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Department of Mathematical and Computational Sciences
National Institute of Technology Karnataka, Surathkal

Even Semester 2023
Course Code: MA606
Date: 13/04/2023

Time: 10:00 AM to 01:00 PM

Examination: End Sem
Course Title: Data Structures and Algorithms
Maximum Marks: 100

Instructions:

1. Answer ALL questions.
2. Rough work should NOT be done anywhere on the Question Paper.

1. Following questions carries ONE mark each

11*1=11

a) How can we define a AVL tree?

- i. A tree which is binary search tree and height balanced tree.
- ii. A tree which is a binary search tree but unbalanced tree.
- iii. A tree with utmost two children
- iv. A tree with utmost three children

b) What would be the asymptotic time complexity to add a node at the end of singly linked list, if the pointer is initially pointing to the head of the list?

- i. $O(1)$
- ii. $O(n)$
- iii. $\theta(n)$
- iv. $\theta(1)$

c) The result of evaluating the postfix expression 5, 4, 6, +, *, 4, 9, 3, /, +, * is?

- i. 600
- ii. 350
- iii. 650
- iv. 588

d) What is the running time of an insertion sort algorithm if the input is pre-sorted?

- i. $O(N^2)$
- ii. $O(N \log N)$
- iii. $O(N)$
- iv. $O(M \log N)$

e) What will be the number of passes to sort the elements using insertion sort?
14, 12, 16, 6, 3, 10, 5.

- i. 6
- ii. 5
- iii. 7
- iv. 1

f) Dijkstra's Algorithm is the prime example for _____

- i. Greedy algorithm
- ii. Branch and bound
- iii. Back tracking
- iv. Dynamic programming

g) Statement 1: In insertion sort, after m passes through the array, the first m elements are in sorted order.

Statement 2: And these elements are the m smallest elements in the array.

- i. Both the statements are true
- ii. Statement 1 is true but statement 2 is false
- iii. Statement 1 is false but statement 2 is true
- iv. Both the statements are false

h) The given array is $\text{arr} = \{3, 4, 5, 2, 1\}$. The number of iterations in bubble sort and selection sort respectively are _____

- i. 5 and 4
- ii. 4 and 5
- iii. 2 and 4
- iv. 2 and 5

i) Which is the safest method to choose a pivot element?

- i. choosing a random element as pivot
- ii. choosing the first element as pivot
- iii. choosing the last element as pivot
- iv. median-of-three partitioning method

j) Entries in a stack are "ordered". What is the meaning of this statement?

- i. A collection of stacks is sortable
- ii. Stack entries may be compared with the ' $<$ ' operation
- iii. The entries are stored in a linked list
- iv. There is a Sequential entry that is one by one

k) In Depth First Search, how many times a node is visited?

- i. Once
- ii. Twice
- iii. Equivalent to number of in-degree of the node
- iv. Thrice

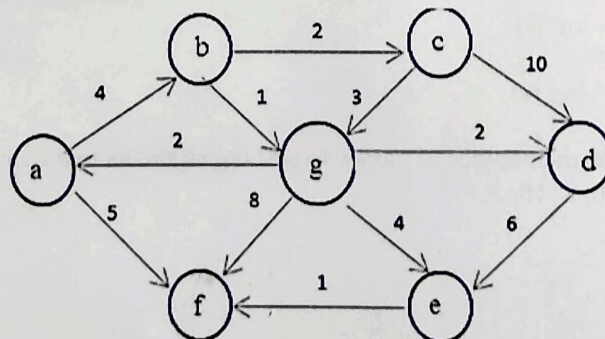
2. Following questions carries **TWO** marks each

$4 \times 2 = 8$

a) Consider the following graph.

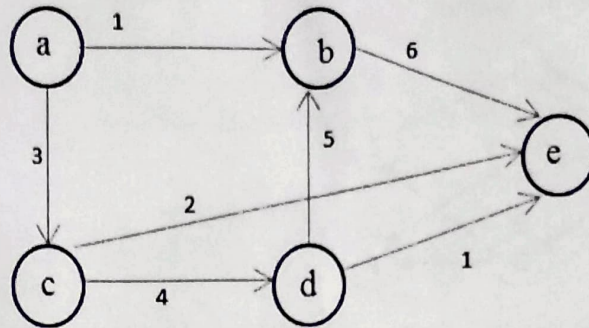
If b is the source vertex, what is the minimum cost to reach f vertex?

- i. 8
- ii. 9
- iii. 4
- iv. 6



b) In the given graph, identify the shortest path having minimum cost to reach vertex E if A is the source vertex.

- i. a-b-e
- ii. a-c-e
- iii. a-c-d-e
- iv. a-c-d-b-e



c) Consider the code given below, which runs insertion sort:

```

void insertionSort(int arr[], int array_size)
{
    int i, j, value;
    for(i=1; i < array_size; i++)
    {
        value = arr[i];
        j = i;
        while ( )
        {
            arr[j] = arr[j - 1];
            j = j - 1;
        }
        arr[j] = value;
    }
}
  
```

Which condition will correctly implement the while loop?

- i. $(j > 0) \parallel (arr[j - 1] > value)$
- ii. $(j > 0) \&\& (arr[j - 1] > value)$
- iii. $(j > 0) \&\& (arr[j + 1] > value)$
- iv. $(j > 0) \&\& (arr[j + 1] < value)$

d) What are the main applications of tree data structure?

- 1) Manipulate hierarchical data
- 2) Make information easy to search (see tree traversal).
- 3) Manipulate sorted lists of data
- 4) Router algorithms
- 5) Form of a multi-stage decision-making, like Chess Game.
- 6) As a workflow for compositing digital images for visual effects

- i. 1, 2, 3, 4 and 6
- ii. 1, 2, 3, 4 and 5
- iii. 1, 3, 4, 5 and 6
- iv. 1, 2, 3, 4, 5 and 6

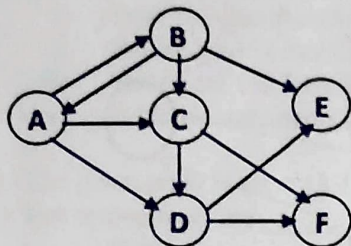
3. For the given data, draw a Binary search tree and show the linked representation of the same: 100, 85, 45, 55, 110, 20, 70, 65 06

4. Construct a Binary Search Tree by using the following in-order and pre-order traversal. 06

In-order : BCAEDGHFI

Pre-order : ABCDEFGHI

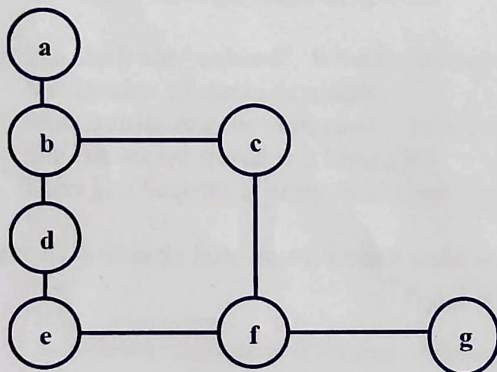
5. Define Graph. For the given graph, show the adjacency matrix and adjacency list representation of the following graph. 10



6. What is bubble sort? Write an algorithm and solve the following elements using bubble sort 10
7, 6, 4, 3

7. Write a pseudo code for insertion sort. Sort the following list using insertion sort. 10
50, 30, 10, 70, 40, 20, 60

8. Differentiate between DFS and BFS. For the given graph consider initial node to be visited is 'a' write the sequence of nodes visited using DFS and BFS. 12



9. What is a tree? With suitable example, define: 12
(i) Binary Tree (ii) Level of Binary tree
(iii) Complete Binary Tree (iv) Degree of the tree

- 10 Differentiate the following: 15

- Prim's algorithm and Kruskal's algorithm
- Selection sort and Insertion sort
- Linear search and Binary search