Computer Simulation in Science (MSc)

University of Wuppertal

Self-Assesment Exercises: Basic programming

Questions:

1. Write functions that take a matrix M of size N × N as an input and calculate the following quantities:
   - **a)** The trace of the matrix.
   - **b)** The sum, mean and maximum of the entries.
   - **c)** The sum, mean and maximum of the absolute value of the entries.
   - **d)** A vector of size N × 1 containing the mean of each row.
   - **e)** A vector of size N × 1 containing the mean of each column.
   - **f)** A matrix of size N × N containing the result of multiplying M with its transpose.
2. Write a function that takes a matrix M of size N × N and a real number a as inputs and returns a matrix A of size N × N where the entry A(i, j) is 1 if $M(i, j) \geq a$ and −1 otherwise.
3. Test all the functions using the matrix M of size 20×20 with entries given as

   $$M(i, j) = 1/2\,(i - j) \qquad \text{where } i, j = 0, ..., 19$$

4. Write a program which takes a vector of size N × 1 whose entries are real numbers and sorts it in ascending order.
5. Write a program which computes prime numbers up to a given maximal number using the iterative algorithm called sieve of Eratosthenes.

Note: - Write the corresponding code in any language without using built-in functions that can directly give the wanted results.

Answers:

Writing the corresponding codes in MATLAB without using built-in functions and comparing the non-built-in function results with built-in function results.

1. Writing a MATLAB function code to compute solution for all sub-questions in question 1. Function code file is attached below with the name called **"Assesment_function_code_1.m"**
2. Writing a MATLAB function code to compute solution for question 2. Function code file is attached below with the name called **"Assesment_function_code_2.m"**
3. To test the above written function codes writing a script code which also includes comparison of non-built-in function results with built-in function results. Script file is attached below with the name called **"Test_code.m"**
4. Writing a code which can sort any kind of real number array into ascending order. Code file attached below with name called **"Real_Num_Ascending_order.m"**
5. Writing a code which can computes prime numbers up to a given maximal number using the iterative algorithm called sieve of Eratosthenes. Code file attached below with name called **"Prime_Num_sieve_Eratosthenes.m"**