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Math128B: Numerical Analysis

Programming Assignment #1, Due Feb. 17, 2010

Program up Algorithms 7.1, 7.2, and 7.3. Using these algorithms to solve the following problem

$$Ax = b,$$

where A is an $n \times n$ symmetric tridiagonal matrix with 2 on the diagonal and -1 on the super-diagonal and subdiagonal; and b is 1 on the first and last entry and 0 everywhere else. The exact solution of this system is a vector of all 1's.

Use the splitting $A = M - N$ with M the diagonal matrix with 2 on the diagonal. Run the algorithms for $n = 100$ and 200, with $TOL = 10^{-6}$, and a random but same initial vector for all algorithms. We will not set maximum number of iterations. For Algorithm 7.3, choose $\omega = \frac{2}{1+\sqrt{1-\rho^2}}$ where $\rho = \cos\left(\frac{\pi}{2(n+1)}\right)$.

You should:

1. Write a report to compare
   (a) the number of iterations required by each algorithm
   (b) the amount of CPU time required by each algorithm
   (c) the error in the computed solutions. For this assignment, the error is defined as $\|x^{(k)} - x\|_2$, where $x^{(k)}$ is the k-th iterate, and x is the vector of all 1's, the exact solution.
2. Email both your report and your matlab code to Alan Tarr (our GSI) at alant@math.berkeley.edu by 11:59PM, Feb. 17.