Homework 5

Strukture podataka i algoritmi I - I053

Homework instructions

The submission deadline is **November 29, 2023** at 9:00. You can type the tasks in LaTeX or write them by hand and scan them. Programming tasks should be submitted as .cpp files. All files need to be submitted to Teams. You can achieve a maximum of 100 points.

Task 1 (10+10+30+10 pts.)**.** You need to design/implement a queue data structure, but you're only allowed to use the stack data structure.

a) Explain how would you implement the `push` operation. **It must run in O(1) amortized time.**

b) Explain how would you implement the `pop` operation. **It must run in O(1) amortized time.**

c) Use the aggregate analysis method, the accounting method, and the potential method to show both operations run in $O(1)$ amortized time. Read chapter 17.3 of CLRS [1] to learn how to use potential method.

d) Implement the data structure and try experimenting with running times by applying many push and pop operations in different orders. Compare your running times to `std::queue`.

Task 2 (30+10 pts.)**.**

a) Implement the move-to-front algorithm. Measure and compare the running times between good examples (i.e. few elements are accessed often) and bad examples (all elements are accessed often).

b) Give a real-life example of the MTF algorithm, such as a database or a caching library that implements the algorithm.

Literatura

[1] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. *Introduction to Algorithms*. MIT Press, 3 edition, 2009.