MTH 451/551 – Lab 3

1. Let $\epsilon = 10^{-10}$ and consider the overdetermined system $Ax = b$ with

$$\begin{bmatrix} 1 & 1 \\ \epsilon & 0 \\ 0 & \epsilon \end{bmatrix} x = \begin{bmatrix} -\epsilon \\ 1 + \epsilon \\ 1 - \epsilon \end{bmatrix}$$

   (a) (0 points) Set up the normal equations (by hand) and show that the least squares solution is uniquely determined. Check that $x = [1, -1]^T$ solves the normal equations. (Do not turn in.)

   (b) (10 points) Try to compute the least squares solution with MATLAB using the command `mldivide` (aka "\", the backslash operator – `A\b` is roughly `inv(A)*b`).

   (c) (10 points) Try to compute the least squares solution with MATLAB using the normal equations and the command `mldivide`.

   (d) (10 points) Use MATLAB's `chol` command to try to compute the least squares solution by the classical Cholesky method.

   (e) (10 points) Use MATLAB's `qr` command to try to compute the least squares solution by the QR method.

   (f) (10 points) Use MATLAB's `svd` command to try to compute the least squares solution via the SVD.

   (g) (50 points) Comment on the difference between results obtained in *each* of the above.

2. **Bonus:** (10 points) Do [TB] 11.3, except use the above solution methods (excluding by hand!). Be sure to answer (g) as well.