1. Compute the LDU factorization of the following matrix:

$$X = \begin{bmatrix} -1 & 0 & 2 \\ 2 & 1 & -1 \\ -3 & 4 & 2 \end{bmatrix}.$$

2. (a) Find a basis for the null space of the following matrix:

$$A = \begin{bmatrix} 1 & 0 & 2 & 3 \\ 0 & 2 & 1 & 3 \\ 2 & -6 & 1 & -3 \\ 3 & 0 & 6 & 9 \end{bmatrix}.$$

   (b) Let

$$\boldsymbol{b} = A \begin{bmatrix} 2 \\ 1 \\ 0 \\ 0 \end{bmatrix}.$$

   Find the general solution $\boldsymbol{v}_{general}$ to $A\boldsymbol{v} = \boldsymbol{b}$.

3. (a) Let $\boldsymbol{v}_1 = \begin{bmatrix} 1 \\ -2 \\ 0 \end{bmatrix}$, $\boldsymbol{v}_2 = \begin{bmatrix} 0 \\ 2 \\ -1 \end{bmatrix}$, and $\boldsymbol{v}_3 = \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}$, and let $B = \begin{bmatrix} \boldsymbol{v}_1 & \boldsymbol{v}_2 & \boldsymbol{v}_3 \end{bmatrix}$. Compute the QR factorization of B.

   (b) Let U be the subspace of $\mathbb{R}^2$ spanned by $\boldsymbol{v}_1$ and $\boldsymbol{v}_2$. Compute P_U, the projection onto U.

   (c) Let W be the orthogonal complement of U. What is a basis for W? Compute P_W, the projection onto W.

4. Let

$$T = \begin{bmatrix} -2 & 3 & -4 \\ 1 & -2 & 3 \\ 3 & -4 & 4 \end{bmatrix}.$$

   Compute $\det(T)$ by row operations, cofactor expansion, and the big formula.