TECHNISCHE HOCHSCHULE LÜBECK

Sheet 3 – Matrix indexing, concatenation and special functions

Please write all commands in the MATLAB editor into one single m-file and save it in a folder that you specifically dedicate to this workshop. If you don't know how a command is being used type “help [commandname]” into the command window. Comment each code line briefly to document what it is doing.

Exercise 1:

Given the matrix `A = [2 4 1; 6 7 2; 3 5 9]`

a) Let MATLAB find all elements of `A` that equal 2 and give linear indices, as well as row/column indices out.

b) Let MATLAB find all elements that are larger or equal to 7 and give linear indices out. Assign these elements to a new matrix `B` at the same positions as before with all other positions being zeros.

c) Let MATLAB find all elements that are smaller or equal to 2 or those which equal 5 (in one logical expression) and assign these elements to a new column vector `x2`.

Exercise 2:

Given the arrays `x = [1 4 8], y = [2 1 5], z = [2 4 2]` and `A = [3 1 6; 5 2 7; 2 3 5]`, determine which of the following statements will correctly execute and provide the result. If the command will not correctly execute, state why not

a) `x + y`

b) `x + A`

c) `x' + y`

d) `A – [x' y' z']`

e) `b = [x; y']`

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f)   c = [x; y]

g)   A(:,2) = []

h)   d = [A; x; y]
```

Exercise 3:

Solve this system of linear equations using Cramer's rule with MATLAB.

$$\begin{aligned} 2x + 4y - 2z &= -6 \\ 6x + 2y + 2z &= 8 \\ 2x - 2y + 4z &= 12 \end{aligned}$$

Exercise 4 (optional):

a) Calculate Eigenvectors and corresponding Eigenvalues for the following matrices:

$$\mathbf{A} = \begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} \quad \text{and} \quad \mathbf{B} = \begin{bmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$$

b) Are the Eigenvectors of each matrix orthogonal?

c) Verify that the following equations hold for the Eigenvalues λ_i of matrix A

$$\sum_{i=1}^{N} \lambda_i = \mathrm{Tr}(\mathbf{A}) \quad \text{and} \quad \prod_{i=1}^{N} \lambda_i = |\mathbf{A}|$$