

$$\textcircled{1} \begin{cases} x_1 - 2x_2 + 3x_3 = 11 \\ 4x_1 + x_2 - x_3 = 4 \\ 2x_1 - x_2 + 3x_3 = 10 \end{cases} \quad \left[\begin{array}{ccc|c} 1 & -2 & 3 & 11 \\ 4 & 1 & -1 & 4 \\ 2 & -1 & 3 & 10 \end{array} \right]$$

$$\begin{array}{l} e_2 - 4e_1 \rightarrow e_2 \\ e_3 - 2e_1 \rightarrow e_3 \end{array} \rightarrow \left[\begin{array}{ccc|c} 1 & -2 & 3 & 11 \\ 0 & 9 & -13 & -40 \\ 0 & 3 & -3 & -12 \end{array} \right] \xrightarrow{e_1 + e_3 \rightarrow e_1}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & 0 & -1 \\ 0 & 9 & -13 & -40 \\ 0 & 3 & -3 & -12 \end{array} \right] \xrightarrow{e_2 - 3e_3 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & 1 & 0 & -1 \\ 0 & 0 & -4 & -4 \\ 0 & 3 & -3 & -12 \end{array} \right] \textcircled{1}$$

$$e_2 / -4 \rightarrow \left[\begin{array}{ccc|c} 1 & 1 & 0 & -1 \\ 0 & 0 & 1 & 1 \\ 0 & 3 & -3 & -12 \end{array} \right] \quad \begin{array}{l} x_1 + 5x_2 = -1 \\ x_3 = -1 \\ 3x_2 - 3x_3 = -12 \end{array}$$

$$\begin{array}{l} x_1 = 2 \\ x_2 = -3 \\ x_3 = 1 \end{array}$$

$$\begin{array}{l} 3x_2 - 3(+1) = -12 \rightarrow 3x_2 = -12 + 3 \rightarrow x_2 = \frac{-9}{3} = x_2 = -3 \\ x_1 + 5(-3) = -1 \rightarrow x_1 = -1 + 15 \rightarrow x_1 = 14 \end{array}$$

$$e_3 / 3 \rightarrow \left[\begin{array}{ccc|c} 1 & 1 & 0 & -1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & -1 & -4 \end{array} \right] \xrightarrow{e_3 + e_1 \rightarrow e_3} \left[\begin{array}{ccc|c} 1 & 1 & 0 & -1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & -3 \end{array} \right]$$

$$e_1 - e_3 \rightarrow e_1 \rightarrow \left[\begin{array}{ccc|c} 1 & 0 & 0 & 2 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & -3 \end{array} \right] \quad \begin{array}{l} x_1 = 2 \\ x_2 = -3 \\ x_3 = 1 \end{array} \textcircled{1}$$

③

$$\begin{aligned} 3x_1 + 6x_2 - 6x_3 &= 9 \\ 2x_1 - 5x_2 + 4x_3 &= 6 \\ -x_1 + 16x_2 - 14x_3 &= -3 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 3 & 6 & -6 & 9 \\ 2 & -5 & 4 & 6 \\ -1 & 16 & -14 & -3 \end{array} \right]$$

$$\xrightarrow{e_3/3} \left[\begin{array}{ccc|c} 1 & 2 & -2 & 3 \\ 2 & -5 & 4 & 6 \\ -1 & 16 & -14 & -3 \end{array} \right] \xrightarrow{\begin{array}{l} e_3 + e_1 \rightarrow e_3 \\ e_2 - 2e_1 \rightarrow e_2 \end{array}} \left[\begin{array}{ccc|c} 1 & 2 & -2 & 3 \\ 0 & -9 & 8 & 0 \\ 0 & 18 & -16 & 0 \end{array} \right]$$

$$\xrightarrow{e_3 + 2e_2 \rightarrow e_3} \left[\begin{array}{ccc|c} 1 & 2 & -2 & 3 \\ 0 & -9 & 8 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

③

$0 = 0$ Infinidad de Soluciones

④

$$\begin{aligned} 3x_1 + 6x_2 - 6x_3 &= 9 \\ 2x_1 - 5x_2 + 4x_3 &= 6 \\ 5x_1 + 28x_2 - 26x_3 &= -8 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 3 & 6 & -6 & 9 \\ 2 & -5 & 4 & 6 \\ 5 & 28 & -26 & -8 \end{array} \right]$$

$$\xrightarrow{e_1/3} \left[\begin{array}{ccc|c} 1 & 2 & -2 & 3 \\ 2 & -5 & 4 & 6 \\ 5 & 28 & -26 & -8 \end{array} \right] \xrightarrow{\begin{array}{l} e_2 - 2e_1 \rightarrow e_2 \\ e_3 - 5e_1 \rightarrow e_3 \end{array}} \left[\begin{array}{ccc|c} 1 & 2 & -2 & 3 \\ 0 & -9 & 8 & 0 \\ 0 & 18 & -16 & -23 \end{array} \right]$$

$$\xrightarrow{e_3 + 2e_2 \rightarrow e_3} \left[\begin{array}{ccc|c} 1 & 2 & -2 & 3 \\ 0 & -9 & 8 & 0 \\ 0 & 0 & 0 & -23 \end{array} \right]$$

④

$0 = 23$ Falso
No tiene solución

(5)
$$\begin{aligned} x_1 + x_2 - x_3 &= 7 \\ 4x_1 - x_2 + 5x_3 &= 4 \\ 2x_1 + 2x_2 - 3x_3 &= 0 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 4 & -1 & 5 & 4 \\ 2 & 2 & -3 & 0 \end{array} \right]$$

$$\begin{array}{l} e_2 - 4e_1 \rightarrow e_2 \\ e_3 - 2e_1 \rightarrow e_3 \end{array} \rightarrow \left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 0 & -5 & 9 & -24 \\ 0 & 0 & -1 & -14 \end{array} \right] \xrightarrow{e_3(-1)} \left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 0 & -5 & 9 & -24 \\ 0 & 0 & 1 & 14 \end{array} \right]$$

$$x_3 = 14$$

$$-5x_2 + 9x_3 = -24 \rightarrow -5x_2 + 9(14) = -24 \rightarrow -5x_2 + 126 = -24$$

$$-5x_2 = -126 - 24 \rightarrow -5x_2 = -150 \rightarrow x_2 = \frac{150}{5} = x_2 = 30$$

$$x_1 + x_2 + x_3 = 7 \rightarrow x_1 + 30 + 14 = 7 = x_1 + 16 = 7 \quad (5)$$

$$x_1 = -16 + 7 \rightarrow x_1 = -9 \rightarrow \text{JORDAN}$$

$$\begin{aligned} x_1 &= -9 \\ x_2 &= 30 \\ x_3 &= 14 \end{aligned}$$

$$\begin{array}{l} e_2 - 9e_3 \rightarrow e_2 \\ e_1 + e_3 \rightarrow e_1 \end{array} \rightarrow \left[\begin{array}{ccc|c} 1 & 1 & 0 & 21 \\ 0 & -5 & 0 & -150 \\ 0 & 0 & 1 & 14 \end{array} \right] \xrightarrow{e_3/-5} \left[\begin{array}{ccc|c} 1 & 1 & 0 & 21 \\ 0 & -5 & 0 & -150 \\ 0 & 0 & 1 & 14 \end{array} \right]$$

$$\left[\begin{array}{ccc|c} 1 & 1 & 0 & 21 \\ 0 & 1 & 0 & 30 \\ 0 & 0 & 1 & 14 \end{array} \right] \xrightarrow{e_1 - e_2 \rightarrow e_1} \left[\begin{array}{ccc|c} 1 & 0 & 0 & -9 \\ 0 & 1 & 0 & 30 \\ 0 & 0 & 1 & 14 \end{array} \right]$$

$$\begin{aligned} x_1 &= -9 \\ x_2 &= 30 \\ x_3 &= 14 \end{aligned}$$

(5)

$$\begin{aligned} \textcircled{6} \quad & x_1 + x_2 - x_3 = 7 \\ & 4x_1 - x_2 + 5x_3 = 4 \\ & 6x_1 + x_2 + 5x_3 = 18 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 4 & -1 & 5 & 4 \\ 6 & 1 & 3 & 18 \end{array} \right]$$

$$\begin{aligned} & \xrightarrow{e_2 - 4e_1 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 0 & -5 & 9 & -24 \\ 0 & -5 & 9 & -24 \end{array} \right] \xrightarrow{e_3 - e_2 \rightarrow e_3} \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 0 & -5 & 9 & -24 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$\textcircled{6}$
 $0=0$ Infinidad de Soluciones

$$\begin{aligned} \textcircled{7} \quad & x_1 + x_2 - x_3 = 7 \\ & 4x_1 - x_2 + 5x_3 = 4 \\ & 6x_1 + x_2 + 3x_3 = 20 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 4 & -1 & 5 & 4 \\ 6 & 1 & 3 & 20 \end{array} \right]$$

$$\begin{aligned} & \xrightarrow{e_2 - 4e_1 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 0 & -5 & 9 & -24 \\ 0 & -5 & 9 & -22 \end{array} \right] \xrightarrow{e_3 - e_2 \rightarrow e_3} \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 7 \\ 0 & -5 & 9 & -24 \\ 0 & 0 & 0 & 2 \end{array} \right]$$

$\textcircled{7}$
 $0=2$ Falso
No tiene Solución

⑧

$$\begin{aligned} x_1 - 2x_2 + 3x_3 &= 0 \\ 4x_1 + x_2 - x_3 &= 0 \\ 2x_1 - x_2 + 3x_3 &= 0 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & -2 & 3 & 0 \\ 4 & 1 & -1 & 0 \\ 2 & -1 & 3 & 0 \end{array} \right] \begin{array}{l} e_2 - 4e_1 \rightarrow e_2 \\ \longrightarrow \\ e_3 - 2e_1 \rightarrow e_3 \end{array}$$

$$\left[\begin{array}{ccc|c} 1 & -2 & 3 & 0 \\ 0 & 9 & -13 & 0 \\ 0 & 3 & -3 & 0 \end{array} \right] \xrightarrow{e_3 - e_2 / 3 \rightarrow e_3} \left[\begin{array}{ccc|c} 1 & -2 & 3 & 0 \\ 0 & 9 & -13 & 0 \\ 0 & 0 & \frac{4}{3} & 0 \end{array} \right] \xrightarrow{e_3 \left(\frac{3}{4} \right)}$$

$$\left[\begin{array}{ccc|c} 1 & -2 & 3 & 0 \\ 0 & 9 & -13 & 0 \\ 0 & 0 & 1 & 0 \end{array} \right] \begin{array}{l} x_3 = 0 \\ 9x_2 - 13(0) = 0 \rightarrow 9x_2 - 0 = 0 \rightarrow x_2 = 0 \\ x_1 - 2(0) - 3(0) \rightarrow x_1 - 0 = 0 \rightarrow x_1 = 0 \end{array} \quad \text{⑧}$$

$$\xrightarrow{e_2 + 13e_3 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & -2 & 3 & 0 \\ 0 & 9 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{array} \right] \begin{array}{l} e_2 / 9 \rightarrow e_2 \\ e_1 + 2e_2 \rightarrow e_1 \end{array} \quad \begin{array}{l} x_1 = 0 \\ x_2 = 0 \\ x_3 = 0 \end{array}$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 3 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{array} \right] \xrightarrow{e_1 - 3e_3 \rightarrow e_1} \left[\begin{array}{ccc|c} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{array} \right]$$

$$\begin{aligned} x_1 &= 0 \\ x_2 &= 0 \\ x_3 &= 0 \end{aligned}$$

⑧

(9)
$$\begin{aligned} x_1 + x_2 - x_3 &= 0 \\ 4x_1 - x_2 + 5x_3 &= 0 \\ 6x_1 + x_2 + 3x_3 &= 0 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 4 & -1 & 5 & 0 \\ 6 & 1 & 3 & 0 \end{array} \right]$$

$$\begin{aligned} & \xrightarrow{e_2 - 4e_1 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 0 & -5 & 9 & 0 \\ 0 & -5 & 9 & 0 \end{array} \right] \xrightarrow{e_3 - e_2 \rightarrow e_3} \left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 0 & -5 & 9 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right] \\ & \xrightarrow{e_3 - 6e_1 \rightarrow e_3} \left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 0 & -5 & 9 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right]
\end{aligned}$$

0 = 0 Infinidad de Soluciones

(10) $0 + 2x_2 + 5x_3 = 6$
 $x_1 + 0 - 2x_3 = 4$
 $2x_1 + 4x_2 + 0 = -2$

$$\left[\begin{array}{ccc|c} 0 & 2 & 5 & 6 \\ 1 & 0 & -2 & 4 \\ 2 & 4 & 0 & -2 \end{array} \right]$$

$e_3 - 2e_1 \rightarrow e_3$

$$\left[\begin{array}{ccc|c} 0 & 2 & 5 & 6 \\ 1 & 0 & -2 & 4 \\ 0 & 4 & 4 & -10 \end{array} \right] \xrightarrow{e_3 - 2e_1 \rightarrow e_3}$$

(10)

$$\left[\begin{array}{ccc|c} 0 & 2 & 5 & 6 \\ 1 & 0 & -2 & 4 \\ 0 & 0 & -6 & -22 \end{array} \right] \xrightarrow{e_3 / -6} \left[\begin{array}{ccc|c} 0 & 2 & 5 & 6 \\ 1 & 0 & -2 & 4 \\ 0 & 0 & 1 & \frac{11}{3} \end{array} \right]$$

$$\begin{aligned} x_3 &= \frac{11}{3} \\ x_2 &= \frac{-37}{6} \\ x_1 &= \frac{34}{3} \end{aligned}$$

$$2x_2 + 5\left(\frac{11}{3}\right) = 6 \rightarrow 2x_2 + \frac{55}{3} = 6 \rightarrow 2x_2 = 6 - \frac{55}{3} \rightarrow 2x_2 = \frac{18}{3} - \frac{55}{3}$$

$$2x_2 = \frac{-37}{3} \rightarrow x_2 = \frac{-37}{6}$$

$$x_1 - 2\left(\frac{11}{3}\right) = 4 \rightarrow x_1 - \frac{22}{3} = 4 \rightarrow x_1 = 4 + \frac{22}{3} = x_1 = \frac{12}{3} + \frac{22}{3} = \frac{34}{3}$$

$e_2 + 2e_3 \rightarrow e_2$

$$\left[\begin{array}{ccc|c} 0 & 2 & 5 & 6 \\ 1 & 0 & 0 & \frac{34}{3} \\ 0 & 0 & 1 & \frac{11}{3} \end{array} \right] \xrightarrow{e_2 + 2e_3 \rightarrow e_2}$$

$$\left[\begin{array}{ccc|c} 0 & 2 & 0 & \frac{-37}{3} \\ 1 & 0 & 0 & \frac{34}{3} \\ 0 & 0 & 1 & \frac{11}{3} \end{array} \right] \xrightarrow{e_1 / 2} \left[\begin{array}{ccc|c} 0 & 1 & 0 & \frac{-37}{6} \\ 1 & 0 & 0 & \frac{34}{3} \\ 0 & 0 & 1 & \frac{11}{3} \end{array} \right]$$

$$\begin{aligned} x_1 &= \frac{34}{3} \\ x_2 &= \frac{-37}{6} \\ x_3 &= \frac{11}{3} \end{aligned}$$

(10)

11

$$x_1 + 2x_2 - x_3 = 4$$

$$3x_1 + 4x_2 - 2x_3 = 7$$

$$\left[\begin{array}{ccc|c} 1 & 2 & -1 & 4 \\ 3 & 4 & -2 & 7 \end{array} \right]$$

$$e_2 - 3e_1 \rightarrow e_2$$

$$\left[\begin{array}{ccc|c} 1 & 2 & -1 & 4 \\ 0 & -2 & 1 & -5 \end{array} \right]$$

$$e_2 + e_1 \rightarrow e_2$$

$$\left[\begin{array}{ccc|c} 1 & 2 & -1 & 4 \\ 1 & 0 & 0 & -1 \end{array} \right]$$

$$x_1 = -1$$

11

$$\textcircled{12} \quad \begin{aligned} x_1 + 2x_2 - 4x_3 &= 4 \\ -2x_1 - 4x_2 + 8x_3 &= -8 \end{aligned} \quad \left[\begin{array}{ccc|c} 1 & 2 & -4 & 4 \\ -2 & -4 & 8 & -8 \end{array} \right]$$

$$\xrightarrow{e_2/2} \left[\begin{array}{ccc|c} 1 & 2 & -4 & 4 \\ -1 & -2 & 4 & -4 \end{array} \right] \xrightarrow{e_2 + e_1 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & 2 & -4 & 4 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$0=0$ Infinidad de Soluciones

$\textcircled{12}$

$$\textcircled{13} \quad \begin{aligned} x_1 + 2x_2 - 4x_3 &= 4 \\ -2x_1 - 4x_2 + 8x_3 &= -9 \end{aligned} \quad \left[\begin{array}{ccc|c} 1 & 2 & -4 & 4 \\ -2 & -4 & 8 & -9 \end{array} \right]$$

$\textcircled{13}$

$$\xrightarrow{e_2 + 2e_1 \rightarrow e_2} \left[\begin{array}{ccc|c} 1 & 2 & -4 & 4 \\ 0 & 0 & 0 & -1 \end{array} \right]$$

$0=-1$ Falso
No tiene solución

$$\textcircled{14} \quad \begin{aligned} x_1 + 2x_2 - x_3 + x_4 &= 7 \\ 3x_1 + 6x_2 - 3x_3 + 3x_4 &= 21 \end{aligned}$$

$$\left[\begin{array}{cccc|c} 1 & 2 & -1 & 1 & 7 \\ 3 & 6 & -3 & 3 & 21 \end{array} \right]$$

$\textcircled{14}$

$$\xrightarrow{e_3 - 3e_1 \rightarrow e_3} \left[\begin{array}{cccc|c} 1 & 2 & -1 & 1 & 7 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right]$$

$0=0$
Infinidad de Soluciones

(17) $x_1 - 2x_2 + x_3 + x_4 = 2$

$3x_1 + 0 + 2x_3 - 2x_4 = -8$

$0 + 4x_2 - x_3 - x_4 = 1$

$5x_1 + 0 + 3x_3 - x_4 = -3$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 3 & 0 & 2 & -2 & -8 \\ 0 & 4 & -1 & -1 & 1 \\ 5 & 0 & 3 & -1 & -3 \end{array} \right]$$

$e_2 - 3e_1 \rightarrow e_2$
 $e_4 - 5e_1 \rightarrow e_4$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 4 & -1 & -1 & 1 \\ 0 & 10 & -2 & -6 & -13 \end{array} \right] \xrightarrow{3e_3 - 2e_2 \rightarrow e_3}$$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 0 & -1 & 7 & 31 \\ 0 & 10 & -2 & -6 & -13 \end{array} \right] \xrightarrow{3e_4 - 5e_2 \rightarrow e_4} \left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 0 & -1 & 7 & 31 \\ 0 & 0 & -1 & 7 & 31 \end{array} \right]$$

$e_4 - e_3 \rightarrow e_4$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 0 & -1 & 7 & 31 \\ 0 & 0 & 0 & 0 & 0 \end{array} \right]$$

$0 = 0$

Infinitud de
Soluciones

(17)

18) $x_1 - 2x_2 + x_3 + x_4 = 2$
 $3x_1 + 0 + 2x_3 - 2x_4 = -8$
 $0 + 4x_2 - x_3 - x_4 = 1$
 $5x_1 + 0 + 3x_3 - x_4 = 0$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 3 & 0 & 2 & -2 & -8 \\ 0 & 4 & -1 & -1 & 1 \\ 5 & 0 & 3 & -1 & 0 \end{array} \right]$$

$e_2 - 3e_1 \rightarrow e_2$
 $e_4 - 5e_1 \rightarrow e_4$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 4 & -1 & -1 & 1 \\ 0 & 10 & -2 & -6 & -10 \end{array} \right]$$

$3e_3 - 2e_2 \rightarrow e_3$
 $3e_4 - 5e_2 \rightarrow e_4$

$$\left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 0 & -1 & 7 & 31 \\ 0 & 0 & -1 & 7 & 40 \end{array} \right] \xrightarrow{e_4 - e_3 \rightarrow e_4} \left[\begin{array}{cccc|c} 1 & -2 & 1 & 1 & 2 \\ 0 & 6 & -1 & -5 & -14 \\ 0 & 0 & -1 & 7 & 31 \\ 0 & 0 & 0 & 0 & 9 \end{array} \right]$$

18)

$0 = 9$ Falso
 No tiene solución

(19)
$$\begin{aligned} x_1 + x_2 &= 4 \\ 2x_1 - 3x_2 &= 7 \\ 3x_1 + 2x_2 &= 8 \end{aligned}$$

$$\left[\begin{array}{cc|c} 1 & 1 & 4 \\ 2 & -3 & 7 \\ 3 & 2 & 8 \end{array} \right] \xrightarrow{\begin{array}{l} e_2 - 2e_1 \rightarrow e_2 \\ e_3 - 3e_1 \rightarrow e_3 \end{array}}$$

$$\left[\begin{array}{cc|c} 1 & 1 & 4 \\ 0 & -5 & -1 \\ 0 & -1 & -4 \end{array} \right] \xrightarrow[\substack{e_3(-1) \\ e_2(-1)}]{s} \left[\begin{array}{cc|c} 1 & 1 & 4 \\ 0 & -1 & 1/5 \\ 0 & 1 & 4 \end{array} \right] \quad x_2 = 4 \text{ or } 1/5$$

$x_2 = 4$
 $x_2 = 1/5$ No tiene solución (19)

(20)
$$\begin{aligned} x_1 + x_2 &= 4 \\ 2x_1 - 3x_2 &= 7 \\ 3x_1 - 2x_2 &= 11 \end{aligned}$$

$$\left[\begin{array}{cc|c} 1 & 1 & 4 \\ 2 & -3 & 7 \\ 3 & -2 & 11 \end{array} \right] \xrightarrow{\begin{array}{l} e_2 - 2e_1 \rightarrow e_2 \\ e_3 - 3e_1 \rightarrow e_3 \end{array}}$$

$$\left[\begin{array}{cc|c} 1 & 1 & 4 \\ 0 & -5 & -1 \\ 0 & -5 & -1 \end{array} \right] \xrightarrow{e_3 - e_2 \rightarrow e_3} \left[\begin{array}{cc|c} 1 & 1 & 4 \\ 0 & -5 & -1 \\ 0 & 0 & 0 \end{array} \right] \quad x_2 = \frac{1}{5}$$

$0 = 0$ Infinidad de Soluciones (20)

$$\begin{aligned} x_1 + \frac{1}{5} &= 4 & x_1 &= \frac{20}{5} - \frac{1}{5} \\ x_1 &= 4 - \frac{1}{5} & x_1 &= \frac{19}{5} \end{aligned}$$

$$\begin{aligned} x &= \frac{19}{5} \\ x_2 &= \frac{1}{5} \end{aligned}$$

$$\begin{aligned} 2x_1 + 2x_2 - x_3 + x_4 &= 4 \\ 4x_1 + 3x_2 - x_3 + 2x_4 &= 6 \\ 8x_1 + 5x_2 - 3x_3 + 4x_4 &= 12 \\ 3x_1 + 3x_2 - 2x_3 + 2x_4 &= 6 \end{aligned}$$

$$\left[\begin{array}{cccc|c} 2 & 2 & -1 & 1 & 4 \\ 4 & 3 & -1 & 2 & 6 \\ 8 & 5 & -3 & 4 & 12 \\ 3 & 3 & -2 & 2 & 6 \end{array} \right]$$

$$\begin{aligned} e_2 - 2e_1 &\rightarrow e_2 \\ e_3 - 4e_1 &\rightarrow e_3 \\ 2e_4 - 3e_1 &\rightarrow e_4 \end{aligned} \quad \left[\begin{array}{cccc|c} 2 & 2 & -1 & 1 & 4 \\ 0 & -1 & 1 & 0 & -2 \\ 0 & -3 & 1 & 0 & -4 \\ 0 & 0 & -1 & 1 & 0 \end{array} \right] \quad \begin{aligned} e_3 - 3e_2 &\rightarrow e_3 \\ \rightarrow \end{aligned}$$

$$\left[\begin{array}{cccc|c} 2 & 2 & -1 & 1 & 4 \\ 0 & -1 & 1 & 0 & -2 \\ 0 & 0 & -2 & 0 & 2 \\ 0 & 0 & -1 & 1 & 0 \end{array} \right] \xrightarrow{e_3 / -2 \rightarrow e_3} \left[\begin{array}{cccc|c} 2 & 2 & -1 & 1 & 4 \\ 0 & -1 & 1 & 0 & -2 \\ 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & -1 & 1 & 0 \end{array} \right]$$

$$x_3 = -1$$

$$-x_3 + x_4 = 0 \rightarrow 1 + x_4 = 0 \rightarrow x_4 = -1$$

$$-x_2 + x_3 = -2 \rightarrow -x_2 - 1 = -2 \rightarrow -x_2 = -2 + 1 \rightarrow x_2 = 1$$

$$2x_1 + 2(1) - 1(-1) + 1(-1) = 4 \rightarrow 2x_1 + 2 + 1 - 1 = 4$$

$$2x_1 + 2 = 4 \rightarrow 2x_1 = 4 - 2 \rightarrow 2x_1 = 2 \rightarrow x_1 = 1$$

$$\begin{aligned} x_1 &= 1 \\ x_2 &= 1 \\ x_3 &= -1 \\ x_4 &= -1 \end{aligned}$$

(21)

$$e_4 + e_3 \rightarrow e_4 \quad \left[\begin{array}{cccc|c} 2 & 2 & -1 & 1 & 4 \\ 0 & -1 & 1 & 0 & -2 \\ 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right] \xrightarrow{e_2 + e_3 \rightarrow e_2}$$

$$\left[\begin{array}{cccc|c} 2 & 2 & -1 & 1 & 4 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right] \xrightarrow{\begin{array}{l} e_1 - e_4 + e_3 - 2e_2 \rightarrow e_1 \\ e_1 / 2 \end{array}}$$

(21)

$$\left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right]$$

$$\begin{array}{l} x_1 = 1 \\ x_2 = 1 \\ x_3 = -1 \\ x_4 = -1 \end{array}$$

(22) $3x_1 + 4x_2 + x_3 + 2x_4 + 3 = 0$
 $3x_1 + 5x_2 + 3x_3 + 5x_4 + 6 = 0$
 $6x_1 + 8x_2 + x_3 + 5x_4 + 8 = 0$
 $3x_1 + 5x_2 + 3x_3 + 7x_4 + 8 = 0$

$$\begin{bmatrix} 3 & 4 & 1 & 2 & -3 \\ 3 & 5 & 3 & 5 & -6 \\ 6 & 8 & 1 & 5 & -8 \\ 3 & 5 & 3 & 7 & -8 \end{bmatrix}$$

$e_2 - e_1 \rightarrow e_2$
 $e_3 - 2e_1 \rightarrow e_3$
 $e_4 - e_1 \rightarrow e_4$

$$\begin{bmatrix} 3 & 4 & 1 & 2 & -3 \\ 0 & 1 & 2 & 3 & -3 \\ 0 & 0 & -1 & 1 & -2 \\ 0 & 1 & 2 & 5 & -5 \end{bmatrix} \xrightarrow{e_4 - e_2 \rightarrow e_4}$$

$$\begin{bmatrix} 3 & 4 & 1 & 2 & -3 \\ 0 & 1 & 2 & 3 & -3 \\ 0 & 0 & -1 & 1 & -2 \\ 0 & 0 & 0 & 2 & -2 \end{bmatrix} \xrightarrow{e_4/2} \begin{bmatrix} 3 & 4 & 1 & 2 & -3 \\ 0 & 1 & 2 & 3 & -3 \\ 0 & 0 & -1 & 1 & -2 \\ 0 & 0 & 0 & 1 & -1 \end{bmatrix}$$

$$-x_3 + x_4 = -2 \rightarrow -x_3 - 1 = -2 \rightarrow -x_3 = -2 + 1$$

$$-x_3 = -1 \rightarrow x_3 = 1$$

$$x_2 + 2x_3 + 3x_4 = -3 \rightarrow x_2 + 2(1) + 3(-1) = -3 \rightarrow$$

$$x_2 + 2 - 3 = -3 \rightarrow x_2 - 1 = -3 \rightarrow x_2 = -2$$

$$3x_1 + 4x_2 + x_3 + 2x_4 = -3 \rightarrow 3x_1 + 4(-2) + 1 - 2(1) = -3$$

$$3x_1 - 8 + 1 - 2 = -3 \rightarrow 3x_1 - 9 = -3 \rightarrow 3x_1 = -3 + 9$$

$$3x_1 = 6 \rightarrow x_1 = 2$$

$$\begin{aligned} x_1 &= 2 \\ x_2 &= -2 \\ x_3 &= 1 \end{aligned}$$

 $x_4 = -1$ (22)

$$-e_3 + e_4 \rightarrow e_3 \rightarrow \left[\begin{array}{cccc|c} 3 & 4 & 1 & 2 & -3 \\ 0 & 1 & 2 & 3 & -3 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right] \xrightarrow{e_2 - 2e_3 - 3e_4 \rightarrow e_2}$$

$$\left[\begin{array}{cccc|c} 3 & 4 & 1 & 2 & -3 \\ 0 & 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right] \xrightarrow{e_1 - 4e_2 - e_3 - 2e_4 \rightarrow e_1}$$

$$\left[\begin{array}{cccc|c} 3 & 0 & 0 & 0 & 6 \\ 0 & 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right] \xrightarrow{e_1/3} \left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 2 \\ 0 & 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right]$$

$$\begin{aligned} x_1 &= 2 \\ x_2 &= -2 \\ x_3 &= 1 \\ x_4 &= -1 \end{aligned}$$

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$$\begin{aligned} 2x_1 + 3x_2 + 11x_3 + 5x_4 &= 2 \\ x_1 + x_2 + 5x_3 + 2x_4 &= 1 \\ 2x_1 + x_2 + 3x_3 + 2x_4 &= -3 \\ x_1 + x_2 + 3x_3 + 4x_4 &= -3 \end{aligned} \quad \left[\begin{array}{cccc|c} 2 & 3 & 11 & 5 & 2 \\ 1 & 1 & 5 & 2 & 1 \\ 2 & 1 & 3 & 2 & -3 \\ 1 & 1 & 3 & 4 & -3 \end{array} \right]$$

$$\begin{aligned} 2e_2 - e_1 &\rightarrow e_2 \\ e_3 - e_1 &\rightarrow e_3 \\ 2e_4 - e_1 &\rightarrow e_4 \end{aligned} \rightarrow \left[\begin{array}{cccc|c} 2 & 3 & 11 & 5 & 2 \\ 0 & -1 & -1 & -1 & 0 \\ 0 & -2 & -8 & -3 & -5 \\ 0 & -1 & -5 & 3 & -8 \end{array} \right] \begin{aligned} e_3 - 2e_2 &\rightarrow e_3 \\ e_4 - e_2 &\rightarrow e_4 \end{aligned}$$

$$\left[\begin{array}{cccc|c} 2 & 3 & 11 & 5 & 2 \\ 0 & -1 & -1 & -1 & 0 \\ 0 & 0 & -6 & -1 & -5 \\ 0 & 0 & -4 & 4 & -8 \end{array} \right] \xrightarrow{3e_4 - 2e_3 \rightarrow e_3} \left[\begin{array}{cccc|c} 2 & 3 & 11 & 5 & 2 \\ 0 & -1 & -1 & -1 & 0 \\ 0 & 0 & -6 & -1 & -5 \\ 0 & 0 & 0 & 14 & -14 \end{array} \right]$$

$$e_4 / 14 \rightarrow e_4 \rightarrow \left[\begin{array}{cccc|c} 2 & 3 & 11 & 5 & 2 \\ 0 & -1 & -1 & -1 & 0 \\ 0 & 0 & -6 & -1 & -5 \\ 0 & 0 & 0 & 1 & -1 \end{array} \right]$$

$$\begin{aligned} x_4 &= -1 \\ x_3 &= 1 \\ x_2 &= 0 \\ x_1 &= -2 \end{aligned}$$

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$$-6x_3 + 1 = -5 \rightarrow -6x_3 = -6 \Rightarrow x_3 = 1$$

$$-x_2 - 1 + 1 = 0 \rightarrow -x_2 = 0$$

$$2x_1 + 3(0) + 11(1) + 5(-1) = 2$$

$$2x_1 + 0 + 11 - 5 = 2$$

$$2x_1 + 6 = 2$$

$$x_1 = -2$$

$$2x_1 = -4$$

$$e_3 + e_4 \rightarrow e_3 \rightarrow \begin{bmatrix} 2 & 3 & 11 & 5 & | & 2 \\ 0 & -1 & -1 & -1 & | & 0 \\ 0 & 0 & -6 & 0 & | & -6 \\ 0 & 0 & 0 & 1 & | & -1 \end{bmatrix} \xrightarrow{e_3 / -6 \rightarrow e_3} \begin{bmatrix} 2 & 3 & 11 & 5 & | & 2 \\ 0 & -1 & -1 & -1 & | & 0 \\ 0 & 0 & 1 & 0 & | & 1 \\ 0 & 0 & 0 & 1 & | & -1 \end{bmatrix} \xrightarrow{e_2 + e_3 + e_4 \rightarrow e_2}$$

$$\begin{bmatrix} 2 & 3 & 11 & 5 & | & 2 \\ 0 & -1 & 0 & 0 & | & 0 \\ 0 & 0 & 1 & 0 & | & 1 \\ 0 & 0 & 0 & 1 & | & -1 \end{bmatrix} \xrightarrow{e_2 (-1) \rightarrow e_2} \begin{bmatrix} 2 & 0 & 0 & 0 & | & -4 \\ 0 & 1 & 0 & 0 & | & 0 \\ 0 & 0 & 1 & 0 & | & 1 \\ 0 & 0 & 0 & 1 & | & -1 \end{bmatrix} \xrightarrow{e_1 - 3e_2 - 11e_3 - 5e_4 \rightarrow e_1}$$

$$\begin{bmatrix} 2 & 0 & 0 & 0 & | & -4 \\ 0 & 1 & 0 & 0 & | & 0 \\ 0 & 0 & 1 & 0 & | & 1 \\ 0 & 0 & 0 & 1 & | & -1 \end{bmatrix} \xrightarrow{e_1 / 2 \rightarrow e_1} \begin{bmatrix} 1 & 0 & 0 & 0 & | & -2 \\ 0 & 1 & 0 & 0 & | & 0 \\ 0 & 0 & 1 & 0 & | & 1 \\ 0 & 0 & 0 & 1 & | & -1 \end{bmatrix}$$

$$\begin{aligned} x_1 &= -2 \\ x_2 &= 0 \\ x_3 &= 1 \\ x_4 &= -1 \end{aligned}$$

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(25) $2x_1 + 5x_2 + 4x_3 + x_4 = 20$
 $x_1 + 3x_2 + 2x_3 + x_4 = 11$
 $2x_1 + 10x_2 + 9x_3 + 7x_4 = 40$
 $3x_1 + 8x_2 + 9x_3 + 2x_4 = 37$

$$\left[\begin{array}{cccc|c} 2 & 5 & 4 & 1 & 20 \\ 1 & 3 & 2 & 1 & 11 \\ 2 & 10 & 9 & 7 & 40 \\ 3 & 8 & 9 & 2 & 37 \end{array} \right]$$

$2e_2 - e_1 \rightarrow e_2$
 $e_3 - e_1 \rightarrow e_3$
 $2e_4 - 3e_1 \rightarrow e_4$

$$\left[\begin{array}{cccc|c} 2 & 5 & 4 & 1 & 20 \\ 0 & 1 & 0 & 1 & 2 \\ 0 & 5 & 5 & 6 & 0 \\ 0 & 1 & 6 & 1 & 14 \end{array} \right] \begin{array}{l} e_3 - 5e_2 \rightarrow e_3 \\ e_4 - e_2 \rightarrow e_4 \end{array}$$

$$\left[\begin{array}{cccc|c} 2 & 5 & 4 & 1 & 20 \\ 0 & 1 & 0 & 1 & 2 \\ 0 & 0 & 5 & 1 & 10 \\ 0 & 0 & 6 & 0 & 12 \end{array} \right] \begin{array}{l} e_4/6 \rightarrow e_4 \\ e_3 - 5e_4 \rightarrow e_3 \end{array} \rightarrow \left[\begin{array}{cccc|c} 2 & 5 & 4 & 1 & 20 \\ 0 & 1 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 2 \end{array} \right]$$

$e_2 - e_3 \rightarrow e_2$

$$\left[\begin{array}{cccc|c} 2 & 5 & 4 & 1 & 20 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 2 \end{array} \right] \xrightarrow{e_1 - 5e_2 - e_3 - 4e_4}$$

$$\left[\begin{array}{cccc|c} 2 & 0 & 0 & 0 & 2 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 2 \end{array} \right] \xrightarrow{e_1/2 \rightarrow e_1} \left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 2 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 2 \end{array} \right]$$

| | |
|-----------|-----------|
| $x_1 = 1$ | $x_3 = 2$ |
| $x_2 = 2$ | $x_4 = 0$ |

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