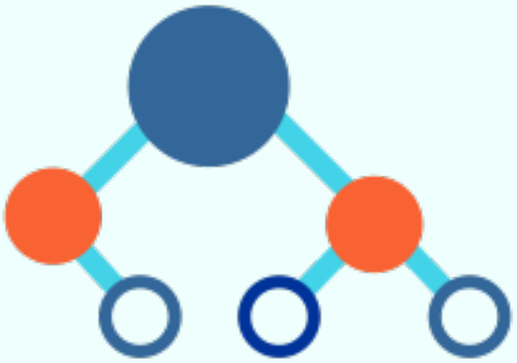
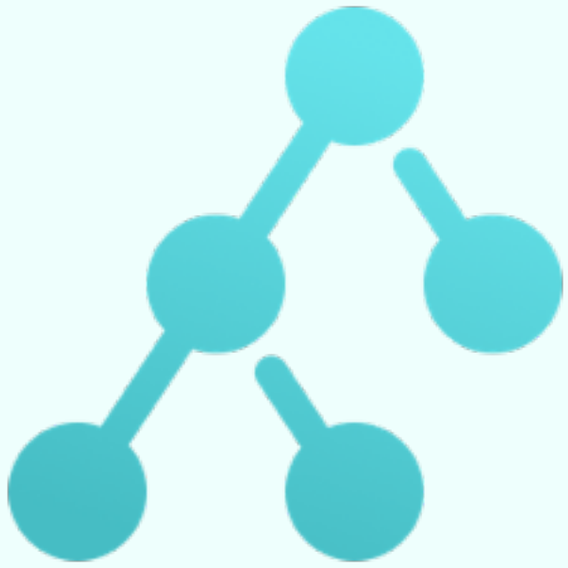
Data Structures

Exercise Session



Marco Vassena



Exercise 1 from 11/12

Analyze the time complexity in terms of N

```
// A : Empty Dynamic Array

// PQ : Priority Queue, |PQ| = N^3

 for(int i = 0; i < N; i++)
    A.add(0 , PQ.deleteMin())
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O(log (|PQ| – i))

Exercise 2 from 11/12

Add to each node a reference to the parent

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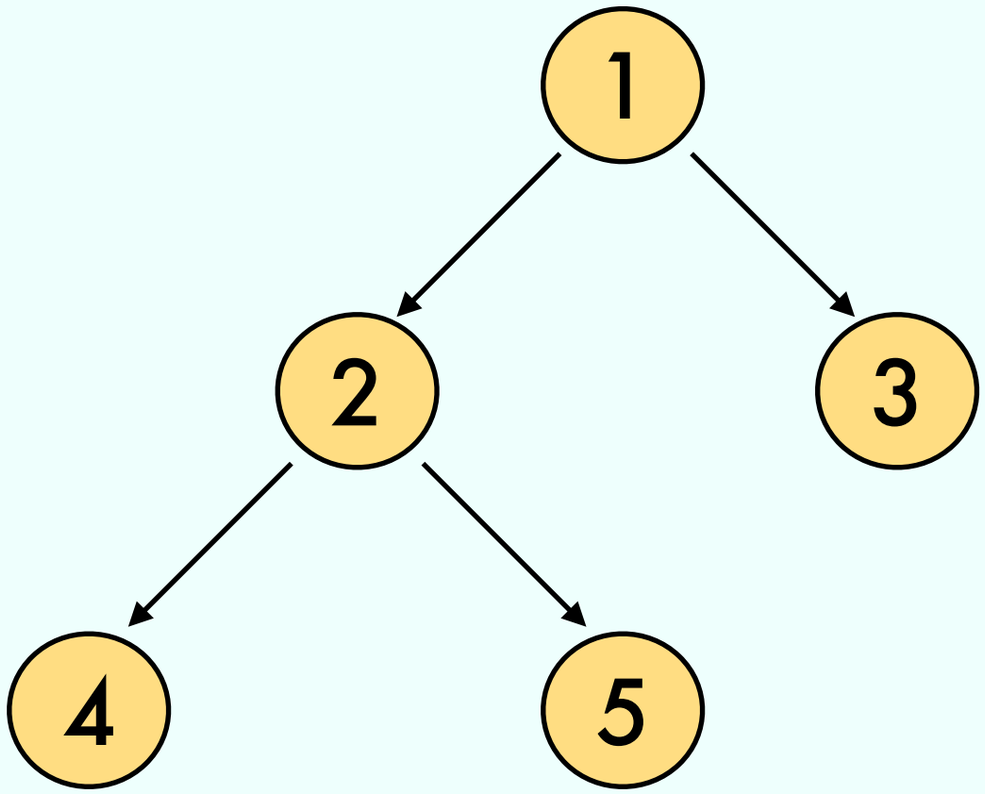

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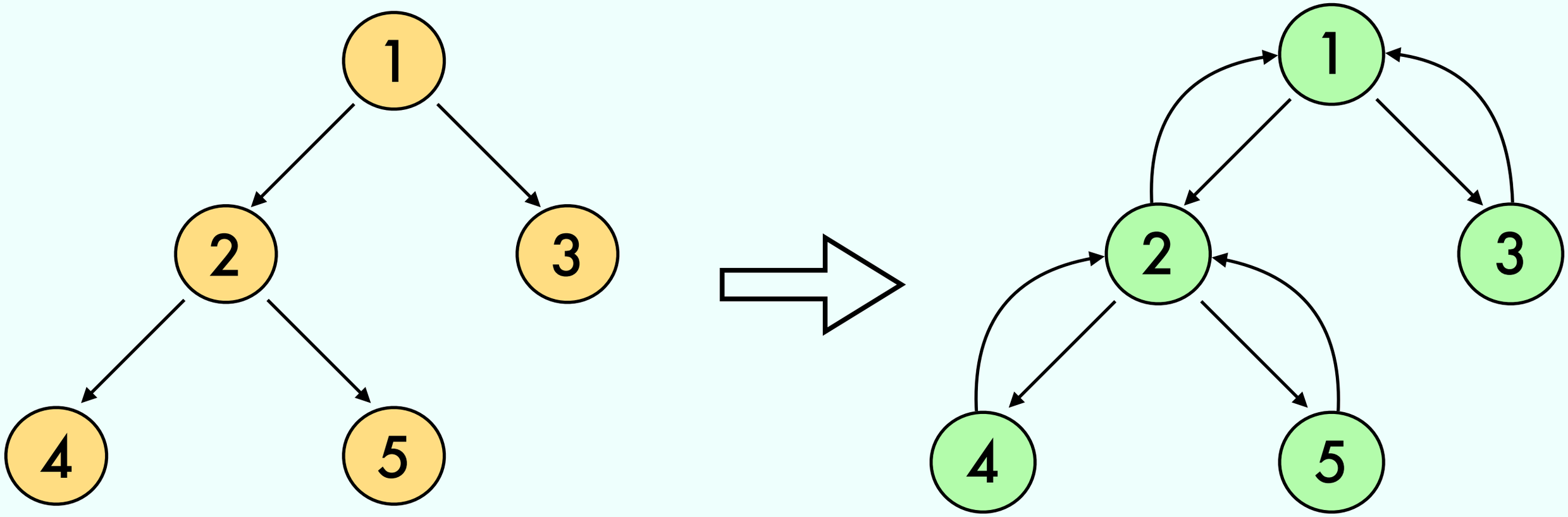

Tree

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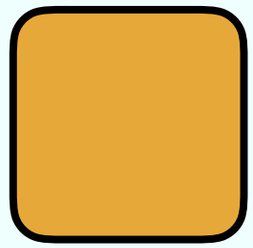

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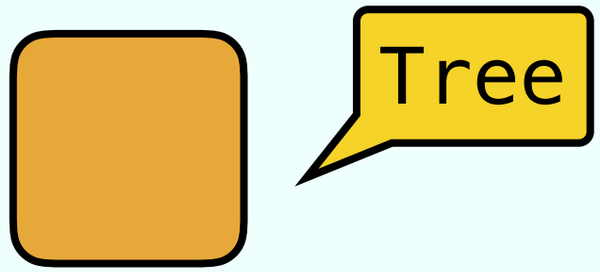

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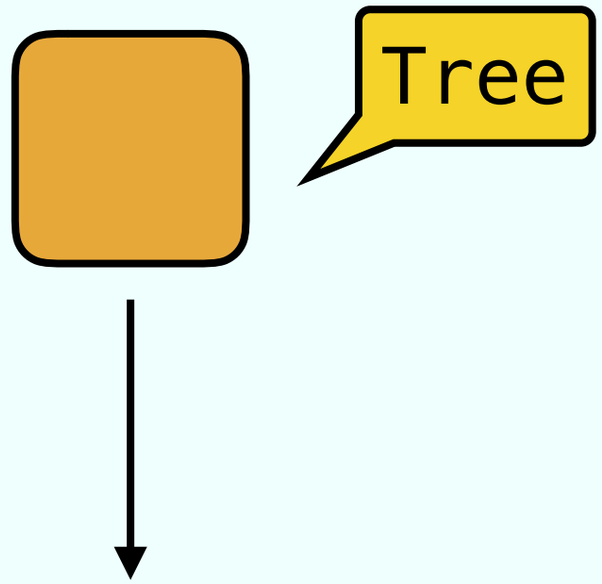

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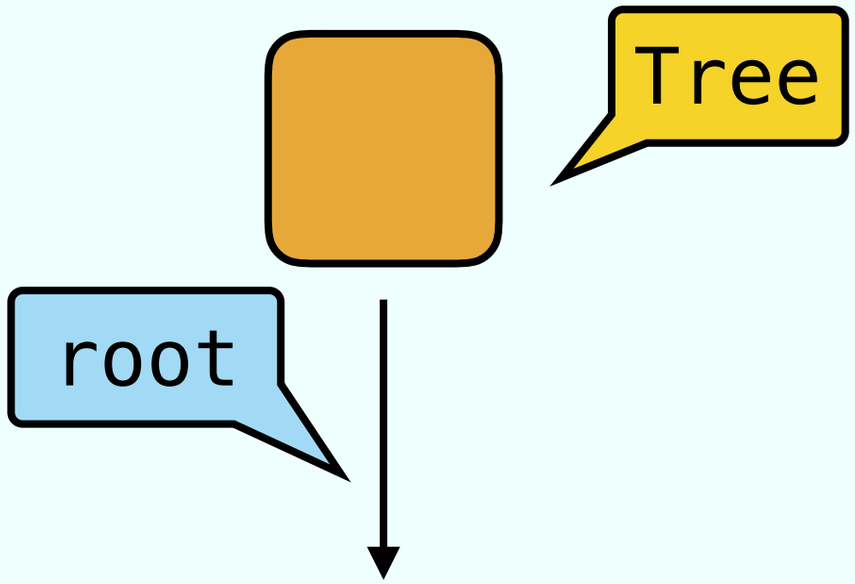

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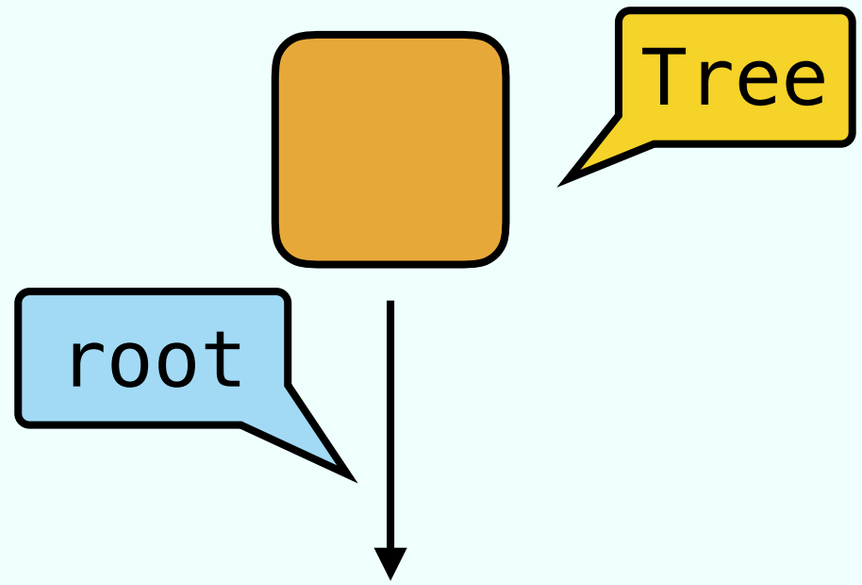

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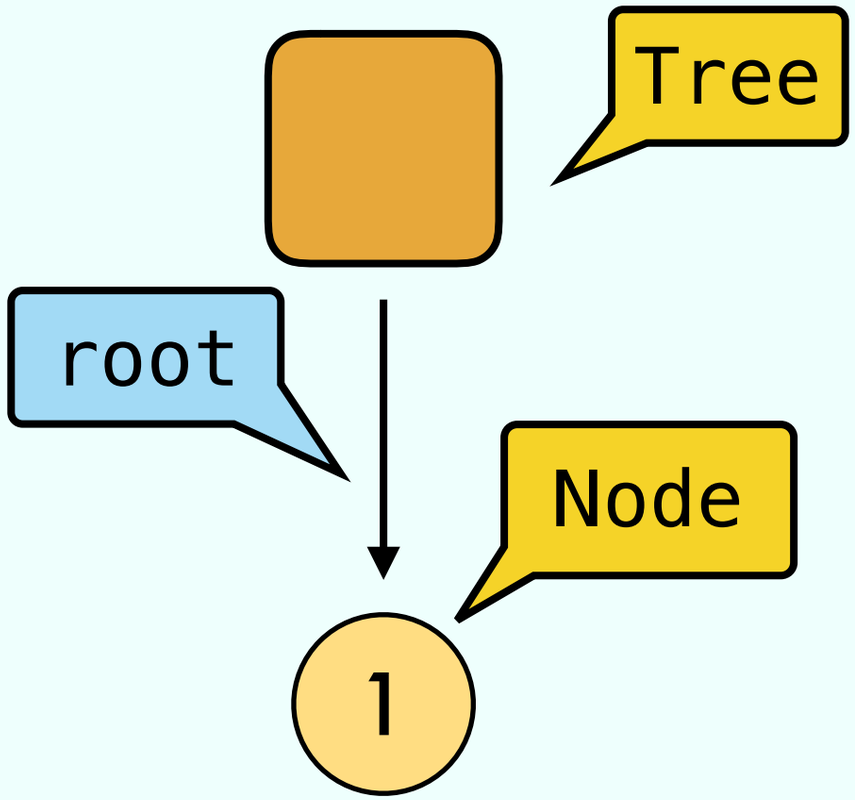

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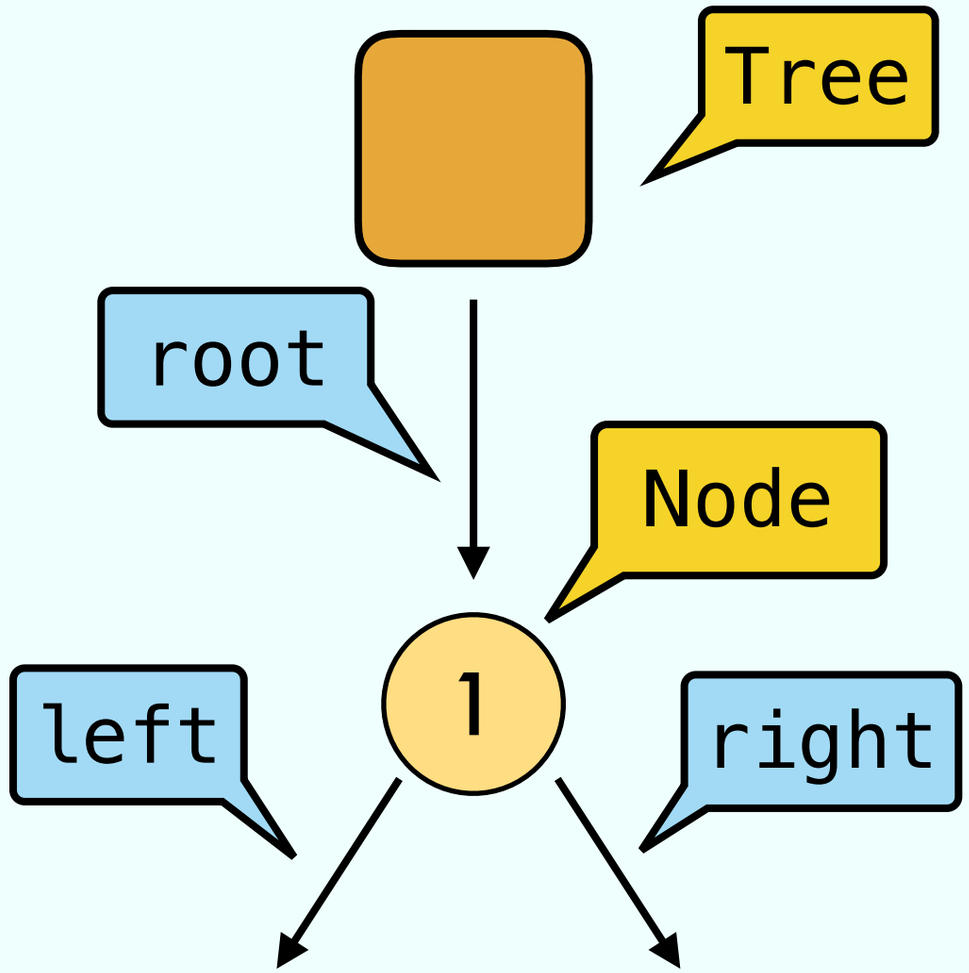

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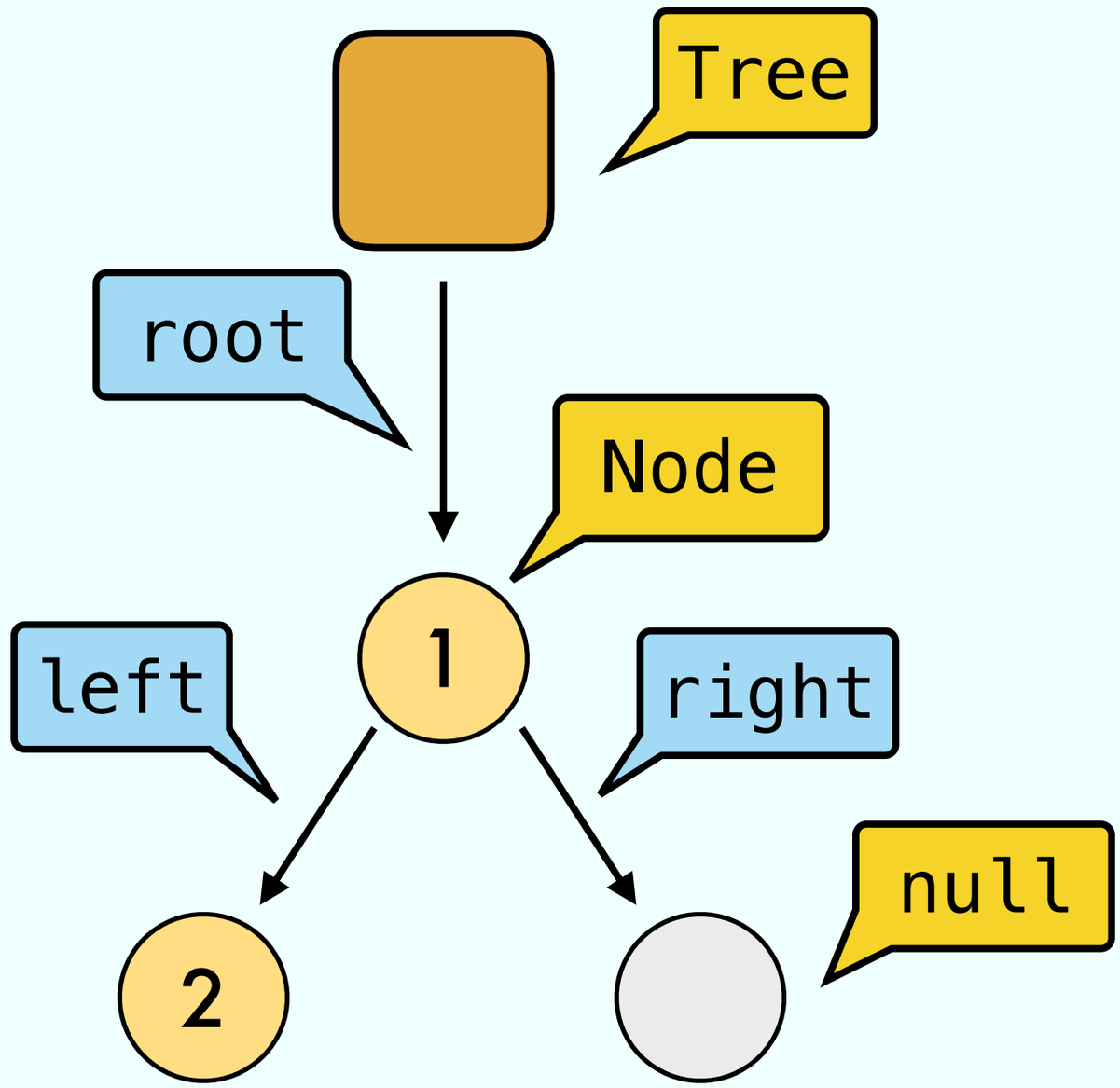

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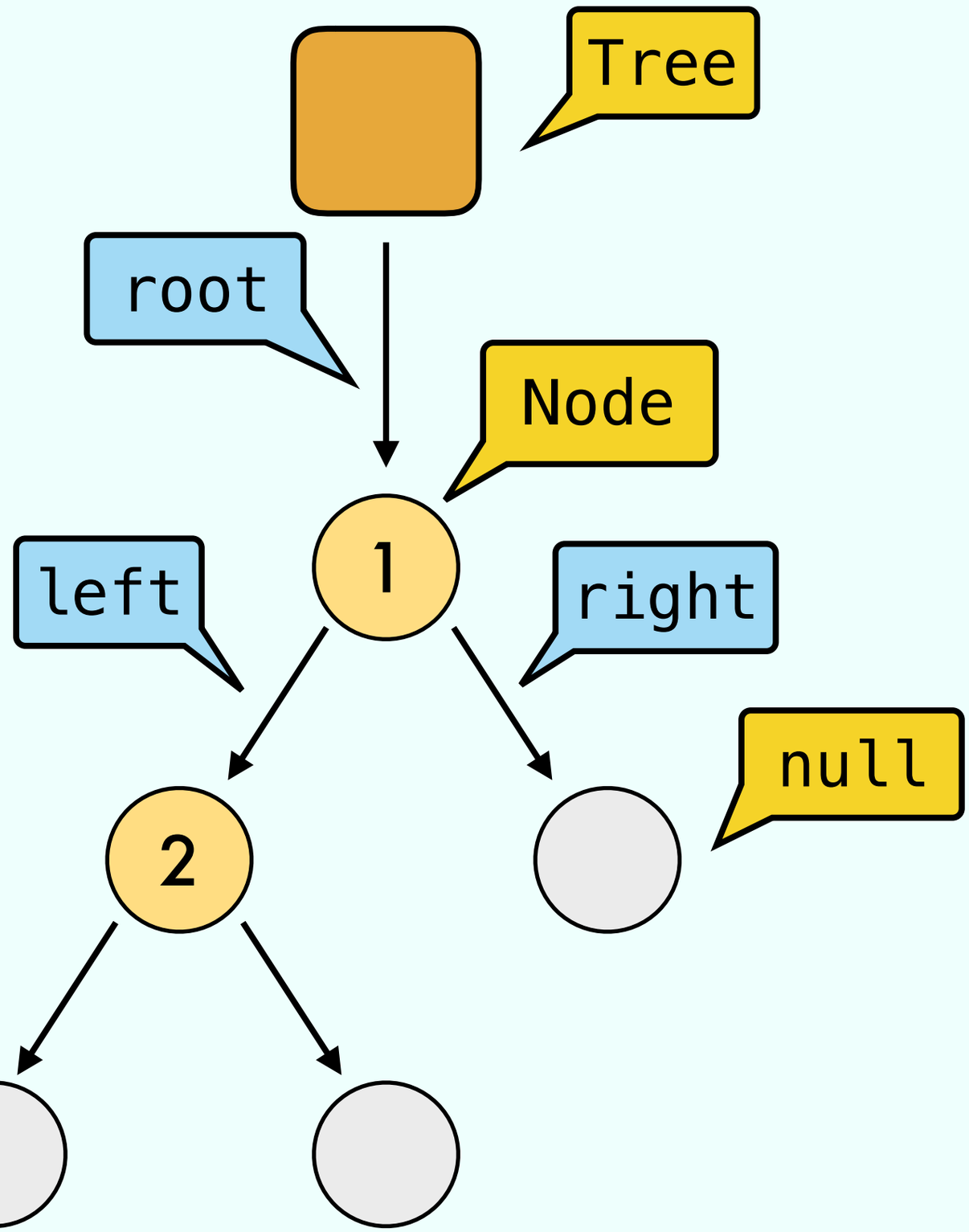
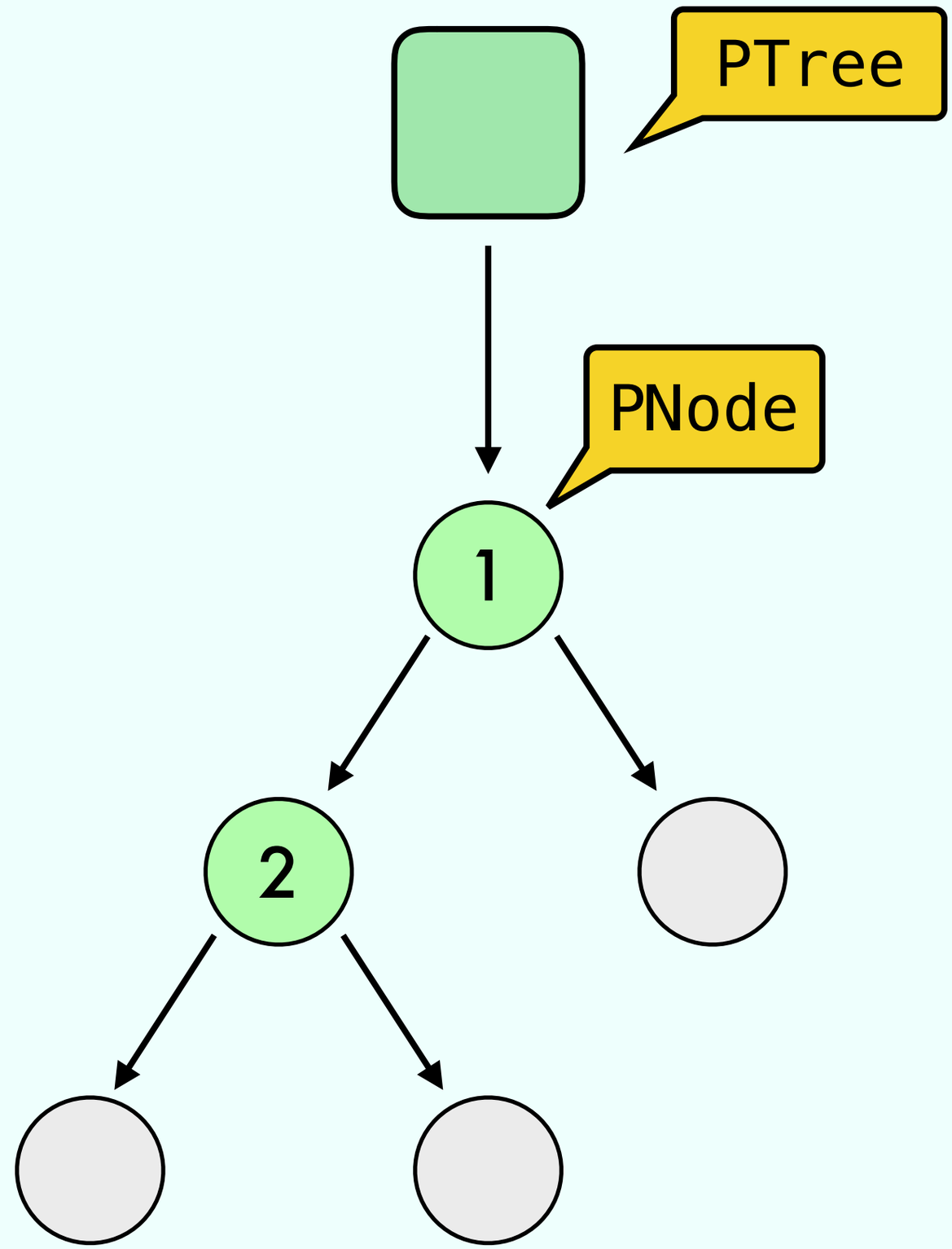


Parent Tree



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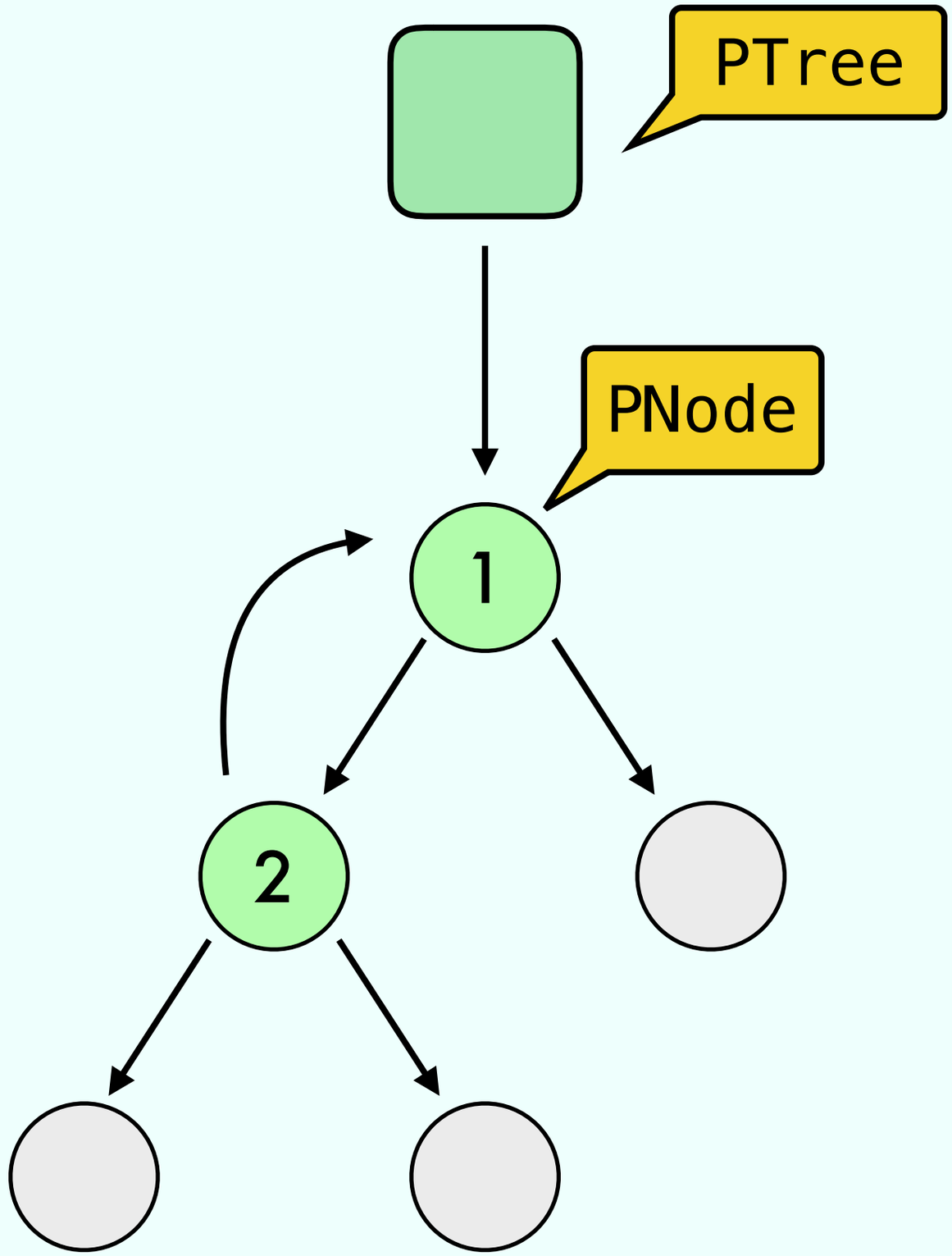

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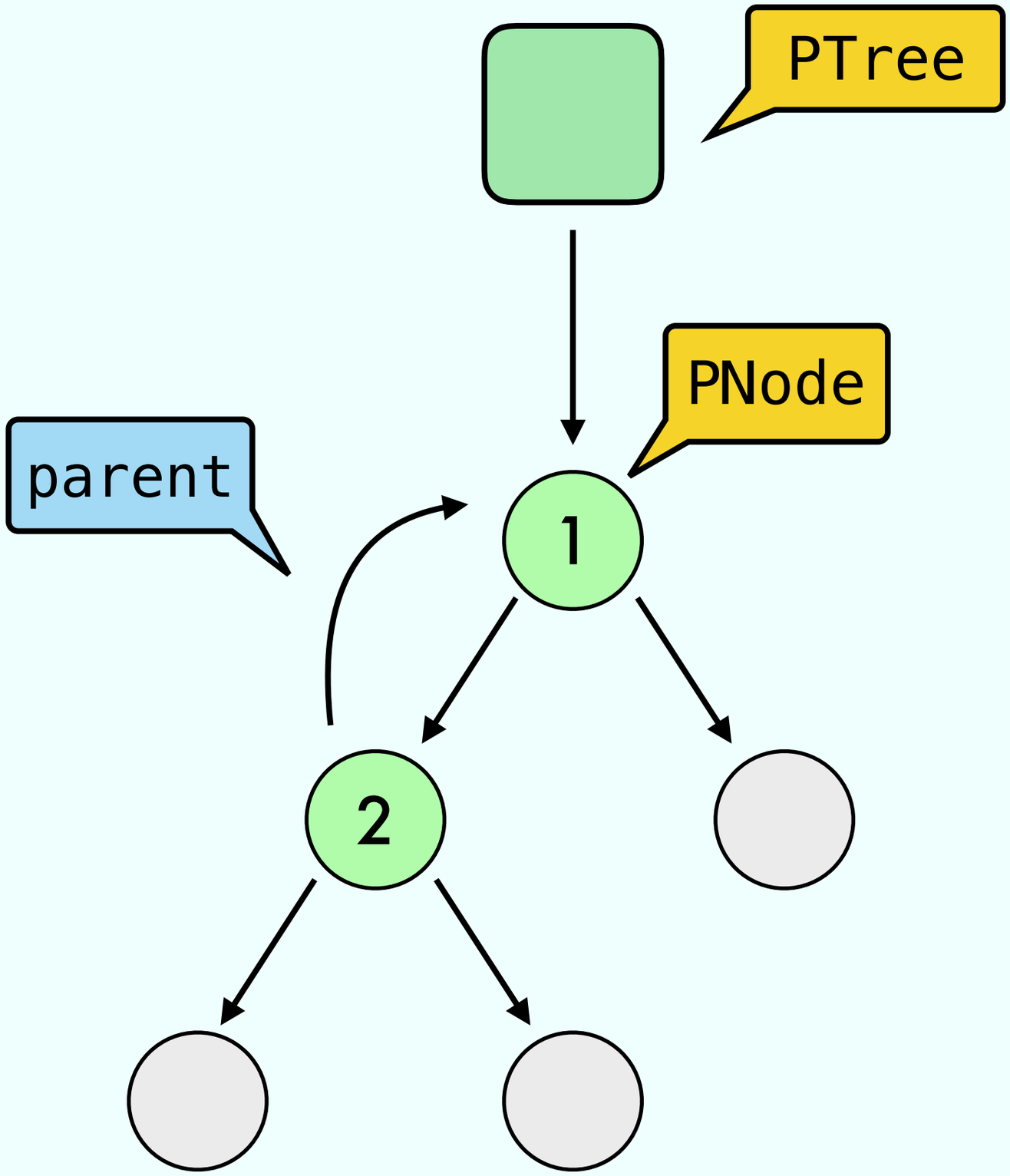

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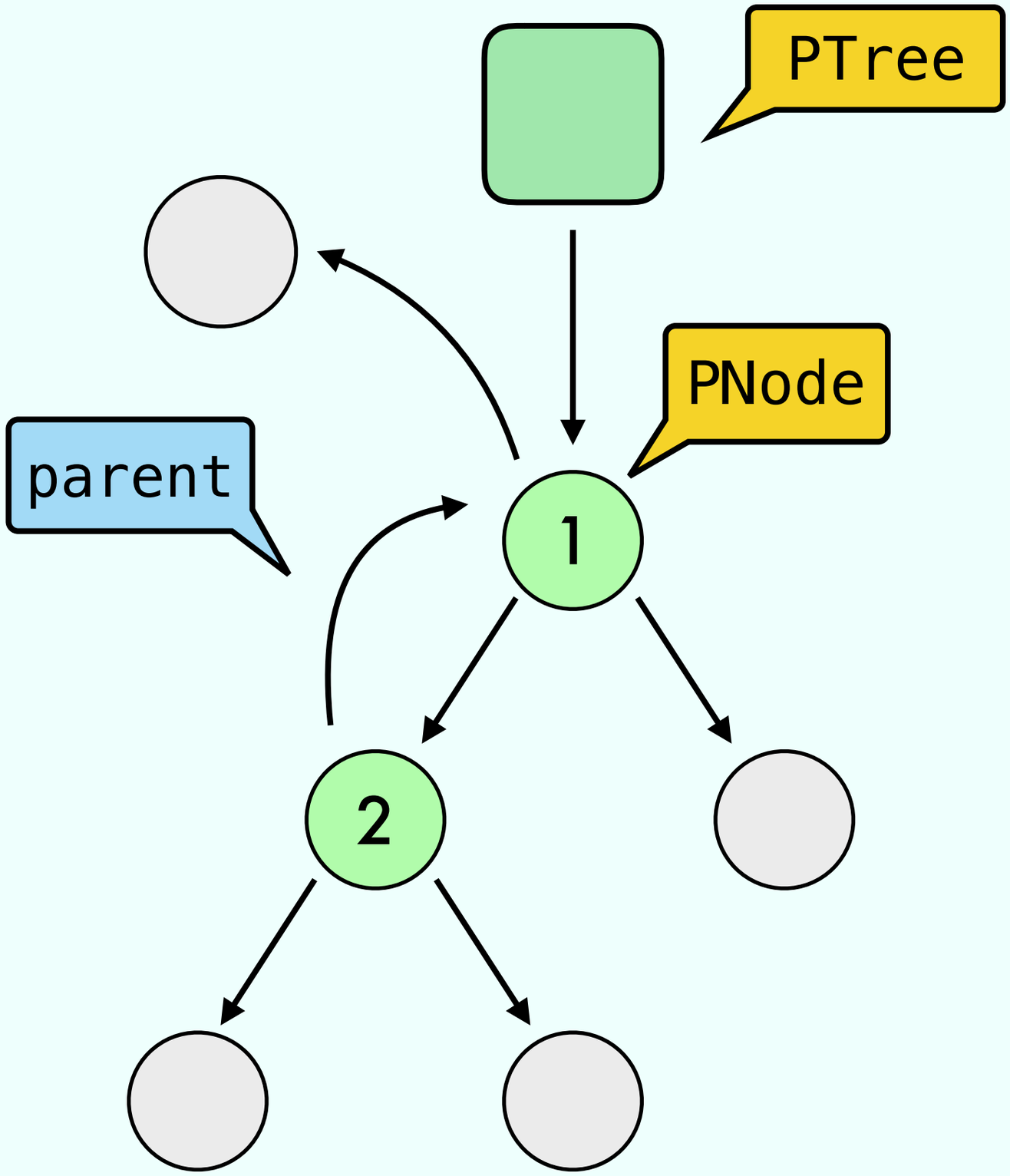
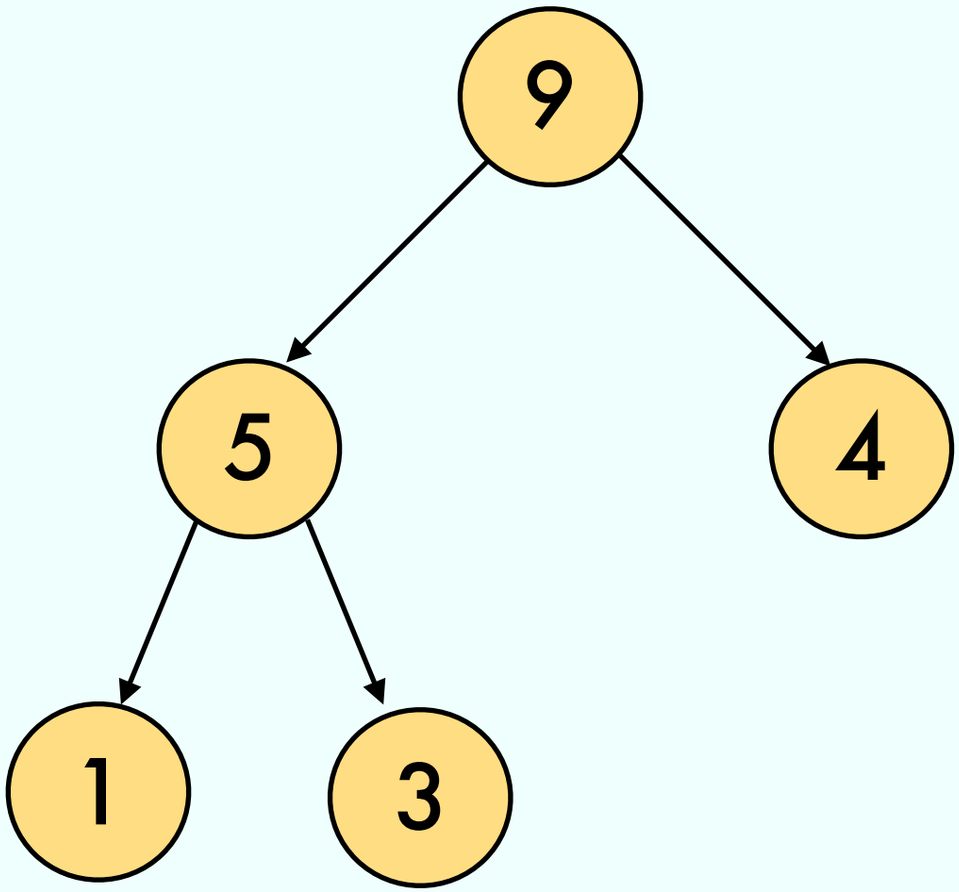
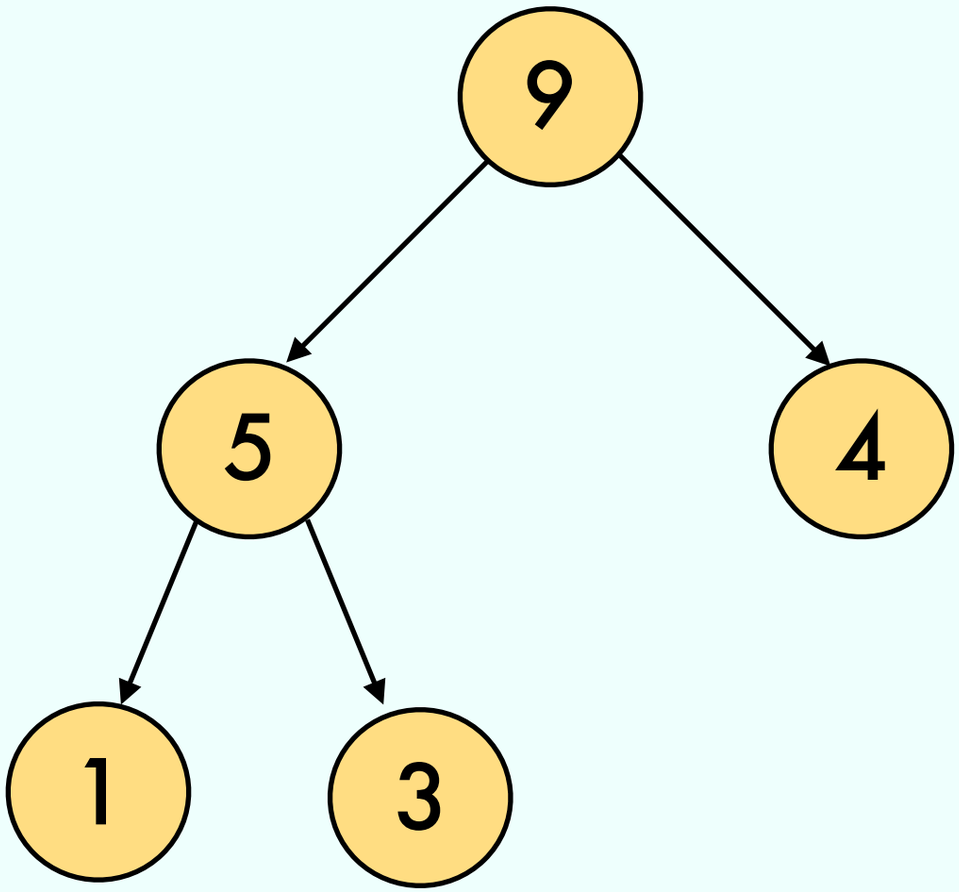


Binary Heap Recap



Binary Heap Recap

Order Property



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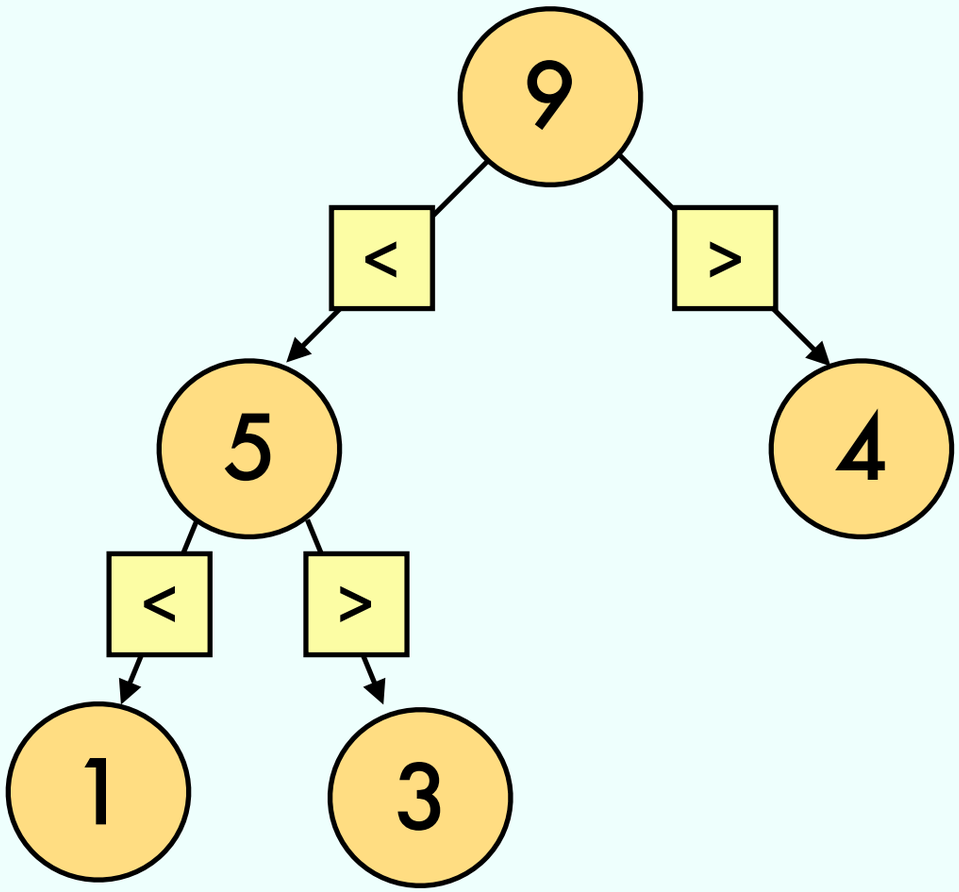

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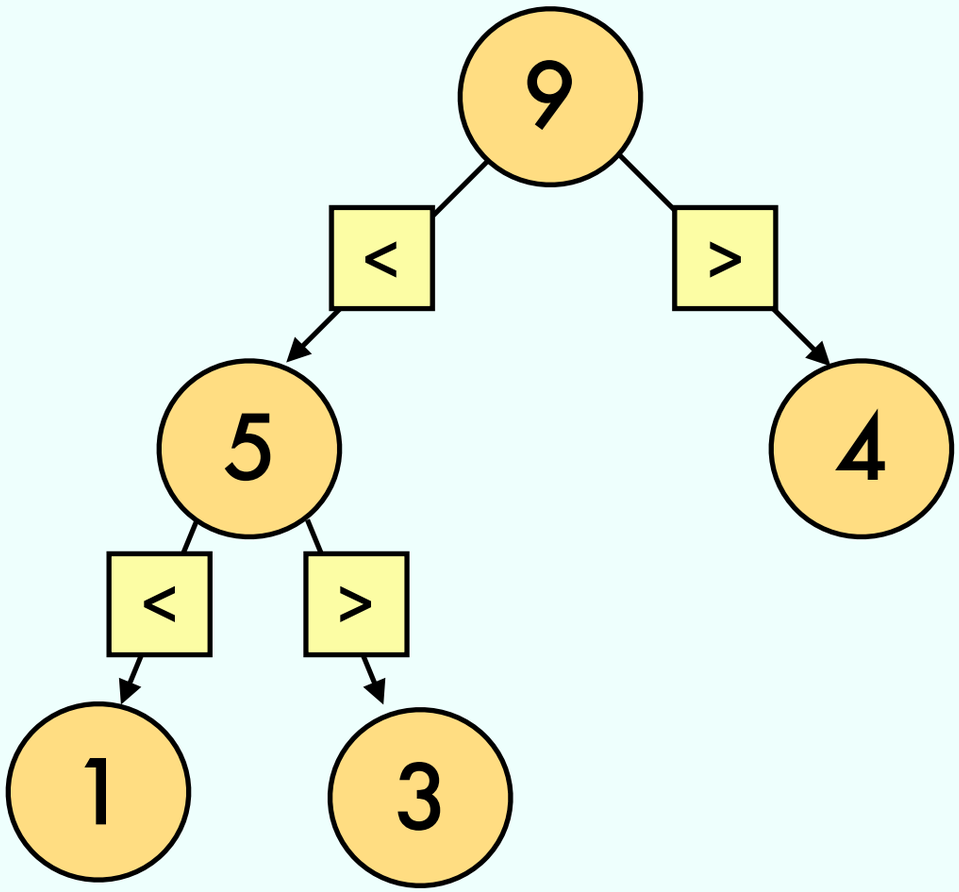

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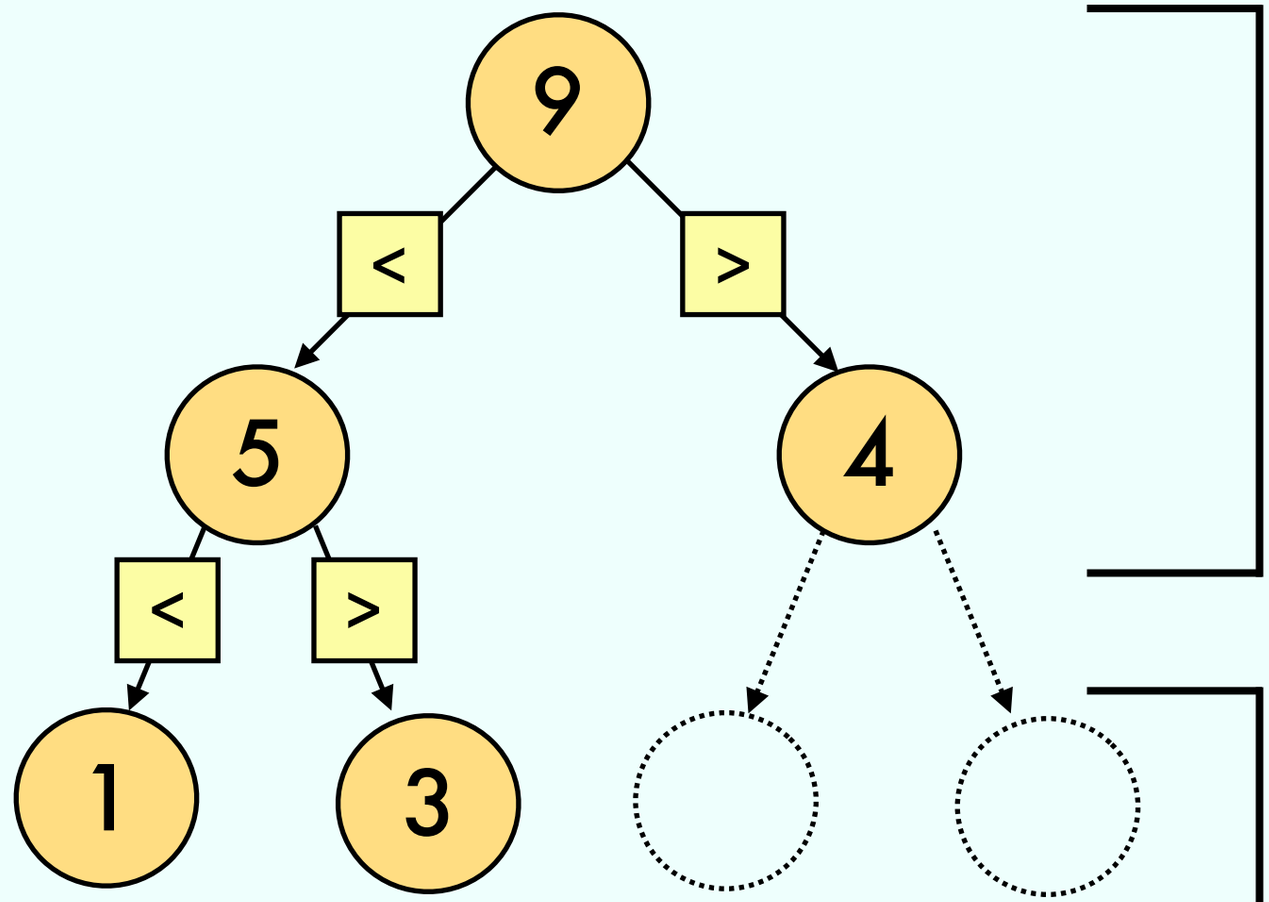
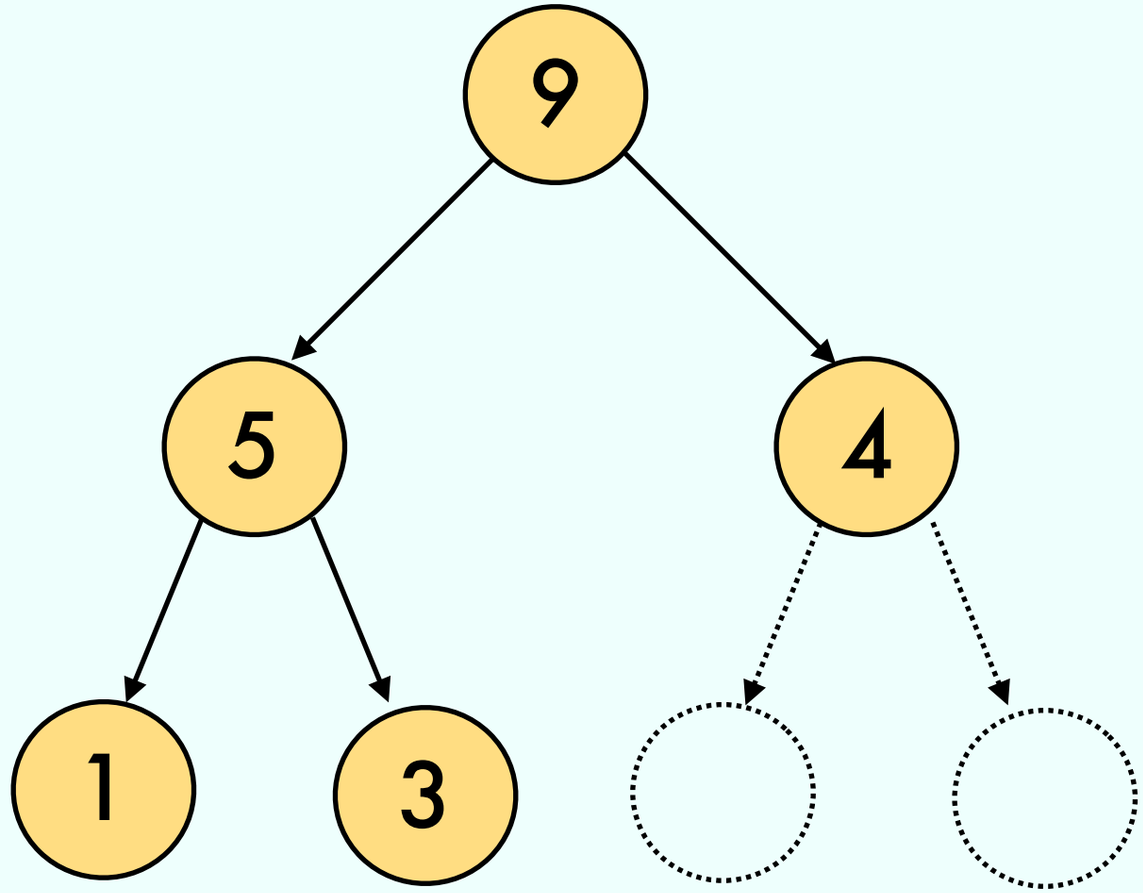


Complete Binary Tree

Except Last Level

Array Representation



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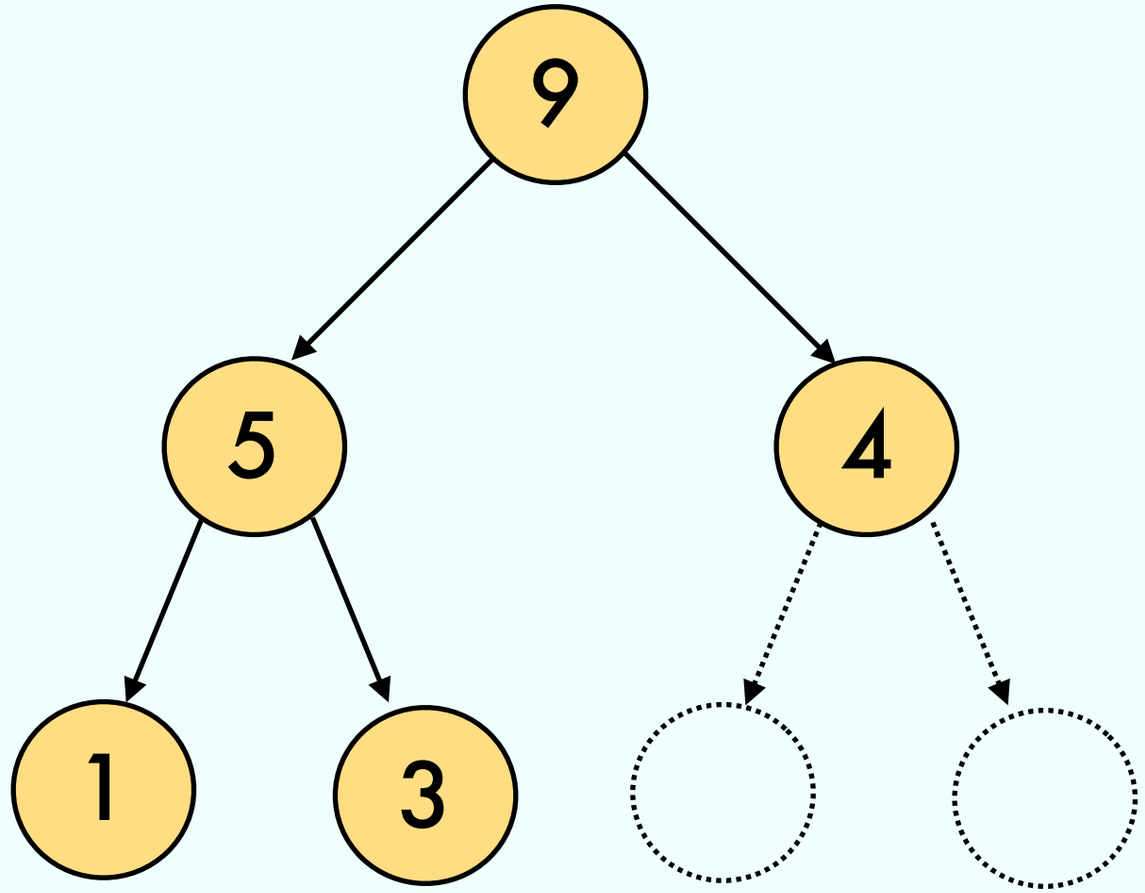

	9	5	4	1	3		

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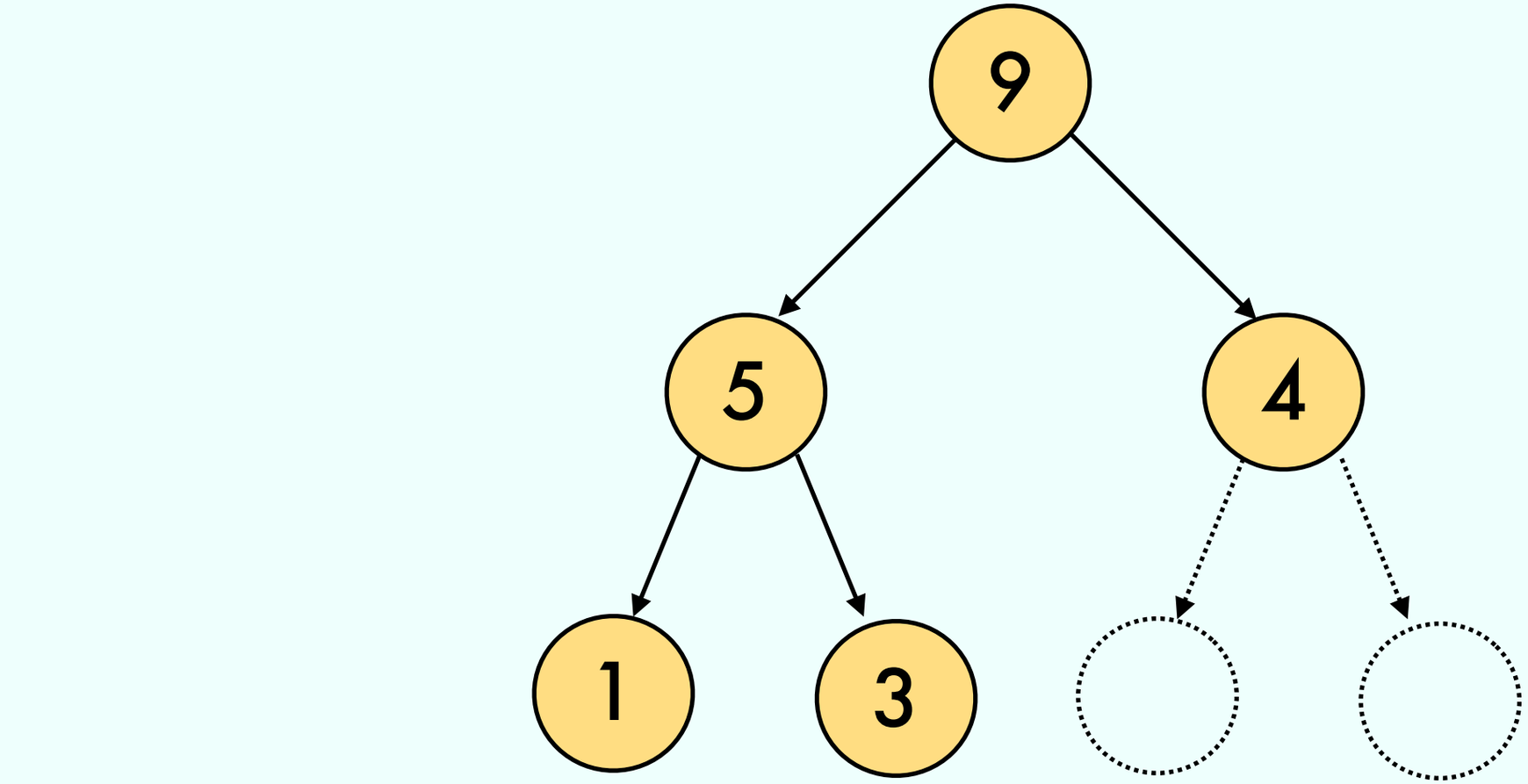

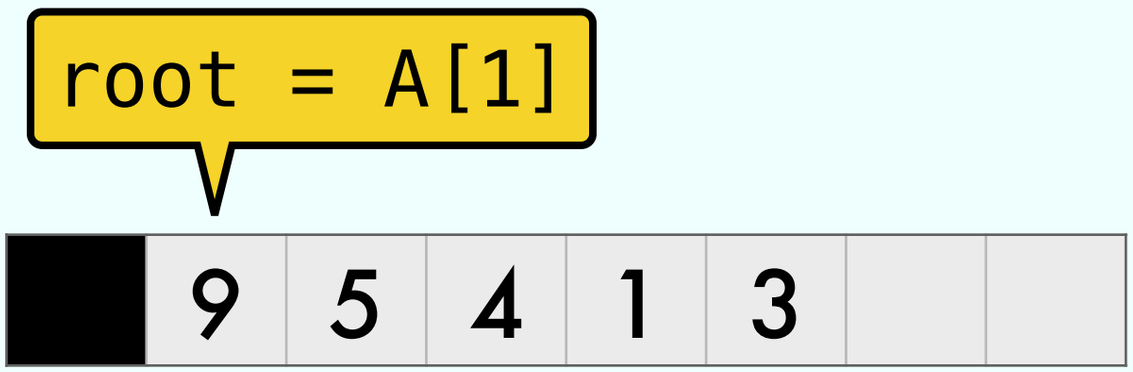

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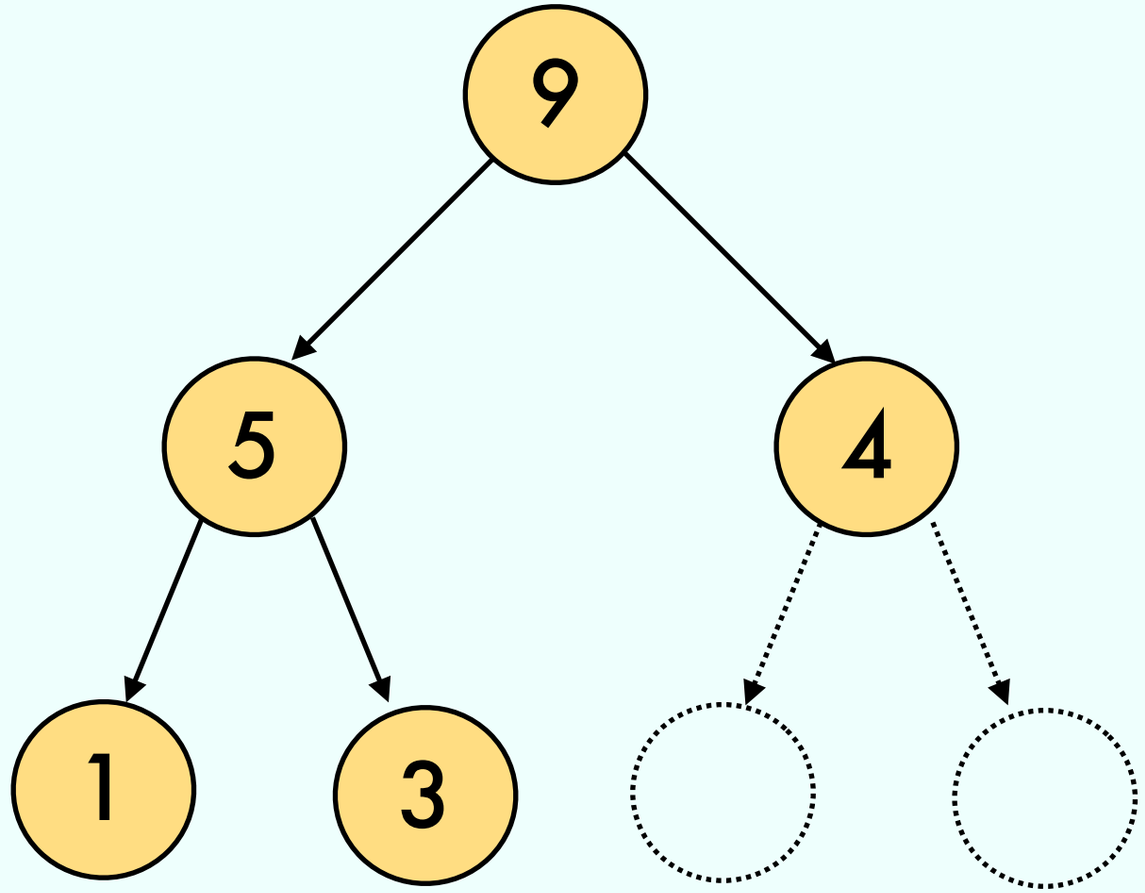

A[0] unused

root = A[1]

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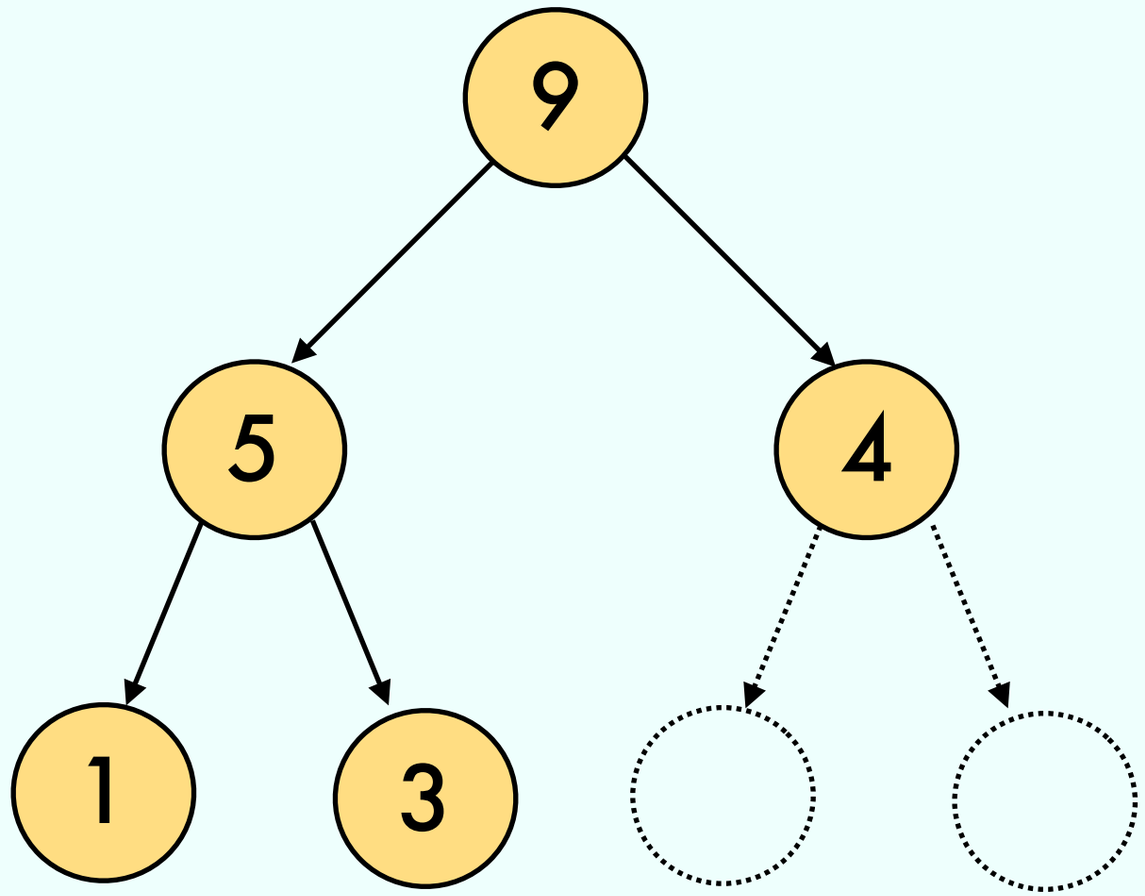
Array Representation

Index Operations

```
left(i) = i*2
right(i) = i*2 + 1
parent(i) = floor(i/2)
```



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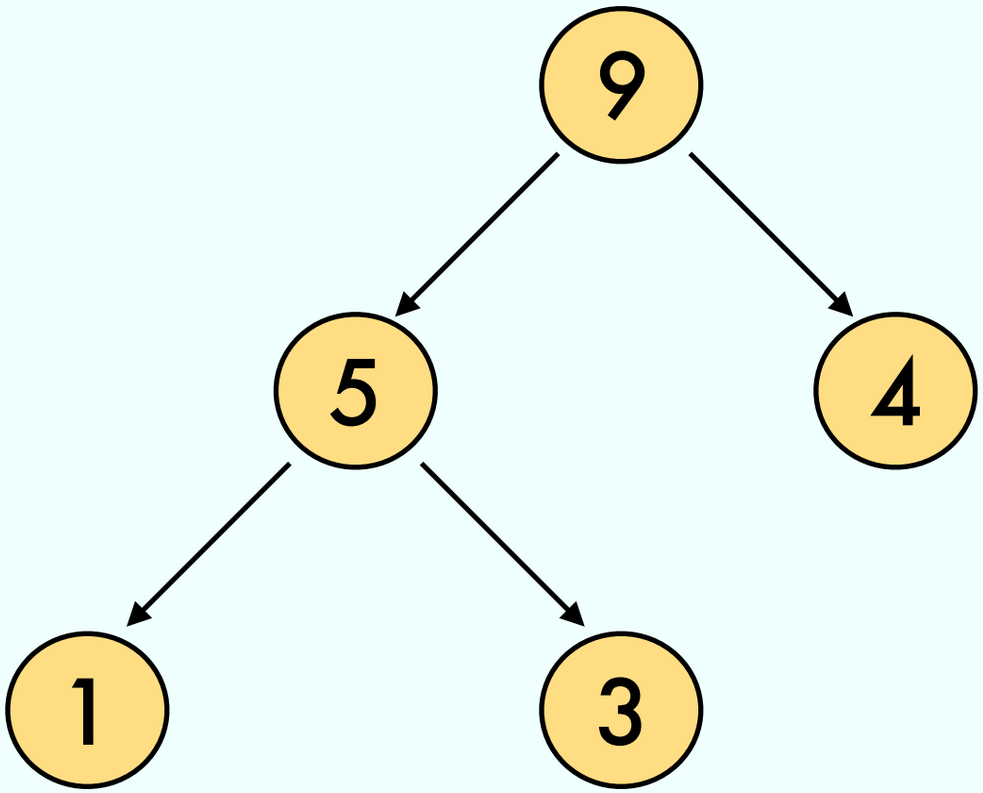

Operation	Time Complexity
`findMax()`	O(1)
`deleteMax()`	O(log N)
`insert(x)`	O(log N)

Exercise 6.2, 6.3

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Check your solution at https://visualgo.net/heap