Lecture 11-heaps

Question 1:
What is the worst-case time complexity of removeMin() in an array-based binary heap?
A. $O(1)$
B. $O(n)$
C. $O(\log n)$
D. $O(n\log n)$

Answer: C. $O(\log n)$

Question 2:
In a min-heap, every node must satisfy which condition?
A. It is greater than its parent
B. It is smaller than or equal to its children
C. It is greater than its children
D. It is smaller than its parent

Answer: B. It is smaller than or equal to its children

Question 3:
In the array representation of a heap, what is the index of the left child of a node at index $i i$?
A. $2i$
B. $2i+1$
C. $i/2$
D. $2i+2$

Answer: B. $2i+1$

Question 4:
Which step is not part of the removeMin() operation in a binary heap?
A. Replace the root with the last node
B. Percolate the new root down
C. Swap the root with the smallest child
D. Sort the entire heap

Answer: D. Sort the entire heap

Question 5:
A complete binary tree:
A. Must be a perfect binary tree
B. Has all levels filled except the last, which is filled left to right

C. Allows gaps in the last level
D. Requires every node to have exactly two children

Answer: B. Has all levels filled except the last, which is filled left to right

Question 6:
What is the time complexity of building a heap using Floyd's buildHeap algorithm?
A. $O(n\log n)$
B. $O(n)$
C. $O(\log n)$
D. $O(n^2)$

Answer: B. $O(n)$

Question 7:
During add(), which operation restores the heap invariant?
A. percolateDown()
B. percolateUp()
C. Rotating the tree
D. Sorting the array

Answer: B. percolateUp()

Question 8:
In a heap's array representation, where is the root node stored?
A. Index 0
B. Index 1
C. The middle of the array
D. The last index

Answer: A. Index 0

Question 10:
Which traversal of a BST returns elements in sorted order?
A. Pre-order
B. In-order
C. Post-order
D. Level-order

Answer: B. In-order

Question 11:
What is the primary advantage of using a heap over a BST for priority queues?
A. Faster search for arbitrary elements

B. Simpler implementation for maintaining min/max
C. Guaranteed $O(1)$ time for all operations
D. In-order traversal returns sorted data

Answer: B. Simpler implementation for maintaining min or max

Question 12:
Which property distinguishes a heap from a BST?
A. Heaps are always complete trees
B. BSTs enforce a strict ordering invariant
C. Heaps allow duplicates
D. BSTs use arrays for storage

Answer: B. BSTs enforce a strict ordering invariant

Question 13:
When using Floyd's buildHeap, why is the time complexity $O(n)$ instead of $O(n\log n)$?
A. Most nodes are near the bottom and require fewer swaps
B. The algorithm uses a sorted array
C. It ignores the heap invariants
D. It skips the percolateDown step

Answer: A. Most nodes are near the bottom and require fewer swaps