Exercise Sheet 6

Issue Date: November 28th, 2023
Due Date: December 4th, 2023 – 10:00 a.m.
$\sum$ 10 Points

Konzepte der Informatik INF-11700
Winter 2023/2024

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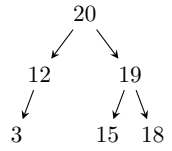
Heap Sort, $\mathcal{O}$-notation & Complexity

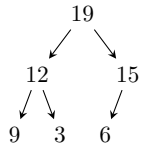
Exercise 1: Heapsort I (*4 points*)

a) (1 point) For each of the following trees A.-D., argue why it is a Heap, or why it is not.

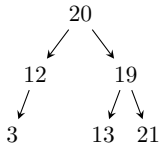
A.



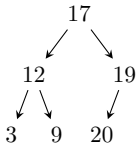
B.



C.



D.



b) (3 points) Sort the array $A = [10, 5, 0, 3, 11, 7, 9, 8, 12, 4, 6]$ using `Heapsort`. Print the array after **every** call of `sink` and indicate where the array is divided into the heap and sorted part.

Exercise 2: $\mathcal{O}$-notation (*3 points*)

Show, by choosing suitable n_0 and c or $\langle c_0, c_1 \rangle$, that

a) $100n + 105 \in \mathcal{O}(n^2)$
b) $0,1n^2 - 5 \in \Omega(n)$
c) $6n^3 + 6n^2 + 6 \in \Theta(n^3)$

Exercise 3: Analyzing a new Algorithm (*3 points*)

Given the following algorithm working on an array $A[1, \ldots, n]$:

```
   Input: array A containing comparable items
1  begin
2      for i ← n, n − 1, . . . , 2 do
3          for j ← 2, 3, . . . , i do
4              if A[j − 1] ≥ A[j] then
5                  swap value in A[j − 1] and A[j]
6          print(A)
```

a) (1 point) Run the algorithm on the input | 1 | 5 | 8 | 5 | 3 | and output the array in a new line for **each** call of print(A).

b) (1 point) *What* (not how) does the algorithm compute (*i.e.*, what is its result)?

c) (1 point) What do you have to change to make the algorithm *stable*?