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Course Code- 21CSC201J Prof Name- Dr. Rajkumar.K

Course Name- DATA STRUCTURES AND ALGORITHMS

DSA SPECIAL PROBLEMS [GATE/ISRO PREVIOUS YEAR]

1.Consider the product of three matrices M1, M2 and M3 having w rows and x columns, x rows and y columns, and y rows and z columns.

Under what condition will it take less time to compute the product as (M1M2) M3 than to compute M1 (M2M3) ? **[ISRO CSE 2020]**

A)Always take the same time

b)(1/x+1/z)<(1/w+1/y)

c)x>y

d)(w+x)>(y+z)

2.Let A1,A2,A3, and A4 be four matrices of dimensions 10x5, 5x20, 20x10, and 10x5, respectively. The minimum number of scalar

multiplications required to find the product A1A2A3A4 using the basic matrix multiplication method is **[GATE CSE 2016 SET 2]**

a)1500

b)5000

c)1000

d)2000

3.Assume that multiplying a matrix G1 of dimension pxq with another matrix G2 of dimension pxq requires pqr scalar multiplications.Computing the product of n matrices G1G2G3 ... Gn can be done by parenthesizing in different ways. Define Gi Gi+1 as an explicitly computed pair for a given parenthesization if they are directly multiplied. For example, in the matrix multiplication chain G1G2G3G4G5G6 using parenthesization (G1(G2G3))(G4(G5G6)), G2G3 and G5G6 are the only explicitly computed pairs. Consider a matrix multiplication chain F1F2F3F4F5, where matrices F1, F2, F3, F4 and F5 are of dimensions 2x25, 25x3, 3x16, 16x1 and 1x1000, respectively. In the parenthesization of F1F2F3F4F5 that minimises the total number of scalar multiplications, the explicitly computed pairs is/are **[GATE CSE 2018]**

In matrix chain multiplication problem, to minimize no. of scalar multiplication we need to determine optimal way to parenthesize the

a)F1F2 and F3F4 only

b)F2F3 only

c)F3F4 only

d)F1F2 and F4F5 only

4.Let A1,A2,A3, and A4 be four matrices of dimensions 10x5, 5x20, 20x10, and 10x5, respectively. The minimum number of scalar multiplications required to find the product A1A2A3A4 using the basic matrix multiplication method is.**[GATE CSE 2016 SET 2]**

a)1500

b)5000

c)1000

d)2000

5.Consider the following C structure:

```
struct Node {
        int data;
        struct Node *next;
};
```

What is the purpose of the struct Node *next member in the Node structure?

[GATE CSE 2019]

a) To store the data of the next node
b) To store the address of the previous node
c) To store the address of the next node
d) To store the address of the current node

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1.Which one of the following sequences when stored in an array at locations A[1], ... ,A[10] forms a max-heap?

[GATE CSE 2023]

✓ a)23, 17, 10, 6, 13, 14, 1, 5, 7, 12

b)23, 17, 14, 7, 13, 10, 1, 5, 6, 12

c)23, 17, 14, 6, 13, 10, 1, 5, 7, 15

d)23, 14, 17, 1, 10, 13, 16, 12, 7, 5

2.Suppose a binary search tree with 1000 distinct elements is also a complete binary tree. The tree is stored using the array representation of binary heap trees. Assuming that the array indices start with 0, the 3rd largest element of the tree is stored at index ________.

[Integer Type] **[GATE CSE 2022]**

3rd largest element w/ 1000 distinct elements stored in array representation can be found 1000-3 = 997

3.The preorder traversal of a binary search tree is 15, 10, 12, 11, 20, 18, 16, 19. Which one of the following is the postorder traversal of the tree? [GATE CSE 2020]

a)20, 19, 18, 16, 15, 12, 11, 10

b)10, 11, 12, 15, 16, 18, 19, 20

✓ c)11, 12, 10, 16, 19, 18, 20, 15

d)19, 16, 18, 20, 11, 12, 10, 15

4.What is the worst case time complexity of inserting n2 elements into an AVL-tree with n elements initially?

[GATE CSE 2020]

a)Θ(n2)

b)Θ (n2 log n)

c)Θ (n4)

d)Θ(n3)

5. The height of a tree is the length of the longest root-to-leaf path in it. The maximum and minimum number of nodes in a binary tree of height 5 are

[GATE CSE 2015 Set 1]

a)63 and 6, respectively

b)64 and 5, respectively

c)32 and 6, respectively

d)31 and 5, respectively

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DSA SPECIAL PROBLEMS [GATE/ISRO PREVIOUS YEAR]

1.A program P reads in 500 integers in the range [0, 100], representing the cores of 500 students. It then prints the frequency of each score above 50. What would be the best way for P to store the frequencies?

(GATE CSE 2005)

a. An array of 50 numbers
b. An array of 100 numbers
c. An array of 500 numbers
d. A dynamically allocated array of 550 numbers

2.Let P be a singly linked list; let Q be the pointer to an intermediate node x in the list. What is the worst-case time complexity of the best-known algorithm to delete node x from the list?

(GATE CSE 2004)

a. O(n)
b. O($\log_2 n$)
c. O(log n)
d. O(1)

3.A queue is implemented using an array such that ENQUEUE and DEQUEUE operations are performed efficiently. Which one of the following statements is CORRECT (n refers to the number of items in the queue)?

(GATE CSE 2016 Set 1)

a. Both operations can be performed in O(1) time
b. At most, one operation can be performed in O(1) time, but the worst-case time for the other operation will be $\Omega(n)$
c. The worst-case time complexity for both operations will ne $\Omega(n)$
d. The worst-case time complexity for both operations will be $\Omega(\log n)$

when using circular array to implement queue both enqueue & dequeue operations can be performed in O(1) time

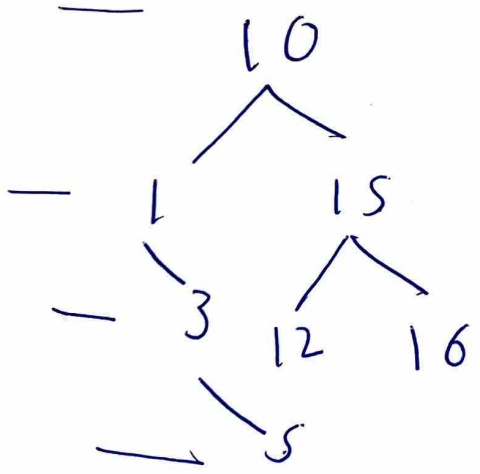
4.Which of the following is/are correct- **(GATE CSE 1996)**

(i) First-in-first out types of computations are efficiently supported by STACKS.
(ii) Implementing LISTS on linked lists is more efficient than implementing LISTS on an array for almost all the basic LIST operations.
(iii) Implementing QUEUES on a circular array is more efficient than implementing QUEUES on a linear array with two indices.
(iv) Last-in-first-out type of computations are efficiently supported by QUEUES.

(ii)
(iii)

5.The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)? [Integer type]

(GATE CSE 2004)



height is 3

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1.Consider the following sequence of operations on an empty stack. push(54); push(52); pop(); push(55); push(62); s=pop(); Consider the following sequence of operations on an empty queue.enqueue(21); enqueue(24); dequeue(); enqueue(28); enqueue(32); q=dequeue(); The value of s+q is [GATE CSE 2021 SET-1]

a)94

b)83

c)79

d)86

2.A stack is implemented with an array of 'A[0 ... N -1]' and a variable 'pos'. The push and pop operations are defined by the following code. [ISRO CSE 2020 Data Structure]

```
push (x)
        A[pos] <- x
        pos <- pos -1
end push
pop ()
        pos <- pos+1
        return A[pos]
end pop
```

Which of the following will initialize an empty stack with capacity N for the above implementation?

a)pos + -1

b)pos < 0

c)pos + 1

d)pos < N -1

3.The best data structure to check whether an arithmetic expression has balanced parenthesis is a: [ISRO CSE 2017]

a)Queue

b)Stack

c)Tree

d)List

4.If the sequence of operations - push (1), push (2), pop, push (1), push (2), pop, pop, pop, push (2), pop are performed on a stack, the sequence of popped out values

[ISRO CSE 2015 Data Structure]

a)2,2,1,1,2

b)2,2,1,2,2

c)2,1,2,2,1

d)2,1,2,2,2

5.The result evaluating the postfix expression 10 5 + 60 6 / * 8 - is[Integer type]

142

[GATE CSE 2015 SET-3 Data Structure]

10 5 + 60 6 / * 8 -

[10, 5] = 10+5 = 15

15 60 6 /

15 * 10

150 8 - = 150 - 8 = 142

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DSA SPECIAL PROBLEMS[GATE/ISRO PREVIOUS YEAR]

1. Breadth First Search (BFS) is started on a binary tree beginning from the root vertex. There is a vertex t at a distance four from the root. If t is the n-th vertex in this BFS traversal, then the maximum possible value of n is 31

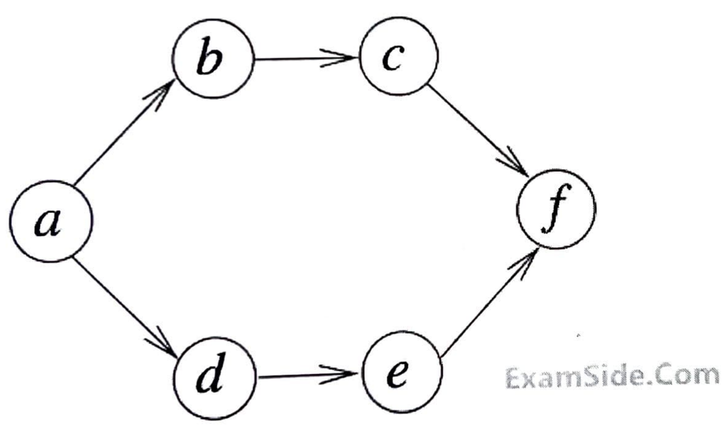
[Integer type]

A tree w/ height h has max no. of nodes $= 2^{h+1} - 1 = 2^{4+1} - 1 = 31$

[GATE CSE 2016 Set 2]

2.Consider the following directed graph:

[Integer type] **[GATE CSE 2016 Set 1]**



The number of different topological orderings of the vertices of the graph is 6.

a)Θ(n)

b)O(n+m)

c)Θ(n2)

d)Θ(m2)

$\frac{4!}{2! * 2!} = 6.$