KATHMANDU UNIVERSITY
End Semester Examination
September 2024

Marks Scored:

Level : B.Tech.
Year : I

Course : AICS 101
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 9 Sep 2024

SECTION "A"
[20Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate answer.

1. If there are 5 discs, then the number of moves required to solve a Tower of Hanoi puzzle is _____?
   a. 10 b. 15 c. 31 d. 63

2. Which of the following is a characteristic of an efficient algorithm?
   a. Uses minimal CPU time
   b. Uses maximum memory
   c. Is difficult to use
   d. Is ambiguous

3. Arrange the following time complexities in ascending order.
   $O(2^n)$, O(n), O(nlogn), O(logn), $O(n^2)$
   a. O(n), O(nlogn), O(logn), $O(n^2)$, $O(2^n)$
   b. O(n), O(logn), O(nlogn), $O(n^2)$, $O(2^n)$
   c. O(logn), O(n), O(nlogn), $O(n^2)$, $O(2^n)$
   d. $O(2^n)$, $O(n^2)$, O(logn), O(nlogn), O(n)

4. Which of the following is not the application of stack?
   a. A parentheses balancing program
   b. Tracking of local variables at run time
   c. Compiler Syntax Analyzer
   d. Data Transfer between two asynchronous process

5. What is the value of the postfix expression 6 3 2 4 + – *?
   a. 1 b. 40 c. 74 d. -18

6. A normal queue, if implemented using an array of size MAX_SIZE, gets full when?
   a. Rear = MAX_SIZE – 1
   b. Rear = Front
   c. Front = (Rear + 1) mod MAX_SIZE
   d. Front = Rear + 1

7. In which scenario is the Linked List becomes an excellent data structure?
   a. When you need to insert elements at the end of the list
   b. When you need to access elements in sequential order
   c. When you need quick access to elements by index
   d. When you need to insert elements in the middle of the list

8. What is a disadvantage of a circular linked list?
   a. It consumes more memory than a doubly linked list
   b. It is complex to implement
   c. A simple loop through the list will never end
   d. All of the above

9. How much extra memory does a Doubly Linked List need over a Singly Linked List per node?

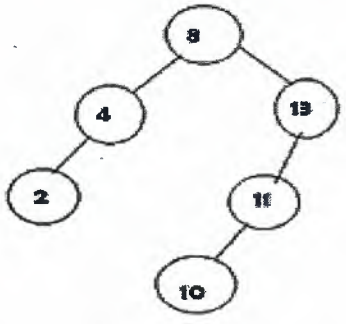
a. 50% more
b. Twice as much
c. Depends on the size of the data
d. No extra memory is needed

10. A binary tree in which all the leaves are on the same level is called _____

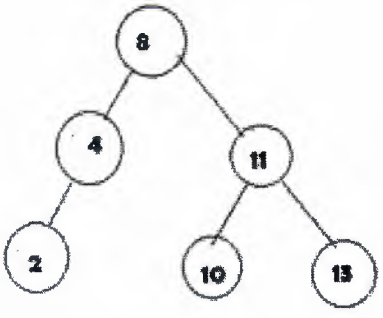
a. Full Binary Tree
b. Binary Search Tree
c. Complete Binary Tree
d. Almost Complete Binary Tree

11. Which of the below diagram is following AVL tree property?

I.



II.

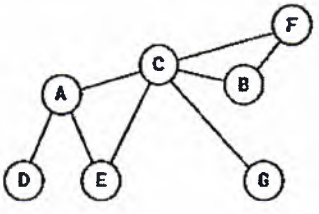


a. Only I
b. Only II
c. Both I and II
d. None

12. Which of the following is **TRUE**?

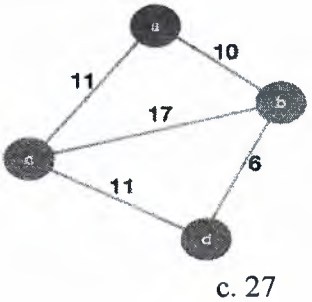
a. B + tree allows only the rapid random access
b. B + tree allows only the rapid sequential access
c. B + tree allows rapid random access and slower sequential access
d. B + tree allows rapid random access as well as rapid sequential access

13. What would be the BFS traversal of the given graph starting from D?



a. D,A,C,E,B,F,G
b. D,A,E,C,B,F,G
c. D,A,C,E,F,B,G
d. All of the above

14. In the given graph, what is the weight of the minimum spanning tree using the Prim's algorithm, starting from vertex a?



a. 23
b. 28
c. 27
d. 11

15. Which algorithm will provide the fastest passing route for a directed graph with weighted nodes containing only non-negative weights?
    a. Prim's Algorithm
    b. Kruskal's Algorithm
    c. Dijkstra's Algorithm
    d. Warshall's Algorithm

16. If the number of records to be sorted is small, then _____ sorting can be efficient.
    a. Selection Sort b. Quick sort c. Merge sort d. Shell sort

17. What is the average case time complexity of merge sort?
    a. O (n) b. O (n * log n) c. O (n^2) d. O(1)

18. Why is Shell sort called as a generalization of Insertion sort?
    a. Shell sort allows an exchange of far items whereas insertion sort moves elements by 1 position
    b. Improved lower bound analysis
    c. Insertion is more efficient than any other algorithms
    d. Shell sort performs internal sorting

19. What is the advantage of recursive approach than an iterative approach of searching?
    a. Consumes less memory
    b. Less code and easy to implement
    c. Consumes more memory
    d. More code has to be written

20. What is the hash function used in the division method?
    a. h(k) = k mod m b. h(k) = m mod k c. h(k) = m/k d. k/m

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SECTION "B"
[6Q. × 4 = 20 marks]

Attempt *ANY SIX* questions.

1. What is a data structure? Explain its types in brief.

2. Define Circular Queue. How is it different from linear queue?

3. How can we use linked list to implement a stack? Explain using suitable program.

4. Why do we need to balance the binary search tree? Justify with an example. Create an AVL tree from the data **24, 12, 8, 15, 35, 30, 57, 40, 45, 78.**

5. What is a DAG? Write about different data structures for the representation of graphs.

6. Discuss how the quick sort works with suitable example.

7. What is hashing? Explain the concept of hash value, hash table and hash function with example.

SECTION "C"
[2Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. What are the different applications of stack? Write an algorithm to evaluate a prefix expression using stack and use the algorithm to evaluate the given prefix expression:
$ * - 6 + 1 2 3 + 2 1

9. What is a Heap Tree? What are the major operations on Heap Tree? What is a procedure to decrease a key of a node in Heap Tree? Construct a Heap tree for the following data and decrease the key value of 3 to 15. **Data: 4, 10, 3, 2, 5, 6**

10. What is a Shortest Path Problem? Write down the Dijkastra's algorithm for finding shortest path in a graph. Use Dijkstra's algorithm to find shortest path from vertex A to remaining vertices in the given graph.