1. Consider a linked list of n elements. What is the time taken to insert an element after an element pointed by some pointer?

   A. O(1)  \hspace{1cm} B. O(n)  \hspace{1cm} C. O(\log_2 n)  \hspace{1cm} D. O(n \log_2 n)

   Answer A

2. An algorithm is made up of two independent time complexities f(n) and g(n). Then the complexities of the algorithm is in the order of

   A. f(n) \times g(n)  \hspace{1cm} B. \text{Max}(f(n), g(n))  \hspace{1cm} C. \text{Min}(f(n), g(n))  \hspace{1cm} D. f(n) + g(n)

   Answer B

3. Two main measures for the efficiency of an algorithm are

   A. Processor and memory  \hspace{1cm} B. Complexity and capacity  \hspace{1cm} C. Time and space  \hspace{1cm} D. Data and space

   Answer C

4. The total number of comparisons in a bubble sort is

   A. O(\log n)  \hspace{1cm} B. O(n \log n)  \hspace{1cm} C. O(n)  \hspace{1cm} D. None of the above

   Answer B

5. Time complexities of three algorithms are given. Which should execute the slowest for large values of N?

   A. (1^2) O(N)  \hspace{1cm} B. O(N)  \hspace{1cm} C. O(\log N)  \hspace{1cm} D. None of these

   Answer B

6. The upper bound of computing time of m coloring decision problem is

   A. O(n^m)  \hspace{1cm} B. O(nm)  \hspace{1cm} C. O(n^m^m)  \hspace{1cm} D. O(n^m^m)

   Answer C

7. The space factor when determining the efficiency of algorithm is measured by

   A. Counting the maximum memory needed by the algorithm
   B. Counting the minimum memory needed by the algorithm
   C. Counting the average memory needed by the algorithm
D. Counting the maximum disk space needed by the algorithm

Answer A

8. If the address of A[1][1] and A[2][1] are 1000 and 1010 respectively and each element occupies 2 bytes then the array has been stored in ________ order.

A. row major  B. column major  C. matrix major  D. none of these

Answer A

9. The time factor when determining the efficiency of algorithm is measured by

A. Counting microseconds
B. Counting the number of key operations
C. Counting the number of statements
D. Counting the kilobytes of algorithm

Answer B

10. The worst case occur in linear search algorithm when

A. Item is somewhere in the middle of the array
B. Item is not in the array at all
C. Item is the last element in the array
D. Item is the last element in the array or is not there at all

Answer D

11. A list of n strings, each of length n, is sorted into lexicographic order using the merge-sort algorithm. The worst case running time of this computation is

A. O (n log n)  B. O (n^2 log n)  C. O (n^2 + log n)  D. O (n^2)

Answer A

12. Which of the following case does not exist in complexity theory

A. Best case  B. Worst case  C. Average case  D. Null case

Answer D

13. The minimum number of multiplications and additions required to evaluate the polynomial P = 4x^3 + 3x^2 - 15x + 45 is
A. 6 & 3  B. 4 & 2  C. 3 & 3  D. 8 & 3

Answer C

14. The concept of order Big O is important because
A. It can be used to decide the best algorithm that solves a given problem
B. It determines the maximum size of a problem that can be solved in a given amount of time
C. It is the lower bound of the growth rate of algorithm
D. Both A and B

Answer A

15. The worst case running time to search for an element in a balanced binary search tree with \(n^2\) elements is
A. \(T(n\log n)\)  B. \(T(n^2)\)  C. \(T(n)\) D. \(T(\log n)\)

Answer C

16. Which of the following sorting algorithm is of divide-and-conquer type?
A. Bubble sort  B. Insertion sort  C. Quick sort  D. All of above

Answer C

17. The quick sort algorithm exploit ________ design technique
A. Greedy  B. Dynamic programming  C. Divide and Conquer  D. Backtracking

Answer C

18. The number of distinct simple graphs with up to three nodes are
A. 15  B. 10  C. 7  D. 9

Answer C

19. The number of unused pointers in a complete binary tree of depth 5 is
A. 4  B. 8  C. 16  D. 32

Answer C

20. A given connected graph \(G\) is a Euler graph, if and only if all vertices of \(G\) are of
A. Same degree  B. Even degree  C. Odd degree  D. Different degree

Answer B
21. What is the maximum number of nodes in a B-tree of order 10 of depth 3 (root at depth 0)?
   A. 111    B. 999    C. 9999    D. None of the above
   Answer D

22. One can convert a binary tree into its mirror image by traversing it in
   A. Inorder   B. Preorder   C. Postorder   D. Any order
   Answer C

23. Graphs are represented using
   A. Adjacency tree   B. Adjacency linked list   C. Adjacency graph   D. Adjacency queue
   Answer B

24. The data structure required for breadth first traversal on a graph is
   A. Queue   B. Stack   C. Array   D. Tree
   Answer A

25. Number of edges of a complete binary tree with 16 leaf nodes are
   A. 14   B. 30   C. 32   D. 28
   Answer B

26. Tree
   A. Is a bipartite graph
   B. With n node contains n-1 edges
   C. Is a connected graph
   D. All of these
   Answer D

27. If every node u in G is adjacent to every other node v in G, a graph is said to be
   A. Isolated   B. Complete   C. Finite   D. Strongly Connected
   Answer B

28. Consider the following pseudo-code:
   If (A > B) and (C > D) then
      A = A + 1
      B = B + 1
   Endif
   The cyclomatic complexity of the pseudo-code is
29. Leaves of which of the following trees are at the same level?
   A. Binary tree  B. B-tree  C. AVL-tree  D. Expression tree
Answer B

30. The Inorder traversal of the tree will yield a sorted listing of elements of tree in
   A. Binary tree  B. Binary search tree  C. Heaps  D. None of the above
Answer B

31. One can make an exact replica of a Binary Search Tree by traversing it in
   A. Inorder  B. Preorder  C. Postorder  D. Any order
Answer B

32. Let A be an adjacency matrix of a graph G. The th ij entry in the matrix K A , gives
   A. The number of paths of length K from vertex Vi to vertex Vj.
   B. Shortest path of K edges from vertex Vi to vertex Vj.
   C. Length of a Eulerian path from vertex Vi to vertex Vj.
   D. Length of a Hamiltonian cycle from vertex Vi to vertex Vj.
Answer B

33. A graph in which all nodes are of equal degree is called
   A. Multi graph  B. Non regular graph  C. Regular graph  D. Complete graph
Answer C

34. The time complexity to build a heap of n elements is
   A. 0(1)  B. 0(lgn)  C. 0(n)  D. 0(nlgn)
Answer D

35. Given a binary tree whose inorder and preorder traversal are given by
   Inorder : EICFBGDJHK
   Preorder : BCEIFDGHJK
   The post order traversal of the above binary tree is
36. The running time of the following sorting algorithm depends on whether the partitioning is balanced or unbalanced
   A. Insertion sort  B. Selection sort  C. Quick sort  D. Merge sort
Answer C

37. In worst case Quick Sort has order
   A. O (n log n)  B. O (n^2/2)  C. O (log n)  D. O (n^2/4)
Answer B

38. The sorting technique where array to be sorted is partitioned again and again in such a way that all elements less than or equal to partitioning element appear before it and those which are greater appear after it, is called
   A. Merge sort  B. Quick sort  C. Selection sort  D. None of these
Answer B

39. The best average behaviour is shown by
   A. Quick Sort  B. Merge Sort  C. Insertion Sort  D. Heap Sort
Answer A

40. Quick sort is also known as
   A. Merge sort  B. Heap sort  C. Bubble sort  D. None of these
Answer D

41. Assuming P \neq NP, which of the following is TRUE?
   A. NP-complete = NP  B. NP-completenP=\theta  C. NP-hard = NP  D. P = NP-complete
Answer B

42. If there is an NP complete language L whose complement is in NP ,then complement of any language in NP is in
   A. P  B. NP  C. Both A and B  D. None of these
Answer B

43. Both P and NP are closed under the operation of
44. If every node u in G is adjacent to every other node v in G, A graph is said to be
   A. Isolated
   B. Complete
   C. Finite
   D. Strongly Connected

Answer: B

45. Which of the following sorting algorithms has the lowest worst case complexity?

   A. Merge sort
   B. Bubble sort
   C. Quick sort
   D. Selection sort

46. Randomized quicksort is an extension of quicksort where the pivot is chosen randomly. What is the worst case complexity of sorting n numbers using randomized quicksort?
   (a) O(n)    (b) O(n log n)    (c) O(n^2)    (d) O(n!)

47. Level of any node of a tree is
   A. Height of its left subtree minus height of its right subtree
   B. Height of its right subtree minus height of its left subtree
   C. Its distance from the root
   D. None of these

48. The total number of comparisons in a bubble sort is
   A. \(O(\log n)\)
   B. \(O(n \log n)\)
   C. \(O(n)\)
   D. None of the above

49. Time complexities of three algorithms are given. Which should execute the slowest for large values of N?
50. The quick sort algorithm exploit ________ design technique

A. Greedy
B. Dynamic programming
C. Divide and Conquer
D. Backtracking

51. A sort which relatively passes through a list to exchange the first element with any element less than it and then repeats with a new first element is called

A. Insertion sort  B. Selection sort
C. Heap sort  Quick sort

52. The pre order and post order traversal of a Binary Tree generates the same output. The tree can have maximum

A. Three nodes
B. Two nodes
C. One node
D. Any number of nodes

53. A search technique where we keep expanding nodes with least accumulated cost so far is called

A. Hill climbing
B. Branch and bound
C. Best first
D. Divide and conquer

54. The spanning tree of connected graph with 10 vertices contains

A. 9 edges  B. 11 edges  C. 10 edges  D. 10 vertices

55. The post order traversal of a binary tree is DEBFCA. Find out the preorder traversal.

A. ABFCDE
B. ADBFEC
C. ABDECF
56. Which of the following statements are TRUE?
(1) The problem of determining whether there exists a cycle in an undirected graph is in P.
(2) The problem of determining whether there exists a cycle in an undirected graph is in NP.
(3) If a problem A is NP-Complete, there exists a non-deterministic polynomial time algorithm to solve A.

A. 1, 2 and 3  
B. 1 and 2 only  
C. 2 and 3 only  
D. 1 and 3 only

57. A binary tree can easily be converted into a 2-tree

A. by replacing each empty sub tree by a new internal node  
B. by inserting an internal nodes for non-empty node  
C. by inserting an external nodes for non-empty node  
D. by replacing each empty sub tree by a new external node

58. Which of the following sorting procedures is the slowest?

A. Quick sort  
B. Heap sort  
C. Shell sort  
D. Bubble sort

59. The pre-order and post order traversal of a Binary Tree generates the same output. The tree can have maximum

A. Three nodes  
B. Two nodes  
C. One node  
D. Any number of nodes

60. Assuming $P \neq NP$, which of the following is TRUE?

(A) NP-complete = NP  
(C) NP-hard = NP  
(B) NP-complete $\cap$ P = $\emptyset$  
(D) P = NP-complete

A. A  
B. B  
C. C  
D. D

61. Two isomorphic graphs must have

A. Equal number of vertices  
B. Same number of edges
62. If each node in a tree has value greater than every value in its left subtree and has value less than every in the its right subtree, the tree is called
   A. Complete tree  B. Full binary tree  
   C. Binary search tree  D. Threaded tree

63. A simple graph in which there exists an edge between pair of vertices is called
   A. Regular graph  B. Planner graph  
   C. Euler graph  D. Complete graph

64. The best average behaviour is shown by
   A. Quick sort  B. Merge sort  
   C. Insertion sort  D. Heap sort

65. Which of the following sorting algorithm is of divide-and-conquer type?
   A. Bubble sort  B. Insertion sort  
   C. Quick sort  D. All of above

66. The recurrence relation capturing the optimal execution time of the Towers of Hanoi problem with n discs is
   A. \( T(n) = 2T(n - 2) + 2 \)  
   B. \( T(n) = 2T(n - 1) + n \)  
   C. \( T(n) = 2T(n/2) + 1 \)  
   D. \( T(n) = 2T(n - 1) + 1 \)

67. What is the time complexity of Bellman-Ford single-source shortest path algorithm on a complete graph of n vertices?
   (A) \( \Theta(n^2) \)  
   (B) \( \Theta(n^2 \log n) \)  
   (C) \( \Theta(n^3) \)  
   (D) \( \Theta(n^3 \log n) \)
   A. A  B. B  C. C  D. D
68. **The goal of hashing is to produce a search that takes**

A. $O(1)$ time  
B. $O(n^2)$ time  
C. $O(\log n)$ time  
D. $O(n \log n)$ time

69. **One can make an exact replica of a Binary Search Tree by traversing it in**

A. Inorder  
B. Preorder  
C. Postorder  
D. Any order

70. **When converting binary tree into extended binary tree, all the original nodes in binary tree are**

A. internal nodes on extended tree  
B. external nodes on extended tree  
C. vanished on extended tree  
D. None of above

71. **The postfix form of $A*B+C/D$ is**

A. $A*B/CD+$  
B. $AB*CD/$  
C. $A*BC+/D$  
D. $ABCD+/*$

72. **For the bubble sort algorithm, what is the time complexity of the best/worst case?**  
(assume that the computation stops as soon as no more swaps in one pass)

(a) best case: $O(n)$ worst case: $O(n*n)$  
(b) best case: $O(n)$ worst case: $O(n*\log(n))$  
(c) best case: $O(n*\log(n))$ worst case: $O(n*\log(n))$  
(d) best case: $O(n*\log(n))$ worst case: $O(n*n)$

Answer : A

73. **For the quick sort algorithm, what is the time complexity of the best/worst case?**

(a) best case: $O(n)$ worst case: $O(n*n)$  
(b) best case: $O(n)$ worst case: $O(n*\log(n))$  
(c) best case: $O(n*\log(n))$ worst case: $O(n*\log(n))$  
(d) best case: $O(n*\log(n))$ worst case: $O(n*n)$

Answer : D
74. In an arbitrary tree (not a search tree) of order M. Its size is N, and its height is K. The computation time needed to find a data item on T is

(a) $O(K \times K)$
(b) $O(M \times M)$
(c) $O(N)$
(d) $O(K)$

Answer: C

75. When we organize our data as an ordered list, what is the time complexity of inserting/deleting a data item to/from the list?

(a) $O(\text{length_of_list} \times \text{length_of_list})$
(b) $O(\text{length_of_list})$
(c) $O(\log(\text{length_of_list} \times \text{length_of_list} ))$
(d) $O(1)$

Answer: B

76. Five statements about B-trees are below. Four of them are correct. Which one is INCORRECT?

(a) All B-trees are also search trees
(b) The word B-tree stands for balanced tree
(c) The word B-tree also stands for binary tree
(d) All leaves of a B-tree must be on the same level

Answer: C

77. For any B-tree of height $H$ ($H>1$), after inserting a new key, is it possible for a key, $K$, which was located in a leaf-node to move up to the root in this regard which of the following is correct?

(a) Can’t be defined without data
(b) Never
(c) Yes, only if $H=2$
(d) Yes

Answer: D

78. When we say the order of a tree is $M$, we mean

(a) Every non-leaf node must have $M$ subtrees
(b) Every non-leaf node must have $M$ keys
(c) Every non-leaf node can have at most $M$ subtrees
(d) Every non-leaf node can have at most $M$ keys

Answer: C
79. T is a search tree of order M, its size is N, and its height is K. The computation time needed to INSERT/DELETE a data item on T is

(a) \( O(1) \)
(b) \( O(M) \)
(c) \( O(\log K) \)
(d) \( O(K) \)

Answer: D

80. Suppose that we have a data file containing records of famous people, and we need to build a hash table to find a record from the person's birthday. The size of the hash table is 4096. The following are hash functions which convert a birthday to an integer. Which of the following function is the best?

(a) \( h_1(\text{day/month/year}) = \text{day} + \text{month} + \text{year} \)
(b) \( h_2(\text{day/month/year}) = \text{day} + \text{month} \times 31 + \text{year} \)
(c) \( h_3(\text{day/month/year}) = (\text{day} + \text{month} \times 31 + \text{year} \times 365) \mod 4096 \)
(d) \( h_4(\text{day/month/year}) = (\text{day} + \text{month} \times 31 + \text{year} \times 365) \mod 4093 \)

Answer: D

EXERCISE QUESTIONS

1. Consider a linked list of n elements. What is the time taken to insert an element after an element pointed by some pointer?

A. \( O(1) \)  B. \( O(n) \)  C. \( O(\log_2 n) \)  D. \( O(n \log_2 n) \)

Answer A

2. An algorithm is made up of two independent time complexities \( f(n) \) and \( g(n) \). Then the complexities of the algorithm is in the order of

A. \( f(n) \times g(n) \)  B. \( \max(f(n), g(n)) \)  C. \( \min(f(n), g(n)) \)  D. \( f(n) + g(n) \)

Answer B

3. Two main measures for the efficiency of an algorithm are

A. Processor and memory  B. Complexity and capacity  C. Time and space  D. Data and space

Answer C

4. The total number of comparisons in a bubble sort is
A. $O(\log n)$ B. $O(n \log n)$ C. $O(n)$ D. None of the above

Answer B

5. Time complexities of three algorithms are given. Which should execute the slowest for large values of $N$?

A. $(\log n)$ B. $O(N)$ C. $O(\log N)$ D. None of these

Answer B

6. The upper bound of computing time of $m$ coloring decision problem is

A. $O(nm)$ B. $O(nm^2)$ C. $O(nm^3)$ D. $O(n^m m^3)$

Answer C

7. The space factor when determining the efficiency of algorithm is measured by

A. Counting the maximum memory needed by the algorithm
B. Counting the minimum memory needed by the algorithm
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Answer D

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Answer A

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A. Best case B. Worst case C. Average case D. Null case

Answer D

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A. 6 & 3 B. 4 & 2 C. 3 & 3 D. 8 & 3

Answer C

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B. It determines the maximum size of a problem that can be solved in a given amount of time
C. It is the lower bound of the growth rate of algorithm
D. Both A and B

Answer A

15. The worst case running time to search for an element in a balanced binary search tree with n^2 elements is
A. T(n log n) B. T(n^2) C. T(n) D. T( log n)

Answer C

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A. Bubble sort B. Insertion sort C. Quick sort D. All of above
17. The quick sort algorithm exploit ________ design technique
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   Answer C

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20. A given connected graph G is a Euler graph, if and only if all vertices of G are of
   A. Same degree B. Even degree C. Odd degree D. Different degree
   Answer B

21. What is the maximum number of nodes in a B-tree of order 10 of depth 3 (root at depth 0)?
   A. 111 B. 999 C. 9999 D. None of the above
   Answer D

22. One can convert a binary tree into its mirror image by traversing it in
   A. Inorder B. Preorder C. Postorder D. Any order
   Answer C

23. Graphs are represented using
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   Answer B

24. The data structure required for breadth first traversal on a graph is
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A = A + 1
B = B + 1
Endif
The cyclomatic complexity of the pseudo-code is
A. 2 B. 3 C. 4 D. 5
Answer D

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Answer B

30. The Inorder traversal of the tree will yield a sorted listing of elements of tree in
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D. Length of a Hamiltonian cycle from vertex Vi to vertex Vj.

Answer B

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Answer C

34. The time complexity to build a heap of n elements is

A. 0(1) B. 0(lgn) C. 0(n) D. 0(nlgn)

Answer D

35. Given a binary tree whose inorder and preorder traversal are given by
   Inorder : EICFBGDJHK
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   The post order traversal of the above binary tree is

A. IEFCGJKHDB B. IEFCJGKHDB C. IEFCGKHDB D. IEFCGJKDBH

Answer A

36. The running time of the following sorting algorithm depends on whether the partitioning is balanced or unbalanced

A. Insertion sort B. Selection sort C. Quick sort D. Merge sort

Answer C

37. In worst case Quick Sort has order

A. O (n log n) B. O (n^2/2) C. O (log n) D. O (n^2/4)

Answer B

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A. Merge sort B. Quick sort C. Selection sort D. None of these

Answer B

39. The best average behaviour is shown by
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Answer A

40. Quick sort is also known as

A. Merge sort B. Heap sort C. Bubble sort D. None of these

Answer D

41. Assuming P ? NP, which of the following is TRUE?

A. NP-complete = NP B. NP-completeNP=theta C. NP-hard = NP D. P = NP-complete

Answer B

42. If there is an NP complete language L whose complement is in NP, then complement of any language in NP is in

A. P B. NP C. Both A and B D. None of these

Answer B

43. Both P and NP are closed under the operation of

A. Union B. Intersection C. Concatenation D. Kleene

Answer D

44. If every node u in G is adjacent to every other node v in G, A graph is said to be

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B. O(N)
C. O(log N)
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A. Greedy
B. Dynamic programming
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A. Insertion sort  B. Selection sort
C. Heap sort  Quick sort

52. **The pre order and post order traversal of a Binary Tree generates the same output. The tree can have maximum**
53. A search technique where we keep expanding nodes with least accumulated cost so far is called

A. Hill climbing  
B. Branch and bound  
C. Best first  
D. Divide and conquer

54. The spanning tree of connected graph with 10 vertices contains

A. 9 edges  
B. 11 edges  
C. 10 edges  
D. 10 vertices

55. The post order traversal of a binary tree is DEBFCA. Find out the preorder traversal.

A. ABFCDE  
B. ADBFEC  
C. ABDECF  
D. ABDCEF

56. Which of the following statements are TRUE?

(1) The problem of determining whether there exists a cycle in an undirected graph is in $P$.  
(2) The problem of determining whether there exists a cycle in an undirected graph is in $NP$.  
(3) If a problem A is $NP$-Complete, there exists a non-deterministic polynomial time algorithm to solve A.

B. 1, 2 and 3  
B. 1 and 2 only  
C. 2 and 3 only  
D. 1 and 3 only

57. A binary tree can easily be converted into a 2-tree

A. by replacing each empty sub tree by a new internal node  
B. by inserting an internal nodes for non-empty node  
C. by inserting an external nodes for non-empty node  
D. by replacing each empty sub tree by a new external node

58. Which of the following sorting procedures is the slowest?

A. Quick sort
59. The pre-order and post order traversal of a Binary Tree generates the same output. The tree can have maximum

A. Three nodes  
B. Two nodes  
C. One node  
D. Any number of nodes

60. Assuming P ≠ NP, which of the following is TRUE?

(A) NP-complete = NP
(B) NP-complete ∩ P = ∅
(C) NP-hard = NP
(D) P = NP-complete

A. A  B. B  C. C  D. D

61. Two isomorphic graphs must have

A. Equal number of vertices  
B. Same number of edges  
C. Same number of vertices  
D. All of the above

62. If each node in a tree has value greater than every value in its left subtree and has value less than every in the its right subtree ,the tree is called

B. Complete tree  
C. Binary search tree  
D. Threaded tree

63. A simple graph in which there exists an edge between pair of vertices is called

B. Regular graph  
C. Euler graph  
D. Complete graph

64. The best average behaviour is shown by

B. Quick sort  
B. Merge sort
65. Which of the following sorting algorithm is of divide-and-conquer type?

   A. Bubble sort  
   B. Insertion sort  
   C. Quick sort 
   D. All of above

66. The recurrence relation capturing the optimal execution time of the Towers of Hanoi problem with n discs is

   A. \( T(n) = 2T(n - 2) + 2 \) 
   B. \( T(n) = 2T(n - 1) + n \) 
   C. \( T(n) = 2T(n/2) + 1 \) 
   D. \( T(n) = 2T(n - 1) + 1 \)

67. What is the time complexity of Bellman-Ford single-source shortest path algorithm on a complete graph of n vertices?

   (A) \( \Theta(n^2) \) 
   (B) \( \Theta(n^2 \log n) \) 
   (C) \( \Theta(n^3) \) 
   (D) \( \Theta(n^3 \log n) \)

   A. A  B. B  C. C  D. D

68. The goal of hashing is to produce a search that takes

   A. \( O(1) \) time 
   B. \( O(n^2) \) time 
   C. \( O(\log n) \) time 
   D. \( O(n \log n) \) time

69. One can make an exact replica of a Binary Search Tree by traversing it in

   B. Inorder  B. Preorder  C. Postorder  D. Any order

70. When converting binary tree into extended binary tree, all the original nodes in binary tree are

   A. internal nodes on extended tree 
   B. external nodes on extended tree 
   C. vanished on extended tree 
   D. None of above

71. The postfix form of \( A*B+C/D \) is
72. **For the bubble sort algorithm, what is the time complexity of the best/worst case?**
(assume that the computation stops as soon as no more swaps in one pass)

(a) best case: $O(n)$ worst case: $O(n^n)$
(b) best case: $O(n)$ worst case: $O(n \log(n))$
(c) best case: $O(n \log(n))$ worst case: $O(n \log(n))$
(d) best case: $O(n \log(n))$ worst case: $O(n^n)$

Answer: A

73. **For the quick sort algorithm, what is the time complexity of the best/worst case?**

(a) best case: $O(n)$ worst case: $O(n^n)$
(b) best case: $O(n)$ worst case: $O(n \log(n))$
(c) best case: $O(n \log(n))$ worst case: $O(n \log(n))$
(d) best case: $O(n \log(n))$ worst case: $O(n^n)$

Answer: D

74. **In an arbitrary tree (not a search tree) of order M. Its size is N, and its height is K. The computation time needed to find a data item on T is**

(a) $O(K^K)$
(b) $O(M^M)$
(c) $O(N)$
(d) $O(K)$

Answer: C

75. **When we organize our data as an ordered list, what is the time complexity of inserting/deleting a data item to/from the list?**

(a) $O(\text{length\_of\_list} \times \text{length\_of\_list})$
(b) $O(\text{length\_of\_list})$
(c) $O(\log(\text{length\_of\_list} \times \text{length\_of\_list}))$
(d) $O(1)$

Answer: B

76. **Five statements about B-trees are below. Four of them are correct. Which one is INCORRECT?**
(a) All B-trees are also search trees
(b) The word B-tree stands for balanced tree
(c) The word B-tree also stands for binary tree
(d) All leaves of a B-tree must be on the same level
Answer : C

77. For any B-tree of height H (H>1), after inserting a new key, is it possible for a key, K, which was located in a leaf-node to move up to the root in this regard which of the following is correct?

(a) Can’t be defined without data
(b) Never
(c) Yes, only if H=2
(d) Yes
Answer : D

78. When we say the order of a tree is M, we mean

(a) Every non-leaf node must have M subtrees
(b) Every non-leaf node must have M keys
(c) Every non-leaf node can have at most M subtrees
(d) Every non-leaf node can have at most M keys
Answer : C

79. T is a search tree of order M, its size is N, and its height is K. The computation time needed to INSERT/DELETE a data item on T is

(a) \(O(1)\)
(b) \(O(M)\)
(c) \(O(\log K)\)
(d) \(O(K)\)
Answer : D

80. Suppose that we have a data file containing records of famous people, and we need to build a hash table to find a record from the person's birthday. The size of the hash table is 4096. The following are hash functions which convert a birthday to an integer. Which of the following function is the best?

(a) \(h_1(\text{day/month/year}) = \text{day} + \text{month} + \text{year}\)
(b) \(h_2(\text{day/month/year}) = \text{day} + \text{month}*31 + \text{year}\)
(c) \(h_3(\text{day/month/year}) = (\text{day} + \text{month}*31 + \text{year}*365) \mod 4096\)
(d) \(h_4(\text{day/month/year}) = (\text{day} + \text{month}*31 + \text{year}*365) \mod 4093\)
Answer : D