

Computational Physics – Exercise 1: Introduction

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Exercises: Warming up



- **Exercise 1**

Write a program (don't forget to add comments) that

1. creates a 6x6 matrix A with random numbers having values between -5.0 and 5.0.
Initialize the random number generator with seed=wxyz, where wxyz are the last four digits of your matricule number.
2. searches for the largest element in a matrix. What is the value of the largest element in the matrix A ? What are the indices of the largest element? Write the answers in a sentence.
3. creates a row vector (--) consisting of the largest elements of each column of A and a column vector (|) consisting of the largest elements of each row of A . Multiply both vectors. What is the result?
4. creates a second random 6x6 matrix B with elements having values between -5.0 and 5.0 and calculates $C = AB$ and $D = BA$

Exercises: Warming up



- **Exercise 2**

The **Chebyshev polynomial** of degree $n \geq 0$ is defined as

$$T_n(x) = \cos(n \arccos x), \quad -1 \leq x \leq 1$$

The Chebyshev polynomials can be evaluated by means of the recurrence relation:

$$\begin{aligned} T_0(x) &= 1 \\ T_1(x) &= x \\ T_{n+1}(x) &= 2xT_n(x) - T_{n-1}(x), \quad n > 1 \end{aligned}$$

1. Write a function `cheby(x, N)` that evaluates all the Chebyshev polynomials of degree less than or equal to N at all of the points in column vector x . The result should be a matrix of size `length(x)` by $N + 1$.
2. Write a program to plot the polynomials $T_0(x), T_1(x), T_2(x), T_3(x), T_4(x)$ in different colors. Label the axes and give the plot a title and legend.

Report

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- Filename: Follow the instructions given by the tutors
- Content of the report:
 - Names + matricule numbers + e-mail addresses + title
 - **Introduction**: describe briefly the problem you are modeling and simulating (write in complete sentences)
 - **Simulation model and method**: describe briefly the model and simulation method (write in complete sentences)
 - **Simulation results**: show figures (use grids, with figure captions !) depicting the simulation results. Give a brief description of the results (write in complete sentences)
 - **Discussion**: summarize your findings
 - **Appendix**: Include the listing of the program

Due date: 10 AM, April 23, 2024