Coding Assignment 2 - Quasi-Newton Methods

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The BFGS (Broyden–Fletcher–Goldfarb–Shanno) algorithm, will be explored in this coding assignment. The calculation for the inverse Hessian matrix is seen in (1). Though Matlab is recommended for this assignment, you may use any language as you like. Start-up Matlab files are provided on canvas.

$$B_{k+1} = B_k + \left[1 + \frac{\partial g^T B \partial g}{\partial x^T \partial g}\right]\left[\frac{\partial x \partial x^T}{\partial x^T \partial g}\right]_k - \left[\frac{B \partial g \partial x^T + \partial x \partial g^T B}{\partial x^T \partial g}\right]_k \qquad (1)$$

1. Your golden section code from coding assignment 1 will be used here to perform line search and find α^* for each iteration. Update your golden section function to have the following inputs and outputs:

   ```
   Function [fx_min,x] = golden_section_method(myfunc,tolerance,lb,ub)
   ```

   Update your code where necessary and test that it works by running "test_golden_section.m" or equivalent if you are using a different language.

2. Code the BFGS algorithm. Complete your code to solve following problem from written Assignment 2:

   a. min $f = x^2 + y^2 - xy - 4x - y$, starting at (4,4)
   b. min $f = (1 - x)^2 + (-x^2 + y)^2$, starting at (6/5,5/4)

   The start-up code includes the first iteration using the steepest descent algorithm for Problem 2.a. Check that this works before continuing with the BFGS algorithm.

   For the first iteration of BFGS, report on the values of x_1, x_2, $f(x_2)$, g_1, α_0, α_1, and B_1. (Note x_1 is the solution from the steepest descent method)

   Now define sensible stopping criteria and run the algorithm until an optimum is found. Discuss your stopping criteria, and comment on your results.

3. Use your BFGS algorithm to solve the following problem.

   a. min $f = (x_1 + 3x_2 + x_3)^2 + 4(x_1 - x_2)^2 + x_1 \sin(x_3)$, starting at (-1,-1,-1)

   Discuss the stopping criteria you established, and your solutions.

4. Submit your solutions to Canvas including your solutions, and your code. Your code should be in an appendix (not Matlab file) and should be properly annotated using comments.