

Homework Problems 4 and 5

Due date: Monday 2 June 2008

4. (10 points) Use your tridiagonal solver to solve

$$\left( \begin{array}{cccc|c} 2 & -1 & 0 & 0 & 1 \\ -1 & 2 & -1 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & -1 & 2 & 1 \end{array} \right) \quad (1)$$

The correct solution is  $(1, 1, 1, 1)'$ , so it is easy to tell that you are using the solver correctly.

Write a main code (you should call it `hw4.f` or something similar) in double precision that builds the matrix and righthand side, calls the solver, and then prints the solution with at least 8 digits after the decimal. Turn in a printout of the code and the output. I encourage you to cut and paste code and output into a word processor such as Word in order to save paper. The issue here is making sure you know how to use the tridiagonal solver.

**IMPORTANT NOTES:** If you use `tridiag.f`, the input format is as follows: subdiagonal array `a` or `AL`: size is  $n$ , first element is not used so set it to 0; main diagonal `b` or `AM`: size is  $n$ , all elements are used; superdiagonal `c` or `AR`: size is  $n$ , last element is not used so set it to 0. If you are using `DGTSV.f`, the input format is as follows: subdiagonal `DL`, size is  $n - 1$ ; main diagonal `D`, size is  $n$ ; superdiagonal `DU`, size is  $n - 1$ . Here, you don't pad the sub- and superdiagonals.

5. (10 points) Use your tridiagonal solver to solve the  $1001 \times 1001$  system

$$\left( \begin{array}{cccc|c} 1 & 0 & 0 & \dots & 0 \\ 1 & -2 & 1 & 0 & \dots & 1 \\ 0 & 1 & -2 & 1 & 0 & \dots & 2 \\ & & \ddots & \ddots & \ddots & & \vdots \\ & & & & 1 & -2 & 1 & 999 \\ \dots & & & & \dots & 0 & 0 & 1 & 1000 \end{array} \right) \quad (2)$$

in the same manner as in Problem 4. You should call your code `hw5.f` or something similar. Turn in the code listing and a PLOT of the output: if the solution vector is  $u$  ( $u(i), i=1:1001$ ), then make the horizontal axis be  $i=1:1001$ . Do not turn in a listing of the output data – that's way too much paper. The issue in this problem is making sure you know how to build a matrix and righthand side using loops, and handling the first and last rows, which always have a different format than the interior rows.