

Assignment 1- Introduction to MATLAB

Go through with the following tasks using MATLAB.

Exercise 1.1 Create matrices $A = \begin{pmatrix} 1 & 3 & 5 \\ 4 & 3 & -1 \\ 6 & -2 & 9 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 2 & 4 \\ 11 & 3 & 8 \\ 9 & 5 & 2 \end{pmatrix}$ and calculate

- a) the entry in the second row and first column of A (1%)
- b) a vector consisting of the first row of A (1%)
- c) a vector consisting of the third column of A (1%)
- d) the row sums of A (1%)
- e) the column products of A (1%)
- f) the mean values of the columns of A (1%)
- g) a vector consisting of all entries of A which are smaller than 2 (1%)
- h) a vector consisting of all entries of b_{ij} of B with $4 < b_{ij} < 9$ (1%)
- i) the sum of values of A after replacing negative values with 0 (1%)
- j) the mean of the values in A without second column (1%)
- k) the transpose of A (1%)
- l) the trace of A (the sum of values on the diagonal) (1%)
- m) the matrix multiplication of A and B (1%)
- n) a matrix consisting of the element-wise multiplication of A and B . (1%)

Exercise 1.2 Save the matrices A and B to a file and clear the workspace. Subsequently load the variable with matrix A . (6%)

Exercise 1.3 Write a function **MatrixBounds** that returns both the minimum and maximum entry of a matrix A . (10%)

Exercise 1.4 Write a function **Factorial** that returns the factorial of a given number n . Don't use the MATLAB function *factorial()*. (10%)

Exercise 1.5 Create a vector of all numbers divisible by 2 and 3 and smaller than 100. Subsequently determine their sum and mean. (10%)

Exercise 1.6 Create a sequence of random numbers normally distributed with mean $\mu = 10$ and standard deviation $\sigma = 10$ of size $n = 100$.

- a) Calculate the mean and standard deviation of the sample. (3%)

- b) Check if the calculated mean is above or below the true value and display an appropriate prompt. **(3%)**
- c) Repeat the step of generating random numbers $N = 10^6$ times using a loop. For every step calculate the minimum, mean, standard deviation and maximum of random values and store them in variables. **(3%)**
- d) Create a plot of mean values obtained in every step of above task. Subsequently add also minimum and maximum values to the same plot using other style. **(3%)**

Exercise 1.7 Create a sequence of dates that contain all your birthdays, since you were born.

- a) Find the dates of your birthday party which takes place on Sunday after your birthday. Assume that if a birthday is on a Sunday, the party takes place on the same day. **(4%)**
- b) Find the dates of your birthday which took place on Sunday. **(4%)**
- c) Calculate how long you have to wait to your next birthday. **(4%)**

Exercise 1.8 Create the following decision variables in YALMIP:

- a) a vector of size 3 of binary decision variables. **(3%)**
- b) a matrix with 3 rows and 4 columns of integer decision variables. **(3%)**
- c) a diagonal matrix of size 5 of real decision variables. **(3%)**

Exercise 1.9 Solve the following problem in MATLAB/YALMIP:

$$\begin{array}{ll} \max_x & c^T x \\ \text{s. t.} & Ax \leq b, \end{array}$$

where

$$c = \begin{pmatrix} -1 \\ -\frac{1}{3} \end{pmatrix}, \quad A = \begin{pmatrix} 1 & 1 \\ 4 & \frac{1}{4} \\ 1 & -1 \\ -\frac{1}{4} & -1 \\ -1 & -1 \\ -1 & 1 \end{pmatrix}, \quad b = \begin{pmatrix} 2 \\ 1 \\ 2 \\ 1 \\ -1 \\ 2 \end{pmatrix}.$$

Using your code find a solution and optimal value. **(17%)**