AMSC 607 / CMSC 764 Homework 2, Fall 2010
20 points
Due September 21, before class begins.

This week's two problems are related to the Forsgren-Gill-Murray (FGM) algorithm:

"Computing Modified Newton Directions Using a Partial Cholesky Factorization," A. Forsgren, P. E. Gill, and W. Murray, SIAM Journal on Scientific Computing 16 (1995) pp. 139-150

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2. Implement the FGM algorithm in a MATLAB function
`function [L, B, perm, n1] = fgmCholesky(H)`.

2a. (10) Include documentation at the beginning that gives a reference to the original paper, your name, the date, a description of each of the input and output variables. Include documentation later in the function, as appropriate, to explain what the code is doing.

2b. (10) Use your algorithm on the matrix in `hw2.m`. Print the resulting `L, B, perm`, and `n1`.

3a. (10) Suppose we have a point x and a function $f(x)$ for which the gradient $g(x) = 0$ and the Hessian $H(x)$ is indefinite (i.e., has both positive and negative eigenvalues). Show that any linear combination of eigenvectors corresponding to negative eigenvalues of $H(x)$ is a direction of negative curvature. Determine the best direction: i.e., among all vectors of the same (sufficiently small) length, the one for which the function decreases the most.

3b. (10) Explain in your own words the algorithm for generating a direction of negative curvature from the FGM factorization and how we know that it really is a direction of negative curvature.

A few tips:

- If you think you might be late to class, you can hand in homework to me in an earlier class or office hours, or you may slide it under my door before 9:15 on the due date.

- Do not slide it under my door after I leave for my 9:30 class on the due date; I will get it late.

- Do not use my first-floor mailbox for homework submission; I will get it late.

- Email submission is acceptable, but files must be pdf or plain text (.txt or .m). It is ok to bundle them using tar, zip, or gzip. I will not accept any Microsoft-formatted files such as .doc, .xls, or .dll.