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Numerical Mathematics II

Exercise Problems 12

Attention: The approach for getting a solution has to be clearly presented. All statements have to be proved, auxiliary calculations have to be written down. Statements given in the lectures can be used without proof.

1. Derive the 3-step Adams–Bashforth method ($q = 3$).
2. Continue Problem 03 from Exercise Problems 08. Consider meshes with $h \in \{1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512, 1/1024\}$. Implement the preconditioned conjugate gradient method (Algorithm 9.8) for solving these equations. Use as preconditioner
 - (a) $M = I$, i.e. no preconditioning, same as Problem 03 from Exercise Problems 08,
 - (b) $M = \text{diag}(A)$, Jacobi preconditioner, see Remark 9.2,
 - (c) $M = SSOR(A)$, see Remark 9.2,
 - (d) $M = L^T L$, where L is the incomplete Cholesky factorization of A .
THIS PART IS AN EXTRA PART. THE USEFUL MATLAB COMMAND `icho1` HAS BEEN ONLY AVAILABLE SINCE VERSION 2011b.

Give the number of iterations for solving the system. What can be observed? Find an explanation for the behavior of the Jacobi preconditioner.

Hint. Since only the number of iterations is of interest, the solution of the linear systems with the preconditioner can be implemented with the backslash command. Also the SSOR preconditioner can be implemented in the form given in Remark 9.2.

The exercise problems should be solved in groups of two students. The written parts have to be submitted until **Tuesday, Jan. 29, 2013** either before one of the lectures or directly at the office of Mrs. Hardering. The executable codes have to be sent by email to Mrs. Hardering.