# MATH 54 – HINTS TO HOMEWORK 17

PEYAM TABRIZIAN

Here are a couple of hints to Homework 17. Enjoy! :)

## SECTION 6.4: THE GRAM-SCHMIDT PROCESS

Use the formula given in Theorem 11. To get an *orthonormal* basis, just divide every vector at the end by its length. At every step, it's helpful to multiply your vector by a scalar to avoid fractions. This is ok, because you'll normalize them at the end anyway!

**6.4.9.** Just apply Gram-Schmidt to the columns of $A$.

**6.4.17.**

(a) **F** (Although the set would be orthogonal, multiplying by $c = 0$ wouldn't give an orthogonal *basis*)
(b) **T** (by $(1)$ in Theorem $11$)
(c) **T** (if $A = QR$, then $Q^T A = Q^T QR = R$, since $Q$ has orthonormal columns)

## SECTION 6.5: LEAST SQUARES PROBLEMS

Here's the general procedure to solve least-squares problems: To solve $A\mathbf{x} = \mathbf{b}$ in the least-squares sense, multiply both sides by $A^T$, and solve the (easier) equation $A^T A\hat{\mathbf{x}} = A^T \mathbf{b}$. Your solution $\hat{\mathbf{x}}$ is called the least-squares solution. The least squares error is $\|A\hat{\mathbf{x}} - \mathbf{b}\|$.

**6.5.9.** The orthogonal projection of $\mathbf{b}$ is given by $\hat{\mathbf{b}} = \frac{\mathbf{b}\cdot a_1}{a_1\cdot a_1}a_1 + \frac{\mathbf{b}\cdot a_2}{a_2\cdot a_2}a_2$, where $a_1, a_2$ are the columns of $A$. Then all you have to do is solve $A\hat{\mathbf{x}} = \hat{\mathbf{b}}$

**6.5.11.** Similar to **6.5.9**, but with a fancier formula.

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**6.5.17.**

(a) **T**
(b) **T**
(c) **F**
(d) **T**
(e) **T**