More on Complete Binary Trees

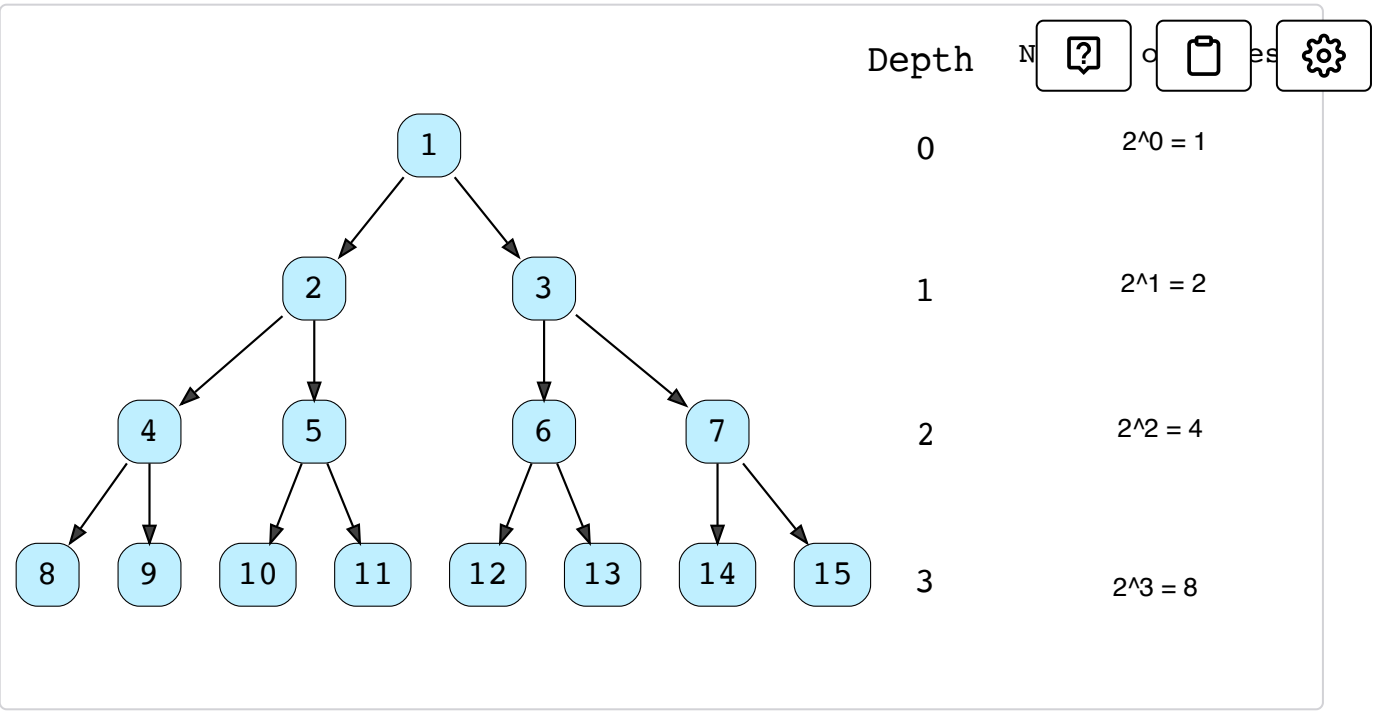
In this lesson, we are going to discuss what Complete Binary Trees are and how elements are inserted into them.

We'll cover the following

Introduction#

We touched upon complete binary trees in the last lesson, but here are some more detailed properties of them.

- All the levels are completely filled except possibly the last one
- Nodes at the last level are as far left as possible
- The total number of nodes, n, in a complete binary tree of height **"h"** are: $2^h \leq nodes \leq 2^{h+1} - 1$. This is again based on the Geometric Series formula: $2^0 + 2^1 + 2^3 + 2^4 + ... + 2^r = 2^{r+1} - 1$



- The total number of non-leaf nodes, n_i in a complete binary tree of height **“h”** are expressed as a range like so:

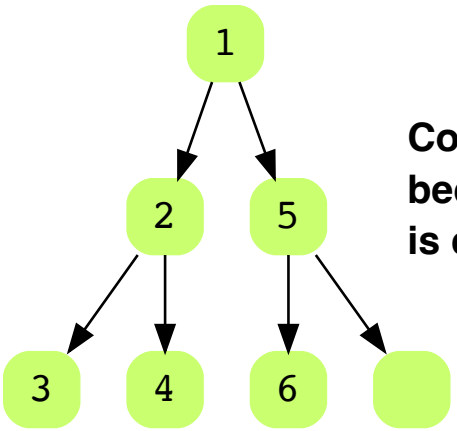
$$2^{h-1} \leq n_i \leq 2^h - 1$$

- The total number of leaf-nodes, n_e in a complete binary tree of height **“h”** is expressed as a range like so:

$$2^{h-1} \leq n_e \leq 2^h$$

- The nodes, n, are present in between the range of:

$$2^h \leq n \leq 2^{h+1} - 1$$



Complete Binary Tree, because the left side is compeletely filled

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Insertion in Complete Binary Trees#

The following rules apply when inserting a value in a Complete Binary Tree:

- Nodes are inserted level by level
- Fill in the left-subtree before moving to the right one

Insertion in Complete Binary Tree

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Explanation#

As you can see in the animation above, Node 4 was inserted as a left child of Node 2 to meet the property of complete binary trees. In a Complete Binary Tree there exist no node that has a right child but not a left child. So during Insertion, make sure to insert a node as a left child first if it's empty to fill in the left sub-tree before moving to right sub-tree.

In the next lesson, we will study *Skewed Trees* which is another variation of Binary Trees!