1. Consider \( \vec{x} = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix} \) and \( H = \text{span}\{ \vec{v}_1, \vec{v}_2, \vec{v}_3 \} \) where

\[
\vec{v}_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}, \quad \vec{v}_2 = \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \\ 0 \end{bmatrix}, \quad \vec{v}_3 = \begin{bmatrix} 1 \\ -1 \\ -1 \\ -1 \\ 0 \end{bmatrix}
\]

Check that \( \vec{v}_1, \vec{v}_2, \vec{v}_3 \) are orthogonal, and find the distance of \( \vec{x} \) to \( H \).

For practice, you can also find the formula for the orthogonal projection onto \( H \).
2. Let $H$ be the null space of matrix $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 \end{bmatrix}$. Find the formula for the orthogonal projection onto $H$. (Or find matrix representation for the projection.)

*Note:* This is a long problem! You need to find a basis for $H$ then find orthogonal basis for $H$, and then the matrix for the projection.