



## Advanced Topics in Numerical Analysis I Programming Exercise No. 3

(WS 2006/2007)

December 13, 2006

### Prgramming exercise 3

Write a computer program that approximates the eigenvalues of a real symmetric matrix  $A \in \mathbb{R}^{n \times n}$  doing the following steps:

- Reduction of the matrix  $A$  to tridiagonal form using Householder transformations.
- Application of the bisection method to the tridiagonal matrix from a) with a given precision  $\varepsilon$ .

Use the theorem of Sturm to determine the number of eigenvalues in an interval.

The starting interval is obtained by applying the theorem of Gerschgorin to the matrix from a).

The output of the programm should be the reduced matrix from a) and the  $n$  intervals of length less than  $\varepsilon$  containing the eigenvalues of  $A$ .

Compute with your programm the following examples ( $\varepsilon = 10^{-6}$ ):

$$A = \begin{pmatrix} 10 & 1 & 2 & 3 & 4 \\ 1 & 9 & -1 & 2 & -3 \\ 2 & -1 & 7 & 3 & -5 \\ 3 & 2 & 3 & 12 & -1 \\ 4 & -3 & -5 & -1 & 15 \end{pmatrix} \quad \text{and}$$

$$A = \begin{pmatrix} n & n-1 & \cdots & 2 & 1 \\ n-1 & n & \ddots & & 2 \\ \vdots & \ddots & \ddots & \ddots & \vdots \\ 2 & & \ddots & n & n-1 \\ 1 & 2 & \cdots & n-1 & n \end{pmatrix}, \quad n = 5, 10.$$

## Change of date

On **10.01.2007 / 17.01.2007 and 24.01.2007** the programming assistance will be at

A-Pool (room -112): 14:00-15:45 h

K-Pool (room 114a): 16:00-17:00 h

---

Please hand in your programming exercise due **Wednesday, January 10, 2006** in computing center. Each 2<sup>nd</sup> Wednesday a programming exercise will be handed out in the tutorial. The programming exercises are also available for download in the WWW:

<http://www.mathematik.uni-karlsruhe.de/ianm3/lehre/numana12006w> .