

CS 550: Iterative and Multigrid Methods
Spring 2007

Homework, Set 4 (midterm project)

Due Thursday March 29, 2007

Write descriptive solutions. Comment your code!

1. Read "Parallel Preconditioning With Sparse Approximate Inverses" by Grote and Huckle (SISC 1997). This was handed out in class; see me if you need a copy.
2. Download SPAI by grote: <http://www.computational.unibas.ch/software/spai/> and compile `--with-matlab`. (also use your own BLAS/LAPACK. Don't let SPAI compile it's own as it is *very very* slow)
3. Download `iluk.m` from <http://www.cs.uiuc.edu/class/sp07/cs550/files/iluk.m>
4. Download `genA.m` from <http://www.cs.uiuc.edu/class/sp07/cs550/files/genA.m> This function will generate a 2D or 3D (5pt or 7pt) discretization of a scalar convection-diffusion-reaction problem of the form

$$\mathcal{L}u = -\nabla \cdot \nabla u + \alpha \cdot \nabla \mathbf{u} + \mathbf{c}u$$

5. The goal of this project is to investigate the cost-benefit-behavior of SPAI preconditioning. We will use Matlab's builtin `bicgstab` to perform the iterations.
6. Establish, computationally, a relationship between ε and effectiveness of the preconditioner. See tables 1 and 2 and figure 6 in the paper for examples of such data. The computational experiments are very open ended. Be methodical, but do not worry about covering every situation. The goal is the highlight cost versus accuracy. Considering different problems *sizes* and parameters is also helpful is such a computational exercise.
7. It may be enlightening to use `iluk.m` to compare with an ILU-type preconditioner.
8. `testgenA.m` should give a good starting point. (the commented lines are unnecessary)
9. Your write-up should be about 3-4 pages and should describe:
 - (i) briefly the SPAI algorithm
 - (ii) your experimental approach
 - (iii) comments on your results
 - (iv) figures and tables to support your comments

Please hand in a tarred-gzipped file with the following name:

`CS550_hw4_FirstInitialLastName.tgz`

For example:

`CS550_hw4_L0lson.tgz`

This should unpack in the directory

`CS550_hw4_L0lson`

with the command

```
tar xvfz CS550_hw4_L0lson.tgz
```

Comments or homework write-up should be included in this directory under `hw4.pdf`.