

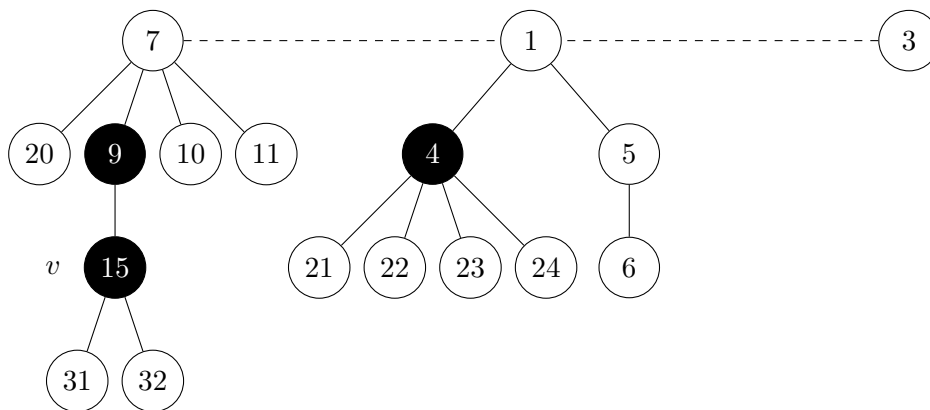
Algorithm Theory

Exercise Sheet 4

Exercise 1: Fibonacci Heaps I

(8 Points)

Consider the following Fibonacci heap (black nodes are marked, white nodes are unmarked). How does the given Fibonacci heap look after a `decrease-key(v, 2)` operation and how does it look after a subsequent `delete-min` operation?



Exercise 2: Fibonacci Heaps II

(10 Points)

Show that in the worst case, the `delete-min` and the `decrease-key` operation on a Fibonacci heap can require time $\Omega(n)$.

Exercise 3: Union Find

(12 Points)

Consider a sequence of operations on a disjoint-set forest using the union-by-size heuristic with path compression. Let f be the number of find-operations and n the number of `make_set`-operations.

Show that the total costs are $O(f + n \cdot \log n)$.