Technische Universität München
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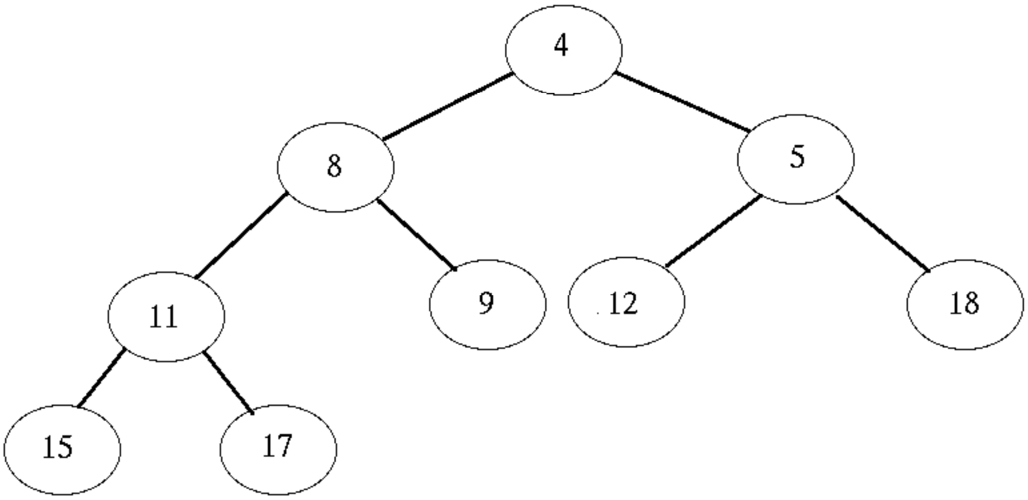
Effiziente Algorithmen und Datenstrukturen I

Aufgabe 1

Consider the following Binary Heap:



Carry out the operations in the following order and show, after each operation, what the Binary Heap looks like(always carry out each operation on the result of the previous operation):

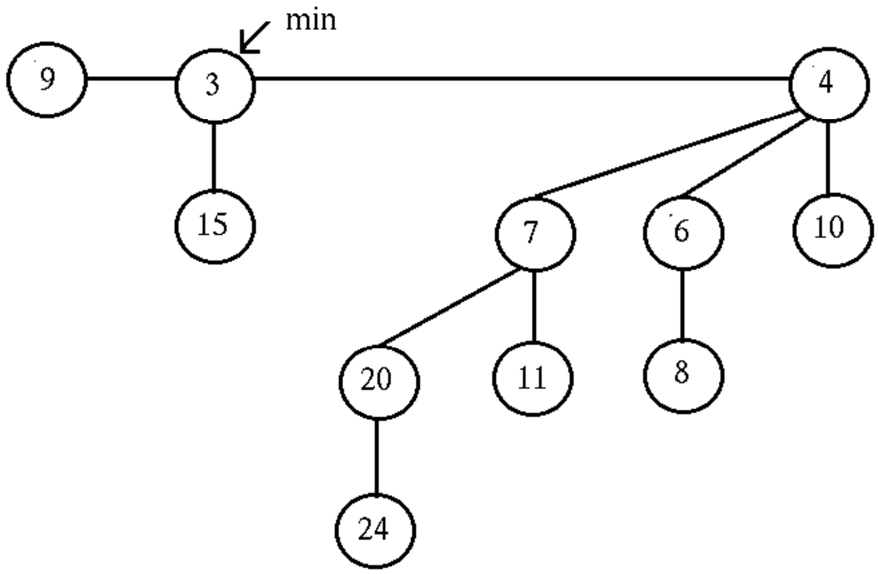
1. deleteMin()
2. insert(3)
3. deleteMin()
4. insert(10)

Aufgabe 2

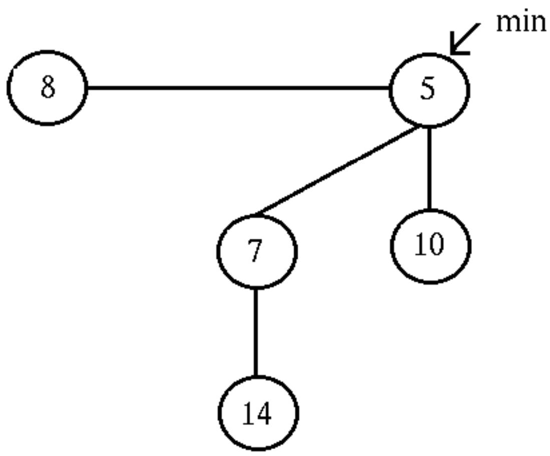
We discussed that the delete operation for Binary Heaps takes $O(\log n)$ time, however we did not discuss how this operation works. Describe how this alorithm would be implemented(or give a pseudo-code algorithm) such that it is correct and that the runtime is $O(\log n)$.

Aufgabe 3

Consider the following Binomial Heaps:
Heap A:



Heap B:

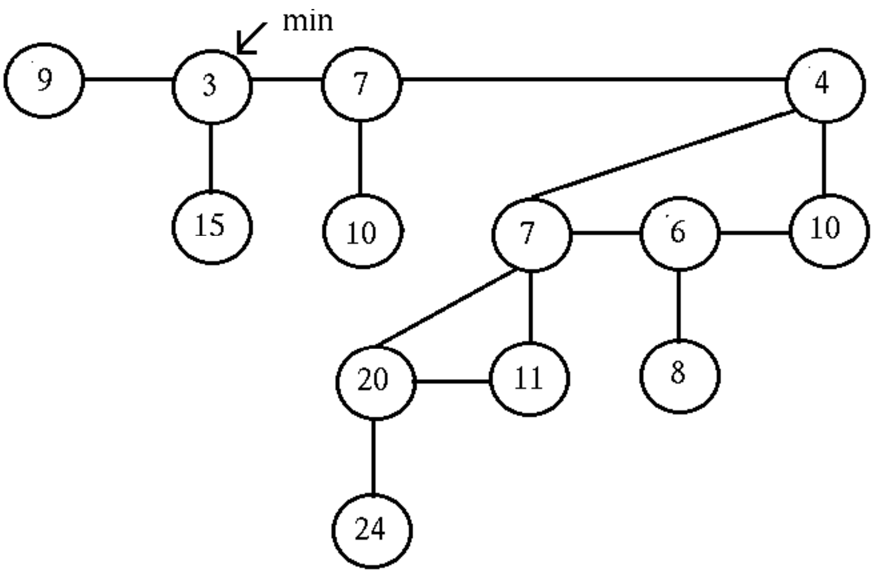


Carry out the operations in the following order and show, after each operation, what the Binomial Heap looks like(always carry out each operation on the result of the previous operation):

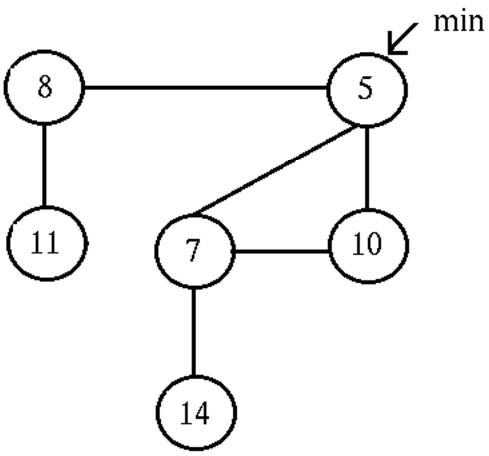
1. merge(A,B)
2. deleteMin()

Aufgabe 4

Consider the following Fibonacci Heaps:
Heap A:



Heap B:



Carry out the operations in the following order and show, after each operation, what the Fibonacci Heap looks like(always carry out each operation on the result of the previous operation):

1. merge(A,B)
2. insert(22)
3. deleteMin()
4. delete(6)

Aufgabe 5

In discussing the Radix Heap, we also discussed the $msd(k_{min}, k)$ function. Assuming $k_{min} = 9$, solve $msd(k_{min}, k)$ for the following values of k:

1. $k = 9$
2. $k = 13$
3. $k = 24$
4. $k = 50$

Aufgabe 6

Consider the $deleteMin()$ operation for Radix Heaps. Assume that k_{min} is the element to be removed, k'_{min} is the smallest element after k_{min} has been removed, and i is the smallest i s.t. $B[i] \neq \emptyset$ after k_{min} has been removed. We said that the following property holds:

$$\forall_{j>i} \forall_{k \in B[j]} msd(k_{min}, k) = msd(k'_{min}, k) = j$$

Please explain why this is the case.