Let $\vec{\mathbf{u}}_1 = \begin{bmatrix} -1 \\ -3 \\ -2 \end{bmatrix}$**,** $\vec{\mathbf{u}}_2 = \begin{bmatrix} -2 \\ 0 \\ 1 \end{bmatrix}$ $\vec{\mathbf{u}}_3 = \begin{bmatrix} 3 \\ -5 \\ 6 \end{bmatrix}$**, and** $\vec{\mathbf{y}} = \begin{bmatrix} 9 \\ -8 \\ 4 \end{bmatrix}$

1. Verify that $\mathcal{B} = \{\vec{\mathbf{u}}_1, \vec{\mathbf{u}}_2, \vec{\mathbf{u}}_3\}$ is an orthogonal basis for $\mathbb{R}^3$

2. Find $\hat{y}_1$, the orthogonal projection of $\vec{\mathbf{y}}$ onto $\vec{\mathbf{u}}_1$
   $\hat{y}_2$, the orthogonal projection of $\vec{\mathbf{y}}$ onto $\vec{\mathbf{u}}_2$
   $\hat{y}_3$, the orthogonal projection of $\vec{\mathbf{y}}$ onto $\vec{\mathbf{u}}_3$

3. Write $\vec{\mathbf{y}}$ as a linear combination of $\vec{\mathbf{u}}_1, \vec{\mathbf{u}}_2, \vec{\mathbf{u}}_3$

4. Form the matrix $A = \begin{bmatrix} \vec{\mathbf{u}}_1 & \vec{\mathbf{u}}_2 & \vec{\mathbf{u}}_3 \end{bmatrix}$, and calculate $A^T A$