MATH 3110 - Fall 2014
Homework 6

Due: Thursday October 16

Questions. Chapter 4.1 of Strang **(total of 16 marks)**

1. Find dimension and basis of the orthogonal complement $S^\perp \subset \mathbb{R}^3$ when (6 marks)

   (a) $S = \{0\}$

   (b) $S = \langle \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \rangle$

   (c) $S = \langle \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, \begin{pmatrix} -3 \\ -2 \\ -1 \end{pmatrix} \rangle$

2. Let $P \subseteq \mathbb{R}^4$ be the plane defined the linear equation $x_1 + 2x_2 + 3x_3 + 4x_4 = 0$. (2 marks)
   Write a basis for $P^\perp$ and construct a matrix that has P as nullspace.
   (HINT: write this equation in the form $Ax = 0$.)

3. Find $A^T A$ if the columns of A are unit vectors of R^3 and all mutually perpendicular. (2 marks)

4. For each of the following sentences, solve it or motivate it if unsolvable. (6 marks)
   (a) Find a matrix with $(1, 4, 2)$ in both its row space and column space.
   (b) Find a matrix with $(1, 4, 2)$ in both its row space and nullspace.
   (c) Find a matrix with $(1, 4, 2)$ in both its column space and nullspace.

   (HINT: reason about the orthogonality of the requested spaces)

Questions. Chapter 4.2 of Strang **(total of 4 marks)**

1. Let $S = \langle \begin{pmatrix} 1 & 2 & 3 \end{pmatrix}^T \rangle$ be a line of $\mathbb{R}^3$. Project the vectors $\begin{pmatrix} 5 & 7 & 3 \end{pmatrix}^T$ and $\begin{pmatrix} -5 & -7 & -3 \end{pmatrix}^T$ onto S. (4 marks)