Lab 7 - Pointers

Solve all the following problems using only pointers, pointer expressions and heap allocation:

1. Write a function to sort a vector with real number elements. ★
2. Write a function to sort a string of characters in alphabetical order. ★
3. Write a function to merge two vectors. The given vectors contain real number elements, in ascending order. The result vector must contain only the distinct elements of the two given vectors, also in ascending order. ★
4. Write functions to read, display, and multiply 2 matrices. ★★
5. Write a function to calculate the transposed of a matrix. ★★
6. Write a function to calculate the k-th power of a square matrix. ★★
7. Write a function to compute the value of the derivative of a polynomial P, of degree n, in a given point $x = x0$. The degree and coefficients of the polynomial and the point $x0$ will be passed as parameters. ★★
8. Write a function to compute the product of two polynomials. ★★★
9. Write a function that has the following parameters:
   - a matrix of floats
   - the number of rows in the matrix
   - the number of columns in the matrix
   - a function that takes as parameters a vector of floats, the length of the vector and returns a float.

   The function should apply the function given as parameter to every column of the matrix and return the results in a new vector.

   E.g.:

$$M = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix} \qquad sum(v, n) = \sum_{i=0}^{n-1} v_i \qquad f(M, 3, 4, sum) \Rightarrow \begin{bmatrix} 15 & 18 & 21 & 24 \end{bmatrix}$$

   ★★★

You are not allowed to use the following in solving the problems:

- stack allocated arrays (e.g. `int v[256]`)
- the indexing operator (e.g. `v[i]`)

References

- Pb. 1-8 [1]

[1] Iosif Ignat & Marius Joldoș. *CP Laboratory Guide 7: Pointers.*