## Lecture 13-sorting algorithms

1. What is the primary characteristic of a binary heap?

a) It is a balanced binary tree

b) It satisfies the heap ordering property

c) It is always sorted

d) It has a fixed number of nodes

Answer: b

2. In a max-heap, where is the largest element located?

a) At the root

b) At the leftmost leaf

c) At the rightmost leaf

d) Randomly distributed

Answer: a

3. What is the time complexity of inserting an element into a binary heap?

a) O(1)

b) O(n)

c) O(log n)

d) O(n log n)

Answer: c

4. Which operation is used to maintain heap order when a node's key becomes larger than its parent's key?

a) Sink

b) Swim

c) Float

d) Rise

Answer: b

5. What is the worst-case time complexity of heapsort?

a) O(n)

b) O(n log n)

c) O(n^2)

d) O(2^n)

Answer: b

6. In quicksort, what is the role of the pivot element?

a) To divide the array into two subarrays

b) To determine the final sorted position

c) To swap with the first element

d) To calculate the median of the array

Answer: a

7. What is the average-case time complexity of quicksort?

a) O(n)

b) O(n log n)

c) O(n^2)

d) O(log n)

Answer: b

8. Which of the following is NOT a common pivot selection strategy in quicksort?

a) First element

b) Last element

c) Random element

d) Sum of all elements

Answer: d

9. What is the primary advantage of mergesort over quicksort?

a) It uses less memory

b) It has a better average-case time complexity

c) It is always stable

d) It is in-place

Answer: c

10. What is the space complexity of mergesort?

a) O(1)

b) O(log n)

c) O(n)

d) O(n log n)

Answer: c

11. Which sorting algorithm is typically used for small subarrays in optimized implementations of mergesort and quicksort?

a) Bubble sort

b) Selection sort

c) Insertion sort

d) Heap sort

Answer: c

12. What is the time complexity of building a heap from an unsorted array?

a) O(n)

b) O(n log n)

c) O(n^2)

d) O(log n)

Answer: a

13. Which of the following sorting algorithms is NOT stable?

a) Insertion sort

b) Merge sort

c) Quick sort

d) Bubble sort

Answer: c

14. What is the primary advantage of heapsort over quicksort?

a) Better average-case performance

b) Guaranteed O(n log n) worst-case performance

c) Less memory usage

d) Simpler implementation

Answer: b

15. In bottom-up mergesort, how are the subarrays initially sized?

a) 1 element

b) 2 elements

c) log n elements

d) n/2 elements

Answer: a

16. What is the purpose of shuffling the array before applying quicksort?

a) To improve best-case performance

b) To reduce memory usage

c) To provide a probabilistic guarantee against worst-case performance

d) To ensure stability

Answer: c

17. Which of the following is true about binary heaps?

a) They are always balanced

b) They are always sorted

c) They have a smallest possible height

d) They require parent pointers

Answer: c

18. What is the time complexity of deleting the maximum element from a binary max-heap?

a) O(1)

b) O(log n)

c) O(n)

d) O(n log n)

Answer: b

19. In quicksort, what happens if all elements are equal?

a) The algorithm fails

b) It results in the worst-case scenario

c) It results in the best-case scenario

d) It performs unnecessary swaps

Answer: b

20. Which sorting algorithm is considered the "holy grail" of sorting, combining the best features of other algorithms?

a) Timsort

b) Introsort

c) Smoothsort

d) Not yet discovered

Answer: d