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Effiziente Algorithmen und Datenstrukturen I

Aufgabe 1 (10 Punkte)

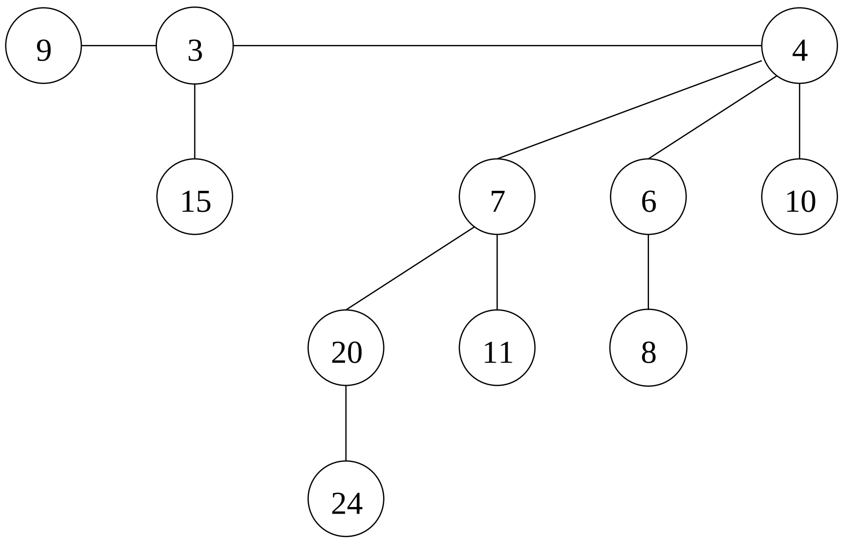
In cuckoo hashing, we double or halve the hash table size and rehash all the elements to ensure that the fill-factor is within a range. Explain formally how we can amortize this cost for rehashing against cost for insertions and deletions, by setting up a potential function.

Aufgabe 2 (10 Punkte)

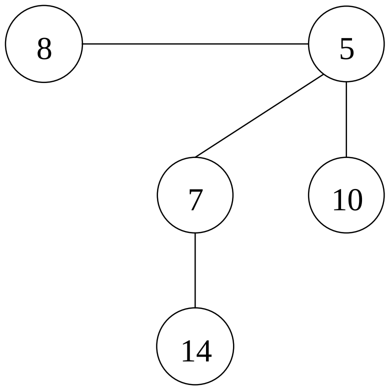
Suppose we label the nodes of a binomial tree B_k in binary as shown in lecture(visit the root, traverse the rightmost subtree, traverse the left subtree). Consider a node x labeled l at depth i. Show that x has i 1's in its binary label l. Also show that the number of children of x is equal to the number of 0's to the right of the rightmost 1 in the binary representation of l (except for the root).

Aufgabe 3 (10 Punkte)

Consider the following Binomial Heaps:
Heap A:



Heap B:



Carry out the following operations sequentially on the heaps and show them after each operation(always carry out each operation on the result of the previous operation):

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

Aufgabe 4 (10 Punkte)

We say that $f(n) = \overset{\infty}{\Omega}(g(n))$ if there exists a positive constant c such that $f(n) \geq cg(n) \geq 0$ for infinitely many integers n. Find inputs that cause DELETE-MIN, DECREASE-KEY, and DELETE to run in $\Omega(\log n)$ time for a binomial heap. Explain why the worst-case running times of INSERT, MINIMUM, and MERGE are $\overset{\infty}{\Omega}(\log n)$ but not $\Omega(\log n)$ for a binary heap.