

## Übungen zur Vorlesung Computermathematik

### Serie 1

**Aufgabe 1.1.** MATLAB provides a rich library of useful functions. For each function, `help functionname` resp. `doc functionname` provide exhaustive informations. Check the use of `reshape`, `find`, and `input`. What are the possible input parameters? What is the possible output? Write appropriate MATLAB scripts to illustrate the use.

**Aufgabe 1.2.** Write a MATLAB script which returns the maximum of a vector  $x \in \mathbb{R}^n$  and how often it is met in  $x$ . Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

**Aufgabe 1.3.** Write a MATLAB script which returns the norm

$$\|A\| := \max_{\substack{j=1,\dots,m \\ k=1,\dots,n}} |A_{jk}|$$

of a given matrix  $A \in \mathbb{C}^{m \times n}$ . Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

**Aufgabe 1.4.** Write a MATLAB script which returns the norm

$$\|A\| := \max_{j=1,\dots,m} \sum_{k=1}^n |A_{jk}|$$

of a given matrix  $A \in \mathbb{C}^{m \times n}$ . Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

**Aufgabe 1.5.** Write a MATLAB script which returns, for a given vector  $x \in \mathbb{C}^N$  and a bound  $C$ , the shortened vector  $y \in \mathbb{C}^n$ , where all entries  $x_j$  with  $|x_j| > C$  are discarded. E.g., for  $x = (1, 6, 5, -7, 3, 2) \in \mathbb{C}^6$  and  $C = 5$ , the vector  $y = (1, 5, 3, 2) \in \mathbb{C}^4$  is obtained. Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

**Aufgabe 1.6.** Write a MATLAB script which, for given dimension  $n$ , returns the checkerboard matrix  $A \in \mathbb{R}^{n \times n}$  with

$$A = \begin{pmatrix} 1 & 0 & 1 & 0 & \cdots \\ 0 & 1 & 0 & 1 & \cdots \\ 1 & 0 & 1 & 0 & \cdots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}.$$

Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

**Aufgabe 1.7.** Write a MATLAB script which, for given dimension  $n$ , returns the matrix  $A \in \mathbb{R}^{n \times n}$  such that, for all  $i, j = 1, \dots, n$ , it holds

$$A_{ij} = \begin{cases} 1 & \text{für } i \in \{1, n\}, \\ 1 & \text{für } j \in \{1, n\}, \\ 0 & \text{sonst.} \end{cases}$$

E.g., for  $n = 4$ , this matrix is

$$A = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix}.$$

Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

**Aufgabe 1.8.** Write a MATLAB script which, for given dimension  $n$ , returns the matrix  $A \in \mathbb{R}^{n \times n}$  with ones on the diagonal and anti-diagonal, while all other entries are zero. E.g., for  $n = 5$ , this matrix is

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}.$$

Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.