AMSC/CMSC 660 Quiz 3 , Fall 2008

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no books, calculators, cellphones, other electronic devices, communication with others, scratchpaper, etc.

Name _____

1. (10) Suppose we have factored $\boldsymbol{A} = \boldsymbol{QR}$, and that we now want to change the 4th and 5th rows of $\boldsymbol{A}$. Recall the formula

$$(\boldsymbol{A} - \boldsymbol{Z}\boldsymbol{V}^T)^{-1} = \boldsymbol{A}^{-1} + \boldsymbol{A}^{-1}\boldsymbol{Z}(\boldsymbol{I} - \boldsymbol{V}^T\boldsymbol{A}^{-1}\boldsymbol{Z})^{-1}\boldsymbol{V}^T\boldsymbol{A}^{-1}.$$

(a) Define $\boldsymbol{Z}$ and $\boldsymbol{V}$ so that the new matrix is $\boldsymbol{A} - \boldsymbol{Z}\boldsymbol{V}^T$.

(b) Given a vector $\boldsymbol{b}$, describe how to use the formula to solve $(\boldsymbol{A} - \boldsymbol{Z}\boldsymbol{V}^T)\boldsymbol{x} = \boldsymbol{b}$.

2. (10) Your research advisor wants to solve a least squares problem

$$\min_{\boldsymbol{x}} \|\boldsymbol{A}\boldsymbol{x} - \boldsymbol{b}\|.$$

The entries in the matrix $\boldsymbol{A}$ were measured with a precision of $\pm 10^{-3}$. Given $\boldsymbol{b}$ and the results on the attached sheet, explain how to solve the problem. (Make clear exactly what you would compute and why.)

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> [U,S,V] = svd(A)

U =

   -0.5468    0.5684   -0.1184   -0.2047    0.5656   -0.0464
   -0.3451   -0.3358    0.5244    0.5478    0.2844   -0.3352
   -0.5090   -0.0719   -0.1584   -0.2461   -0.5874   -0.5523
   -0.4232   -0.4894    0.2331   -0.4489    0.0157    0.5703
   -0.3490    0.3332   -0.0486    0.5659   -0.4363    0.5042
   -0.1478   -0.4567   -0.7933    0.2752    0.2522    0.0323


S =

    3.2143         0         0         0         0
         0    1.1092         0         0         0
         0         0    0.3060         0         0
         0         0         0    0.0006         0
         0         0         0         0    0.0002
         0         0         0         0         0


V =

   -0.3278    0.5021   -0.4255   -0.6029   -0.3098
   -0.5640   -0.3190    0.6510   -0.2702   -0.2885
   -0.2664    0.2047   -0.1087    0.7069   -0.6129
   -0.6410    0.2826   -0.0163    0.2526    0.6672
   -0.3043   -0.7241   -0.6189   -0.0006   -0.0005
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