Assignment Set 3, MATH-UA0252-1

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The following assignments are due on Friday March 13 at 12:00 noon. No homework will be accepted after that time. You should give me your homework in class or put it under my office door (WWH612). Do not use my mailbox in the WWH lobby.

You should turn in your MATLAB/OCTAVE programs and printouts which shows how they work different cases. In addition, is is important that you comment on what you can learn about the performance of the methods. Always use format long e in MATLAB. Note that in MATLAB, all numbers are represented with approximately 16 decimals; we will discuss computer arithmetic in the middle of the term.

1. Write a MATLAB program to solve two nonlinear real equations of two real variables by Newton's method. Note that in addition to subroutines that computes the two functions for the two variables, you also need subroutines that compute the two partial derivatives of each of the two functions.

   (a) Find all the solutions of the system of Example 4.1 of the text book by using Newton's method. (For each of them, you need to provide a suitable initial guess.) Comment on the rate of convergence of the iterations.

   (b) Rewrite the equations as in example 4.4 and find the solution in the first quadrant by a simultaneous iteration. How does the rate of convergence compare with that of Newton's method?

2. (a) Write a MATLAB program which turns any symmetric real matrix into a symmetric tridiagonal matrix with the same eigenvalues. Use Householder transforms; cf. subsection 5.5 of the text book. Test your program on the matrix given by (5.16) and some substantially much larger matrix.

   (b) Write a MATLAB program that computes the smallest and the largest eigenvalues of any symmetric matrix by first transforming it to a tridiagonal matrix with the same eigenvalues by using Householder transformations and then applying the Sturm sequence algorithm of Section 5.6. Try to find approximations of the two eigenvalues which are correct to within $10^{-6}|\lambda_{max}|$, where λ_{max} is the largest eigenvalue, in absolute value, of the matrix.

(c) Explore what is available in MATLAB for these same two tasks. Compare the results of your program and that of the MATLAB program of the MATLAB system.

3. Problem 4.7 from the text book.

4. Problem 5.7 from the text book.

5. Problem 5.10 from the text book.

6. Problem 5.12 from the text book.