Homework 3: QR and Eigenproblems

CS 205A: Mathematical Methods for Robotics, Vision, and Graphics (Spring 2015)
Stanford University
Due Tuesday, April 26, 9:00am (**beginning** of class—changed!)

Textbook problems: 5.1 (20 points), 6.3 (30 points), 6.9(a) (30 points)

Regularized Least-Squares without A^TA: (20 points) When solving over-determined $A\vec{x} = \vec{b}$ systems (where A is m-by-n matrix with $m > n$), we have seen how QR can be used to avoid forming the poorly conditioned normal equations' A^TA matrix. However, one convenience of the normal equations was that it was easy to apply Tikhonov regularization by adding a constant to the diagonal to get $A^TA + \alpha I$. **Show** that the augmented matrix $B = \begin{bmatrix} A \\ \beta I \end{bmatrix}$ can be used to form a linear system $B\vec{x} = \vec{c}$, where $\beta \in \mathbb{R}$ and $\vec{c} \in \mathbb{R}^{2n}$, which has the same mathematical solution to the regularized normal equations, while avoiding the formation of A^TA. What are β and $\vec{c}$?

Extra credit: 5.5 (5 points), 6.5 (5 points)