

MA 784, Assignment 2, Due 3/24/11

There are four problems. **Do at least one of them**, which will count toward the six you owe me for the term.

This is the second assignment. It's due on 3/24/11. The third (and last) assignment will be given out during the month of March. It's time to seriously work on your presentations. Please try to either (1) come up with an idea and discuss it with me or (2) ask me to tell you what to do. Trust me, (1) is better.

When the norm is not specified, use the l^2 norm. Discussions of results should explain why the numbers and/or plots do or do not match the theory, how you decide which of several alternatives is performing best, and how you implemented things that were not in the codes that I provided. Turn in your codes and your **typeset** discussion.

1. **Do three of the following.**

- (a) 7.5.3 in the nonlinear equations book.
 - (b) 7.5.9 in the nonlinear equations book.
 - (c) 8.5.4 in the nonlinear equations book.
 - (d) 8.5.5 in the nonlinear equations book.
2. Implement a Newton-CGMR code and apply it to H-equation example with $N = 100$, $c = .9$ and $c = 1$. Implement the matrix-vector **and** transpose-vector product in an **efficient(!!!)** way. How does the performance (in terms of time, function evaluations, Jacobian-vector products) compare to Broyden's method and Newton-GMRES?
3. **For math geeks only.** Prove that the H-equation has a complex-conjugate pair of solutions for $c > 1$. One way to do this is to split the equation into real and imaginary parts and use the Kantorovich theorem (see § 5.5). Solve the resulting equation for $c = 1.1, 2, 10$ using any of the codes from this course.
4. Problems 2.7.1, 2.7.2, and 2.7.4 from the optimization book.
5. Problems 2.7.13, 3.5.1, and 3.5.4 from the optimization book.