1. Show that \( \vec{e}_1 = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \) and \( \vec{e}_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \) form a basis for \( \mathbb{R}^2 \). Generalize this to a basis for \( \mathbb{R}^n \). Conclude that \( \mathbb{R}^n \) has dimension \( n \). [Note: This is called the standard basis for \( \mathbb{R}^n \).] 

2. Prove that the vectors \( \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix} \), \( \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} \), and \( \begin{bmatrix} 4 \\ 1 \\ 3 \end{bmatrix} \) do not span \( \mathbb{R}^3 \).
3. Show that two vectors are linearly dependent if and only if one is a scalar multiple of the other.