

1. (a) Is $\bar{\mathbf{b}} = \begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$ in the range of the linear transformation T defined by $T\bar{\mathbf{x}} = A\bar{\mathbf{x}}$, with

$$A = \begin{pmatrix} 1 & -4 & 5 & -5 \\ 0 & 1 & -4 & 5 \\ 3 & -10 & 7 & -4 \end{pmatrix}?$$
 If so, describe the vector(s) $\bar{\mathbf{x}}$ for which $T\bar{\mathbf{x}} = \bar{\mathbf{b}}$.

(b) Is T one-to-one? Is T onto? Justify your answers.

2. a) Find the LU factorization of $A = \begin{pmatrix} 1 & 1 & 1 \\ 2 & 4 & 5 \\ -1 & 5 & 9 \end{pmatrix}$.

b) Use the LU factorization to solve $Ax = b = \begin{pmatrix} 3 \\ 9 \\ 7 \end{pmatrix}$ by first solving $Lc = b$ and then solving $Ux = c$.