

$$u_{11} = -1, u_{12} = 0, u_{13} = 0, u_{14} = 0$$

$$u_{15} = 0, \dots$$

$$a) \text{Matrix } A = \begin{bmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & -1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 \end{bmatrix}$$

$$b) 1: V_3 \xrightarrow{A_5} V_4 \xrightarrow{A_8} V_7 \xrightarrow{A_6} V_3$$

$$A_5 = \begin{bmatrix} 0 \\ 0 \\ -1 \\ 1 \\ 0 \end{bmatrix}, A_8 = \begin{bmatrix} 0 \\ 0 \\ 0 \\ -1 \\ 0 \end{bmatrix}, A_6 = \begin{bmatrix} 0 \\ 0 \\ -1 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{array}{ccc} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \end{array}$$

Notemos que $A_5 \neq \alpha A_8 \neq \beta A_6$

$$2. V_2 \xrightarrow{A_4} V_6 \xrightarrow{A_{11}} V_8 \xrightarrow{A_{10}} V_5 \xrightarrow{A_3} V_2$$

$$A_4 = \begin{bmatrix} 0 \\ -1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}, A_{11} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -1 \\ 0 \\ 1 \end{bmatrix}, A_{10} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ -1 \\ 0 \\ 0 \\ 1 \end{bmatrix}, A_3 = \begin{bmatrix} 0 \\ -1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

$$A_4 \neq \alpha A_{11} \neq \beta A_{10} \neq \lambda A_3$$

$$c) \{A_1, A_7\}$$

$$A_1 \neq \alpha A_7$$

o) Básicamente, las columnas siempre serán l.i.