Kunal Jha
Course: GATE
Computer Science Engineering(CS)

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MULTIPLE SUBJECT : ALGORITHMS + PROGRAMMING AND DATA STRUCTURES (GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(33) | CORRECT(0) | INCORRECT(0) | SKIPPED(33)

Q. 1 Have any Doubt ?

Consider the following C program:

```
int main ( )
{
    int x = 20;
    static int y = x;
    if (x == y)
        printf ("Equal");
    else
        printf ("Not Equal");
    return 0;
}
```

What will be the output for above C program?

A. Equal

B. Not Equal

C. Runtime error

D. Compile time error — Correct Option

Solution :
(d)
In C, static variable can be initialized only using constant literals. They can't be assign like this, so it will generate compile time error.

QUESTION ANALYTICS +

Q. 2 Solution Video | Have any Doubt ?

Consider an unweighted undirected graph with m edge and n vertices. What is the worst case time complexity to check if there exists path between vertices 'a' to 'b'?

A. $O(mn)$

B. $O(n \log n)$

C. $O(n + m)$ — Correct Option

Solution :
(c)
So worst case time complexity using BFS = $O(n + m)$.

D. $O(m + n \log n)$

QUESTION ANALYTICS +

Q. 3 Have any Doubt ?

Consider following C program:

```
#include <stdio.h>
int main ( )
{
    char * ptr = "MadeEasy";
    char a, b;
    for (int i = 0; i < 3; i++) {
            a = *++ ptr;
            b = *ptr++;
    }
    printf ("%c %c", a, b);
    return 0,
}
```

A. a, s

B. s, y

C. a, a — Correct Option

Solution :
(c)

Both a and b points at the 6^{th} location (index 5) of the array because once in a loop, pointer is increamented twice.

D s, s

QUESTION ANALYTICS +

Q. 4 Solution Video Have any Doubt ?

Which of the following is correct statement?

A Intermediate result of Kruskal algorithm is always forest.

B Intermediate result of Kruskal algorithm is may be forest. Correct Option

Solution :
(b)
Intermediate result of Prim's algorithm is always connected but Kruskal's algorithm may produce forest.

C Intermediate result of Prim's algorithm is may be forest.

D Intermediate result of Prim's algorithm is always forest.

QUESTION ANALYTICS +

Q. 5 Have any Doubt ?

In delete operation of binary search tree, we need inorder successor (or predecessor) of a node when a node to be deleted where it has both left and right child. Which of the following is true about inorder successor needed in delete operation?

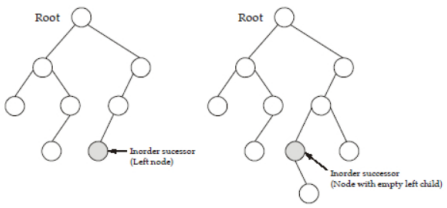
A Inorder successor is always either leaf node or a node with empty right child.

B Inorder successor maybe a an ancestor of the node.

C Inorder successor is always a leaf node.

D Inorder successor is always either a leaf node or a node with empty left child. Correct Option

Solution :
(d)
Successor of Root element is always the smallest element of the Right subtree.



QUESTION ANALYTICS +

Q. 6 Solution Video Have any Doubt ?

Which of the following is not true?

A For a directed graph, the absence of back edges in a DFS tree means graph has no cycle.

B BFS take $O(V^2)$ time in a graph G(V, E) if graph is a represented with an adjacency matrix.

C The depth of any DFS tree rooted at a vertex is at least as much on the depth of any BFS tree rooted at the same vertex.

D None of these Correct Option

Solution :
(d)
For a directed graph, if no back edge in DFS means no cycle. BFS takes $O(V^2)$ time for adjacency matrix.

QUESTION ANALYTICS +

Q. 7

Solution Video | Have any Doubt ?

Consider the following code:

```
void f(int n)
{
    int s = 0
    for (int i = 0; i² < n; i++)
        for (int j = i; j < log (i); j++)
        s = s + 1;
        return s;
}
```

What is the time complexity of function f( )?

A $O(n\log n)$ $O(n^2)$

B $O(\sqrt{n})$ — Correct Option

Solution :
(b)
1st for loop will run $i^2 < n$; $i = \sqrt{n}$ times. 2nd for loop will run 1 time for each i.e. i is always greater than $\log(i)$

$$\text{Time complexity} = O(\sqrt{n}) \times 1$$
$$= O(\sqrt{n})$$

C $O(n^2)$

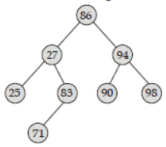
D $O(n)$

QUESTION ANALYTICS +

Q. 8

Have any Doubt ?

Consider the following AVL tree.



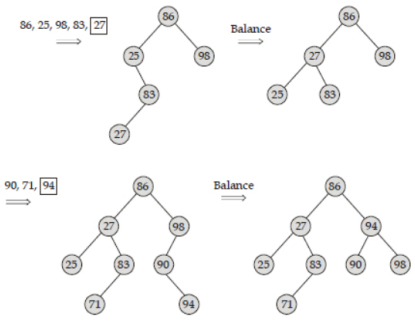
Which of the following order of elements are inserted into an empty AVL tree, so that it is possible to get the above AVL tree?

A 94, 71, 86, 25, 98, 83, 27, 90

B 98, 94, 90, 83, 86, 25, 71, 27

C 86, 25, 98, 83, 27, 90, 71, 94 — Correct Option

Solution :
(c)



The order: 86, 25, 98, 83, 27, 90, 71, 94 will result the given AVL
Option (c) is correct.
[Note: Option (a) & option (b) will generate different AVL trees]

D None of these

QUESTION ANALYTICS +

Q. 9

Solution Video | Have any Doubt ?

Given the input sequence {11, 33, 43, 99, 79, 19} and hash table of size 10 with the hash function h(k) = k mod 10, if hash table uses quadratic probing, the number of collisions occurred while mapping the given sequence is _____.

5 — Correct Option

Solution :
5

11 maps to 1
33 map to 3

$h(43) = 3$ (collision)
$= 3 + 1^2 = 4$
$h(99) = 9$
$h(79) = 9$ (collision) $= 9 + 1^2 = 0$
$h(19) = 9$ (collision 1)
$= 9 + 1^2 = 0$ (collision 2)
$= 9 + 2^2 = 3$ (collision 3)
$= 9 + 3^2 = 8$

79	11		33	43				19	9
0	1	2	3	4	5	6	7	8	

Total 5 collisions.

QUESTION ANALYTICS +

Q. 10

Solution Video | Have any Doubt ?

Consider the 5 items along with their weights and values.

Item	Weight	Value
I_1	20	100
I_2	40	160
I_3	5	30
I_4	10	20
I_5	30	90

The Knapsack has capacity W = 60, the maximum profit that can be achieved using fractional Knapsack is _____.

270 Correct Option

Solution :
270

Item	$P_i = V_i / W_i$
I_1	5
I_2	4
I_3	6
I_4	2
I_5	3

Item I_3 and I_1 is selected.

Profit = 100 + 30
Weight remaining = 60 – 5 – 20 = 35
40 units of I_2 has 160 value.

35 unit $I_2 = \frac{35 \times 160}{40} = 140$
Total profit = 30 + 100 + 140 = 270

QUESTION ANALYTICS +

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Q. 11 Have any Doubt ?

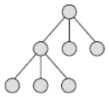
A 3-array tree is a tree in which every internal node has exactly 3 children. The number of leaf nodes in such a tree with 20 internal nodes will be _____.

41 — Correct Option

Solution :
41

$n \rightarrow$ number of internal nodes :

Let $n = 1$  $\Rightarrow 3 \Rightarrow 2(1-1)+3$

Let $n = 2$  $\Rightarrow 5 \Rightarrow 2(2-1)+3$

Let $n = 3$  $\Rightarrow 7 \Rightarrow 2(3-1)+3$

Number of internal nodes $= 2(n-1)+3 = 2(20-1)+3 = 41$

QUESTION ANALYTICS +

Q. 12 Solution Video | Have any Doubt ?

For an $O(\log_2 \log_2 n)$ algorithm, X takes 22 seconds to executes the given data, Y runs the same algorithm on same machine and it took 33 sec for data size of 256, the data size of X is _____.

16 — Correct Option

Solution :
16

Let X's data size be 'n'

$$C \cdot \log_2 \log_2 n = 22$$
$$C \cdot \log\log 256 = 33$$
$$C = \frac{33}{3} = 11$$
$$11 \cdot \log\log n = 22$$
$$\log \log n = 2$$
$$n = 16$$

QUESTION ANALYTICS +

Q. 13 Solution Video | Have any Doubt ?

Consider 3 dimensional Array A[90] [30] [40] stored in linear array in column major order. If the base address starts at 10, The location of A [20] [20] [30] is _____. (Assume the first element is stored at A[1][1][1] and each element take 1 memory location)

23699 — Correct Option

Solution :
23699

	i	j	k
Let	$A[r_1]$	$[r_2]$	$[r_3]$
	90	30	40
	(planes)	(rows)	(columns)

For column major order

$$\text{loc}(A(i,j,k)) = \text{Base Address} + [(i-1)r_2r_3 + (k-1)r_2 + (j-1)]$$
$$= 10 + [19 \times (30)(40) + 29 \times (30) + 19]$$
$$= 23699$$

QUESTION ANALYTICS +

Q. 14 Solution Video | Have any Doubt ?

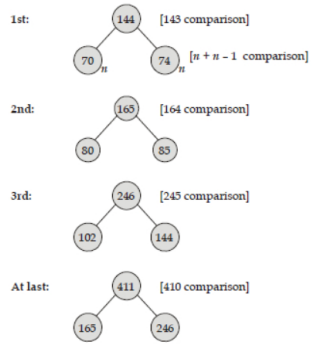
Let A, B, C, D, E are sorted sequences having length 70, 74, 80, 85, 102 respectively. They are merged into a single sequence by merging together two sequences at a time. The maximum number of comparison that will be needed by best algorithm for doing merging is _____.

962 — Correct Option

Solution :
962

Given file size: 70, 74, 80, 85, 102 create min heap.

Algorithm: Take 1st 2 min element, merge it, and put back result into heap, again find next two min element, merge them, repeat until one element left.



So, total comparison = [143 + 164 + 245 + 410] = 962

QUESTION ANALYTICS +

Q. 15

Have any Doubt ?

Consider the following statements:
S_1 : Implementation of stack using queue, deletion of second element from top of stack time complexity O(n), when insertion take O(1) time.
S_2 : In implementation of queue using stack, deletion of second element from front take O(1) time, when insertion take O(n) time. Number of correct statements _____.

2 — Correct Option

Solution :
2

In implementation of stack using queue:
If we do some extra work in inserting the element then deletion of second element from top of stack required queue $(n - 1)$ element in another queue then again $(n - 1)$ i.e. $(n - 2)$ element to another queue so it take $O(n)$ time.
In implementation of using stack; will take O(1) time to delete second element from front will take O(1) time.

QUESTION ANALYTICS +

Q. 16

Have any Doubt ?

Consider the following C function which reverses the single linked list by taking first element address as an input argument

```
struct node * reverse (struct node * start)
{
    struct node * prev, * ptr, * next;
    prev = NULL;
    ptr = start;
    while (ptr! = NULL)
        {
            _____
            _____
            _____
        }
    start = prev;
    return start;
}
```

Number of correct alternative for replace the blank line _____.

I.
```
next = ptr → link;
ptr → link = prev;
ptr = next;
pre = ptr;
```

II.
```
next = ptr → link;
ptr = next;
prev = ptr;
```

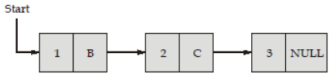
III.
```
next = ptr → link;
ptr → link = prev;
prev = ptr; ptr = next;
```

IV.
```
next = ptr → link;
ptr = prev → link;
prev = ptr; ptr = next;
```

1 — Correct Option

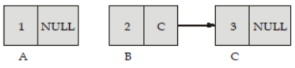
Solution :
1

Take an example as a single linked list:

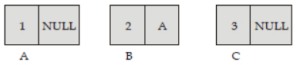


A B C

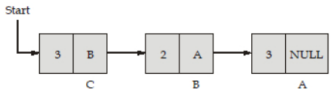
prev = NULL
ptr = start = (A); address of first element
while (ptr! = NULL) // A! = NULL
{
next = ptr → link // next = B
ptr → link = prev // NULL
prev = ptr // prev = A
ptr = next // B
}
After 1 iteration,



2nd iteration
{
next = ptr → link // next = C
ptr → link = prev // A
prev = ptr // prev = B
ptr = next // C
}
After 2nd iteration,



3rd iteration
{
next = ptr → link // next = NULL
ptr → link = prev // B
prev = ptr // prev = C
ptr = next // NULL
}
Now loop ends,
start = prev // start = C
return start;
So finally linked list,



QUESTION ANALYTICS +

Q. 17 Solution Video Have any Doubt ?

Consider a graph G = (V, E) be any connected edge weighted graph, the weights of the edges in E are positive and distinct.
Which of the following is true about above graph?
I. Minimum spanning tree of G need not be unique but cost is unique.
II. Minimum spanning tree of G does not contain edge with highest weight.

A I only

B II only

C Both I and II

D Neither I nor II Correct Option

Solution :
(d)
When graph contain positive distinct edge weight then graph contain unique MST with unique cost.
When graph contain positive distinct weight then MST may contain edge with highest weight if it is not part of any cycle.

QUESTION ANALYTICS +

Q. 18 Solution Video Have any Doubt ?

The running time of an algorithm is given by
$T(n) = T(n-1) + T(n-2) - T(n-3)$ if $n > 3$
n otherwise
What is the order of this algorithm?

A $O(\log n)$

B $O(n)$ Correct Option

Solution :
(b)

$$T(n) = T(n-1) + T(n-2) - T(n-3),\ n > 3$$
$$T(4) = T(3) + T(2) - T(1)$$
$$= 3 + 2 - 1 = 4$$
$$T(5) = T(4) + T(3) - T(2)$$
$$= 4 + 3 - 2 = 5$$

By induction

$$T(n) = T(n-1) + T(n-2) - T(n-3)$$
$$= (n-1) + (n-2) - (n-3) = n$$
$$T(n) = O(n)$$

C $O(n^2)$

D $O(n^3)$

QUESTION ANALYTICS +

Q. 19 Have any Doubt ?

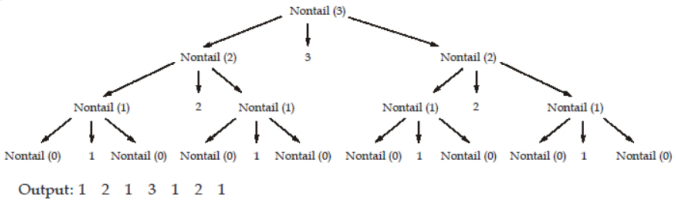
Consider following function:

```
Nontail (int n)
{
    if (n ≤ 0) return;
    else
    {
        Nontail (n – 1);
        printf("%d", n);
        Nontail (n – 1);
    }
}
```

What will be the output if 3 is passed to the given function?

A 1 2 1 3 1 2 1 — Correct Option

Solution :
(a)



Output: 1 2 1 3 1 2 1

B 1 2 3 1 2 1

C 1 1 2 2 3 2 2 1 1

D 1 1 2 3 2 1 1

QUESTION ANALYTICS +

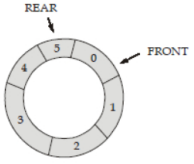
Q. 20 Have any Doubt ?

Suppose a circular queue of capacity (n – 1) elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = 0. Which of the following conditions to detect queue full and empty queue?

A a) Full : (REAR + 1) mod n == FRONT, Empty (FRONT + 1) mod n . REAR

B Full : (REAR + 1) mod n == FRONT, Empty: REAR = FRONT — Correct Option

Solution :
(b)
Queue will be empty when both REAR and FRONT will point to the same location. i.e. REAR = FRONT.
Queue will be full when (REAR + 1) mod n = FRONT.
Ex:



here FRONT = 0 and REAR = 5
FRONT = (5 + 1) mod 6 = 0

C Full : REAR == FRONT, Empty (REAR + 1) mod n == FRONT

D Full : (FRONT + 1) mod n == REAR, Empty: REAR == FRONT

QUESTION ANALYTICS +

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Q. 21 Solution Video | Have any Doubt ?

Consider the following statements:
I. By using binary search instead of linear search insertion sort take O(nlogn) time in worst case.
II. Bubble sort runs in O(n) time if input sequence in ascending order.
III. Heap sort runs in O(nlogn) time if input sequence in descending order.
Which of the above statement(s) is/are true?

A I and II only

B II and III only — Correct Option

Solution :
(b)
I. By using binary search insertion sort take $O(n^2)$ in worst case because number of swap not change.
II. Bubble sort runs in $O(n)$ time in sorted order input.
III. Heap sort runs in $O(n\log n)$ time, input sequence is ascending or descending order.

C I and III only

D II only

QUESTION ANALYTICS +

Q. 22 Have any Doubt ?

Identify the functionality of the following code when function returns the value 1. ["head" pointer point to the first node of the non-empty linked list]

```
int find (Node * head)
{
   Node * P1 = head, * P2 = head;
   if (head → next != NULL)
{
   P1 = head → next;
   P2 = (head → next)? head → next → next: NULL;
}
   while ((P1! = NULL) && (P2! = NULL))
   {
      if (P1 == P2) return 1;
      P1 = P1 → next;
         P2 = (P2 → next != NULL)? P2 → next → next: NULL;
   }
      return 0;
}
```

A It finds the duplicate element in the list

B It finds the middle node in the list

C It finds the cycle in the list — Correct Option

Solution :
(c)
P1 is slower pointer, which moves to the next node in every iteration of while loop.
P2 is faster pointer, which moves to the next to next node in every iteration.
If there exist a cycle in the linked list (non-empty), it returns 1 by checking P1 == P2.
otherwise it returns 0.

D It finds the last node in the list

QUESTION ANALYTICS +

Q. 23 Solution Video | Have any Doubt ?

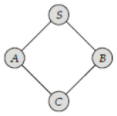
Consider two vertices 'a' and 'b' that are simultaneously on the FIFO queue at same point during the execution of breadth first search from 's' in an undirected graph. Consider the following statements:
S_1 : The number of edges on the shortest path between 's' and 'a' is atmost one more than the number of edges on the shortest path between 's' and 'b'.
S_2 : The number of edges on the shortest path between 's' and 'a' is atleast one less than the number of edges on the shortest path between 's' and 'b'.
S_3 : There is a path between 'a' and 'b'.
Which of the following is true?

A S_1 only

B S_1 and S_2 only

C S_1 and S_3 only — Correct Option

Solution :
(c)
Consider a graph



During the breadth first traversal of the graph. The status of the queue will be as follows:

S		
A	B	

$\therefore$ $S - A \rightarrow 1$ edge
$S - B \rightarrow 1$ edge
Difference = 0

B	C	

$\therefore$ $S - B \rightarrow 1$ edge
$S - C \rightarrow 2$ edge
Difference = 1
Hence, statements S_1 and S_3 are correct.

D S_1, S_2 and S_3

QUESTION ANALYTICS +

Q. 24 — Solution Video — Have any Doubt ?

You are given the postorder traversal, P of a binary search tree on the n element 1, 2, ... *n*. You have to determine the unique BST that has P as its postorder traversal. What is the time complexity of the most efficient algorithm for doing this?

A θ(log*n*)

B θ(*n*)

C θ(nlog*n*) — Correct Option

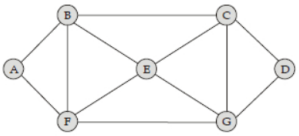
Solution :
(c)
We have postorder traversal and the tree is BST so inorder traversal of BST is ascending order. Thus, θ(*n*log*n*).
Using these two we can make unique tree.

D None of the above

QUESTION ANALYTICS +

Q. 25 — Have any Doubt ?

Consider the following graph:



The minimum size of queue required when performing BFS on above graph is _____.
(Size of queue is represented by maximum number of element at any time).

4 — Correct Option

Solution :
4
Assume BFS starts with vertex "E"

Step 1:	E	
Step 2:	B C F G	Adjacent of 'A'
Step 3:	C F G A	Adjacent to C, A added
Step 4:	F G A D	D added, adjacent to C
Step 5:	G A D	
Step 6:	A D	
Step 7:	D	

So, minimal size of queue is 4.

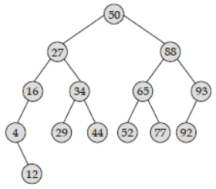
QUESTION ANALYTICS +

Q. 26 Solution Video | Have any Doubt ?

A binary search tree was constructed by inserting following elements into an initially empty binary tree.
50, 27, 16, 88, 34, 65, 52, 77, 93, 4, 12, 29, 44, 92
Preorder and postorder traversals of the resultant binary search tree were stored in arrays A and B respectively. The length of the longest common subsequence out of the traversals obtained is _____.

6 — Correct Option

Solution :
6



		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Array A:	Preorder:	50	27	16	4	12	34	29	44	88	65	52	77	93	92

		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Array B:	Postorder:	12	4	16	29	44	34	27	52	77	65	92	93	88	50

LCS: 16, 29, 44, 52, 77, 93
∴ The maximum length is 6.

QUESTION ANALYTICS +

Q. 27 Have any Doubt ?

Consider the following C-segment:

```
main ( )
{
int sum = 0;
for (int bound = 1; bound ≤ n; bound × = 2)
{
   for (int i = 0; i < bound; i++)
   {
      for (int j = 0; j < n; j += 2)
      {
         sum += j ;
      }
      for (int j = 1; j < n; j × = 2)
      {
         sum × = j;
      }
   }
}
```

The time complexity of above program is $O(n^p \log^q n)$. Then the value of 100p + 2q is _____.

200 — Correct Option

Solution :
200

Loop will be executed as,

$$1 \times n + 2 \times n + 4 \times n + 8 \times n + \ldots + \log_2 n \times n$$
$$= n(1 + 2 + 4 + 8 + \ldots + \log_2 n)$$
$$= \frac{n(1(2^{\log n} - 1))}{2 - 1} = n^2$$

The time complexity of above code is $O(n^2)$.

So $p = 2, q = 0$

So value of $100p + 2 \times q = 100 \times 2 + 2 \times 0 = 200$

QUESTION ANALYTICS +

Q. 28 Solution Video | Have any Doubt ?

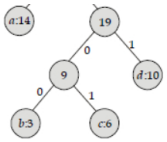
Consider the following table:

Character	a	b	c	d
Frequency	14	3	6	10

The number of bits that are needed to encode a string containing 14 a's, 3 b's, 6 c's and 10 d's using the Huffman coding are _____.

61 — Correct Option

Solution :
61



$a = 0, b = 100, c = 101, d = 11$

$14\ a's + 3\ b's + 6\ c's + 10\ d's$

$= 14 \times 1 + 3 \times 3 + 6 \times 3 + 10 \times 2$

$= 14 + 9 + 18 + 20 = 61$

QUESTION ANALYTICS +

Q. 29 Have any Doubt ?

Consider the following C-fragment where size of int is 1 B (Assume starting address of array is 1000)

```
int main ( )
{
   int S[6] = {10, 20, 30, 40, 50, 60};
   int * Str = (int *) (&S + 1);
   printf("% d", Str);
}
```

The output generated by above code is _____.

1006 Correct Option

Solution :
1006

1000	S	10	20	30	40	50	60
1000		1000	1001	1002	1003	1004	1005

str 1006 = (int *) (&S + 1)

⇒ (int *) (Base address of (S) + 1 * (size of (S))
⇒ (1000 + 6 B)
⇒ (1000 + 6)
⇒ 1006

QUESTION ANALYTICS +

Q. 30 Have any Doubt ?

Consider the following statements:
S_1 : Connected components of a graph can be obtained by depth first traversal but not by breadthfirst traversal.
S_2 : In DFS traversal every vertex of the graph is visited exactly once.
S_3 : DFS traversal and BFS traversal on a complete binary tree of height atleast 2 will always give same output.
Number of correct statements _____.

0 Correct Option

Solution :
0

- Both BFT as well as DFT can be applied to find the connected components of a graph.
- No, vertex can be visited as many times as the nodes adjacent to it are unvisited.
- DFS traversal and BFS traversal on a complete binary tree of height atleast 2 will give different output since BFS visited all the adjacent vertices first but DFS visited node in depth wise.

QUESTION ANALYTICS +

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MULTIPLE SUBJECT : ALGORITHMS + PROGRAMMING AND DATA STRUCTURES (GATE - 2020) - REPORTS

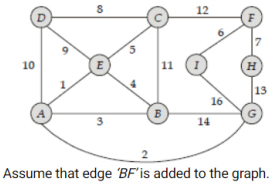
OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(33) CORRECT(0) INCORRECT(0) SKIPPED(33)

Q. 31

Solution Video | Have any Doubt ?

Consider the weighted undirected graph below:

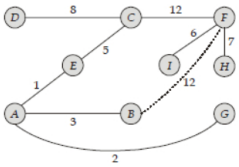


Assume that edge *'BF'* is added to the graph. The maximum value of *'BF'* so that this new edge can belong to the minimum spanning tree is _____.

12 — Correct Option

Solution :
12

Minimum spanning tree:



If *BF* edge represented by dotted line is added to the MST we can throw away largest edge in the loop (*AECFBA*).

$$BF_{max} = 12$$

QUESTION ANALYTICS +

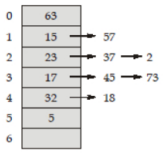
Q. 32

Have any Doubt ?

The keys 15, 17, 23, 32, 37, 45, 57, 63, 2, 5, 18, 73 are inserted into an initially empty hash table of length 7 with hash function h(k) = k mod 7. The collisions are resolved by chaining. The average chain length of hash table is _____. (Upto 2 decimal place) (Assume every element stored outside the hash table)

1.71 [1.7 - 1.8] — Correct Option

Solution :
1.71 [1.7 - 1.8]



$$\text{Average chain length} = \frac{1+2+3+3+2+1+0}{7} = 1.71$$

QUESTION ANALYTICS +

Q. 33

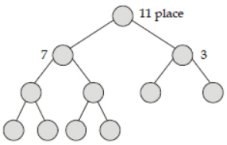
Solution Video | Have any Doubt ?

Total number of ordering possible with elements 12, 10, 8, 5, 3, 2, 1, 13, 7, 9, 18 such that it satisfied max heap property _____.

19200 — Correct Option

Solution :
19200

Max heap will be a full binary tree



Total 7 elements are there.

$$\frac{11!}{\quad}$$

Number of ordering possible = $\frac{}{11\times7\times3\times3\times3} = 19200$

QUESTION ANALYTICS +