Time Complexity of building a heap

Consider the following algorithm for building a Heap of an input array A.

```
BUILD-HEAP(A)
    heapsize := size(A);
    for i := floor(heapsize/2) downto 1
        do HEAPIFY(A, i);
    end for
END
```

What is the worst case time complexity of the above algo?
Although the worst case complexity looks like O(nLogn), upper bound of time complexity is O(n). See following links for the proof of time complexity.

http://www.cse.iitk.ac.in/users/sbaswana/Courses/ESO211/heap.pdf/

http://www.cs.sfu.ca/CourseCentral/307/petra/2009/SLN_2.pdf

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groomnestle • 5 months ago

It is easier to write heapsort with first heap index as 1 instead of 0, in this case
with a simple formula:
parent = k, left child = 2k, right child= 2k+1.

stack!

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Venki • 3 years ago

The complexity O(n log n) is an upper bound. The upper bound is calculated a
log n. But in reality it is not the case. Height of node varies in the heap. By defi
path length from that node to leaf node. This way the root is at maximum heigh

The build-heap time complexity is function of node's height f(h). How can we e
having N elements, we can observe that there will be maximum of f(h) = [N/2^
given N = 7 i.e. a full binary tree of height 2, the root is at height of 2 and f(2) =
satisfying our assumption. Infact, it is an approximation and as the height of tre
exact limit.

Now, it is easy to check the tighter bound on building the heap. To build heap,
O(h) and we call it on nodes from nodes n/2 to 1. These nodes form internal n
computational cost we need to sum the cost of heapifying each node. Yet we
need to find the cost of **a node* at each level and integrate (sum) them to find

Mathematically T(n) = summation of [h x f(h)] in the interval 0 to logN (i.e. heigh
we will arrive at 2N which is linear in N.

Hope it helps in better understanding the heap build analysis. The tighter boun

see more

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Sandeep Venki • 3 years ago

@Venki: Both O(n) and O(nLogn) are upper bounds for build heap. O(r

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tk • 3 years ago

Ineresting fact. Good to know.

Vinay • 3 years ago

one conceptual question from Cormen:why the loop goes down from heapsize
heapsize/2?

Amit Vinay • 3 years ago

If you index i=1 to n/2 you can observe that you will need to modify you
this and you will able to see the differnece).... so in Cormen to avoid th

Both indexing will work but the efficient way will be the latter case....

kartik Vinay • 3 years ago

I think its because the way Heapify process works. When we Heapify a
the subtrees of i are heapified. Also, the Heapify process must go in up
maximum (or minimum) element is at the top.

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