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Numerical Mathematics III – Partial Differential Equations

Exercise Problems 05

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. *Matrix property, detail of the proof of Theorem 2.44.* In the proof of Theorem 2.44, the following argument is used: Let $A, B \in \mathbb{R}^{n \times n}$ be two symmetric and positive definite matrices with $AB = BA$ and

$$(A\underline{x}, \underline{x}) \geq (B\underline{x}, \underline{x}) \quad \forall \underline{x} \in \mathbb{R}^n,$$

then $\|A\underline{x}\|_2 \geq \|B\underline{x}\|_2$ for all $\underline{x} \in \mathbb{R}^n$. The symbols denote the Euclidean inner product and the Euclidean vector norm. Prove this statement.

2. *Code for nine point stencil.* The problem is formulated analogously as Problem 4 from Exercise Problems 03. The only difference is that the finite difference scheme with the nine point stencil should be used (instead of using the five point stencil).

The exercise problems should be solved in groups of two or three students. The written parts have to be submitted until **Thursday, May 23, 2019** to A. Jha. The executable codes have to be send by email to A. Jha.