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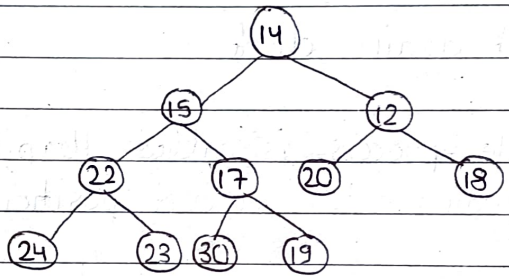
Heap - 2

* **Build Heap:**

⇉ We have created a heap in O(nlogn) T.C in previous method.



	0	1	2	3	4	5	6	7	8	9	10
arr →	14	15	12	22	17	20	18	24	23	30	19

⇒

30	24	20	22	23	12	18	14	17	15	19

⇉ We will start from index → 1 then check with parent ((i-1)/2) and if child is greater than parent, swap them.

⇉ This method will also take O(nlogn) T.C.

⇉ This is called step up.

⇉ Now, we will do step down.

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⇒ Here, parent will compare with its children.

⇒ Parent → i

↓

child → left → 2*i+1

→ right → 2*i+2

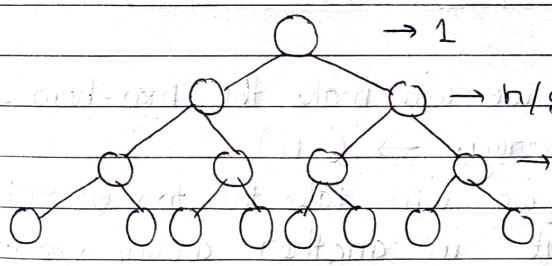
T.C in

⇒ In this method, we will start with that node that have children, so we don't have to compare leaf nodes.

⇒ So, starting index will be —

$$\frac{(n-1)-1}{2} \Rightarrow \frac{n}{2} - 1$$

Time complexity for step up:



⇒ $\frac{n}{2}(\log n) + \frac{n}{4}(\log n) + \frac{n}{8}(\log n) + \ldots$

⇒ $(n \log n)\left(\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots\right)$

⇒ $n \log n\,(1) \Rightarrow n \log n$

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Step down:

⇒ So, at n/4, every node can come down one time only.

⇒ In the same way, ~~we~~ as the level decreases then the no. of down time increases.

⇒ $\frac{n}{4} \times 1 + \frac{n}{8} \times 2 + \frac{n}{16} \times 3 + \ldots \log n$

⇒ $n\left[\frac{1}{4} + \frac{2}{8} + \frac{3}{16} + \ldots\right]$

⇒ $O(n)$

* Heap sort:

arr →

10	11	14	8	3	19	12

⇒ First, we will make the max-heap of the given array. → $O(n)$

⇒ Then, we will take the top element, store it in another array, delete it & ~~p~~ replace it with last element.

⇒ After that, put the first element at their correct position.

⇒ so, here, we are using an extra array.

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⇉ So, how can we solve it by using O(1) S.C.

⇉ We know that after changing the top element with last element, there will be a space remain in the array.

⇒ So, we will store the top element in the last element position.

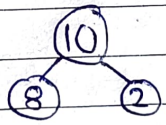
* Priority Queue:

⇉ In PQ, every element have some priority.

⇒ We can also say that, there is some type of priority condition in the queue.

⇉ Ex: If we have 2, 8, 10 & the priority condition is that the biggest no. serve the first then 10 will be served first.

⇒ And this is what ... this is max heap.



⇉ Priority Queue is used in Computer Network, OS, etc.