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① $v_1 = (2, 5, 0, 3)$ $v_2 = (5, -3, 4, 10)$ $v_3 = (-7, -2, -4, -13)$

$v_1 + v_2 + v_3 = (0, 0, 0, 0)$

$$\begin{pmatrix} 2 & 5 & -7 \\ 5 & -3 & -2 \\ 0 & 4 & -4 \\ 3 & 10 & -13 \end{pmatrix} \begin{pmatrix} +1 \\ +1 \\ +1 \\ +1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

② a) $$\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mm} \end{pmatrix} \begin{pmatrix} c_1 \\ c_2 \\ \vdots \\ c_m \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

b) $\sum_{j=1}^{m} c_j \cdot a_j = 0$

③ a) $v = (1, 1, 0)$ $w = (0, 1, 1)$ $z = (1, -1, 1)$ $u = (x, y, z)$

$z = v \times w$

$$z = \det \begin{pmatrix} i & j & k \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{pmatrix} = i(1) - j(1) + k(1)$$

b) $\langle u, v \rangle \neq 0 \rightarrow x + y \neq 0$ $u = (1, 1, 1)$

$\langle u, z \rangle \neq 0 \rightarrow x - y + z \neq 0$

④ $A = CR$

$$A = \begin{pmatrix} 1 & 4 & 9 \\ 1 & 4 & 9 \\ 1 & 4 & 9 \end{pmatrix} \quad C = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \quad R = \begin{pmatrix} 1 \\ 4 \\ 9 \end{pmatrix}$$

⑤ a) $$C_1 = \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix} \quad C_2 = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

b) C_1 tem 1 dimensão enquanto C_2 tem 3.

c) A_1 é rank 1 e A_2 é rank 3

d) linha independente de $A_1 = (1 \quad 3 \quad -2)$

linhas independentes de $A_2 = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$

⑥ $A_1 = \begin{pmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ $A_2 = \begin{pmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ $A_3 = \begin{pmatrix} 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$

$A_1 = \begin{pmatrix} 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{pmatrix}$ $A_2 = \begin{pmatrix} 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{pmatrix}$

$A_3 = \begin{pmatrix} 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{pmatrix}$ Todos são rank 2

⑦ $A = \begin{pmatrix} 3 & 2 & 4 \\ 1 & 1 & 2 \\ 4 & 3 & -2 \end{pmatrix}$ a) $A_1 = \begin{pmatrix} 3 & 2 & 4 \\ 0 & -1 & -2 \\ 4 & 3 & 2 \end{pmatrix}$

$L_1 . A = A_1$

$L_1 . A (A^{-1}) = A_1 (A^{-1})$

$L_1 I = A_1 (A^{-1})$

$A^{-1} = \left(\begin{array}{ccc|ccc} 3 & 2 & 4 & 1 & 0 & 0 \\ 1 & 1 & 2 & 0 & 1 & 0 \\ 4 & 3 & -2 & 0 & 0 & 1 \end{array}\right) \to \left(\begin{array}{ccc|ccc} 1 & 1 & 2 & 0 & 1 & 0 \\ 3 & 2 & 4 & 1 & 0 & 0 \\ 4 & 3 & -2 & 0 & 0 & 1 \end{array}\right) \to$

$\left(\begin{array}{ccc|ccc} 1 & 1 & 2 & 0 & 1 & 0 \\ 0 & -1 & -2 & 1 & -3 & 0 \\ 4 & 3 & -2 & 0 & 0 & 1 \end{array}\right) \to \left(\begin{array}{ccc|ccc} 1 & 1 & 2 & 0 & 1 & 0 \\ 0 & -1 & -2 & 1 & -3 & 0 \\ 0 & -1 & -10 & 0 & -4 & 1 \end{array}\right) \to$

$\left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 1 & -2 & 0 \\ 0 & -1 & -2 & 1 & -3 & 0 \\ 0 & 0 & -8 & -1 & -1 & 1 \end{array}\right) \to \left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 1 & -2 & 0 \\ 0 & -1 & -2 & 1 & -3 & 0 \\ 0 & 0 & 1 & -1/8 & -1/8 & 1/8 \end{array}\right)$

$$\left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 1 & -2 & 0 \\ 0 & -1 & -2 & 1 & -3 & 0 \\ 0 & 0 & 1 & -1/8 & -1/8 & 1/8 \end{array}\right) \rightarrow \left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 1 & -2 & 0 \\ 0 & -1 & 0 & 6/8 & -26/8 & 2/8 \\ 0 & 0 & 1 & -1/8 & -1/8 & 1/8 \end{array}\right) \rightarrow$$

$$\left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 1 & -2 & 0 \\ 0 & 1 & 0 & -3/4 & 13/4 & -1/4 \\ 0 & 0 & 1 & -1/8 & -1/8 & 1/8 \end{array}\right) \quad A^{-1} = \begin{pmatrix} 1 & -2 & 0 \\ -3/4 & 13/4 & -1/4 \\ -1/8 & -1/8 & 1/8 \end{pmatrix}$$

$L_1 = A_1 \cdot (A^{-1})$

$$L_1 = \begin{pmatrix} 1 & 1 & 2 \\ 0 & -1 & -2 \\ 4 & 3 & 2 \end{pmatrix} \cdot \begin{pmatrix} 1 & -2 & 0 \\ -3/4 & 13/4 & -1/4 \\ -1/8 & -1/8 & 1/8 \end{pmatrix}$$

$$L_1 = \begin{pmatrix} 1.1 + 1(-3/4) + 2(-1/8) & 1(-2) + (+1)(13/4) + 2(-1/8) & 1.0 + 1(-1/4) + 2(1/8) \\ 0.1 + (-1)(-3/4) + (-2)(-1/8) & 0(-2) + (-1)(13/4) + (-2)(-1/8) & 0.0 + (-1)(-1/4) + (-2)(1/8) \\ 4.1 + 3(-3/4) + 2(-1/8) & 4(-2) + 3(13/4) + 2(-1/8) & 4.0 + 3(-1/4) + 2(1/8) \end{pmatrix}$$

$$L_1 = \begin{pmatrix} 0 & -1/2 & 0 \\ 1 & -3 & 0 \\ 6/4 & 6 & -1/2 \end{pmatrix}$$

b) $L_2 = A_2 (A^{-1})$

$$L_2 = \begin{pmatrix} 1 & 1 & 2 \\ 0 & -1 & -2 \\ 0 & -1 & -10 \end{pmatrix} \begin{pmatrix} 1 & -2 & 0 \\ -3/4 & 13/4 & -1/4 \\ -1/8 & -1/8 & 1/8 \end{pmatrix}$$

$$L_2 = \begin{pmatrix} 1 - 0 & -1/2 & 0 \\ (3/4) + 1/4 & -13/4 + 1/4 & 1/4 - 1/4 \\ (3/4) + (5/4) & -13/4 + 5/4 & 1/4 - 5/4 \end{pmatrix}$$

$$L_2 = \begin{pmatrix} 0 & -1/2 & 0 \\ 1 & -3 & 0 \\ 2 & -2 & -1 \end{pmatrix}$$

8) a é uma matriz $1 \times m$ e b é uma matriz $1 \times p$, Não é possível multiplicar ab^t pois seria multiplicar uma matriz $1 \times m$ por uma $p \times 1$, se $m \neq p$, isso é impossível

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(9) For k=1 to m

For i=1 to m

For j=1 to p

c(i,j) = C(i,j) + A(i,k) * A(k,j)

(10) $A = \begin{bmatrix} 3 & 4 \\ 4 & 3 \end{bmatrix}$ $b = \begin{pmatrix} 3 & 4 \\ 4 & 3 \end{pmatrix}$ $C = \begin{pmatrix} 25 & 25 \\ 25 & 25 \end{pmatrix}$