

Homework Assignment 4

Due Date: March 18, 2022, 23:59

EXERCISE 1.

- (i) Show how addressable priority queues using doubly linked lists can be realised, where each list item represents an element in the queue, and a handle is a handle of a list item.
- (ii) Determine and the complexity of queue operations for two different options using sorted lists or unsorted lists.

total points: 8

EXERCISE 2.

- (i) Design an algorithm for inserting k new elements into a max-heap with n elements.
- (ii) Give an algorithm with time complexity in $O(k + \log n)$.

Hint. Use an approach similar to the building of a heap.

total points: 13

EXERCISE 3.

- (i) Show that the running time of `siftUp`(n) is $O(\log n)$ and hence an insert into a heap takes time in $O(\log n)$.
- (ii) The `siftDown` used in the *heapsort* algorithm requires about $2 \log n$ comparisons. Show how to reduce this to $\log n + O(\log \log n)$.

Hint: Determine first a path p along which elements need to be swapped, then perform a binary search on this path to find the proper position for the root element.

total points: 9

EXERCISE 4.

- (i) Implement max-heaps using arrays. In particular, implement *build_heap* and *sift-down*.
- (ii) Implement heapsort using max-heaps.

Programming instructions. Use the class template `HEAP` and add the missing member functions.

Testing instructions. Use the main program provided in `heap.cpp` to test your programs.

total points: 20