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Numerical Mathematics II

Exercise Problems 09

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. Consider the initial value problem

$$y'(x) = f(x, y), \quad y(x_0) = y_0.$$

Derive a formula for one step of the trapezoidal rule, from x_k to x_{k+1} , for solving this initial value problem from the Butcher tableau of the trapezoidal rule.

2. Prove Theorem 2.57 from the lecture notes *Numerical Methods for Ordinary Differential Equations*.
3. Sparse matrices are stored usually in the so-called Compressed Sparse Row (CSR) format.
 - (a) Read Section 3.4 in the book by Saad (1996) about this topic.
 - (b) Give the CSR storage of the matrix

$$\begin{pmatrix} 4 & 0 & 0 & -1 & 0 & 0 & 8 & 10 & 0 \\ 0 & 10 & -3 & 0 & 0 & 8 & 0 & 0 & 2 \\ -1 & 0 & 0 & 0 & 6 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 17 & 0 & 0 & 0 & 0 & 0 \\ 0 & -6 & 0 & 0 & 0 & 11 & 0 & 0 & 7 \end{pmatrix}.$$

Hint: One can download the book from the homepage of Yousef Saad.

The exercise problems should be solved in groups of two students. The written parts have to be submitted until **Tuesday, Jan. 08, 2013** either before one of the lectures or directly at the office of Mrs. Hardering. The executable codes have to be send by email to Mrs. Hardering.