## Lecture 8-binary search tree and trie

1. What defines a tree data structure?

a) Multiple roots

b) Cycles allowed

c) Single root and no cycles

d) Unlimited parents per node

Answer: c)

2. In a binary tree, how many children can each node have?

a) Any number

b) At most 1

c) At most 2

d) Exactly 2

Answer: c)

3. Which traversal method visits the root node first?

a) In-order

b) Pre-order

c) Post-order

d) Level-order

Answer: b)

4. Which traversal method visits the root node last?

a) In-order

b) Pre-order

c) Post-order

d) Level-order

Answer: c)

5. What is the time complexity of searching in a balanced binary search tree?

a) O(1)

b) O(log n)

c) O(n)

d) O(n^2)

Answer: b)

6. In a binary tree, which traversal visits nodes level by level from left to right?

a) In-order

b) Pre-order

c) Post-order

d) Level-order

Answer: d)

7. Which data structure is used for implementing level-order traversal?

a) Stack

b) Queue

c) Linked List

d) Array

Answer: b)

8. Which traversal method would print a binary search tree's values in ascending order?

a) Pre-order

b) In-order

c) Post-order

d) Level-order

Answer: b)

9. What is the worst-case time complexity for searching in an unbalanced binary search tree?

a) O(1)

b) O(log n)

c) O(n)

d) O(n^2)

Answer: c)

**10. What is the defining property of a Binary Search Tree?**  
 a) All nodes must have exactly two children  
 b) Left subtree contains nodes ≤ parent, right subtree contains nodes ≥ parent  
 c) The height difference between left/right subtrees cannot exceed 1  
 d) Post-order traversal gives sorted data  
**Answer:** b)

**11. Which traversal of a BST always produces nodes in ascending order?**  
 a) Pre-order  
 b) Post-order  
 c) Level-order  
 d) In-order  
**Answer:** d)

**12. A full binary tree with height 3 has how many nodes?**  
 a) 7  
 b) 15  
 c) 31  
 d) 8  
**Answer:** b) 15 [Formula: n=2^(h+1)−1 for h=3]

13. Which formula calculates the minimum height of a BST with n nodes?

a) ⌈log₂(n+1)⌉ - 1

b) n - 1

c) ⌈n/2⌉

d) 2^h - 1

Answer: a)

**14. The maximum height of a binary tree with 10 nodes is:**  
 a) 3  
 b) 9  
 c) 10  
 d) 4  
**Answer:** b) 9

**15. The minimum height of a binary tree with 10 nodes is:**  
 a) 3  
 b) 9  
 c) 10  
 d) 4  
**Answer:** a) Method 1: For a binary tree with n nodes, the height h is bounded by: ⌈log₂(n+1)⌉ - 1 ≤ h ≤ n – 1. Plug in n=10, ⌈log₂(11)⌉ - 1= 3. But this may require a calculator. Method 2: For a binary tree with height of 3, the maximum number of nodes is 2^4-1=15. For a binary tree with height of 2, the maximum number of nodes is 2^3-1=7. Since 2^3-1=7 <10 < 2^4-1=15, hence the minimum height of a binary tree with 10 nodes.

16.When deleting a node with two children in a BST, you must:

a) Replace it with its in-order predecessor/successor

b) Remove both subtrees

c) Randomly choose a child to promote

d) Swap it with the root node

Answer: a)

17. Inserting 3 elements in increasing order creates a BST with height:

a) 2

b) 3

c) 4

d) 1

Answer: a) 2

18. The worst-case time complexity for searching in an unbalanced BST is:

a) O(1)

b) O(log n)

c) O(n)

d) O(n log n)

Answer: c)

19. BSTs are preferred over hash tables when:

a) Fast insertion is critical

b) Returning a list of elements in sorted order

c) Memory usage must be minimized

d) Handling collisions is a priority

Answer: b)

20. The main advantage of a balanced BST over an unbalanced BST is:

a) Reduced memory usage

b) Guaranteed O(log n) operations

c) Faster in-order traversal

d) Simpler deletion logic

Answer: b)