

## CSE408 MCQs – Design and Analysis of Algorithm

### Unit – 1

1. What is the primary motivation behind analyzing algorithms?

- A) To understand the underlying hardware
- B) To determine the efficiency and scalability of algorithms
- C) To develop new programming languages
- D) To study the history of computer science

- Answer: B

2. Who is credited with the invention of Quicksort?

- A) Donald Knuth
- B) Alan Turing
- C) Tony Hoare
- D) Edsger Dijkstra

- Answer: C

3. What does Big-O notation describe?

- A) The exact time complexity of an algorithm
- B) The worst-case time complexity of an algorithm
- C) The best-case time complexity of an algorithm
- D) The average-case time complexity of an algorithm

- Answer: B

4. In the context of asymptotic analysis, what does the notation  $O(n^2)$  represent?

- A) The algorithm runs in linear time
- B) The algorithm runs in quadratic time
- C) The algorithm runs in logarithmic time
- D) The algorithm runs in constant time

- Answer: B

5. Which of the following is a common example of a recurrence relation?

- A)  $T(n) = T(n-1) + n$
- B)  $T(n) = n \cdot T(n/2)$
- C)  $T(n) = 2T(n/2) + n$
- D)  $T(n) = n^2 + T(n-1)$

- Answer: C

6. What sorting algorithm uses the divide-and-conquer approach and has a recurrence relation  $T(n) = 2T(n/2) + n$ ?

- A) QuickSort
- B) MergeSort
- C) BubbleSort
- D) InsertionSort

- Answer: B

7. What does the Master Theorem provide a way to solve?

- A) Linear equations
- B) Differential equations
- C) Recurrence relations
- D) Polynomial equations

- Answer: C

8. What is an ordinary generating function (OGF)?

- A) A function used to generate random numbers
- B) A series used to represent sequences
- C) A method to solve differential equations
- D) A type of binary tree

- Answer: B

9. Catalan numbers are a sequence of natural numbers that occur in various counting problems. Which of the following is the second Catalan number ( $C_2$ )?

- A) 1

- B) 2
- C) 3
- D) 5
- Answer: A

10. Which of the following describes exponential generating functions (EGFs)?

- A) They generate exponential sequences
- B) They are used to solve polynomial equations
- C) They encode sequences where the  $n$ th term's coefficient is divided by  $(n!)$
- D) They are used in binary search algorithms
- Answer: C

11. What does asymptotic analysis help us to understand about algorithms?

- A) The exact runtime for small inputs
- B) The runtime behavior for large inputs
- C) The correctness of the algorithm
- D) The memory usage of the algorithm
- Answer: B

12. In the context of trees, what is a binary search tree (BST)?

- A) A tree where each node has at most three children
- B) A tree where each node has exactly two children
- C) A tree where each node follows the left child  $<$  parent  $<$  right child property
- D) A tree used for sorting strings
- Answer: C

13. What is the path length of a tree?

- A) The number of nodes in the tree
- B) The sum of the lengths of the paths from the root to all other nodes
- C) The height of the tree
- D) The number of leaves in the tree

- Answer: B

14. Which of the following is a type of tree used in computer science?

- A) Binary Heap
- B) AVL Tree
- C) Red-Black Tree
- D) All of the above

- Answer: D

15. What is the main idea of telescoping in the context of solving recurrence relations?

- A) Simplifying a sum by cancellation of terms
- B) Expanding a product into a sum
- C) Converting a series into a polynomial
- D) Transforming a differential equation

- Answer: A

16. Which of the following is true about the MergeSort algorithm?

- A) It has a best-case time complexity of  $O(n \log n)$
- B) It has a worst-case time complexity of  $O(n^2)$
- C) It sorts in place
- D) It uses the quicksort partitioning method

- Answer: A

17. What is the significance of generating functions in combinatorial mathematics?

- A) They are used to generate random numbers
- B) They provide a way to encode sequences and manipulate them algebraically
- C) They simplify numerical integration
- D) They are used in machine learning algorithms

- Answer: B

18. Which of the following best describes the Master Theorem for divide-and-conquer recurrences?

- A) It provides exact solutions for all recurrences
- B) It offers a way to solve recurrences of the form  $T(n) = aT(n/b) + f(n)$
- C) It applies only to linear recurrences
- D) It is used to solve differential equations
- Answer: B

19. What is an important property of binary search trees (BSTs) that allows efficient searching?

- A) Each node has two children
- B) Nodes are stored in sequential order
- C) The left child is always smaller than the parent, and the right child is always larger
- D) They use hashing for fast lookup
- Answer: C

20. What does the term "asymptotic of finite sums" refer to in algorithm analysis?

- A) The exact computation of sums
- B) The behavior of sums as the number of terms grows
- C) The sum of an infinite series
- D) The average value of a finite sum
- Answer: B

## UNIT – 2

1. What is a trie?

- A) A type of binary search tree
- B) A tree data structure used to store a dynamic set of strings
- C) A sorting algorithm
- D) A type of linked list
- Answer: B

2. Which of the following is a characteristic feature of tries?

- A) They store keys in a hash table
- B) Each node represents a single character of a string
- C) They are used for arithmetic operations
- D) They are a type of balanced binary tree
- Answer: B

3. What is a suffix tree?

- A) A compressed trie of all the suffixes of a given string
- B) A binary search tree of suffixes
- C) A sorted array of suffixes
- D) A hash table of suffixes
- Answer: A

4. What is the main advantage of using a suffix tree for pattern matching?

- A) It requires less memory
- B) It can find all occurrences of a pattern in linear time
- C) It is easier to implement
- D) It is more flexible than other methods
- Answer: B

5. Which data structure is used to store the sorted order of suffixes of a string?

- A) Suffix tree
- B) Suffix array
- C) Trie
- D) Hash table
- Answer: B

6. What is the time complexity of constructing a suffix array?

- A)  $O(n \log n)$
- B)  $O(n^2)$
- C)  $O(n)$
- D)  $O(n \log^2 n)$
- Answer: A

7. Which algorithm is used for efficient pattern matching that preprocesses the pattern to create a partial match table?

- A) Rabin-Karp algorithm
- B) Knuth-Morris-Pratt (KMP) algorithm
- C) Boyer-Moore algorithm
- D) Brute force algorithm
- Answer: B

8. What is the purpose of the partial match table in the KMP algorithm?

- A) To store the positions of matches
- B) To skip unnecessary comparisons
- C) To count the number of matches
- D) To reverse the pattern
- Answer: B

9. What is the time complexity of the Knuth-Morris-Pratt (KMP) algorithm for pattern matching?

- A)  $O(m+n)$
- B)  $O(mn)$

- C)  $O(m \log n)$
- D)  $O(n^2)$
- Answer: A

10. In the context of tries, what is a common application?

- A) Searching sorted arrays
- B) Dictionary implementations
- C) Performing matrix multiplications
- D) Implementing stacks and queues
- Answer: B

11. How does a suffix tree improve the performance of finding all occurrences of a pattern in a text?

- A) By sorting all characters
- B) By allowing linear-time queries
- C) By using less memory than other data structures
- D) By avoiding the need for preprocessing
- Answer: B

12. What is the main difference between a suffix tree and a trie?

- A) Suffix trees are used for sorting, while tries are not
- B) Suffix trees are compressed versions of tries with all suffixes of a string
- C) Tries can only store binary data
- D) Suffix trees can only store numeric data
- Answer: B

13. What is the purpose of the LCP (Longest Common Prefix) array in the context of suffix arrays?

- A) To store the longest prefix of the string
- B) To store the lengths of the longest common prefixes between suffixes
- C) To store the suffixes in sorted order
- D) To store the characters of the string
- Answer: B



14. Which of the following best describes the bit string with restrictions in the context of tries?

- A) A string that can contain only 0s
- B) A string that follows specific patterns or constraints
- C) A string that can be converted to a trie
- D) A string used in sorting algorithms
- Answer: B

15. What is the primary advantage of using a trie over a hash table for storing strings?

- A) Faster search time
- B) Supports prefix-based queries efficiently
- C) Uses less memory
- D) Easier to implement
- Answer: B

16. Which algorithm can be used to construct a suffix tree in linear time?

- A) Ukkonen's algorithm
- B) QuickSort
- C) MergeSort
- D) Dijkstra's algorithm
- Answer: A

17. What is the main use of the suffix array in string matching?

- A) To find the shortest substring
- B) To perform efficient pattern matching and substring searches
- C) To sort the characters of a string
- D) To reverse the string
- Answer: B

18. In the KMP algorithm, what does the "failure function" do?

- A) It determines the next character to match

- B) It calculates the hash value of the pattern
- C) It precomputes the longest prefix which is also a suffix
- D) It sorts the characters of the pattern
- Answer: C

19. What is a common real-world application of suffix trees and arrays?

- A) Image processing
- B) Network routing
- C) Text indexing and DNA sequence analysis
- D) Financial modeling
- Answer: C

20. Which of the following is true about the Knuth-Morris-Pratt (KMP) algorithm?

- A) It is inefficient for large texts
- B) It preprocesses the text to create a partial match table
- C) It preprocesses the pattern to create a partial match table
- D) It uses randomization for pattern matching
- Answer: C

## UNIT – 3

1. What is the main idea behind divide and conquer algorithms?

- A) Solving a problem by merging multiple smaller problems
- B) Dividing a problem into smaller subproblems, solving each subproblem, and then combining their solutions
- C) Using brute force to solve a problem
- D) Solving a problem iteratively without recursion
- Answer: B

2. Which of the following problems can be efficiently solved using the divide and conquer technique?

- A) Sorting
- B) Matrix multiplication
- C) Finding the closest pair of points
- D) All of the above
- Answer: D

3. What is the goal of the Max Subarray Problem?

- A) To find the maximum element in an array
- B) To find the contiguous subarray with the largest sum
- C) To sort an array in ascending order
- D) To divide an array into two halves
- Answer: B

4. What is the time complexity of the divide and conquer approach for the Max Subarray Problem?

- A)  $O(n)$
- B)  $O(n \log n)$
- C)  $O(n^2)$
- D)  $O(\log n)$
- Answer: B

5. What is Karatsuba's Multiplication Algorithm used for?

- A) Sorting arrays
- B) Multiplying large numbers
- C) Finding the maximum subarray sum
- D) Solving linear equations
- Answer: B

6. What is the time complexity of Karatsuba's Multiplication Algorithm?

- A)  $O(n^2)$
- B)  $O(n \log n)$
- C)  $O(n^{\log_2 3})$
- D)  $O(n)$
- Answer: C

7. What does FFT stand for in the context of divide and conquer algorithms?

- A) Fast Function Transformation
- B) Fourier Functional Technique
- C) Fast Fourier Transform
- D) Functional Fourier Transformation
- Answer: C

8. Which of the following is a key application of the FFT algorithm?

- A) Polynomial multiplication
- B) Sorting large datasets
- C) Image compression
- D) Searching in a database
- Answer: A

9. What is the primary use of complex numbers in FFT?

- A) To represent data in a different format
- B) To handle real and imaginary parts of the transform

- C) To simplify the algorithm
- D) To perform arithmetic operations faster
- Answer: B

10. What is the main benefit of using FFT for polynomial multiplication?

- A) It reduces the time complexity to  $O(n \log n)$
- B) It provides more accurate results
- C) It simplifies the multiplication process
- D) It uses less memory
- Answer: A

11. How does the divide and conquer approach work in the FFT algorithm?

- A) By sorting the input data
- B) By dividing the DFT into smaller DFTs, solving them recursively, and combining their results
- C) By performing matrix multiplication
- D) By using dynamic programming to store results
- Answer: B

12. What is the time complexity of the Fast Fourier Transform (FFT) algorithm?

- A)  $O(n^2)$
- B)  $O(n \log n)$
- C)  $O(n)$
- D)  $O(\log n)$
- Answer: B

13. What is a key application of FFT in data analysis?

- A) Image processing
- B) Audio signal processing
- C) Stock market analysis
- D) All of the above
- Answer: D

14. Which part of the FFT algorithm is responsible for combining the results of smaller DFTs?

- A) The initial division of the data
- B) The recursive calls to compute smaller DFTs
- C) The merging process
- D) The final multiplication of results
- Answer: C

15. In the context of FFT, what is a discrete Fourier transform (DFT)?

- A) A method to multiply polynomials
- B) A way to transform a sequence of complex numbers into another sequence representing frequency components
- C) A sorting algorithm
- D) A dynamic programming technique
- Answer: B

16. What is the main advantage of the FFT algorithm over the direct computation of the DFT?

- A) Simplicity of implementation
- B) Improved time complexity
- C) Reduced memory usage
- D) More accurate results
- Answer: B

17. Which of the following is true about the relationship between FFT and DFT?

- A) FFT is an approximation of DFT
- B) FFT and DFT are completely unrelated
- C) FFT is a fast algorithm to compute the DFT
- D) DFT is only used in theoretical computations
- Answer: C

18. How does the FFT algorithm handle the computation of complex exponentials efficiently?

- A) By using lookup tables
- B) By recursive subdivision and combination of results
- C) By parallel processing
- D) By simplifying the equations
- Answer: B

19. What is a practical use of FFT in real-time systems?

- A) Real-time audio signal processing
- B) Real-time video streaming
- C) Real-time database querying
- D) Real-time stock trading
- Answer: A

20. Which step in Karatsuba's Multiplication Algorithm divides the numbers into parts?

- A) The addition step
- B) The subtraction step
- C) The splitting step
- D) The multiplication step
- Answer: C