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) $\lceil \log_2(n+1) \rceil - 1$
  b) n - 1
  c) $\lceil n/2 \rceil$
  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: $\lceil \log_2(n+1) \rceil - 1 \leq h \leq n - 1$. Plug in n=10, $\lceil \log_2(11) \rceil - 1 = 3$. 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)