

KATHMANDU UNIVERSITY  
End Semester Examination  
March/April, 2025

Marks Scored:

Level : B.E.

Year : II

Exam Roll No. :

Time: 30 mins.

Course : COMP 202

Semester : I

F. M. : 10

Registration No.:

Date : 13 APR 2025

SECTION "A"

[20Q.  $\times$  0.5 = 10 marks]

Select and **encircle** the most appropriate answer.

1. Which characteristic of an algorithm ensures that each step is unambiguous and executable?  
a. Finiteness                      b. Definiteness                      c. Effectiveness                      d. Scalability
2. A function has a loop that runs in  $O(n)$  time, followed by a nested loop that runs in  $O(n^2)$  time. What is the overall time complexity?  
a.  $O(n)$                       b.  $O(n^2)$                       c.  $O(n^3)$                       d.  $O(n + n^2)$
3. What is the postfix form of the prefix expression - / A B + C D?  
a. A B / C D + -                      b. A B C D + / -  
c. A B / C D - +                      d. A B / - C D +
4. During postfix expression evaluation, underflow occurs when:  
a. There are more operators than operands  
b. Parentheses are mismatched  
c. The stack size exceeds available memory  
d. An operand is invalid
5. Which application explicitly requires a priority queue over a regular queue?  
a. Managing customer service calls in a first-come, first-served system.  
b. Implementing a printer queue with equal priority jobs.  
c. Storing temporary data in a buffer with fixed capacity.  
d. CPU scheduling with tasks of varying urgency.
6. In a circular queue implemented with an array of size MAX\_SIZE, which condition correctly indicates the queue is full?  
a. front == -1                      b. (rear + 1) % MAX\_SIZE == front  
c. rear == MAX\_SIZE - 1                      d. front == rear
7. In a priority queue implemented using a linked list, which of the following insertion methods is most efficient?  
a. Insert at the beginning                      b. Insert at the end  
c. Insert at the correct sorted position                      d. Insert randomly and sort later
8. Which operation is not possible with a singly linked list?  
a. Inserting at the end                      b. Deleting the head node  
c. Finding the  $k^{\text{th}}$  to last element                      d. Traversing in reverse
9. What is the maximum number of nodes at level  $L$  (root at level 0) in a binary tree?  
a.  $2^L$                       b.  $2^L - 1$                       c.  $2^L + 1$                       d.  $L^2$

10. In Huffman coding, what is a key property of the generated codes?
- They must all have the same length
  - They should be randomly assigned to characters
  - They must follow the prefix property (no code is a prefix of another)
  - They must be stored in a binary search tree for efficiency
11. In a directed graph, the in-degree of a vertex is defined as:
- The number of edges pointing to it
  - The number of edges leaving it
  - The number of edges in the graph
  - The number of self-loops at the vertex
12. In a weighted graph, which of the following statements is always TRUE for a minimum spanning tree (MST)?
- The MST is unique
  - The MST contains the highest-weight edge
  - The MST contains no cycles
  - The MST must be a complete graph
13. Which data structure is typically used in Prim's Algorithm for efficient edge selection?
- Stack
  - Queue
  - Priority Queue
  - Hash Table
14. Which representation is most space-efficient for a sparse graph with  $V$  vertices and  $E$  edges?
- Adjacency Matrix
  - Adjacency List
  - Incidence Matrix
  - Edge List
15. Which pivot selection strategy minimizes the chance of worst-case performance?
- Always pick the first element
  - Always pick the last element
  - Use a random element
  - Use the middle element
16. Suppose we are sorting an array of eight integers using some quadratic sorting algorithm. After four iterations of the algorithm's main loop, the array elements are ordered as shown here:  
 34    39    77    80    55    44    91    30  
 Which statement is correct? (Let our selection sort picks smallest items first.)
- The algorithm might be either selection sort or insertion sort.
  - The algorithm might be selection sort but could not be insertion sort.
  - The algorithm might be insertion sort but could not be selection sort.
  - The algorithm is neither selection sort nor insertion sort.
17. A key is mapped to index 5 in a hash table of size 10 using quadratic probing. After two collisions, what is the next index probed?
- 6
  - 7
  - 8
  - 9
18. You are given a sorted array of integers. You need to find the index of the last occurrence of a given element  $x$ . Which of the following modifications to Binary Search would you use to solve this problem?
- Modify Binary Search to return the first occurrence of the element.
  - Modify Binary Search to continue searching in the right half even after finding the element.
  - Modify Binary Search to search for the largest element smaller than  $x$ .
  - No modification is needed, Binary Search directly gives the last occurrence.
19. Which property holds for an almost complete binary tree?
- All levels (except possibly the last) are completely filled.
  - Nodes are filled from left to right in the last level.
  - Height of a complete binary tree with  $N$  nodes is  $O(\log N)$
  - All of the above
20. In a binary tree, which traversal method is best suited for converting the tree into a prefix expression?
- In-order traversal
  - Pre-order traversal
  - Post-order traversal
  - Level-order traversal

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F. M. : 40

13 APR 2025  
SECTION "B"

[6Q. × 4 = 24 marks]

Attempt ANY SIX questions.

1. Generate the steps of evaluating postfix expression using Stack. Simulate the evaluation of the postfix expression  $5\ 3\ 2\ ^\ 4\ / - 6 +$  using the stack-based algorithm. Show the state of the stack after processing each token and provide the final result. [1+3]
2. What do you mean by Queue ADT. What are the advantages and disadvantages of using an array-based queue compared to a linked list-based queue? [1+3]
3. Write a pseudo code/algorithm to delete a node with a given key from a doubly linked list. Ensure that your function correctly handles the following cases:
  - The node to be deleted is the head
  - The node to be deleted is the tail
  - The node to be deleted is somewhere in the middle
  - The key does not exist in the list
4. When deleting a node with two children in a Binary Search Tree (BST), we cannot simply remove the node because it has both a left and right subtree. Instead, we must replace the node with a suitable value while maintaining the BST property. Explain the steps with example to delete a node with two children in a BST.
5. Construct the adjacency matrix for the graph given below (Figure 1) and perform a Breadth-First Search (BFS) starting from node A, listing the traversal order.

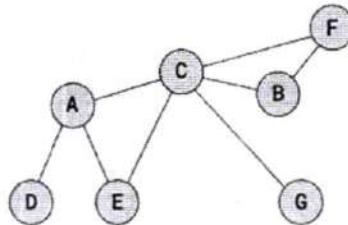


Figure 1: An undirected graph

6. Explain how Binary Search works and in which scenarios it is more efficient than Linear Search. Additionally, discuss the limitations of Binary Search.
7. Explain with suitable examples the difference between open addressing and chaining for collision resolution in hash tables. Which method is more memory-efficient for datasets with high collision rates, and why?

P.T.O.

SECTION "C"  
[2Q. × 8 = 16 marks]

Attempt ANY TWO questions.

8. Trace the following elements to simulate the Heap Sort. First generate a Max-Heap Tree and perform sorting using Heap Sort algorithm.

21    43    69    12    38    14

9. Consider a graph shown in Figure 2. Apply Dijkstra's Algorithm to find the shortest path from node *s* to all other nodes. Show step-by-step calculations.

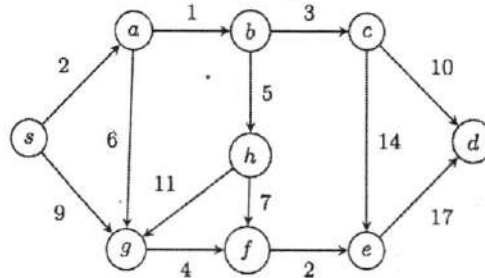


Figure 2: A directed graph

10. You are given the following set of characters and their frequencies:

Character	Frequency
A	45
B	13
C	12
D	16
E	9
F	5

Perform the Huffman Encoding Algorithm and answer the following:

- a. Construct the Huffman tree step by step, showing the merging process. [5]
- b. Generate the Huffman codes for each character. [1]
- c. Encode the string "ABACDA" using the generated Huffman codes. [1]
- d. Given the Huffman-encoded binary string 110011011100, decode it to the original characters. [1]