Priority Queue

- A kind of queue (dequeue, enqueue)
- dequeue gets element with the highest priority
- priority is based on a comparable value of each object (smaller value higher priority or higher value higher priority)

Applications in computer

operating system: run the shortest-job first
printer: print the shortest document first

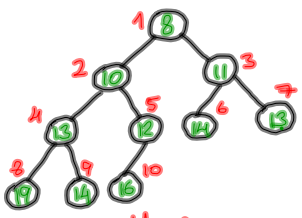
Minimum Priority Queue

We use a data structure named heap to implement a priority queue.

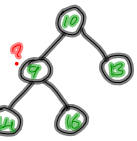
A Binary Heap

Structural property:
Binary tree & completely filled (bottom level is filled from left to right.

Heap order property:
Any node is smaller than (or equal to) all of its children.



Min Heap



Not Heap

Implementation of a binary heap

	0	1	2	3	4	5	6	7	8	9	10
min heap		8	10	11	13	12	14	13	19	14	16

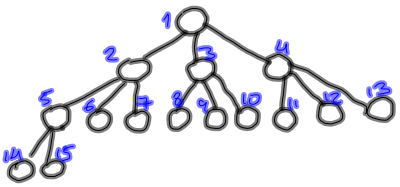
Heap as a Tree

Root of tree: first element in the array after index 0

$$parent(i) = \lfloor \frac{i}{2} \rfloor \rightarrow floor$$
$$left(i) = 2i$$
$$right(i) = 2i+1$$

mapping

Question: What is the mapping if we use a 3-ary tree as a heap.



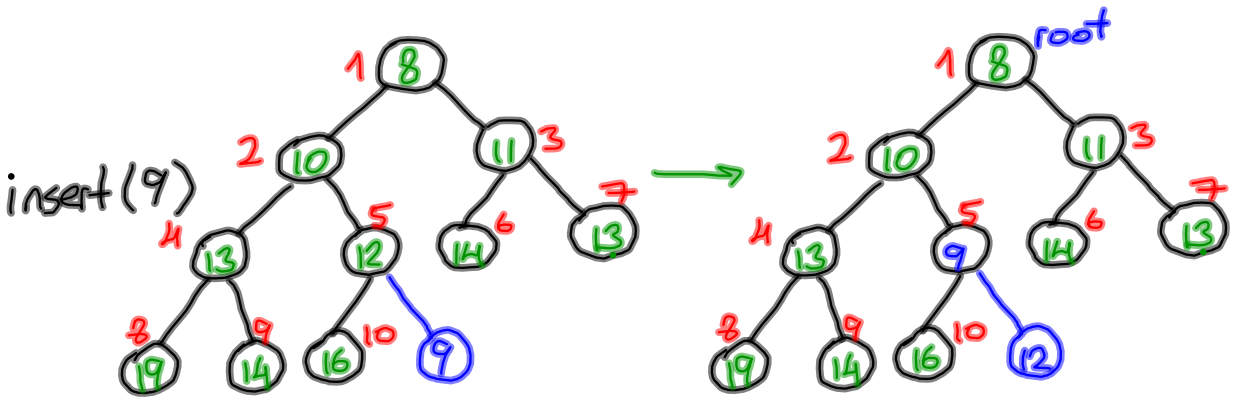
$$parent(i) = \lfloor \frac{i+1}{3} \rfloor$$
$$left(i) = 3i-1$$
$$middle(i) = 3i$$
$$right(i) = 3i+1$$

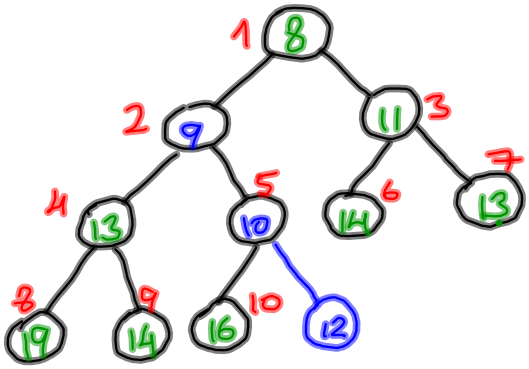
$2 \rightarrow 1$ $11 \rightarrow 4$
$3 \rightarrow 1$ $12 \rightarrow 4$
$4 \rightarrow 1$ $13 \rightarrow 4$

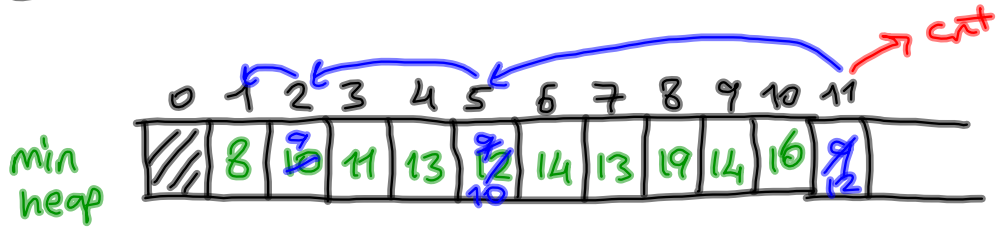
$i = 13$
$\frac{13+1}{3} = \frac{14}{3} = 4.33$

Insert

- Insert into the next available location
- Move it up (swap with its parent) until there is no violation for heap order property. This procedure is called **percolate up**.

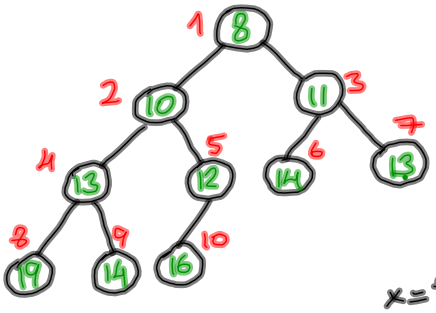






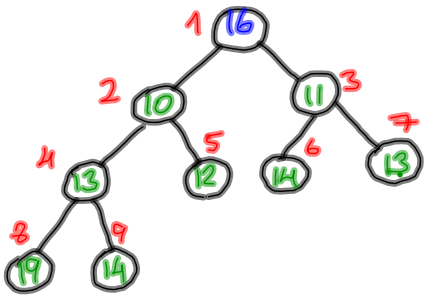
Delete (return the min and delete it)

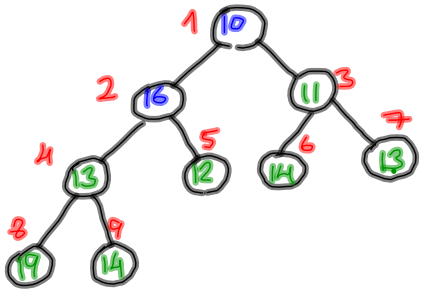
- Keep the min. Move the last element in the heap to the first place.
- Move the first element down until there is no violation for heap order property. This process is called percolate down. Finally, we return the min which is stored.

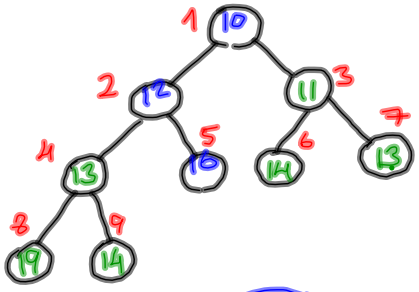


delete( ) call returns 8 and it rearranges the heap

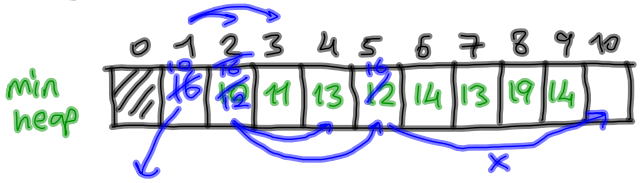
x=8



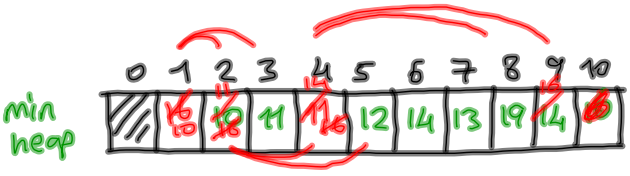




return x



return 8



8