Übungen zur Vorlesung
Computermathematik

Serie 1

Aufgabe 1.1. MATLAB provides numerous useful functions. For each function, you get a detailed description by typing `help funktionsname` resp. `doc funktionsname`. Check the functionality of `diag`, `find`, and `sum`. What are possible parameters? What are possible outputs? Prepare simple examples which explain the function and implement them in an easy MATLAB-script.

Aufgabe 1.2. Let $A \in \mathbb{R}^{m_A \times n_A}$ and $B \in \mathbb{R}^{m_B \times n_B}$ be given matrices. Write a MATLAB-script which generates a block diagonal matrix C of the form

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

Here, the 0-entries are 0-matrices of appropriate dimension. Avoid loops, and use only appropriate vector/matrix functions and indexing instead.

Aufgabe 1.3. Write a MATLAB-script which computes and displays the row-sum norm of a given matrix $A \in \mathbb{C}^{m \times n}$

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

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

Aufgabe 1.4. Write a MATLAB-script which determines the maximum $x_{\max} := \max_{1 \le i \le n} x_i$ of a vector $x \in \mathbb{R}^n$. Further, all entries x_i with $|x_i| \ge x_{\max}$ should be replaced by $\mathrm{sign}(x_i) x_{\max}$. Avoid loops and arithmetics, and use only appropriate vector/matrix functions and indexing instead.

Aufgabe 1.5. Write a MATLAB-script which displays for a given vector $x \in \mathbb{C}^N$ the trimmed vector $x' \in \mathbb{C}^{N-2}$, where entry with highest resp. lowest absolute value are cut out of x. The remaining vector should be sorted ascendingly with respect to the absolut value. In case of equality, the elements are sorted ascendingly with respect to the imaginary part. Avoid loops, and use only appropriate vector/matrix functions and indexing instead.

Aufgabe 1.6. Write a MATLAB-script which generates, for odd $n \ge 5$ and three digits $m \in \{0, \ldots, 9\}$ of your choice, matrices $A \in \mathbb{R}^{n \times n}$ with structure corresponding to the digit m. For $n = 5$ and $m = 0, 1, 2$ the matrices have the following form:

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & & & & 1 \\ 1 & & & & 1 \\ 1 & & & & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}, \quad \begin{pmatrix} & & 1 & & \\ & & 1 & & \\ & & 1 & & \\ & & 1 & & \\ & & 1 & & \end{pmatrix}, \quad \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ & & & & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & & & & \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix},$$

where all entries which are not shown have to be initialized with 0. Avoid loops, 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 $A \in \mathbb{R}^{n \times n}$ with ones on the diagonal and anti-diagonal, while all other entries are zero.

For $n = 5$, this matrix reads as

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

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

Aufgabe 1.8. Write a MATLAB-script which generates, for given $n \in \mathbb{N}$, the following block diagonal matrix $A \in \mathbb{R}^{2n \times 2n}$.

$$A := \begin{pmatrix} 1 & 1 & & & & & \\ 1 & 1 & & & & & \\ & & 1 & 1 & & & \\ & & 1 & 1 & & & \\ & & & & \ddots & & \\ & & & & & 1 & 1 \\ & & & & & 1 & 1 \end{pmatrix}$$

All entries which are not shown have to be initialized with 0. Avoid loops, and use only appropriate vector/matrix functions and indexing instead.