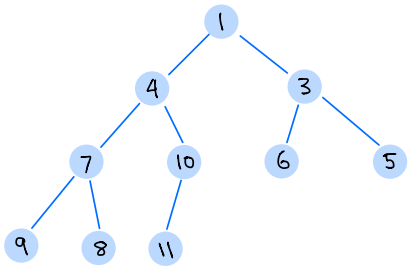
Problem 3

[1, 4, 3, 7, 10, 6, 5, 9, 8, 11]

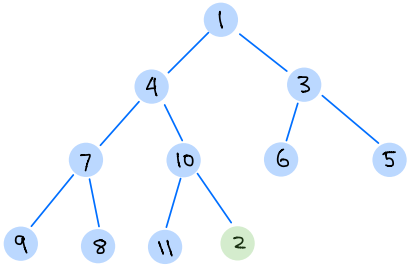
graph translation →



(is a correct binary min heap)

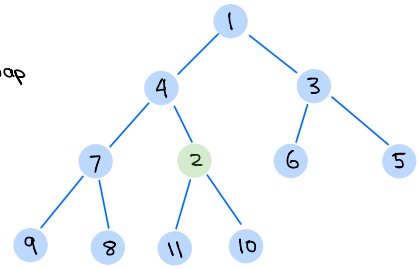
Inserting 2

step 1: insert 2 at bottom of heap

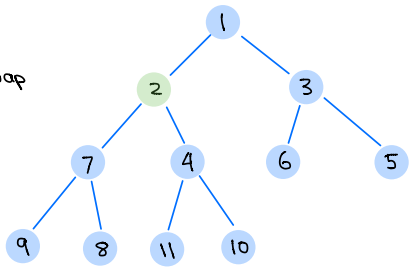


step 2: bubble up 2 until its parent is smaller or it is root node, else, swap w/parent

10 > 2 so swap →



4 > 2 so swap →

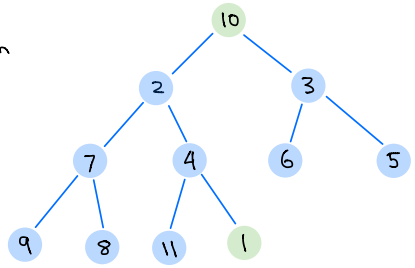


1 < 2 so this is our result after inserting 2.

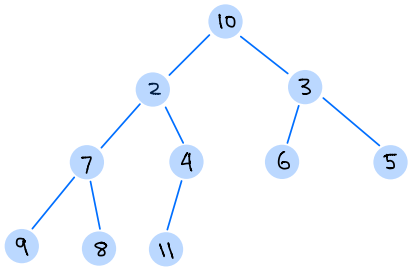
Removing smallest element

step 1: swap root node with bottom of heap, remove new bottom (the min value)

swap top & bottom →

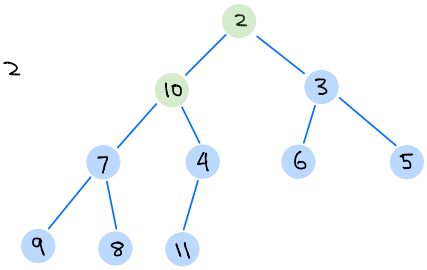


remove bottom →



step 2: trickle down top node by swapping with smallest child until smaller than all its children

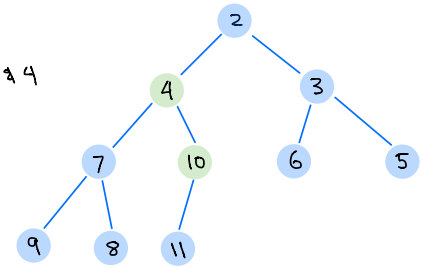
swap 10 & 2 →



10 > 2, 3 and 2 < 3

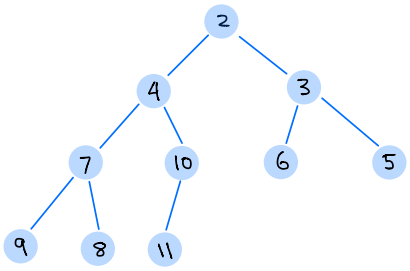
so swap 10 & 2

swap 10 & 4 →



10 > 7, 4 and 4 < 7

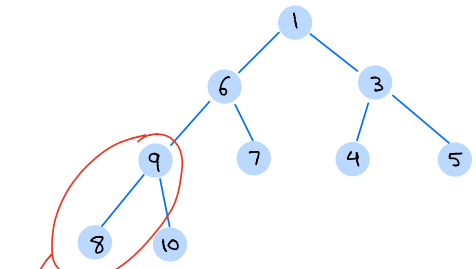
so swap 10 and 4



10 < 11, so it is smaller than all of its children, thus this is our heap after removing the minimum

[1, 6, 3, 9, 7, 4, 5, 8, 10]

graph translation



This is <u>not</u> a correct minheap because in a minheap, the parent node is <u>less than or equal to</u> both of its children respectively, but we observe here that the parent node 9 has a child 8 that is smaller than it $9 \nleq 8$. Therefore this is not a correct minheap.