_{32}u_{26} + u_{36}$$

$$a_{46} = l_{41}u_{16} + l_{42}u_{26} + l_{43}u_{36} + u_{46}$$
$$a_{56} = l_{51}u_{16} + l_{52}u_{26} + l_{53}u_{36} + l_{54}u_{46} + u_{56}$$
$$a_{66} = l_{61}u_{16} + l_{62}u_{26} + l_{63}u_{36} + l_{64}u_{46} + l_{65}u_{56} + u_{66}$$

$$u_{11} = a_{11}$$
$$l_{21} = \frac{a_{21}}{u_{11}}$$
$$l_{31} = \frac{a_{31}}{u_{11}}$$
$$l_{41} = \frac{a_{41}}{u_{11}}$$
$$l_{51} = \frac{a_{51}}{u_{11}}$$
$$l_{61} = \frac{a_{61}}{u_{11}}$$
$$u_{12} = a_{12}$$
$$u_{22} = a_{22} - l_{21}u_{12}$$
$$l_{32} = \frac{a_{32} - l_{31}u_{12}}{u_{22}}$$
$$l_{42} = \frac{a_{42} - l_{41}u_{12}}{u_{22}}$$
$$l_{52} = \frac{a_{52} - l_{51}u_{12}}{u_{22}}$$
$$l_{62} = \frac{a_{62} - l_{61}u_{12}}{u_{22}}$$
$$u_{13} = a_{13}$$
$$u_{23} = a_{23} - l_{21}u_{13}$$
$$u_{33} = a_{33} - l_{31}u_{13} - l_{32}u_{23}$$
$$l_{43} = \frac{a_{43} - l_{41}u_{13} - l_{42}u_{23}}{u_{33}}$$
$$l_{53} = \frac{a_{53} - l_{51}u_{13} - l_{52}u_{23}}{u_{33}}$$
$$l_{63} = \frac{a_{63} - l_{61}u_{13} - l_{62}u_{23}}{u_{33}}$$
$$u_{14} = a_{14}$$
$$u_{24} = a_{24} - l_{21}u_{14}$$
$$u_{34} = a_{34} - l_{31}u_{14} - l_{32}u_{24}$$
$$u_{44} = a_{44} - l_{41}u_{14} - l_{42}u_{24} - l_{43}u_{34}$$
$$l_{54} = \frac{a_{54} - l_{51}u_{14} - l_{52}u_{24} - l_{53}u_{34}}{u_{44}}$$
$$l_{64} = \frac{a_{64} - l_{61}u_{14} - l_{62}u_{24} - l_{63}u_{34}}{u_{44}}$$
$$u_{15} = a_{15}$$
$$u_{25} = a_{25} - l_{21}u_{15}$$
$$u_{35} = a_{35} - l_{31}u_{15} - l_{32}u_{25}$$
$$u_{45} = a_{45} - l_{41}u_{15} - l_{42}u_{25} - l_{43}u_{35}$$
$$u_{55} = a_{55} - l_{51}u_{15} - l_{52}u_{25} - l_{53}u_{35} - l_{54}u_{45}$$
$$l_{65} = \frac{a_{65} - l_{61}u_{15} - l_{62}u_{25} - l_{63}u_{35} - l_{64}u_{45}}{u_{55}}$$
$$u_{16} = a_{16}$$
$$u_{26} = a_{26} - l_{21}u_{16}$$
$$u_{36} = a_{36} - l_{31}u_{16} - l_{32}u_{26}$$
$$u_{46} = a_{46} - l_{41}u_{16} - l_{42}u_{26} - l_{43}u_{36}$$
$$u_{56} = a_{56} - l_{51}u_{16} - l_{52}u_{26} - l_{53}u_{36} - l_{54}u_{46}$$
$$u_{66} = a_{66} - l_{61}u_{16} - l_{62}u_{26} - l_{63}u_{36} - l_{64}u_{46} - l_{65}u_{56}$$

3 Metodo uL

3.1 Caso de matrices de 2×2

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} = \begin{pmatrix} 1 & u_{12} \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} \\ l_{21} & l_{22} \end{pmatrix}$$

$$\begin{aligned} a_{22} &= l_{22} \\ a_{12} &= u_{12} l_{22} \\ a_{21} &= l_{21} \\ a_{11} &= l_{11} + u_{12} l_{21} \end{aligned}$$

$$\begin{aligned} l_{22} &= a_{22} \\ u_{12} &= \frac{a_{12}}{l_{22}} \\ l_{21} &= a_{21} \\ l_{11} &= a_{11} - u_{12} l_{21} \end{aligned}$$

3.2 Caso de matrices de 3×3

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} \\ 0 & 1 & u_{23} \\ 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} l_{11} & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} \\ l_{21} & l_{22} & u_{23} \\ l_{31} & l_{32} & l_{33} \end{pmatrix}$$

$$\begin{aligned} a_{33} &= l_{33} \\ a_{23} &= u_{23} l_{33} \\ a_{13} &= u_{13} l_{33} \\ a_{32} &= l_{32} \\ a_{22} &= l_{22} + u_{23} l_{32} \\ a_{12} &= u_{12} l_{22} + u_{13} l_{32} \\ a_{31} &= l_{31} \\ a_{21} &= l_{21} + u_{23} l_{31} \\ a_{11} &= l_{11} + u_{12} l_{21} + u_{13} l_{31} \end{aligned}$$

$$\begin{aligned} l_{33} &= a_{33} \\ u_{23} &= \frac{a_{23}}{l_{33}} \\ u_{13} &= \frac{a_{13}}{l_{33}} \\ l_{32} &= a_{32} \\ l_{22} &= a_{22} - u_{23} l_{32} \\ u_{12} &= \frac{a_{12} - u_{13} l_{32}}{l_{22}} \\ l_{31} &= a_{31} \\ l_{21} &= a_{21} - u_{23} l_{31} \\ l_{11} &= a_{11} - u_{12} l_{21} - u_{13} l_{31} \end{aligned}$$

3.3 Caso de matrices de 4×4

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} \\ 0 & 1 & u_{23} & u_{24} \\ 0 & 0 & 1 & u_{34} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} l_{11} & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} & u_{14} \\ l_{21} & l_{22} & u_{23} & u_{24} \\ l_{31} & l_{32} & l_{33} & u_{34} \\ l_{41} & l_{42} & l_{43} & l_{44} \end{pmatrix}$$

$$\begin{aligned} a_{44} &= l_{44} \\ a_{34} &= u_{34} l_{44} \\ a_{24} &= u_{24} l_{44} \\ a_{14} &= u_{14} l_{44} \\ a_{43} &= l_{43} \\ a_{33} &= l_{33} + u_{34} l_{43} \end{aligned}$$

$$\begin{aligned} a_{23} &= u_{23} l_{33} + u_{24} l_{43} \\ a_{13} &= u_{13} l_{33} + u_{14} l_{43} \\ a_{42} &= l_{42} \\ a_{32} &= l_{32} + u_{34} l_{42} \\ a_{22} &= l_{22} + u_{23} l_{32} + u_{24} l_{42} \\ a_{12} &= u_{12} l_{22} + u_{13} l_{32} + u_{14} l_{42} \\ a_{41} &= l_{41} \end{aligned}$$

$$a_{31} = l_{31} + u_{34}l_{41}$$
$$a_{21} = l_{21} + u_{23}l_{31} + u_{24}l_{41}$$
$$a_{11} = l_{11} + u_{12}l_{21} + u_{13}l_{31} + u_{14}l_{41}$$

$$l_{44} = a_{44}$$
$$u_{34} = \frac{a_{34}}{l_{44}}$$
$$u_{24} = \frac{a_{24}}{l_{44}}$$
$$u_{14} = \frac{a_{14}}{l_{44}}$$
$$l_{43} = a_{43}$$
$$l_{33} = a_{33} - u_{34}l_{43}$$
$$u_{23} = \frac{a_{23} - u_{24}l_{43}}{l_{33}}$$
$$u_{13} = \frac{a_{13} - u_{14}l_{43}}{l_{33}}$$
$$l_{42} = a_{42}$$
$$l_{32} = a_{32} - u_{34}l_{42}$$
$$l_{22} = a_{22} - u_{23}l_{32} - u_{24}l_{42}$$
$$u_{12} = \frac{a_{12} - u_{13}l_{32} - u_{14}l_{42}}{l_{22}}$$
$$l_{41} = a_{41}$$
$$l_{31} = a_{31} - u_{34}l_{41}$$
$$l_{21} = a_{21} - u_{23}l_{31} - u_{24}l_{41}$$
$$l_{11} = a_{11} - u_{12}l_{21} - u_{13}l_{31} - u_{14}l_{41}$$

3.4 Caso de matrices de 5×5

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} & u_{15} \\ 0 & 1 & u_{23} & u_{24} & u_{25} \\ 0 & 0 & 1 & u_{34} & u_{35} \\ 0 & 0 & 0 & 1 & u_{45} \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} l_{11} & 0 & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ l_{21} & l_{22} & u_{23} & u_{24} & u_{25} \\ l_{31} & l_{32} & l_{33} & u_{34} & u_{35} \\ l_{41} & l_{42} & l_{43} & l_{44} & u_{45} \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} \end{pmatrix}$$

$$a_{55} = l_{55}$$
$$a_{45} = u_{45}l_{55}$$
$$a_{35} = u_{35}l_{55}$$
$$a_{25} = u_{25}l_{55}$$
$$a_{15} = u_{15}l_{55}$$
$$a_{54} = l_{54}$$
$$a_{44} = l_{44} + u_{45}l_{54}$$
$$a_{34} = u_{34}l_{44} + u_{35}l_{54}$$
$$a_{24} = u_{24}l_{44} + u_{25}l_{54}$$
$$a_{14} = u_{14}l_{44} + u_{15}l_{54}$$
$$a_{53} = l_{53}$$
$$a_{43} = l_{43} + u_{45}l_{53}$$
$$a_{33} = l_{33} + u_{34}l_{43} + u_{35}l_{53}$$

$$a_{23} = u_{23}l_{33} + u_{24}l_{43} + u_{25}l_{53}$$
$$a_{13} = u_{13}l_{33} + u_{14}l_{43} + u_{15}l_{53}$$
$$a_{52} = l_{52}$$
$$a_{42} = l_{42} + u_{45}l_{52}$$
$$a_{32} = l_{32} + u_{34}l_{42} + u_{35}l_{52}$$
$$a_{22} = l_{22} + u_{23}l_{32} + u_{24}l_{42} + u_{25}l_{52}$$
$$a_{12} = u_{12}l_{22} + u_{13}l_{32} + u_{14}l_{42} + u_{15}l_{52}$$
$$a_{51} = l_{51}$$
$$a_{41} = l_{41} + u_{45}l_{51}$$
$$a_{31} = l_{31} + u_{34}l_{41} + u_{35}l_{51}$$
$$a_{21} = l_{21} + u_{23}l_{31} + u_{24}l_{41} + u_{25}l_{51}$$
$$a_{11} = l_{11} + u_{12}l_{21} + u_{13}l_{31} + u_{14}l_{41} + u_{15}l_{51}$$

$$l_{55} = a_{55}$$
$$u_{45} = \frac{a_{45}}{l_{55}}$$
$$u_{35} = \frac{a_{35}}{l_{55}}$$
$$u_{25} = \frac{a_{25}}{l_{55}}$$
$$u_{15} = \frac{a_{15}}{l_{55}}$$
$$l_{54} = a_{54}$$
$$l_{44} = a_{44} - u_{45}l_{54}$$
$$u_{34} = \frac{a_{34} - u_{35}l_{54}}{l_{44}}$$
$$u_{24} = \frac{a_{24} - u_{25}l_{54}}{l_{44}}$$
$$u_{14} = \frac{a_{14} - u_{15}l_{54}}{l_{44}}$$
$$l_{53} = a_{53}$$
$$l_{43} = a_{43} - u_{45}l_{53}$$
$$l_{33} = a_{33} - u_{34}l_{43} - u_{35}l_{53}$$
$$u_{23} = \frac{a_{23} - u_{24}l_{43} - u_{25}l_{53}}{l_{33}}$$
$$u_{13} = \frac{a_{13} - u_{14}l_{43} - u_{15}l_{53}}{l_{33}}$$
$$l_{52} = a_{52}$$
$$l_{42} = a_{42} - u_{45}l_{52}$$
$$l_{32} = a_{32} - u_{34}l_{42} - u_{35}l_{52}$$
$$l_{22} = a_{22} - u_{23}l_{32} - u_{24}l_{42} - u_{25}l_{52}$$
$$u_{12} = \frac{a_{12} - u_{13}l_{32} - u_{14}l_{42} - u_{15}l_{52}}{l_{22}}$$
$$l_{51} = a_{51}$$
$$l_{41} = a_{41} - u_{45}l_{51}$$
$$l_{31} = a_{31} - u_{34}l_{41} - u_{35}l_{51}$$
$$l_{21} = a_{21} - u_{23}l_{31} - u_{24}l_{41} - u_{25}l_{51}$$
$$l_{11} = a_{11} - u_{12}l_{21} - u_{13}l_{31} - u_{14}l_{41} - u_{15}l_{51}$$

3.5 Caso de matrices de 6×6

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & 1 & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & 1 & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & 1 & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & 1 & u_{56} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} l_{11} & 0 & 0 & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} & 0 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} & 0 \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & l_{66} \end{pmatrix}$$

$$\begin{pmatrix} l_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ l_{21} & l_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ l_{31} & l_{32} & l_{33} & u_{34} & u_{35} & u_{36} \\ l_{41} & l_{42} & l_{43} & l_{44} & u_{45} & u_{46} \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} & u_{56} \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & l_{66} \end{pmatrix}$$

$$a_{66} = l_{66}$$
$$a_{56} = u_{56}l_{66}$$
$$a_{46} = u_{46}l_{66}$$
$$a_{36} = u_{36}l_{66}$$
$$a_{26} = u_{26}l_{66}$$
$$a_{16} = u_{16}l_{66}$$
$$a_{65} = l_{65}$$
$$a_{55} = l_{55} + u_{56}l_{65}$$
$$a_{45} = u_{45}l_{55} + u_{46}l_{65}$$
$$a_{35} = u_{35}l_{55} + u_{36}l_{65}$$
$$a_{25} = u_{25}l_{55} + u_{26}l_{65}$$
$$a_{15} = u_{15}l_{55} + u_{16}l_{65}$$
$$a_{64} = l_{64}$$
$$a_{54} = l_{54} + u_{56}l_{64}$$
$$a_{44} = l_{44} + u_{45}l_{54} + u_{46}l_{64}$$
$$a_{34} = u_{34}l_{44} + u_{35}l_{54} + u_{36}l_{64}$$
$$a_{24} = u_{24}l_{44} + u_{25}l_{54} + u_{26}l_{64}$$
$$a_{14} = u_{14}l_{44} + u_{15}l_{54} + u_{16}l_{64}$$
$$a_{63} = l_{63}$$
$$a_{53} = l_{53} + u_{56}l_{63}$$
$$a_{43} = l_{43} + u_{45}l_{53} + u_{46}l_{63}$$
$$a_{33} = l_{33} + u_{34}l_{43} + u_{35}l_{53} + u_{36}l_{63}$$
$$a_{23} = u_{23}l_{33} + u_{24}l_{43} + u_{25}l_{53} + u_{26}l_{63}$$
$$a_{13} = u_{13}l_{33} + u_{14}l_{43} + u_{15}l_{53} + u_{16}l_{63}$$
$$a_{62} = l_{62}$$
$$a_{52} = l_{52} + u_{56}l_{62}$$
$$a_{42} = l_{42} + u_{45}l_{52} + u_{46}l_{62}$$
$$a_{32} = l_{32} + u_{34}l_{42} + u_{35}l_{52} + u_{36}l_{62}$$
$$a_{22} = l_{22} + u_{23}l_{32} + u_{24}l_{42} + u_{25}l_{52} + u_{26}l_{62}$$
$$a_{12} = u_{12}l_{22} + u_{13}l_{32} + u_{14}l_{42} + u_{15}l_{52} + u_{16}l_{62}$$
$$a_{61} = l_{61}$$
$$a_{51} = l_{51} + u_{56}l_{61}$$
$$a_{41} = l_{41} + u_{45}l_{51} + u_{46}l_{61}$$

$$a_{31} = l_{31} + u_{34}l_{41} + u_{35}l_{51} + u_{36}l_{61}$$
$$a_{21} = l_{21} + u_{23}l_{31} + u_{24}l_{41} + u_{25}l_{51} + u_{26}l_{61}$$
$$a_{11} = l_{11} + u_{12}l_{21} + u_{13}l_{31} + u_{14}l_{41} + u_{15}l_{51} + u_{16}l_{61}$$

$$l_{66} = a_{66}$$
$$u_{56} = \frac{a_{56}}{l_{66}}$$
$$u_{46} = \frac{a_{46}}{l_{66}}$$
$$u_{36} = \frac{a_{36}}{l_{66}}$$
$$u_{26} = \frac{a_{26}}{l_{66}}$$
$$u_{16} = \frac{a_{16}}{l_{66}}$$
$$l_{65} = a_{65}$$
$$l_{55} = a_{55} - u_{56}l_{65}$$
$$u_{45} = \frac{a_{45} - u_{46}l_{65}}{l_{55}}$$
$$u_{35} = \frac{a_{35} - u_{36}l_{65}}{l_{55}}$$
$$u_{25} = \frac{a_{25} - u_{26}l_{65}}{l_{55}}$$
$$u_{15} = \frac{a_{15} - u_{16}l_{65}}{l_{55}}$$
$$l_{64} = a_{64}$$
$$l_{54} = a_{54} - u_{56}l_{64}$$
$$l_{44} = a_{44} - u_{45}l_{54} - u_{46}l_{64}$$
$$u_{34} = \frac{a_{34} - u_{35}l_{54} - u_{36}l_{64}}{l_{44}}$$
$$u_{24} = \frac{a_{24} - u_{25}l_{54} - u_{26}l_{64}}{l_{44}}$$
$$u_{14} = \frac{a_{14} - u_{15}l_{54} - u_{16}l_{64}}{l_{44}}$$
$$l_{63} = a_{63}$$
$$l_{53} = a_{53} - u_{56}l_{63}$$
$$l_{43} = a_{43} - u_{45}l_{53} - u_{46}l_{63}$$
$$l_{33} = a_{33} - u_{34}l_{43} - u_{35}l_{53} - u_{36}l_{63}$$
$$u_{23} = \frac{a_{23} - u_{24}l_{43} - u_{25}l_{53} - u_{26}l_{63}}{l_{33}}$$
$$u_{13} = \frac{a_{13} - u_{14}l_{43} - u_{15}l_{53} - u_{16}l_{63}}{l_{33}}$$
$$l_{62} = a_{62}$$
$$l_{52} = a_{52} - u_{56}l_{62}$$
$$l_{42} = a_{42} - u_{45}l_{52} - u_{46}l_{62}$$
$$l_{32} = a_{32} - u_{34}l_{42} - u_{35}l_{52} - u_{36}l_{62}$$
$$l_{22} = a_{22} - u_{23}l_{32} - u_{24}l_{42} - u_{25}l_{52} - u_{26}l_{62}$$
$$u_{12} = \frac{a_{12} - u_{13}l_{32} - u_{14}l_{42} - u_{15}l_{52} - u_{16}l_{62}}{l_{22}}$$
$$l_{61} = a_{61}$$
$$l_{51} = a_{51} - u_{56}l_{61}$$
$$l_{41} = a_{41} - u_{45}l_{51} - u_{46}l_{61}$$
$$l_{31} = a_{31} - u_{34}l_{41} - u_{35}l_{51} - u_{36}l_{61}$$
$$l_{21} = a_{21} - u_{23}l_{31} - u_{24}l_{41} - u_{25}l_{51} - u_{26}l_{61}$$
$$l_{11} = a_{11} - u_{12}l_{21} - u_{13}l_{31} - u_{14}l_{41} - u_{15}l_{51} - u_{16}l_{61}$$

4 Metodo Ul

4.1 Caso de matrices de 2×2

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} \\ 0 & u_{22} \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 \\ l_{21} & 1 \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} \\ l_{21} & u_{22} \end{pmatrix}$$

$$a_{22} = u_{22}$$
$$a_{12} = u_{12}$$
$$a_{21} = u_{22} l_{21}$$
$$a_{11} = u_{11} + u_{12} l_{21}$$

$$u_{22} = a_{22}$$
$$u_{12} = a_{12}$$
$$l_{21} = \frac{a_{21}}{u_{22}}$$
$$u_{11} = a_{11} - u_{12} l_{21}$$

4.2 Caso de matrices de 3×3

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} \\ l_{21} & u_{22} & u_{23} \\ l_{31} & l_{32} & u_{33} \end{pmatrix}$$

$$a_{33} = u_{33}$$
$$a_{23} = u_{23}$$
$$a_{13} = u_{13}$$
$$a_{32} = u_{33} l_{32}$$
$$a_{22} = u_{22} + u_{23} l_{32}$$
$$a_{12} = u_{12} + u_{13} l_{32}$$
$$a_{31} = u_{33} l_{31}$$
$$a_{21} = u_{22} l_{21} + u_{23} l_{31}$$
$$a_{11} = u_{11} + u_{12} l_{21} + u_{13} l_{31}$$

$$u_{33} = a_{33}$$
$$u_{23} = a_{23}$$
$$u_{13} = a_{13}$$
$$l_{32} = \frac{a_{32}}{u_{33}}$$
$$u_{22} = a_{22} - u_{23} l_{32}$$
$$u_{12} = a_{12} - u_{13} l_{32}$$
$$l_{31} = \frac{a_{31}}{u_{33}}$$
$$l_{21} = \frac{a_{21} - u_{23} l_{31}}{u_{22}}$$
$$u_{11} = a_{11} - u_{12} l_{21} - u_{13} l_{31}$$

4.3 Caso de matrices de 4×4

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} \\ 0 & u_{22} & u_{23} & u_{24} \\ 0 & 0 & u_{33} & u_{34} \\ 0 & 0 & 0 & u_{44} \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 \\ l_{41} & l_{42} & l_{43} & 1 \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} \\ l_{21} & u_{22} & u_{23} & u_{24} \\ l_{31} & l_{32} & u_{33} & u_{34} \\ l_{41} & l_{42} & l_{43} & u_{44} \end{pmatrix}$$

$$a_{44} = u_{44}$$
$$a_{34} = u_{34}$$
$$a_{24} = u_{24}$$
$$a_{14} = u_{14}$$
$$a_{43} = u_{44} l_{43}$$
$$a_{33} = u_{33} + u_{34} l_{43}$$
$$a_{23} = u_{23} + u_{24} l_{43}$$
$$a_{13} = u_{13} + u_{14} l_{43}$$
$$a_{42} = u_{44} l_{42}$$
$$a_{32} = u_{33} l_{32} + u_{34} l_{42}$$
$$a_{22} = u_{22} + u_{23} l_{32} + u_{24} l_{42}$$
$$a_{12} = u_{12} + u_{13} l_{32} + u_{14} l_{42}$$
$$a_{41} = u_{44} l_{41}$$

$$a_{31} = u_{33}l_{31} + u_{34}l_{41}$$
$$a_{21} = u_{22}l_{21} + u_{23}l_{31} + u_{24}l_{41}$$
$$a_{11} = u_{11} + u_{12}l_{21} + u_{13}l_{31} + u_{14}l_{41}$$

$$u_{44} = a_{44}$$
$$u_{34} = a_{34}$$
$$u_{24} = a_{24}$$
$$u_{14} = a_{14}$$
$$l_{43} = \frac{a_{43}}{u_{44}}$$
$$u_{33} = a_{33} - u_{34}l_{43}$$
$$u_{23} = a_{23} - u_{24}l_{43}$$
$$u_{13} = a_{13} - u_{14}l_{43}$$
$$l_{42} = \frac{a_{42}}{u_{44}}$$
$$l_{32} = \frac{a_{32} - u_{34}l_{42}}{u_{33}}$$
$$u_{22} = a_{22} - u_{23}l_{32} - u_{24}l_{42}$$
$$u_{12} = a_{12} - u_{13}l_{32} - u_{14}l_{42}$$
$$l_{41} = \frac{a_{41}}{u_{44}}$$
$$l_{31} = \frac{a_{31} - u_{34}l_{41}}{u_{33}}$$
$$l_{21} = \frac{a_{21} - u_{23}l_{31} - u_{24}l_{41}}{u_{22}}$$
$$u_{11} = a_{11} - u_{12}l_{21} - u_{13}l_{31} - u_{14}l_{41}$$

4.4 Caso de matrices de 5×5

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} \\ 0 & 0 & u_{33} & u_{34} & u_{35} \\ 0 & 0 & 0 & u_{44} & u_{45} \\ 0 & 0 & 0 & 0 & u_{55} \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & 1 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & 1 \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ l_{21} & u_{22} & u_{23} & u_{24} & u_{25} \\ l_{31} & l_{32} & u_{33} & u_{34} & u_{35} \\ l_{41} & l_{42} & l_{43} & u_{44} & u_{45} \\ l_{51} & l_{52} & l_{53} & l_{54} & u_{55} \end{pmatrix}$$

$$a_{55} = u_{55}$$
$$a_{45} = u_{45}$$
$$a_{35} = u_{35}$$
$$a_{25} = u_{25}$$
$$a_{15} = u_{15}$$
$$a_{54} = u_{55}l_{54}$$
$$a_{44} = u_{44} + u_{45}l_{54}$$
$$a_{34} = u_{34} + u_{35}l_{54}$$
$$a_{24} = u_{24} + u_{25}l_{54}$$
$$a_{14} = u_{14} + u_{15}l_{54}$$
$$a_{53} = u_{55}l_{53}$$
$$a_{43} = u_{44}l_{43} + u_{45}l_{53}$$
$$a_{33} = u_{33} + u_{34}l_{43} + u_{35}l_{53}$$

$$a_{23} = u_{23} + u_{24}l_{43} + u_{25}l_{53}$$
$$a_{13} = u_{13} + u_{14}l_{43} + u_{15}l_{53}$$
$$a_{52} = u_{55}l_{52}$$
$$a_{42} = u_{44}l_{42} + u_{45}l_{52}$$
$$a_{32} = u_{33}l_{32} + u_{34}l_{42} + u_{35}l_{52}$$
$$a_{22} = u_{22} + u_{23}l_{32} + u_{24}l_{42} + u_{25}l_{52}$$
$$a_{12} = u_{12} + u_{13}l_{32} + u_{14}l_{42} + u_{15}l_{52}$$
$$a_{51} = u_{55}l_{51}$$
$$a_{41} = u_{44}l_{41} + u_{45}l_{51}$$
$$a_{31} = u_{33}l_{31} + u_{34}l_{41} + u_{35}l_{51}$$
$$a_{21} = u_{22}l_{21} + u_{23}l_{31} + u_{24}l_{41} + u_{25}l_{51}$$
$$a_{11} = u_{11} + u_{12}l_{21} + u_{13}l_{31} + u_{14}l_{41} + u_{15}l_{51}$$

$$u_{55} = a_{55}$$

$$u_{45} = a_{45}$$

$$u_{35} = a_{35}$$

$$u_{25} = a_{25}$$

$$u_{15} = a_{15}$$

$$l_{54} = \frac{a_{54}}{u_{55}}$$

$$u_{44} = a_{44} - u_{45}l_{54}$$

$$u_{34} = a_{34} - u_{35}l_{54}$$

$$u_{24} = a_{24} - u_{25}l_{54}$$

$$u_{14} = a_{14} - u_{15}l_{54}$$

$$l_{53} = \frac{a_{53}}{u_{55}}$$

$$l_{43} = \frac{a_{43} - u_{45}l_{53}}{u_{44}}$$

$$u_{33} = a_{33} - u_{34}l_{43} - u_{35}l_{53}$$

$$u_{23} = a_{23} - u_{24}l_{43} - u_{25}l_{53}$$

$$u_{13} = a_{13} - u_{14}l_{43} - u_{15}l_{53}$$

$$l_{52} = \frac{a_{52}}{u_{55}}$$

$$l_{42} = \frac{a_{42} - u_{45}l_{52}}{u_{44}}$$

$$l_{32} = \frac{a_{32} - u_{34}l_{42} - u_{35}l_{52}}{u_{33}}$$

$$u_{22} = a_{22} - u_{23}l_{32} - u_{24}l_{42} - u_{25}l_{52}$$

$$u_{12} = a_{12} - u_{13}l_{32} - u_{14}l_{42} - u_{15}l_{52}$$

$$l_{51} = \frac{a_{51}}{u_{55}}$$

$$l_{41} = \frac{a_{41} - u_{45}l_{51}}{u_{44}}$$

$$l_{31} = \frac{a_{31} - u_{34}l_{41} - u_{35}l_{51}}{u_{33}}$$

$$l_{21} = \frac{a_{21} - u_{23}l_{31} - u_{24}l_{41} - u_{25}l_{51}}{u_{22}}$$

$$u_{11} = a_{11} - u_{12}l_{21} - u_{13}l_{31} - u_{14}l_{41} - u_{15}l_{51}$$

4.5 Caso de matrices de 6×6

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & u_{33} & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & u_{44} & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & u_{55} & u_{56} \\ 0 & 0 & 0 & 0 & 0 & u_{66} \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & 1 & 0 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & 1 & 0 \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & 1 \end{pmatrix}$$

$$\begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ l_{21} & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ l_{31} & l_{32} & u_{33} & u_{34} & u_{35} & u_{36} \\ l_{41} & l_{42} & l_{43} & u_{44} & u_{45} & u_{46} \\ l_{51} & l_{52} & l_{53} & l_{54} & u_{55} & u_{56} \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & u_{66} \end{pmatrix}$$

$$a_{66} = u_{66}$$

$$a_{56} = u_{56}$$

$$a_{46} = u_{46}$$

$$a_{36} = u_{36}$$

$$a_{26} = u_{26}$$

$$a_{16} = u_{16}$$

$$a_{65} = u_{66}l_{65}$$

$$a_{55} = u_{55} + u_{56}l_{65}$$

$$a_{45} = u_{45} + u_{46}l_{65}$$

$$a_{35} = u_{35} + u_{36}l_{65}$$

$$a_{25} = u_{25} + u_{26}l_{65}$$

$$a_{15} = u_{15} + u_{16}l_{65}$$

$$a_{64} = u_{66}l_{64}$$

$$a_{54} = u_{55}l_{54} + u_{56}l_{64}$$

$$a_{44} = u_{44} + u_{45}l_{54} + u_{46}l_{64}$$

$$a_{34} = u_{34} + u_{35}l_{54} + u_{36}l_{64}$$

$$a_{24} = u_{24} + u_{25}l_{54} + u_{26}l_{64}$$

$$a_{14} = u_{14} + u_{15}l_{54} + u_{16}l_{64}$$

$$a_{63} = u_{66}l_{63}$$

$$a_{53} = u_{55}l_{53} + u_{56}l_{63}$$

$$a_{43} = u_{44}l_{43} + u_{45}l_{53} + u_{46}l_{63}$$

$$a_{33} = u_{33} + u_{34}l_{43} + u_{35}l_{53} + u_{36}l_{63}$$

$$a_{23} = u_{23} + u_{24}l_{43} + u_{25}l_{53} + u_{26}l_{63}$$

$$a_{13} = u_{13} + u_{14}l_{43} + u_{15}l_{53} + u_{16}l_{63}$$

$$a_{62} = u_{66}l_{62}$$

$$a_{52} = u_{55}l_{52} + u_{56}l_{62}$$

$$a_{42} = u_{44}l_{42} + u_{45}l_{52} + u_{46}l_{62}$$

$$a_{32} = u_{33}l_{32} + u_{34}l_{42} + u_{35}l_{52} + u_{36}l_{62}$$

$$a_{22} = u_{22} + u_{23}l_{32} + u_{24}l_{42} + u_{25}l_{52} + u_{26}l_{62}$$

$$a_{12} = u_{12} + u_{13}l_{32} + u_{14}l_{42} + u_{15}l_{52} + u_{16}l_{62}$$

$$a_{61} = u_{66}l_{61}$$

$$a_{51} = u_{55}l_{51} + u_{56}l_{61}$$

$$a_{41} = u_{44}l_{41} + u_{45}l_{51} + u_{46}l_{61}$$

$$a_{31} = u_{33}l_{31} + u_{34}l_{41} + u_{35}l_{51} + u_{36}l_{61}$$

$$a_{21} = u_{22}l_{21} + u_{23}l_{31} + u_{24}l_{41} + u_{25}l_{51} + u_{26}l_{61}$$

$$a_{11} = u_{11} + u_{12}l_{21} + u_{13}l_{31} + u_{14}l_{41} + u_{15}l_{51} + u_{16}l_{61}$$

$$u_{66} = a_{66}$$

$$u_{56} = a_{56}$$

$$u_{46} = a_{46}$$

$$u_{36} = a_{36}$$

$$u_{26} = a_{26}$$

$$u_{16} = a_{16}$$

$$l_{65} = \frac{a_{65}}{u_{66}}$$

$$u_{55} = a_{55} - u_{56}l_{65}$$

$$u_{45} = a_{45} - u_{46}l_{65}$$

$$u_{35} = a_{35} - u_{36}l_{65}$$

$$u_{25} = a_{25} - u_{26}l_{65}$$

$$u_{15} = a_{15} - u_{16}l_{65}$$

$$l_{64} = \frac{a_{64}}{u_{66}}$$

$$l_{54} = \frac{a_{54} - u_{56}l_{64}}{u_{55}}$$

$$u_{44} = a_{44} - u_{45}l_{54} - u_{46}l_{64}$$

$$u_{34} = a_{34} - u_{35}l_{54} - u_{36}l_{64}$$

$$u_{24} = a_{24} - u_{25}l_{54} - u_{26}l_{64}$$

$$u_{14} = a_{14} - u_{15}l_{54} - u_{16}l_{64}$$

$$l_{63} = \frac{a_{63}}{u_{66}}$$

$$l_{53} = \frac{a_{53} - u_{56}l_{63}}{u_{55}}$$

$$l_{43} = \frac{a_{43} - u_{45}l_{53} - u_{46}l_{63}}{u_{44}}$$

$$u_{33} = a_{33} - u_{34}l_{43} - u_{35}l_{53} - u_{36}l_{63}$$

$$u_{23} = a_{23} - u_{24}l_{43} - u_{25}l_{53} - u_{26}l_{63}$$

$$u_{13} = a_{13} - u_{14}l_{43} - u_{15}l_{53} - u_{16}l_{63}$$

$$l_{62} = \frac{a_{62}}{u_{66}}$$

$$l_{52} = \frac{a_{52} - u_{56}l_{62}}{u_{55}}$$

$$l_{42} = \frac{a_{42} - u_{45}l_{52} - u_{46}l_{62}}{u_{44}}$$

$$l_{32} = \frac{a_{32} - u_{34}l_{42} - u_{35}l_{52} - u_{36}l_{62}}{u_{33}}$$

$$u_{22} = a_{22} - u_{23}l_{32} - u_{24}l_{42} - u_{25}l_{52} - u_{26}l_{62}$$

$$u_{12} = a_{12} - u_{13}l_{32} - u_{14}l_{42} - u_{15}l_{52} - u_{16}l_{62}$$

$$l_{61} = \frac{a_{61}}{u_{66}}$$

$$l_{51} = \frac{a_{51} - u_{56}l_{61}}{u_{55}}$$

$$l_{41} = \frac{a_{41} - u_{45}l_{51} - u_{46}l_{61}}{u_{44}}$$

$$l_{31} = \frac{a_{31} - u_{34}l_{41} - u_{35}l_{51} - u_{36}l_{61}}{u_{33}}$$

$$l_{21} = \frac{a_{21} - u_{23}l_{31} - u_{24}l_{41} - u_{25}l_{51} - u_{26}l_{61}}{u_{22}}$$

$$u_{11} = a_{11} - u_{12}l_{21} - u_{13}l_{31} - u_{14}l_{41} - u_{15}l_{51} - u_{16}l_{61}$$

5 Resolución de matrices triangulares L

5.1 Caso de matrices de 2×2

$$\begin{pmatrix} y_1 \\ y_2 \end{pmatrix} = \begin{pmatrix} l_{11} & 0 \\ l_{21} & l_{22} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

$$\begin{aligned} y_1 &= l_{11}x_1 \\ y_2 &= l_{21}x_1 + l_{22}x_2 \end{aligned} \qquad \begin{aligned} x_1 &= \frac{y_1}{l_{11}} \\ x_2 &= \frac{y_2 - l_{21}x_1}{l_{22}} \end{aligned}$$

5.2 Caso de matrices de 3×3

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

$$\begin{aligned} y_1 &= l_{11}x_1 \\ y_2 &= l_{21}x_1 + l_{22}x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + l_{33}x_3 \end{aligned} \qquad \begin{aligned} x_1 &= \frac{y_1}{l_{11}} \\ x_2 &= \frac{y_2 - l_{21}x_1}{l_{22}} \\ x_3 &= \frac{y_3 - l_{31}x_1 - l_{32}x_2}{l_{33}} \end{aligned}$$

5.3 Caso de matrices de 4×4

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}$$

$$\begin{aligned} y_1 &= l_{11}x_1 \\ y_2 &= l_{21}x_1 + l_{22}x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + l_{33}x_3 \\ y_4 &= l_{41}x_1 + l_{42}x_2 + l_{43}x_3 + l_{44}x_4 \end{aligned} \qquad \begin{aligned} x_1 &= \frac{y_1}{l_{11}} \\ x_2 &= \frac{y_2 - l_{21}x_1}{l_{22}} \\ x_3 &= \frac{y_3 - l_{31}x_1 - l_{32}x_2}{l_{33}} \\ x_4 &= \frac{y_4 - l_{41}x_1 - l_{42}x_2 - l_{43}x_3}{l_{44}} \end{aligned}$$

5.4 Caso de matrices de 5×5

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

$$\begin{aligned} y_1 &= l_{11}x_1 \\ y_2 &= l_{21}x_1 + l_{22}x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + l_{33}x_3 \\ y_4 &= l_{41}x_1 + l_{42}x_2 + l_{43}x_3 + l_{44}x_4 \\ y_5 &= l_{51}x_1 + l_{52}x_2 + l_{53}x_3 + l_{54}x_4 + l_{55}x_5 \end{aligned} \qquad \begin{aligned} x_1 &= \frac{y_1}{l_{11}} \\ x_2 &= \frac{y_2 - l_{21}x_1}{l_{22}} \\ x_3 &= \frac{y_3 - l_{31}x_1 - l_{32}x_2}{l_{33}} \\ x_4 &= \frac{y_4 - l_{41}x_1 - l_{42}x_2 - l_{43}x_3}{l_{44}} \\ x_5 &= \frac{y_5 - l_{51}x_1 - l_{52}x_2 - l_{53}x_3 - l_{54}x_4}{l_{55}} \end{aligned}$$

5.5 Caso de matrices de 6×6

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ y_6 \end{pmatrix} = \begin{pmatrix} l_{11} & 0 & 0 & 0 & 0 & 0 \\ l_{21} & l_{22} & 0 & 0 & 0 & 0 \\ l_{31} & l_{32} & l_{33} & 0 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & l_{44} & 0 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & l_{55} & 0 \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & l_{66} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \end{pmatrix}$$

$$\begin{aligned} y_1 &= l_{11}x_1 \\ y_2 &= l_{21}x_1 + l_{22}x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + l_{33}x_3 \\ y_4 &= l_{41}x_1 + l_{42}x_2 + l_{43}x_3 + l_{44}x_4 \\ y_5 &= l_{51}x_1 + l_{52}x_2 + l_{53}x_3 + l_{54}x_4 + l_{55}x_5 \\ y_6 &= l_{61}x_1 + l_{62}x_2 + l_{63}x_3 + l_{64}x_4 + l_{65}x_5 + l_{66}x_6 \end{aligned}$$

$$\begin{aligned} x_1 &= \frac{y_1}{l_{11}} \\ x_2 &= \frac{y_2 - l_{21}x_1}{l_{22}} \\ x_3 &= \frac{y_3 - l_{31}x_1 - l_{32}x_2}{l_{33}} \\ x_4 &= \frac{y_4 - l_{41}x_1 - l_{42}x_2 - l_{43}x_3}{l_{44}} \\ x_5 &= \frac{y_5 - l_{51}x_1 - l_{52}x_2 - l_{53}x_3 - l_{54}x_4}{l_{55}} \\ x_6 &= \frac{y_6 - l_{61}x_1 - l_{62}x_2 - l_{63}x_3 - l_{64}x_4 - l_{65}x_5}{l_{66}} \end{aligned}$$

6 Resolución de matrices triangulares l

6.1 Caso de matrices de 2×2

$$\begin{pmatrix} y_1 \\ y_2 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ l_{21} & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

$$\begin{aligned} y_1 &= x_1 \\ y_2 &= l_{21}x_1 + x_2 \end{aligned}$$

$$\begin{aligned} x_1 &= y_1 \\ x_2 &= y_2 - l_{21}x_1 \end{aligned}$$

6.2 Caso de matrices de 3×3

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

$$\begin{aligned} y_1 &= x_1 \\ y_2 &= l_{21}x_1 + x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + x_3 \end{aligned}$$

$$\begin{aligned} x_1 &= y_1 \\ x_2 &= y_2 - l_{21}x_1 \\ x_3 &= y_3 - l_{31}x_1 - l_{32}x_2 \end{aligned}$$

6.3 Caso de matrices de 4×4

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 \\ l_{41} & l_{42} & l_{43} & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}$$

$$\begin{aligned} y_1 &= x_1 \\ y_2 &= l_{21}x_1 + x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + x_3 \\ y_4 &= l_{41}x_1 + l_{42}x_2 + l_{43}x_3 + x_4 \end{aligned}$$

$$\begin{aligned} x_1 &= y_1 \\ x_2 &= y_2 - l_{21}x_1 \\ x_3 &= y_3 - l_{31}x_1 - l_{32}x_2 \\ x_4 &= y_4 - l_{41}x_1 - l_{42}x_2 - l_{43}x_3 \end{aligned}$$

6.4 Caso de matrices de 5×5

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & 1 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

$$\begin{aligned} y_1 &= x_1 \\ y_2 &= l_{21}x_1 + x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + x_3 \\ y_4 &= l_{41}x_1 + l_{42}x_2 + l_{43}x_3 + x_4 \\ y_5 &= l_{51}x_1 + l_{52}x_2 + l_{53}x_3 + l_{54}x_4 + x_5 \end{aligned}$$

$$\begin{aligned} x_1 &= y_1 \\ x_2 &= y_2 - l_{21}x_1 \\ x_3 &= y_3 - l_{31}x_1 - l_{32}x_2 \\ x_4 &= y_4 - l_{41}x_1 - l_{42}x_2 - l_{43}x_3 \\ x_5 &= y_5 - l_{51}x_1 - l_{52}x_2 - l_{53}x_3 - l_{54}x_4 \end{aligned}$$

6.5 Caso de matrices de 6×6

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ y_6 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ l_{21} & 1 & 0 & 0 & 0 & 0 \\ l_{31} & l_{32} & 1 & 0 & 0 & 0 \\ l_{41} & l_{42} & l_{43} & 1 & 0 & 0 \\ l_{51} & l_{52} & l_{53} & l_{54} & 1 & 0 \\ l_{61} & l_{62} & l_{63} & l_{64} & l_{65} & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \end{pmatrix}$$

$$\begin{aligned} y_1 &= x_1 \\ y_2 &= l_{21}x_1 + x_2 \\ y_3 &= l_{31}x_1 + l_{32}x_2 + x_3 \\ y_4 &= l_{41}x_1 + l_{42}x_2 + l_{43}x_3 + x_4 \\ y_5 &= l_{51}x_1 + l_{52}x_2 + l_{53}x_3 + l_{54}x_4 + x_5 \\ y_6 &= l_{61}x_1 + l_{62}x_2 + l_{63}x_3 + l_{64}x_4 + l_{65}x_5 + x_6 \end{aligned}$$

$$\begin{aligned} x_1 &= y_1 \\ x_2 &= y_2 - l_{21}x_1 \\ x_3 &= y_3 - l_{31}x_1 - l_{32}x_2 \\ x_4 &= y_4 - l_{41}x_1 - l_{42}x_2 - l_{43}x_3 \\ x_5 &= y_5 - l_{51}x_1 - l_{52}x_2 - l_{53}x_3 - l_{54}x_4 \\ x_6 &= y_6 - l_{61}x_1 - l_{62}x_2 - l_{63}x_3 - l_{64}x_4 - l_{65}x_5 \end{aligned}$$

7 Resolución de matrices triangulares U

7.1 Caso de matrices de 2×2

$$\begin{pmatrix} y_1 \\ y_2 \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} \\ 0 & u_{22} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

$$\begin{aligned} y_2 &= u_{22}x_2 \\ y_1 &= u_{11}x_1 + u_{12}x_2 \end{aligned}$$

$$\begin{aligned} x_2 &= \frac{y_2}{u_{22}} \\ x_1 &= \frac{y_1 - u_{12}x_2}{u_{11}} \end{aligned}$$

7.2 Caso de matrices de 3×3

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

$$\begin{aligned} y_3 &= u_{33}x_3 \\ y_2 &= u_{22}x_2 + u_{23}x_3 \\ y_1 &= u_{11}x_1 + u_{12}x_2 + u_{13}x_3 \end{aligned}$$

$$\begin{aligned} x_3 &= \frac{y_3}{u_{33}} \\ x_2 &= \frac{y_2 - u_{23}x_3}{u_{22}} \\ x_1 &= \frac{y_1 - u_{12}x_2 - u_{13}x_3}{u_{11}} \end{aligned}$$

7.3 Caso de matrices de 4×4

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} \\ 0 & u_{22} & u_{23} & u_{24} \\ 0 & 0 & u_{33} & u_{34} \\ 0 & 0 & 0 & u_{44} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}$$

$$y_4 = u_{44}x_4$$
$$y_3 = u_{33}x_3 + u_{34}x_4$$
$$y_2 = u_{22}x_2 + u_{23}x_3 + u_{24}x_4$$
$$y_1 = u_{11}x_1 + u_{12}x_2 + u_{13}x_3 + u_{14}x_4$$

$$x_4 = \frac{y_4}{u_{44}}$$
$$x_3 = \frac{y_3 - u_{34}x_4}{u_{33}}$$
$$x_2 = \frac{y_2 - u_{23}x_3 - u_{24}x_4}{u_{22}}$$
$$x_1 = \frac{y_1 - u_{12}x_2 - u_{13}x_3 - u_{14}x_4}{u_{11}}$$

7.4 Caso de matrices de 5×5

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} \\ 0 & 0 & u_{33} & u_{34} & u_{35} \\ 0 & 0 & 0 & u_{44} & u_{45} \\ 0 & 0 & 0 & 0 & u_{55} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

$$y_5 = u_{55}x_5$$
$$y_4 = u_{44}x_4 + u_{45}x_5$$
$$y_3 = u_{33}x_3 + u_{34}x_4 + u_{35}x_5$$
$$y_2 = u_{22}x_2 + u_{23}x_3 + u_{24}x_4 + u_{25}x_5$$
$$y_1 = u_{11}x_1 + u_{12}x_2 + u_{13}x_3 + u_{14}x_4 + u_{15}x_5$$

$$x_5 = \frac{y_5}{u_{55}}$$
$$x_4 = \frac{y_4 - u_{45}x_5}{u_{44}}$$
$$x_3 = \frac{y_3 - u_{34}x_4 - u_{35}x_5}{u_{33}}$$
$$x_2 = \frac{y_2 - u_{23}x_3 - u_{24}x_4 - u_{25}x_5}{u_{22}}$$
$$x_1 = \frac{y_1 - u_{12}x_2 - u_{13}x_3 - u_{14}x_4 - u_{15}x_5}{u_{11}}$$

7.5 Caso de matrices de 6×6

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ y_6 \end{pmatrix} = \begin{pmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & u_{33} & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & u_{44} & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & u_{55} & u_{56} \\ 0 & 0 & 0 & 0 & 0 & u_{66} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \end{pmatrix}$$

$$y_6 = u_{66}x_6$$
$$y_5 = u_{55}x_5 + u_{56}x_6$$
$$y_4 = u_{44}x_4 + u_{45}x_5 + u_{46}x_6$$
$$y_3 = u_{33}x_3 + u_{34}x_4 + u_{35}x_5 + u_{36}x_6$$
$$y_2 = u_{22}x_2 + u_{23}x_3 + u_{24}x_4 + u_{25}x_5 + u_{26}x_6$$
$$y_1 = u_{11}x_1 + u_{12}x_2 + u_{13}x_3 + u_{14}x_4 + u_{15}x_5 + u_{16}x_6$$

$$x_6 = \frac{y_6}{u_{66}}$$
$$x_5 = \frac{y_5 - u_{56}x_6}{u_{55}}$$
$$x_4 = \frac{y_4 - u_{45}x_5 - u_{46}x_6}{u_{44}}$$
$$x_3 = \frac{y_3 - u_{34}x_4 - u_{35}x_5 - u_{36}x_6}{u_{33}}$$
$$x_2 = \frac{y_2 - u_{23}x_3 - u_{24}x_4 - u_{25}x_5 - u_{26}x_6}{u_{22}}$$
$$x_1 = \frac{y_1 - u_{12}x_2 - u_{13}x_3 - u_{14}x_4 - u_{15}x_5 - u_{16}x_6}{u_{11}}$$

8 Resolución de matrices triangulares u

8.1 Caso de matrices de 2×2

$$\begin{pmatrix} y_1 \\ y_2 \end{pmatrix} = \begin{pmatrix} 1 & u_{12} \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

$$\begin{aligned} y_2 &= x_2 \\ y_1 &= x_1 + u_{12}x_2 \end{aligned}$$

$$\begin{aligned} x_2 &= y_2 \\ x_1 &= y_1 - u_{12}x_2 \end{aligned}$$

8.2 Caso de matrices de 3×3

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} \\ 0 & 1 & u_{23} \\ 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

$$\begin{aligned} y_3 &= x_3 \\ y_2 &= x_2 + u_{23}x_3 \\ y_1 &= x_1 + u_{12}x_2 + u_{13}x_3 \end{aligned}$$

$$\begin{aligned} x_3 &= y_3 \\ x_2 &= y_2 - u_{23}x_3 \\ x_1 &= y_1 - u_{12}x_2 - u_{13}x_3 \end{aligned}$$

8.3 Caso de matrices de 4×4

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} \\ 0 & 1 & u_{23} & u_{24} \\ 0 & 0 & 1 & u_{34} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}$$

$$\begin{aligned} y_4 &= x_4 \\ y_3 &= x_3 + u_{34}x_4 \\ y_2 &= x_2 + u_{23}x_3 + u_{24}x_4 \\ y_1 &= x_1 + u_{12}x_2 + u_{13}x_3 + u_{14}x_4 \end{aligned}$$

$$\begin{aligned} x_4 &= y_4 \\ x_3 &= y_3 - u_{34}x_4 \\ x_2 &= y_2 - u_{23}x_3 - u_{24}x_4 \\ x_1 &= y_1 - u_{12}x_2 - u_{13}x_3 - u_{14}x_4 \end{aligned}$$

8.4 Caso de matrices de 5×5

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} & u_{15} \\ 0 & 1 & u_{23} & u_{24} & u_{25} \\ 0 & 0 & 1 & u_{34} & u_{35} \\ 0 & 0 & 0 & 1 & u_{45} \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

$$\begin{aligned} y_5 &= x_5 \\ y_4 &= x_4 + u_{45}x_5 \\ y_3 &= x_3 + u_{34}x_4 + u_{35}x_5 \\ y_2 &= x_2 + u_{23}x_3 + u_{24}x_4 + u_{25}x_5 \\ y_1 &= x_1 + u_{12}x_2 + u_{13}x_3 + u_{14}x_4 + u_{15}x_5 \end{aligned}$$

$$\begin{aligned} x_5 &= y_5 \\ x_4 &= y_4 - u_{45}x_5 \\ x_3 &= y_3 - u_{34}x_4 - u_{35}x_5 \\ x_2 &= y_2 - u_{23}x_3 - u_{24}x_4 - u_{25}x_5 \\ x_1 &= y_1 - u_{12}x_2 - u_{13}x_3 - u_{14}x_4 - u_{15}x_5 \end{aligned}$$

8.5 Caso de matrices de 6×6

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ y_6 \end{pmatrix} = \begin{pmatrix} 1 & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & 1 & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & 1 & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & 1 & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & 1 & u_{56} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \end{pmatrix}$$

$$y_6 = x_6$$

$$y_5 = x_5 + u_{56}x_6$$

$$y_4 = x_4 + u_{45}x_5 + u_{46}x_6$$

$$y_3 = x_3 + u_{34}x_4 + u_{35}x_5 + u_{36}x_6$$

$$y_2 = x_2 + u_{23}x_3 + u_{24}x_4 + u_{25}x_5 + u_{26}x_6$$

$$y_1 = x_1 + u_{12}x_2 + u_{13}x_3 + u_{14}x_4 + u_{15}x_5 + u_{16}x_6$$

$$x_6 = y_6$$

$$x_5 = y_5 - u_{56}x_6$$

$$x_4 = y_4 - u_{45}x_5 - u_{46}x_6$$

$$x_3 = y_3 - u_{34}x_4 - u_{35}x_5 - u_{36}x_6$$

$$x_2 = y_2 - u_{23}x_3 - u_{24}x_4 - u_{25}x_5 - u_{26}x_6$$

$$x_1 = y_1 - u_{12}x_2 - u_{13}x_3 - u_{14}x_4 - u_{15}x_5 - u_{16}x_6$$