Math 6316, Spring 2016
Due 29 January 2016

Homework 1 – Nonlinear Solvers

1. (Matlab) In a file named `broyden.m`, write a Matlab function to implement the Broyden method from section 7.1 of the book, but that includes the following changes:

(a) Remove the input `Q` and add an input for the Jacobian function (as in the Newton solver from class); before beginning the Broyden iteration, initialize `Q` as the Jacobian evaluated at the initial guess.

(b) Include both relative and absolute solution tolerances, `rtol` and `atol` respectively.

(c) Include a logical input argument, `output`, that dictates whether diagnostic information is output to the screen during the solve.

(d) Add checks for valid input arguments (maximum number of iterations, relative and absolute tolerances).

In a Matlab script `hw1.m`, run both Newton's method and Broyden's method on the semiconductor device simulator example from class. For the Newton solver, use the function provided in class. For your tests, use the same discretization size and model parameters as those from class, but with $\lambda = 0.049$. Run four tests for each method, with the solver tolerances $(\text{rtol}, \text{atol}) \in \{(10^{-5}, 10^{-6}), (10^{-7}, 10^{-8}), (10^{-9}, 10^{-10}), (10^{-11}, 10^{-12})\}$. Allow a maximum of 20 iterations per solve, and output the iteration history as the solves proceed. At the end of the tests, output a table summarizing the run time and iteration count results.