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Übungen zur Vorlesung
Computermathematik

Serie 1

Aufgabe 1.1. MATLAB provides a wide library with numerous useful functions. For each function you get a detailed description by typing `help funktionsname` resp. `doc funktionsname`. Inform yourself about `diag`, `find` and `sum`. What are possible parameters? What are possible outputs? Think about easy examples with which you can explain the function and implement them in an easy MATLAB-script.

Aufgabe 1.2. 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! Instead, use matrix functions and matrix indexing!

Aufgabe 1.3. Write a MATLAB-script which generates, for odd $n \geq 5$ 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! Instead, use matrix functions and matrix indexing!

Aufgabe 1.4. Write a MATLAB-script which determines the maximum of a vector $x \in \mathbb{R}^n$ and how often the maximum appears in x. The result has to be displayed. Avoid loops! Instead, use matrix functions and matrix indexing!

Aufgabe 1.5. Write a MATLAB-script which generates and displays a chessboard-matrix $A \in \mathbb{R}^{n \times n}$ of the form

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

Avoid loops! Instead, use matrix functions and matrix indexing!

Aufgabe 1.6. 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 following form.

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

Here, the 0-entries are 0-matrices of appropriate dimension. Avoid loops! Instead, use matrix functions and matrix indexing!

Aufgabe 1.7. Write a MATLAB-script which displays for a given vector $x \in \mathbb{C}^N$ and a given bound $C > 0$ the trimmed vector $y \in \mathbb{C}^n$ where all entries x_j with $|x_j| > C$ are cut out of x. For example, for $x = (1, 6, 5, -7, 3, 2) \in \mathbb{C}^6$ and $C = 5$ the trimmed vector is $y = (1, 5, 3, 2) \in \mathbb{C}^4$. Avoid loops! Instead, use matrix functions and matrix indexing!

Aufgabe 1.8. Write a MATLAB-script which generates and displays for given dimension n an arrow-matrix $A \in \mathbb{R}^{n \times n}$ of the form

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

where all entries which are not shown have to be initialized with 0. Avoid loops! Instead, use matrix functions and matrix indexing!