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Session 5
Question 1

If a full binary tree has 32 leaves, what is the height $H$ of the tree?

A. 4
B. 5
C. 6
D. Can’t say!
E. None of the above
Question 1 - Explanation

We know that:

• The number of nodes at any level in a full binary tree is $2^{L-1}$.
• Leaves in a full binary tree are all located at level $H$.
• Hence, the number of leaves in a full binary tree is $2^{H-1}$.

If a full binary tree has 32 leaves, then $2^{H-1} = 32$.
Take the $\log_2$ on both sides: $\log_2 2^{H-1} = \log_2 32$
This becomes: $H - 1 = \log_2 32$

$H - 1 = 5$

$H = 6$
Question 2

If a complete binary tree has 17 nodes, how many leaves does it have?

A. 8
B. 16
C. 17
D. Can’t say!
E. None of the above
We know that:

- The number of nodes in a full binary tree is $2^H - 1$.
- A full binary tree is a complete binary tree.

So, the largest full binary tree that can be contained in a complete binary tree of 17 nodes is a full tree of 15 nodes, i.e., of height $H = 4$ ($2^H - 1 = 2^4 - 1 = 15$) with $2^{H-1}$ leaves, i.e., 8 leaves.

This signifies that the complete binary tree has 2 ($\rightarrow 17 - 15$) extra nodes (leaves), i.e., 2 nodes have been inserted into a full binary tree of 15 nodes of which 8 are leaves. But one of these leaves has now become the parent of these 2 extra nodes.

So, how many leaves does the complete binary tree of 17 nodes have?

Answer: 2 extra nodes inserted at level $H$ of the complete tree + 7 leaves at level $H-1$ (i.e., 7 leaves of the full tree) $\rightarrow$ 9 leaves in total.
Question 3

If we insert G, E, Y, S, C, F, Z into a binary search tree, how can we describe the result?

A. The result is a binary search tree.
B. The result is a full binary tree.
C. The result is a complete binary tree.
D. All of the above
E. None of the above