Let 
$$A = \begin{bmatrix} -1 & 2 \\ 2 & -3 \\ -1 & 3 \end{bmatrix}$$
 and let  $\mathbf{b} = \begin{bmatrix} 4 \\ 1 \\ 2 \end{bmatrix}$ .

a. Show that the equation  $A\mathbf{x} = \mathbf{b}$  has no solutions.

- b. Find a basis for Col *A*.
- c. Find an orthogonal basis for Col *A* . (Hint: Use Gram-Schmidt.)

d. Compute  $\text{proj}_{\text{Col}A}$  **b**. Recall that this vector,  $\hat{\mathbf{b}}$ , is the closest vector in Col *A* to **b**.

e. Compute the matrix  $A^T A$  and the vector  $A^T \mathbf{b}$ .