# 2017 Fall EE203001 Linear Algebra - Quiz 5

Name: ID:

1. Given $S$ is a subspace of $R^4$.
   (a) If $S$ contains only the zero vector, what is $S^{\perp}$?
   (b) If $S$ is spanned by (1, -1, 0, 1) and (0, 1, -1, -1), what is the basis for $S^{\perp}$?

**Sol:**

(a)$S^{\perp}$ is $R^4$.

(b)$\begin{bmatrix} 1 & -1 & 0 & 1 \\ 0 & 1 & -1 & -1 \end{bmatrix} \mathbf{x} = \mathbf{0} \Rightarrow \begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & -1 \end{bmatrix} \mathbf{x} = \mathbf{0}$

Let $x_3 = c_1$ and $x_4 = c_2$. Then $x_1 = c_1$ and $x_2 = c_1 + c_2$.

$S^{\perp}$=$c_1$(1, 1, 1, 0)+$c_2$(0, 1, 0, 1)

$S^{\perp}$ is spanned by (1, 1, 1, 0) and (0, 1, 0, 1).

Note that $S^{\perp}$ is also spanned by (1, 0, 1, -1) and (0, 1, 0, 1). (Let $x_1 = c_1$ and $x_2 = c_2$.)