

1st homework for ma798k: Due on March 21, 2008.

Directions: Do all problems. Email the results to me as a single pdf file. Include your code.

1. Do problems 15 and 16 on page 72 of the multigrid book. You may use my 1-D codes as a model or you may use problem 13 on page 71. Make sure that nested iteration (FMG, problem 16) is a part of your MG code. If it's not the complexity study in Problem 3 won't work.
2. Find f so that $u(x, y) = e^{xy} \sin(\pi x) \sin(\pi y)$ is the solution to

$$-u_{xx} - u_{yy} = f, u(x, 1) = u(x, 0) = u(0, y) = u(1, y) = 0.$$

You'll be solving this problem for the rest of the assignment. Why am I less interested in the test problems you solved for problems 15 and 16?

3. Solve the boundary value problem posed in Problem 2 with your FMG V-cycle (problem 16) code. Use a grid of equally spaced points with mesh width h . Apply your code with a coarse mesh of $h = 1/16$ and fine meshes of $h = 1/32, 1/64, \text{ and } 1/128$ (and finer if your computer can do that) and tabulate the error at each level, the run time when each level is complete, and the total run time. Can you do all of this with a single run?
4. Now use your V-cycle (problem 15) routine as a preconditioner for CG. Use a single V-cycle as the preconditioner in a nested-iteration CG-MG code. Repeat the complexity study from above. Explain and justify your choice of termination criterion for the CG iteration.