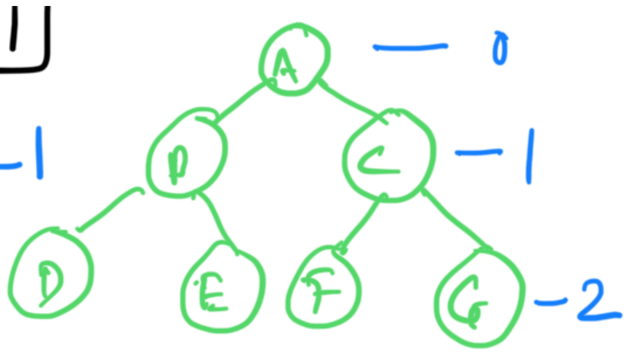
Depth = 3 $\boxed{d \geq 1}$

Max. of nodes $= 2^d - 1$

$= 2^3 - 1$

$= 7$ node.



Depth = 2 $\boxed{d \geq 0}$

Total no. of nodes

$= 2^{d+1} - 1$

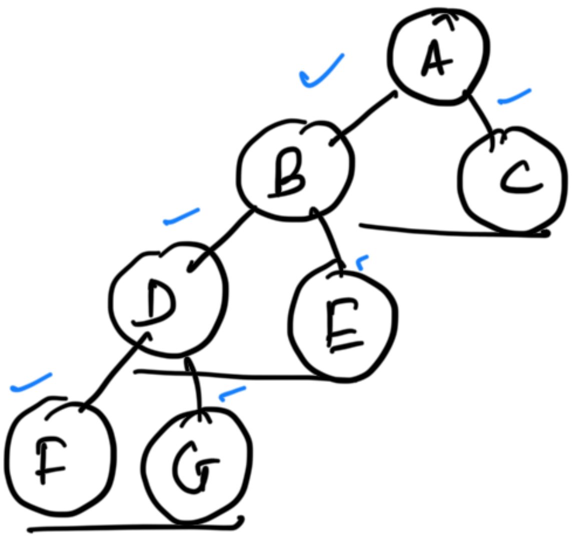
$= 2^{2+1} - 1$

$= 2^3 - 1$

$= 8 - 1$

$= 7$

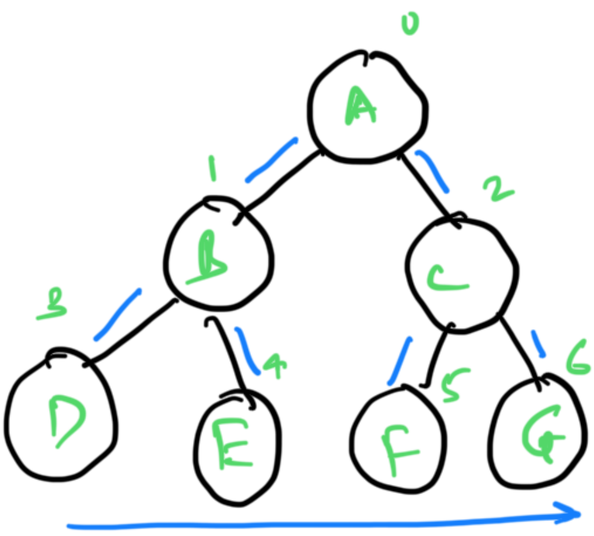
$\boxed{\text{The binary tree of depth } d \text{ that contains exactly } 2^d - 1 \text{ nodes}}$



Full Binary Tree

Complete Binary Tree

- BT with n nodes and depth d whose nodes corresponds to the node numbered from 0 to n-1 in the full binary tree of depth k.



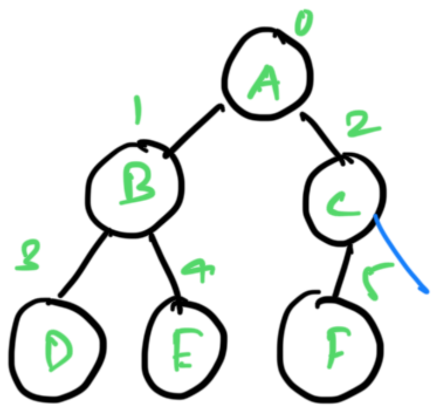
0 – 6

0 – n (L to R)

Complete BT ✓

Full BT ✓

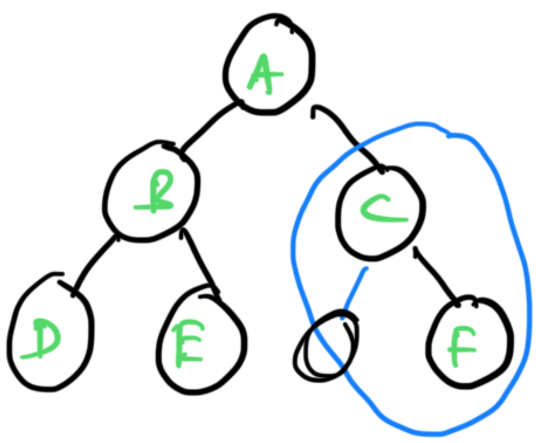
Strictly BT ✓



Complete BT

Full BT ✗

Strictly BT ✗



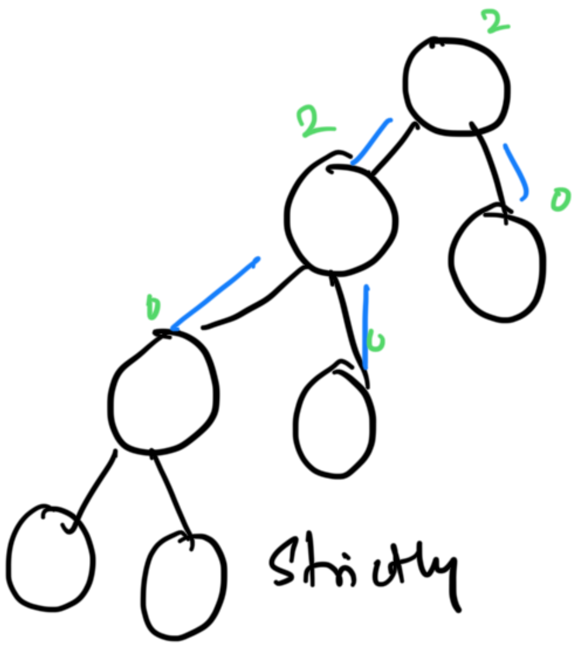
BT ✓

SBT ✗

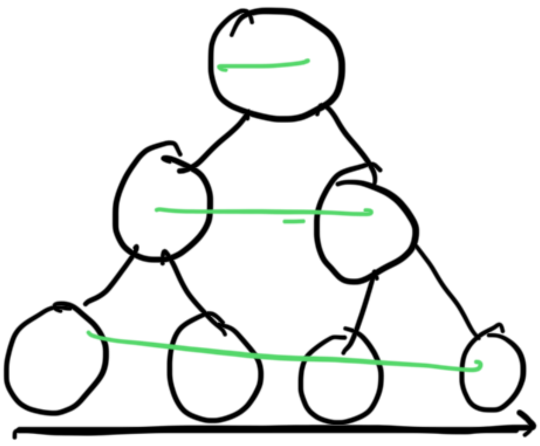
FBT ✗

CBT ✗

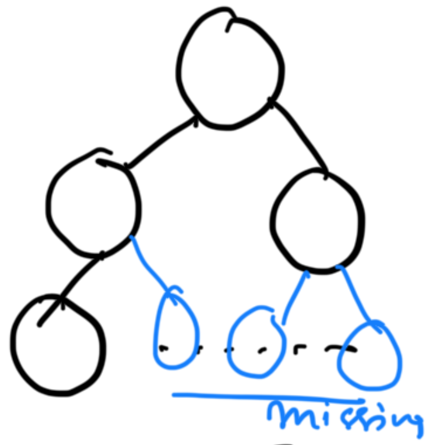
Incomplete BT



Strictly

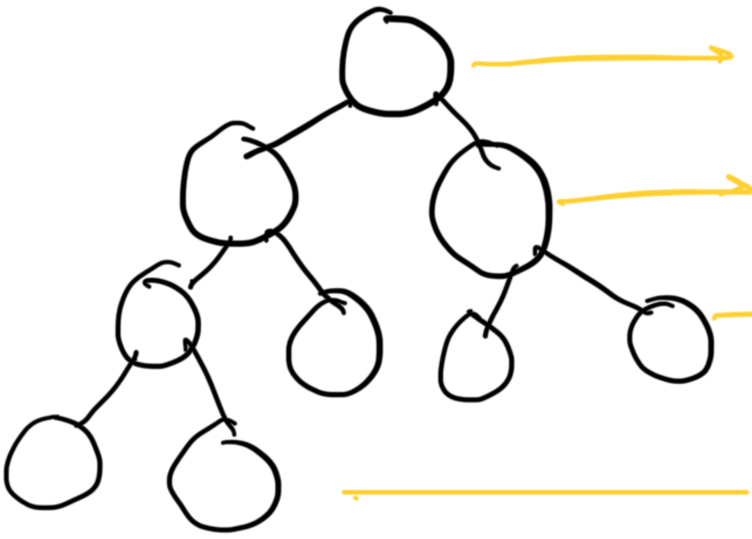


Full BT



CBT

ACBT



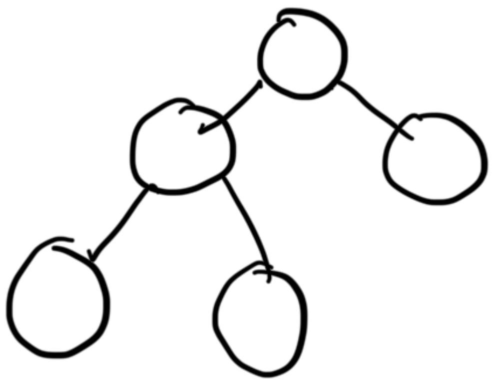
$2^0 = 1$

$2^1 = 2$

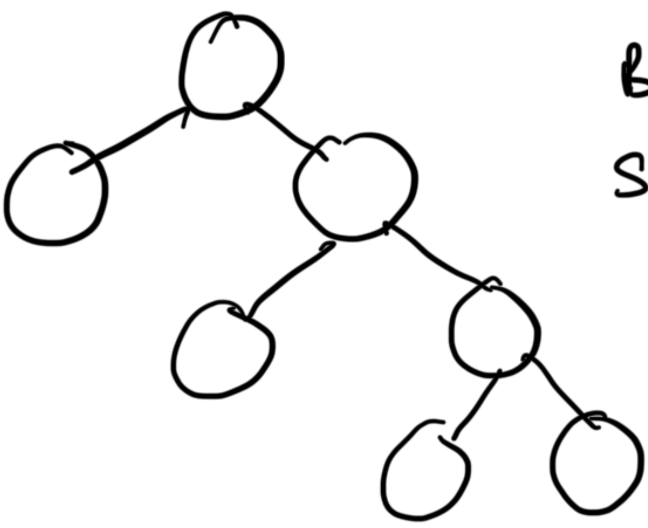
$2^2 = 4$

$2^3 = 8 - 2 = 6$ (missing)

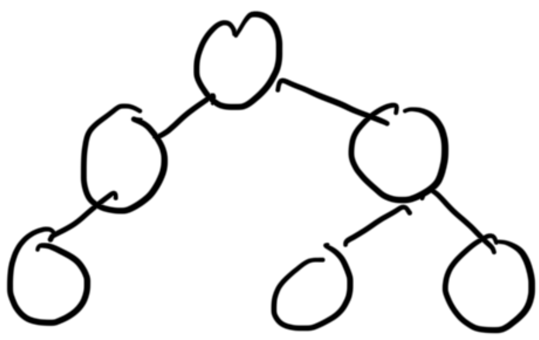
BT ✓
SBT ✓
FBT ✗
CBT ✓



BT ✓
SBT ✓
FBT ✓
CBT ✓
ACBT ✓



BT ✓
SBT ✓
CBT ✗
0 – n



BT ✓
SBT ✗
FBT ✗
CBT ✗

Perfect Binary Tree

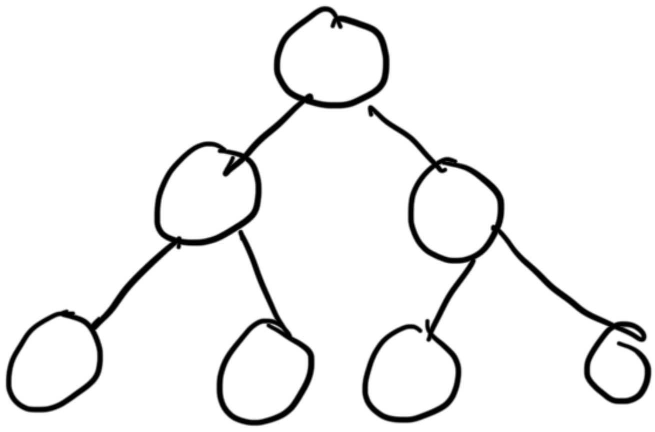
... BT in which all the leaf nodes

– special type of BT

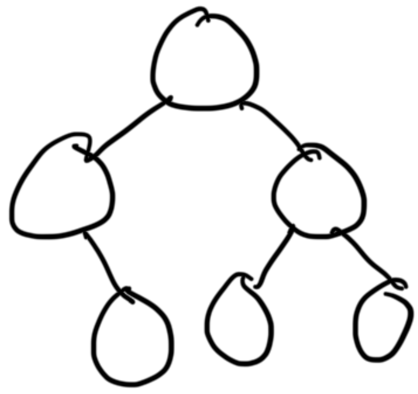
are at the same depth, and all non-leaf nodes have two childrens.

$2^0 = 1$

Perfect BT



Perfect BT



Not a PBT

1. Number of leaf nodes ⇒ height h
   then no. of leaf nodes $= 2^h$

2. Depth of a node $\Theta(\log(n))$

3. Relation between leaf nodes & non-leaf nodes
   = Leaf nodes = non leaf nodes + 1

4. Total number of node of height h
   $= 2^{h+1} - 1$

5. Height of the tree – with 'N' no. of nodes
   $\log(N+1) - 1 = \log n$

2^0
$+ 2^1$
$+ 2^2$
$+ \vdots$
$+ 2^h$

$$\frac{\quad}{2^{h+1}-1}$$