

GATE

CRASH COURSE

Data Science & AI

Subject

Data Structure & Algorithms
Most Expected 25 Model GATE Questions of
DS in DA
Lecture No. - 06

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Topics to be covered

- 1 Homework Problem Solution
- 2 BST – Insertion, Construction
- 3 BST – Deletion
- 4 Binary Heap – Insertion, Deletion
- 5 Examples



Question - 1

AVL: Height balanced BST



Choose Incorrect statement(s) from below:

MSQ

Ans: A, B, D



Every BST is a CBT.



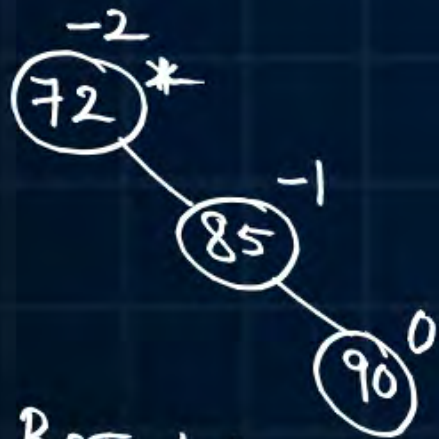
Every AVL Tree is a BST.



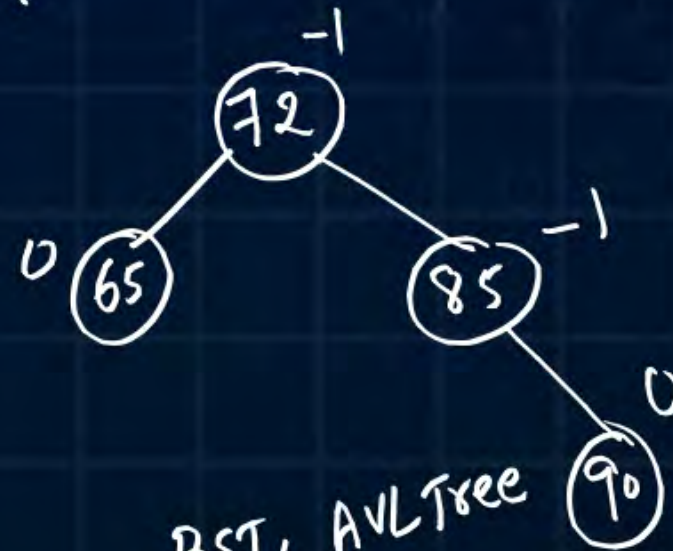
Every AVL Tree is a CBT.



Every BST is an AVL Tree



BST but
not CBT
Not an AVL Tree



BST, AVL Tree
but not CBT

[illegible]

MSQ

$$\text{Maximum} = [0 \text{ (or) } 1 \text{ (or) } 2]$$

- Every non-root node has exactly one parent.

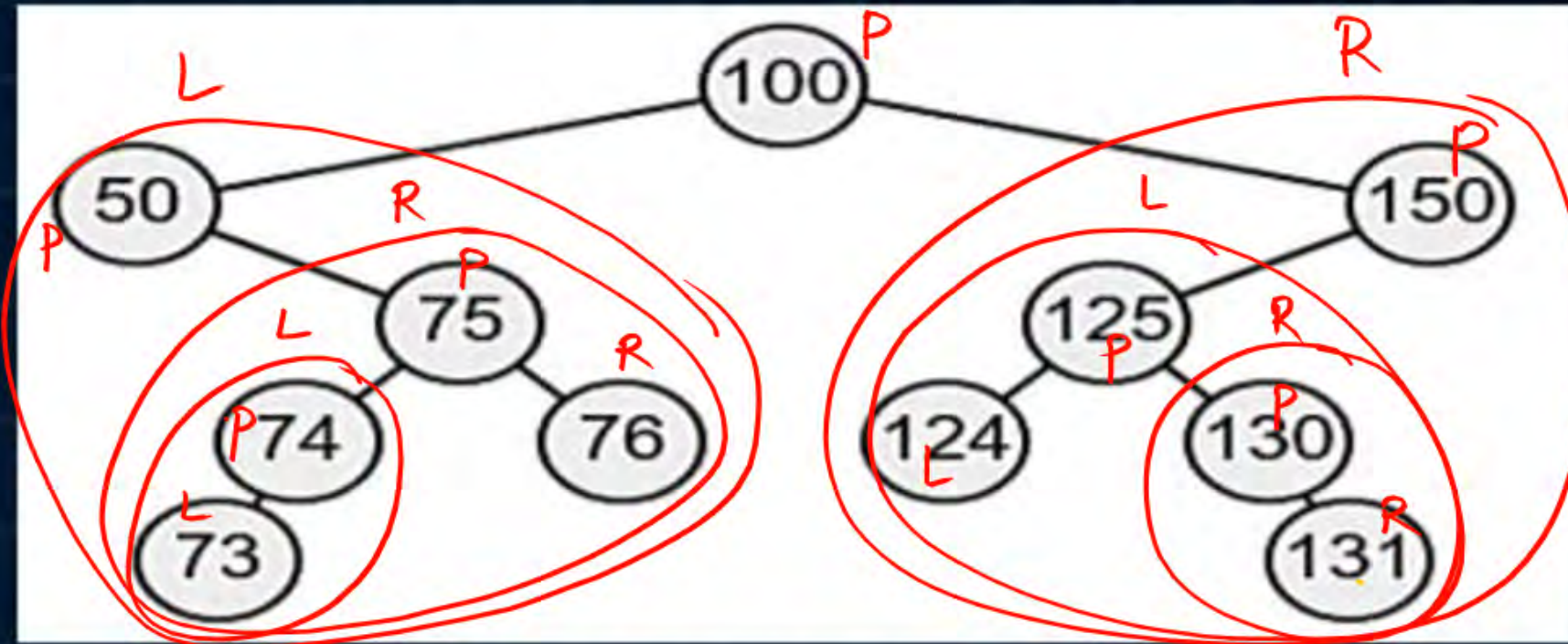


Question - 3



Choose Incorrect traversal Sequence(s) from below, for given tree:

MSQ



Ans: B, C

A

(LPR)

In Order : 50, 73, 74, 75, 76, 100, 124, 125, 130, 131, 150

B

(PLR)

Pre Order: 100, 50, 75, 74, 73, 76, 150, 125, 124, 130, 131

C

(LRP)

Post Order: 73, 74, 76, 75, 50, 124, 131, 130, 125, 150, 100

D

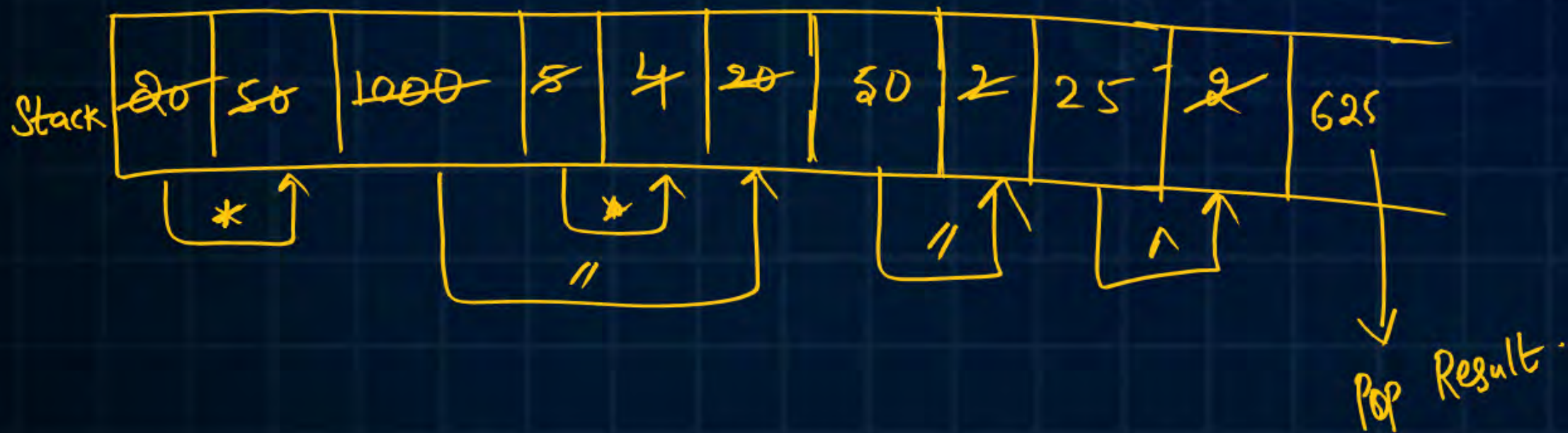
Level Order: 100, 50, 150, 75, 125, 74, 76, 124, 130, 73, 131

Question - 4



The Result after evaluating the below Postfix Expression is 625:

20 50 * 5 4 * // 2 // 2 ^



Match the items in Column 1 with the items in Column 2 in the following table:

Column 1

(p) First In First Out

(q) Lookup Operation

(r) Last In First Out

Column 2

(i) Stacks

(ii) Queues

(iii) Hash Tables

- ☒ (A) (p) - (ii), (q) - (iii), (r) - (i)
(B) (p) - (ii), (q) - (i), (r) - (iii)
(C) (p) - (i), (q) - (ii), (r) - (iii)
(D) (p) - (i), (q) - (iii), (r) - (ii)

#Q. A function f defined on stacks of integers satisfies the following properties.

$f(\text{empty stack}) = 0$ and $f(\text{push}(S, i)) = \max(f(S), 0) + i$ for all stacks S and integers i .

If a stack S contains the integers $2, -3, 2, -1, 2$ in order from bottom to top, what is $f(S)$?

$f(\text{stack}) = 3$

A

6

$$f(\text{push}(S, 2)) = \max(0, 0) + 2 = 2$$

B

4

$$f(\text{push}(S, -3)) = \max(2, 0) + (-3) = 2 + (-3) = -1$$

C

3

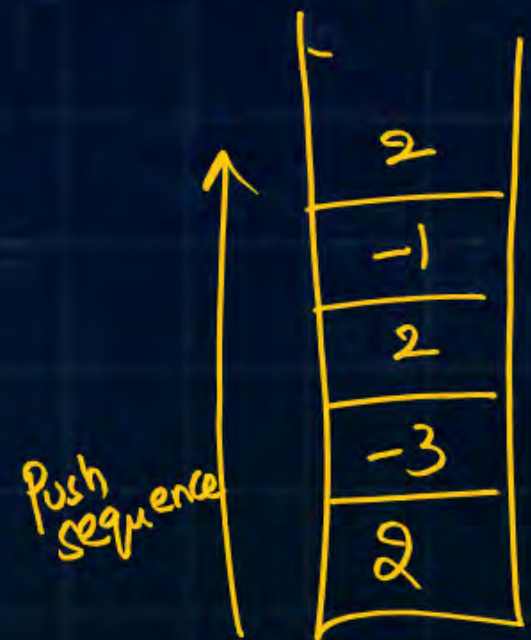
$$f(\text{push}(S, 2)) = \max(-1, 0) + 2 = 0 + 2 = 2$$

D

2

$$f(\text{push}(S, -1)) = \max(2, 0) + (-1) = 2 + (-1) = 1$$

$$f(\text{push}(S, 2)) = \max(1, 0) + 2 = 1 + 2 = 3$$



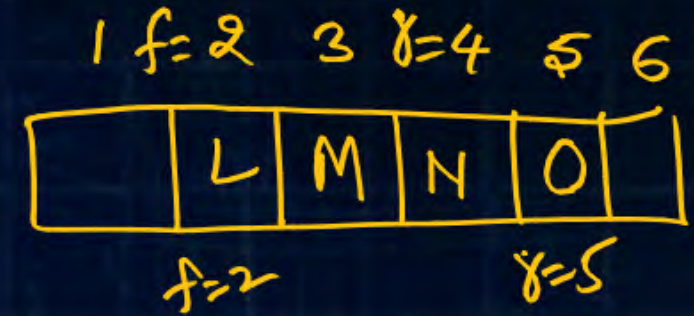
Question - 7



Let the following circular queue can accommodate maximum six elements with the following data

Indexing from '1'

front = 2 rear = 4, queue = _____; L, M, N, _____



What will happen after ADD O operation takes place?

- a) front = 2 rear = 5, queue = _____; L, M, N, O, _____
- b) front = 3 rear = 5, queue = L, M, N, O, _____
- c) front = 3 rear = 4, queue = _____; L, M, N, O, _____
- d) front = 2 rear = 4, queue = L, M, N, O, _____

#Q. Suppose a circular queue of capacity (n) elements is implemented with an array(list) of n elements. Assume that the insertion and deletion operations are carried out using REAR and FRONT as index variables, respectively. Initially REAR=FRONT = -1. The conditions to detect queue full and queue is empty are?

a) ✓ Full: $(\text{REAR}+1) \bmod n == \text{FRONT}$

Empty: $\text{REAR} == \text{FRONT}$

b) Full: $(\text{REAR}+1) \bmod n == \text{FRONT}$

Empty: $(\text{FRONT}+1) \bmod n == \text{REAR}$

c) Full: $\text{REAR} == \text{FRONT}$

Empty: $(\text{REAR}+1) \bmod n == \text{FRONT}$

d) Full: $(\text{FRONT}+1) \bmod n == \text{REAR}$

Empty: $\text{REAR} == \text{FRONT}$

Question - 9



#Q. The postfix form of the expression $(A+B) * (C*D-E)*F/G$ is _____

- A. $AB+CD*E-FG/**$
- ☒ B. $AB+CD*E-*F*G/$
- C. $AB+CD*E-F**G/$
- D. $AB+CDE*- *F*G/$

Stack



Postfix Exp: $AB+CD*E-*F*G/$

If Top Element \geq Scanned Element:

Pop Top, add to Postfix

Push scanned element.

else:

Push Scanned Element.

Question - 10



Let 's' be a stack and push and pop be functions implementing the Insertion and Deletion operations in a Stack. push takes 2 parameters: the stack and the element to be inserted, pop takes a single parameter: the stack. What will be the contents of the stack after the following operations: push(s,A), push(s,B), push(s,C), pop(s), pop(s), push(s, D), push (s, E), pop(s) ?

- ☒ A. A D
- B. D E
- C. C E
- D. A E

Score ?
10



Ans: D

#Q. A program attempts to generate as many permutations as possible of the string, 'abcd' by pushing the characters a, b, c, d in the same order onto a stack, but it may pop off the top character at any time. Which one of the following strings CANNOT be generated using this program?

(A) abcd

Push(a), Pop, Push(b), Pop, Push(c), Pop, Push(d), Pop

(B) dcba

Push(a), Push(b), Push(c), Push(d), Pop, Pop, Pop, Pop

(C) cbad

Push(a), Push(b), Push(c), Pop, Pop, Pop, Push(d), Pop

~~(D) cabd~~



Question - 12

#Q. What does the following function print for a given Linked List with input 1,2,3,4,5,6?

```
class Node:
```

```
    def __init__(self, data):
```

```
        self.data = data
```

```
        self.next = None
```

```
def fun1(head):
```

```
    if head.next is None:
```

```
        return
```

```
    print(head.data, end=' ')
```

```
    fun1(head.next)
```

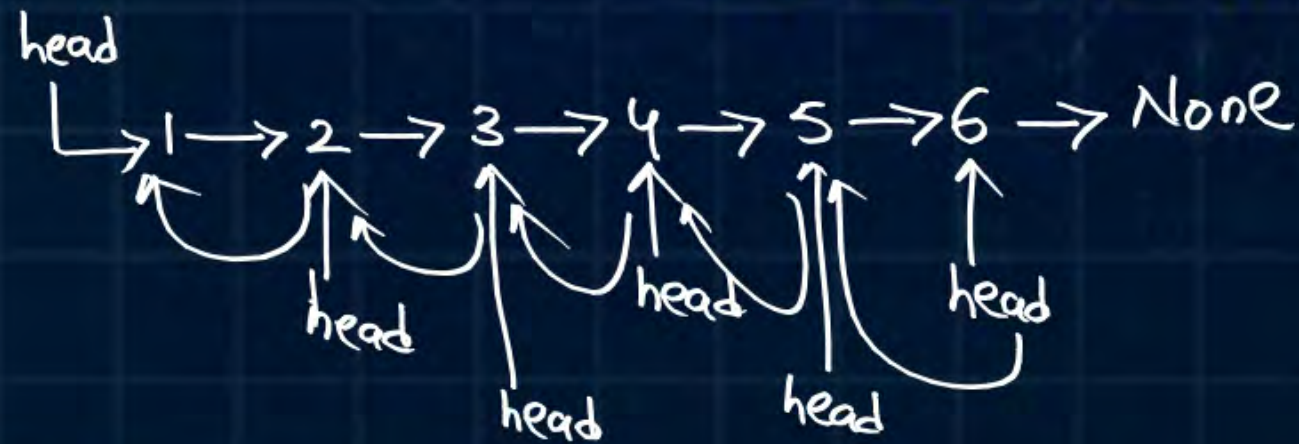
```
    print(head.data, end=' ')
```

a) 1, 2, 3, 4, 5, 6, 6, 5, 4, 3, 2, 1

b) 2, 3, 4, 5, 6, 6, 5, 4, 3, 2

☒ c) 1, 2, 3, 4, 5, 5, 4, 3, 2, 1

d) 1, 2, 3, 4, 5, 6, 5, 4, 3, 2, 1



o/p: 1 2 3 4 5 5 4 3 2 1

#Q. Consider the function foo and the binary tree shown.

class Node:

def __init__(self, val=0, left=None, right=None):

self.val = val

self.left = left

self.right = right

def foo(p):

if p is None:

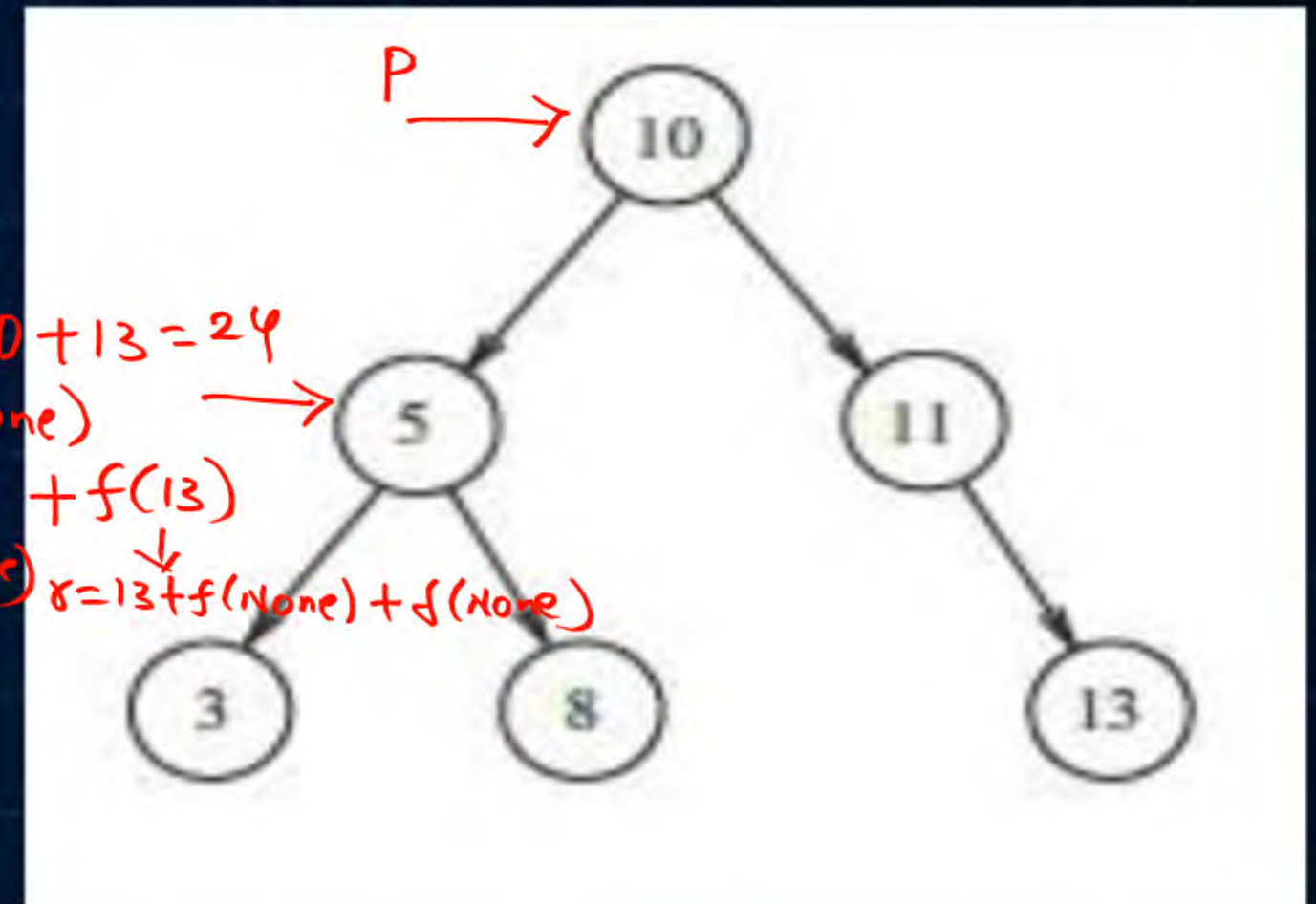
return 0

else:

retval = p.val + foo(p.left) + foo(p.right)

print(retval, end=" ")

return retval



$$\begin{aligned}
 &= 10 + 16 + 24 = 50 \\
 &x = 10 + \underbrace{f(5)}_{=10+16+24=50} + f(11) \\
 &\quad \downarrow \quad \quad \quad \downarrow \\
 &x = 5 + f(3) + f(8) \quad 11 + f(\text{None}) + f(13) \\
 &\quad \downarrow \quad \quad \quad \downarrow \quad \quad \quad \downarrow \\
 &x = 3 + f(\text{None}) + f(\text{None}) \quad x = 8 + f(\text{None}) + f(\text{None}) \quad x = 13 + f(\text{None}) + f(\text{None}) \\
 &\quad \quad \quad \downarrow \quad \quad \quad \downarrow \quad \quad \quad \downarrow \\
 &\quad \quad \quad 0 \quad \quad \quad 0 \quad \quad \quad 0
 \end{aligned}$$

o/p: 3, 8, 16, 13, 24, 50

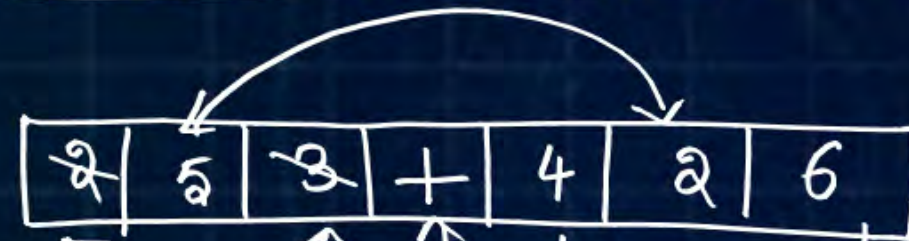
[Reference]

When foo is called with a pointer to the root node of the given binary tree, what will it print?

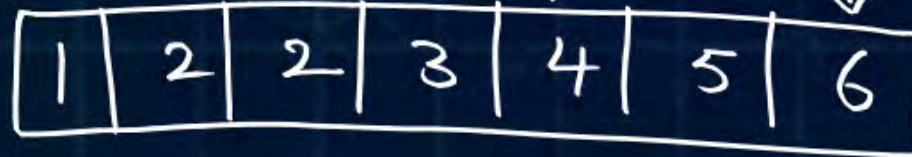
- A) 3 8 5 13 11 10
- B) 3 5 8 10 11 13
- C) 3 8 16 13 24 50
- D) 3 16 8 50 24 13

#Q. Let A be an array containing integer values. The distance of A is defined as the minimum number of elements in A that must be replaced with another integer so that the resulting array is sorted in a non-decreasing order. The distance of the array $[2, 5, 3, 1, 4, 2, 6]$ is

Given List :



Result List :



$$\begin{aligned}\text{distance} &= \text{min No. of replacements} \\ &= 3\end{aligned}$$

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

- 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



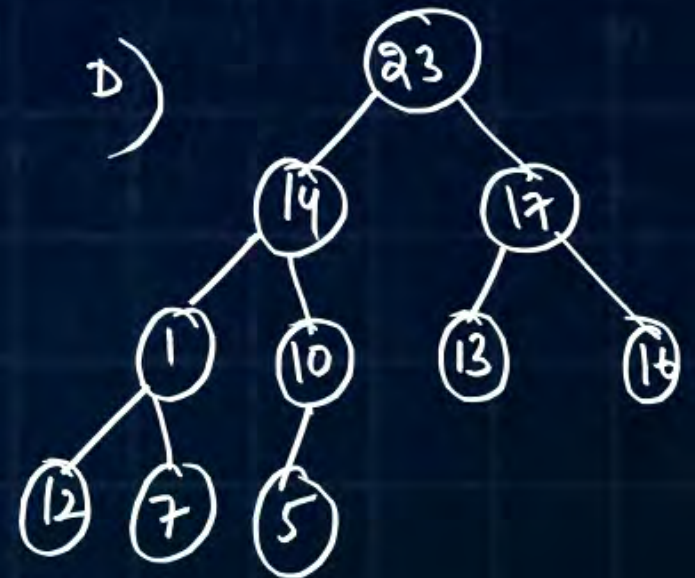
$6 < 7, 10 < 14$
Not Max-heap



Max-heap



$6 < 7, 13 < 15$
Not Max-heap



$1 < 12, 1 < 7$
Not Max-heap

#Q. You are given a set V of distinct integers. A binary search tree T is created by inserting all elements of V one by one, starting with an empty tree. The tree T follows the convention that, at each node, all values stored in the left subtree of the node are smaller than the value stored at the node. You are not aware of the sequence in which these values were inserted into T , and you do not have access to T .

Which one of the following statements is TRUE?

- ☒ (A) In order traversal of T can be determined from V
- (B) The root node of T can be determined from V
- (C) Preorder traversal of T can be determined from V
- (D) Post order traversal of T can be determined from V



7 Root Node

In: 5, 7, 9

Pre: 7, 5, 9

Post: 5, 9, 7

5, 9, 7

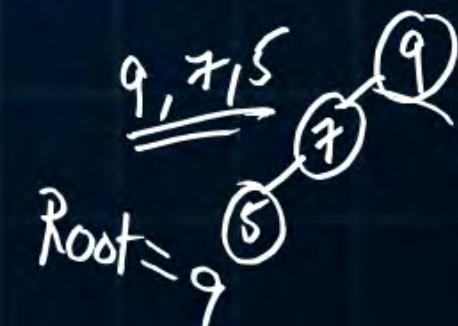


Root = 5

In order: 5, 7, 9

Pre order: 5, 9, 7

Post order: 7, 9, 5



Root = 9

In: 5, 7, 9

Pre: 9, 7, 5

Post: 5, 7, 9

#Q. Convert the following infix expression to postfix expression

$B * C - C + D / A / (E + E)$ →

a) $BC * C - DA / EE + / +$

b) $BCC - * D / AEE + / +$

c) $BCC - * DA / EE + / +$

d) $BCC * - DA / EE + / +$

Stack

| | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|
| * | - | + | / | / | (| + |
| Pop | Pop | Pop | Pop | Pop | Pop | Pop |

Postfix:
Exp: $BC * C - DA / EE + / +$

Question- 18



#Q. Consider a min heap with elements 15, 30, 25, 40, 42, 27. After inserting elements 20 and 7, The Level order traversal sequence would be _____.

- ☒ A. 7, 15, 20, 30, 40, 42, 27, 25
- ☒ B. 7, 15, 20, 30, 42, 40, 27, 25
- ☒ C. 7, 15, 20, 30, 27, 42, 40, 25
- ☒ D. 7, 15, 20, 30, 42, 27, 25, 40



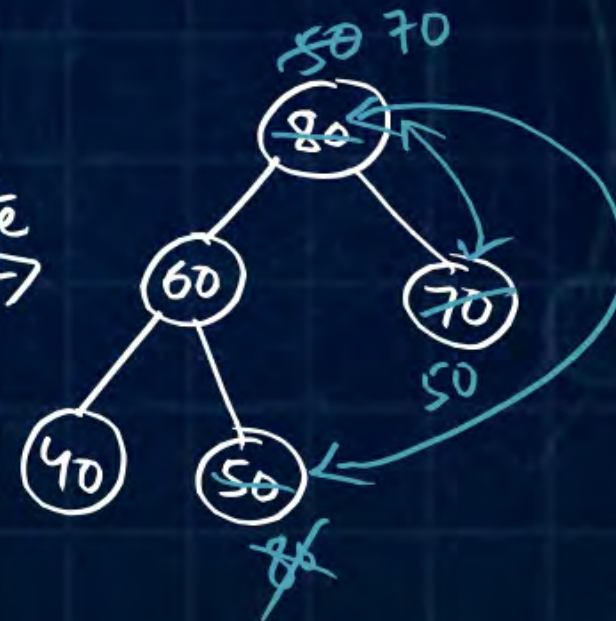
Level order: 7, 15, 20, 30, 42, 27, 25, 40

#Q. Consider a Max Heap with elements 90, 80, 70, 60, 50, 40. After 2 delete Operations, the level order traversal sequence would be -----

- A. 70, 60, 50, 40
- B. 70, 60, 40, 50
- C. 70, 50, 60, 40
- D. 70, 50, 40, 60



Delete →



Delete →



Level order: 70, 60, 50, 40

GATE-2024-DA

Ans: A, B, C

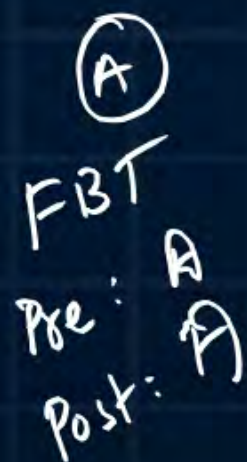
#Q. Consider the following tree traversals on a full binary tree: (MSQ)

- (i) Preorder
- (ii) Inorder
- (iii) Postorder

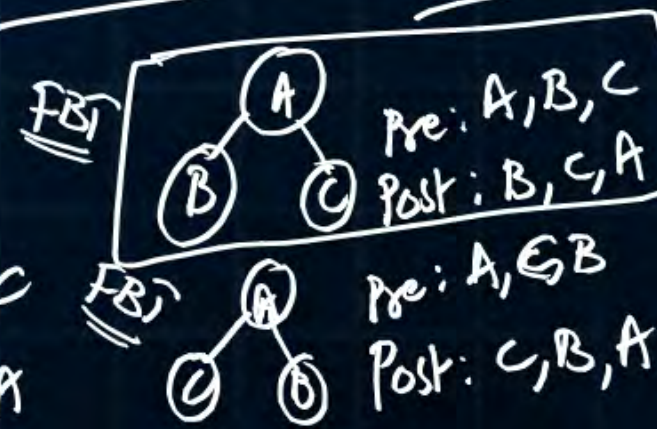
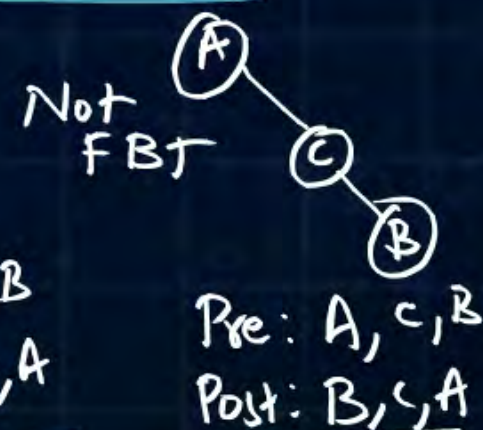
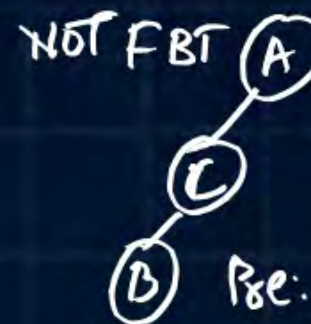
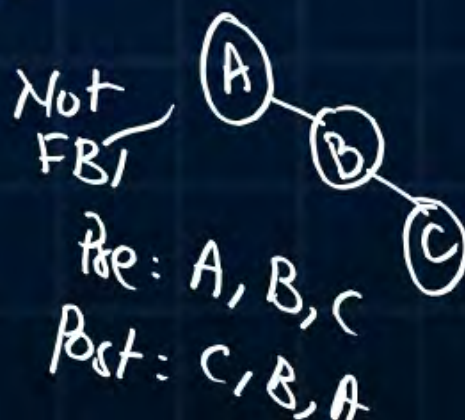
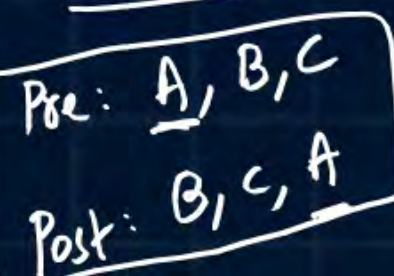
Which of the following traversal options is/are sufficient to uniquely reconstruct the full binary tree?

- ☒ (A) (i) and (ii)
- ☒ (B) (ii) and (iii)
- ☒ (C) (i) and (iii)
- ☐ (D) (ii) only

only 1 Node



3 Nodes



GATE-2024-DAH/W

#Q. Let H, I, L , and N represent height, number of internal nodes, number of leaf nodes, and the total number of nodes respectively in a rooted binary tree.

Which of the following statements is/are always TRUE?

- (A) $L \leq I+1$
- (B) $H+1 \leq N \leq 2^{H+1}-1$
- (C) $H \leq I \leq 2^H-1$
- (D) $H \leq L \leq 2^H-1$

#Q. A circularly linked list is used to represent a Queue. A single variable p is used to access the Queue. To which node should p point such that both the operations enQueue and deQueue can be performed in constant time?

- A. rear node
- B. front node
- C. not possible with a single pointer
- D. node next to front

#Q

#Q. What will be post order traversal of a binary Tree T, if preorder and in order traversals of T are given by ABCDEF and BADCFE respectively?

- a) BEFDCA
- b) BFDECA
- c) BCFDEA
- d) BDFECA

#Q. Given the following Python function, what does it do?

```
def insert(root, key):  
    if root is None:  
        return Node(key)  
    else:  
        if root.val < key:  
            root.right = insert(root.right, key)  
        else:  
            root.left = insert(root.left, key)  
    return root
```

A

Deletes a node from the BST

C

Searches for a node in the BST

B

Inserts a node into the BST

D

Finds the minimum value in the BST

Question - 25

H/W



#Q. In searching an element in a binary tree, number of comparisons is

- A** $O(\log n - 1)$
- B** $O(\log n - 2)$
- C** $O(\log n)$
- D** $O(n \log n)$

$$\frac{\text{Score?}}{20}$$



Post Your Queries / Doubts in My Telegram Channel



t.me/ satyasirpw

The word 'Thank' is written in a large, yellow, cursive script. A yellow arrow starts from the top of the 'T', extends horizontally to the right, and then curves downwards to point at the end of the word.

THANK



Keep Hustling!