1. True/False
   (1) If \( u \) is in subspace \( W \), and \( u \) is also in \( W^\perp \), then \( u = 0 \).

   (2) If \( y \) is in subspace \( W \), the orthogonal projection of \( y \) onto \( W \) is \( y \).

   (3) If \( x \) is orthogonal to \( v \) and \( w \), then \( x \) is also orthogonal to \( v - w \).

2. Give examples
   (1) two linearly independent vectors that are orthogonal to \[
   \begin{pmatrix}
   2 \\
   0 \\
   -1
   \end{pmatrix}
   .
   
   (2) a subspace of \( \mathbb{R}^3 \), \( S \), such that \( \dim(S^\perp) = 2 \).
3. a) Compute dot product of every pair of two vectors from 
\[ u = \begin{pmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \\ 1 \end{pmatrix}, \quad v = \begin{pmatrix} 1/\sqrt{2} \\ -1/\sqrt{2} \\ 0 \end{pmatrix} \text{ and } w = \begin{pmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \\ -1 \end{pmatrix}. \]

b) What are the eigenvalues and eigenvectors of the 3 \times 3 matrix \( A = vv^T \)?

c) What is the column space and null space of the matrix \( A = vv^T \)?