

$$\begin{cases} x_1 + x_2 - x_3 - 2x_4 = 0 \\ 2x_1 + x_2 - x_3 + x_4 = -2 \\ 2x_1 + x_2 - 3x_3 + x_4 = 4 \end{cases}$$

$$A = \begin{pmatrix} 1 & 1 & -1 & -2 \\ 2 & 1 & -1 & 1 \\ 2 & 1 & -3 & 1 \end{pmatrix}, b = \begin{pmatrix} 0 \\ -2 \\ 4 \end{pmatrix} \Rightarrow$$

$$\left[\begin{array}{cccc|c} 1 & 1 & -1 & -2 & 0 \\ 2 & 1 & -1 & 1 & -2 \\ 2 & 1 & -3 & 1 & 4 \end{array} \right] \xrightarrow{\begin{matrix} x(-2) \\ x(-1) \end{matrix}} \Rightarrow \left[\begin{array}{cccc|c} 1 & 1 & -1 & -2 & 0 \\ 0 & -1 & 1 & 5 & -2 \\ 0 & 0 & -2 & 3 & 4 \end{array} \right] \xrightarrow{\begin{matrix} :(-1) \\ :(-1) \end{matrix}}$$

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

$$x_1 + x_2 - x_3 - 2x_4 = 0$$

$$x_2 - x_3 - 5x_4 = 2 \Rightarrow \text{Domysum } x_4 \geq 0 \Rightarrow$$

$$x_3 - 1,5x_4 = -2$$

$$\Rightarrow \begin{cases} x_1 = 0 - 2 + 0 \\ x_2 = 2 - 2 + 0 \end{cases} \Rightarrow x_1 = -2; x_2 = 0; x_3 = -2; x_4 = 0$$



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$$a) \begin{cases} 3x_1 - x_2 + x_3 = 4 \\ 2x_1 - 5x_2 - 3x_3 = -17 \\ x_1 + x_2 - x_3 = 0 \end{cases}$$

$$A = \begin{pmatrix} 3 & -1 & 1 \\ 2 & -5 & -3 \\ 1 & 1 & -1 \end{pmatrix} \quad b = \begin{pmatrix} 4 \\ -17 \\ 0 \end{pmatrix} \quad 4 \neq (-17) + 0$$



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$$\xrightarrow[A_r \cdot 2]{\left(\begin{array}{ccc|c} 3 & -1 & 1 & 4 \\ 2 & -5 & -3 & -17 \\ 1 & 1 & -1 & 0 \end{array} \right) \times (-2)} \Rightarrow \left(\begin{array}{ccc|c} 0 & -13 & -11 & -59 \\ 2 & -5 & -3 & -17 \\ 1 & 1 & -1 & 0 \end{array} \right) \xrightarrow[\times 1/2]{\leftarrow (-1/2)}$$

$$\Rightarrow \left(\begin{array}{ccc|c} 0 & -13 & -11 & -59 \\ 0 & 7 & 1 & 17 \\ 1 & 1 & -1 & 0 \end{array} \right) \xrightarrow[\times 1/3]{\leftarrow (-13/7)} \Rightarrow \left(\begin{array}{ccc|c} 0 & 0 & -64 & -196 \\ 0 & 7 & 1 & 17 \\ 1 & 1 & -1 & 0 \end{array} \right)$$

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 $r(A_r) = 3$

$$A = \begin{pmatrix} 0 & 0 & -64 \\ 0 & 7 & 1 \\ 1 & 1 & -1 \end{pmatrix} \quad r(A) = 3$$

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$r(A) = 3 = r(A_1) = 3 \Rightarrow$ colineare cuorante

$$\begin{cases} -6x_2 = -12 \\ 7x_2 + x_3 = 17 \\ x_1 + x_2 - x_3 = 0 \end{cases} \Rightarrow \begin{cases} x_2 = 3 \\ x_2 = (17 - 3) \cdot 7 = 2 \\ x_1 = 3 - 2 = 1 \end{cases} \Rightarrow$$

\Rightarrow lueeue onperpendicolare (perpendicoli ognuno)

$$d) \begin{cases} 2x_1 - 4x_2 + 6x_3 = 1 \\ x_1 - 2x_2 + 3x_3 = -2 \\ 3x_1 - 6x_2 + 9x_3 = 5 \end{cases}$$

$$A_2 \begin{pmatrix} 2 & -4 & 6 \\ 1 & -2 & 3 \\ 3 & -6 & 9 \end{pmatrix} \quad b = \begin{pmatrix} 1 \\ -2 \\ 5 \end{pmatrix}$$

$$A_1 = \begin{pmatrix} 2 & -4 & 6 & | & 1 \\ 1 & -2 & 3 & | & -2 \\ 3 & -6 & 9 & | & 5 \end{pmatrix} \xrightarrow{\begin{matrix} R_1 \times (-1) \\ R_2 + R_1 \\ R_3 + R_1 \end{matrix}} \begin{pmatrix} 0 & 0 & 0 & | & -5 \\ 1 & -2 & 3 & | & -2 \\ 3 & -6 & 9 & | & 5 \end{pmatrix} \xrightarrow{\begin{matrix} R_3 + R_2 \\ R_3 + R_2 \end{matrix}} \Rightarrow$$

$$\Rightarrow \begin{pmatrix} 0 & 0 & 0 & | & -5 \\ 0 & 0 & 0 & | & 11 \\ 0 & 0 & 0 & | & 11 \end{pmatrix} \Rightarrow r(A) = 1 \quad r(A_1) = 2 \Rightarrow$$

cuorante parallele

$r(A) \neq r(A_1) \Rightarrow$ perpendicoli



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$$b) \begin{cases} x_1 + 2x_2 + 5x_3 = 4 \\ 3x_1 + x_2 - 8x_3 = -2 \end{cases}$$

$$A = \begin{pmatrix} 1 & 2 & 5 \\ 3 & 1 & -8 \end{pmatrix} \quad b = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$$

$$A_1 = \left(\begin{array}{ccc|c} 1 & 2 & 5 & 4 \\ 3 & 1 & -8 & -2 \end{array} \right) \xrightarrow{\text{R2} \rightarrow \text{R2} - 3\text{R1}} \left(\begin{array}{ccc|c} 1 & 2 & 5 & 4 \\ 0 & -5 & -23 & -14 \end{array} \right)$$

$r(A) = 2 = r(A_1) = 2 \Rightarrow$ correct solution

$$\begin{cases} -5x_2 = -14 + 23x_3 \\ 2x_1 + x_2 = -2 + 8x_3 \end{cases} \Rightarrow \begin{cases} x_2 = 2,8 - 4,6x_3 \\ 2x_1 = -2 + 8x_3 - 2,8 + 4,6x_3 \end{cases}$$

$$\Rightarrow \begin{cases} x_2 = 2,8 - 4,6x_3 \\ x_1 = -1,6 + 4,2x_3 \end{cases} \Rightarrow \begin{array}{l} \text{cucende rengje} \\ \text{u uweert dan de 1e reng} \end{array}$$