Let $\vec{\mathbf{u_1}} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$, $\vec{\mathbf{u_2}} = \begin{bmatrix} 3 \\ 0 \\ 1 \end{bmatrix}$, and $\vec{\mathbf{u_3}} = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}$

1. Find a vector $\vec{\mathbf{x}}$ in $\mathbb{R}^3$ that is orthogonal to $\vec{\mathbf{u_1}}$.
2. Find a vector $\vec{\mathbf{y}}$ that is orthogonal to both $\vec{\mathbf{u_1}}$ and $\vec{\mathbf{u_2}}$.
3. Find all vectors $\vec{\mathbf{z}}$ in $\mathbb{R}^3$ that are orthogonal to $\vec{\mathbf{u_1}}$, $\vec{\mathbf{u_2}}$, and $\vec{\mathbf{u_3}}$.
4. Let $A = \begin{bmatrix} \vec{\mathbf{u_1}} \\ \vec{\mathbf{u_2}} \\ \vec{\mathbf{u_3}} \end{bmatrix}$. How is each $\vec{\mathbf{z}}$ from part 3 related to row(A)?

   Which fundamental subspace of A do the $\vec{\mathbf{z}}$ lie in?