

**Problem 1.** Determine whether the linear transformation given by the matrix

$$\begin{pmatrix} 2 & 1 \\ -4 & 3 \\ 6 & 1 \end{pmatrix}$$

is:

- (1) one-to-one.
- (2) onto.

We use elementary row operations to make it into echelon form:

$$\begin{pmatrix} 2 & 1 \\ 0 & 7 \\ 0 & -2 \end{pmatrix}$$

$$\begin{pmatrix} \underline{2} & 1 \\ 0 & \underline{7} \\ 0 & 0 \end{pmatrix}$$

where the underlined elements are pivots. Since every column has a pivot, the linear transformation is one-to-one; Since there is a row without pivot (third row), the linear transformation is not onto.