

Quiz – 3

Data Structures (CSD102)

Date: 19-11-2024

[Total Marks = 15]

Time: 4:00pm – 4:30pm

1. Draw the B-tree of order 4 created by inserting the following data arriving in sequence, 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16
If node split, promote middle key up and redraw the tree after handling each split case.

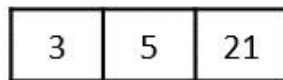
[3 Marks]

Answer:

Insert 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16 into a B tree

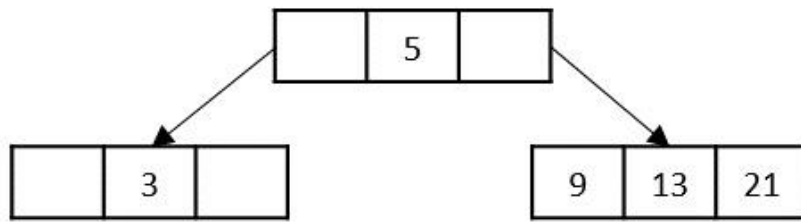
- Order (m) = 4
- Maximum Keys ($m - 1$) = 3
- Minimum Keys ($\lceil \frac{m}{2} \rceil - 1$) = 1
- Maximum Children = 4
- Minimum Children ($\lceil \frac{m}{2} \rceil$) = 2

Insert 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16 into a B tree



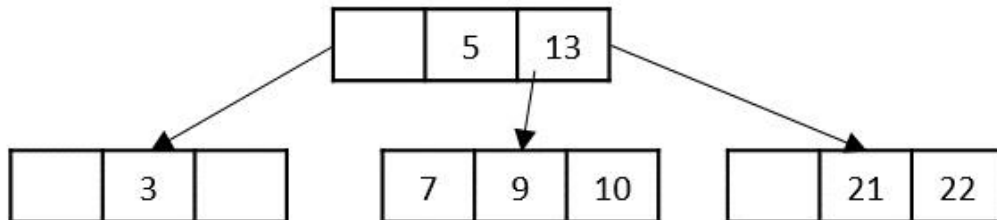
Adding 9 will cause overflow in the node; hence it must be split.

Insert 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16 into a B tree



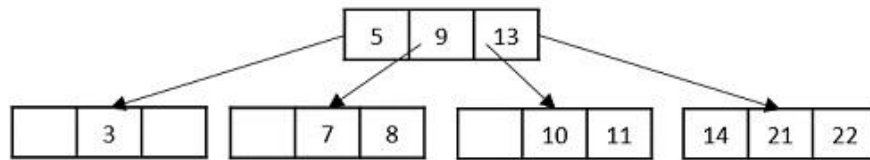
Adding 22 will cause overflow in the node; hence it must be split.

Insert 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16 into a B tree



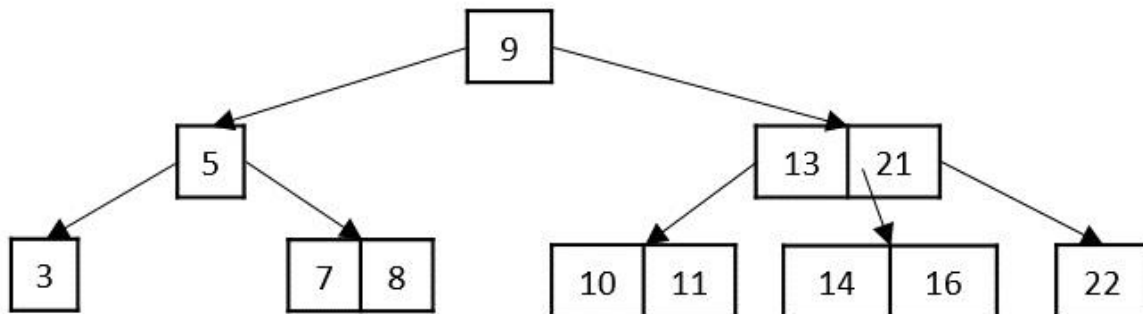
Adding 11 will cause overflow in the node; hence it must be split.

Insert 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16 into a B tree



Adding 16 will cause overflow in the node; hence it must be split.

Insert 5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16 into a B tree

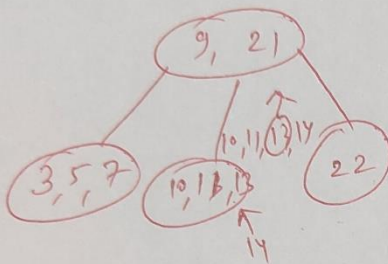
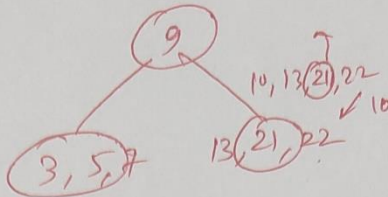
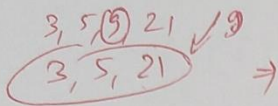


OR (Right Bias case)

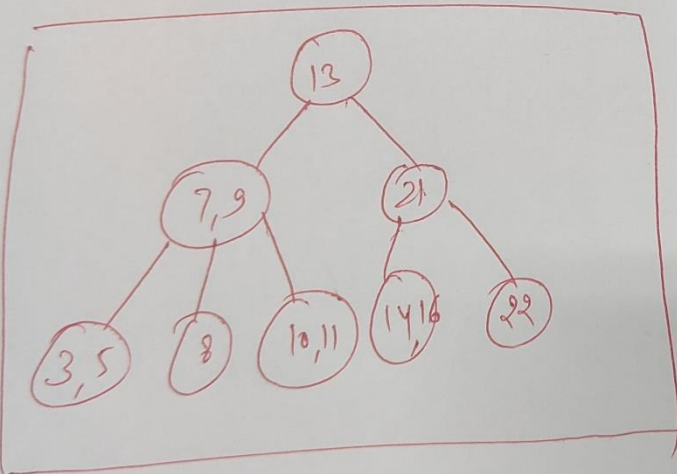
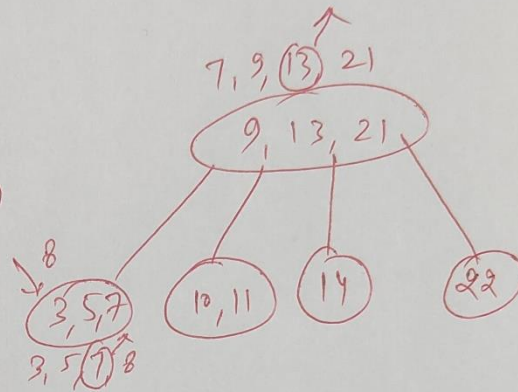
① (Right Bias)

B-tree

~~4~~, ~~8~~, ~~21~~, ~~9~~, ~~13~~, ~~22~~, ~~7~~, ~~10~~, ~~11~~, ~~14~~, ~~8~~, ~~16~~



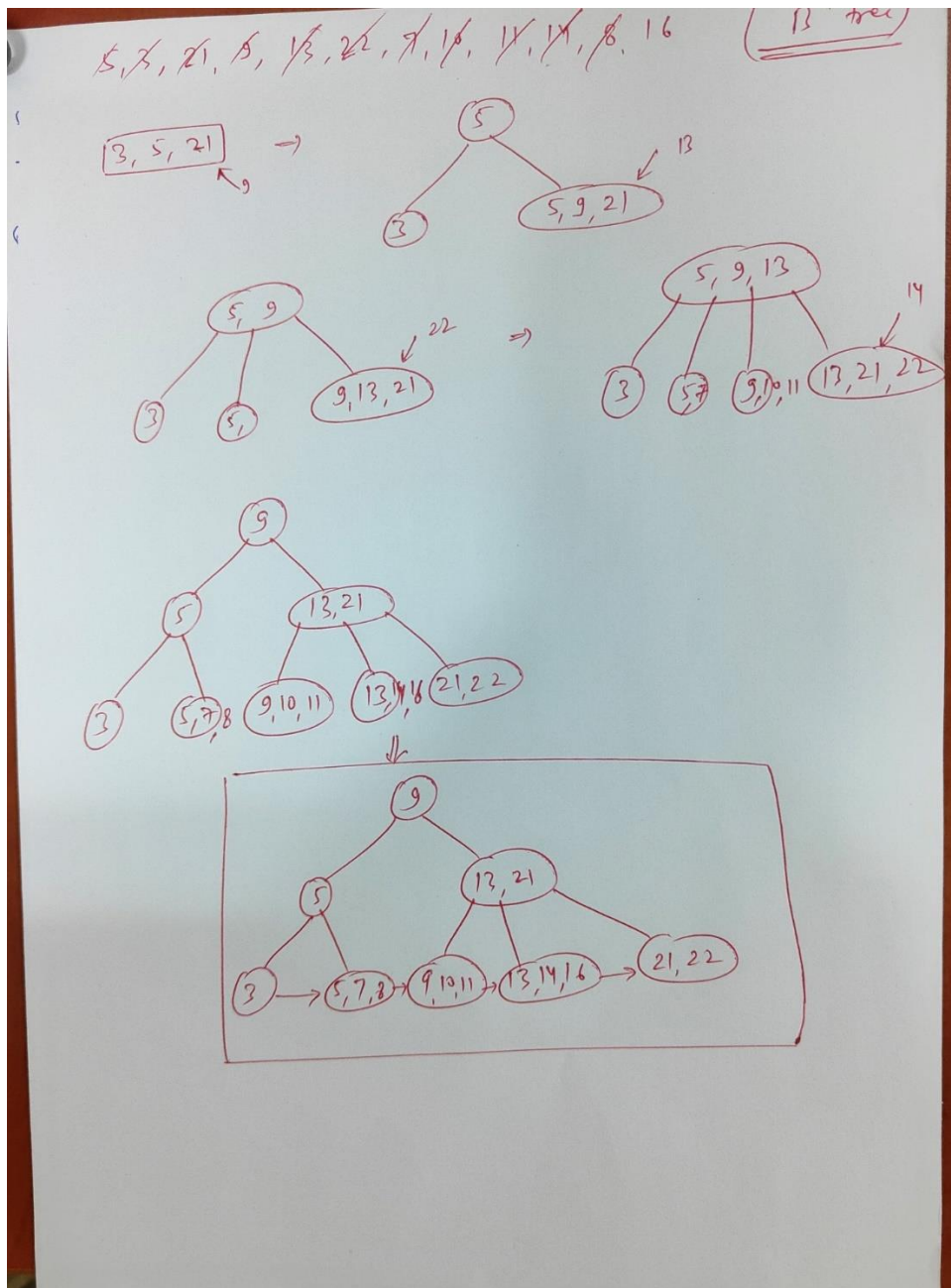
\Rightarrow



2. Draw the B+tree of order 4 created by inserting the following data arriving in sequence,
5, 3, 21, 9, 13, 22, 7, 10, 11, 14, 8, 16

If node split, promote middle key up while keeping the promoted key copy in right subtree (only for leaf node split) and redraw the tree after handling each split case. **[3 Marks]**

Answer: (Left Bias)

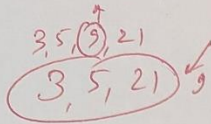


OR (Right Bias case)

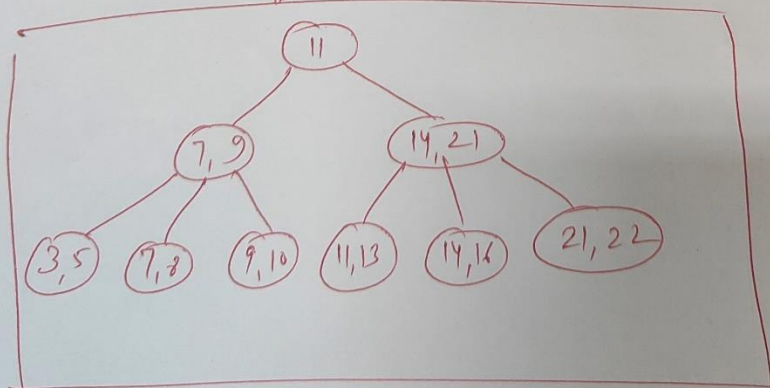
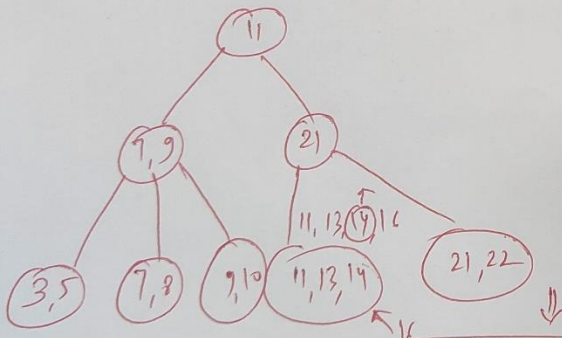
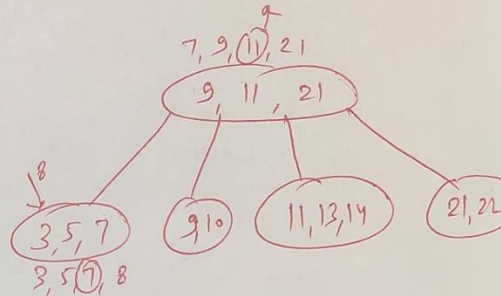
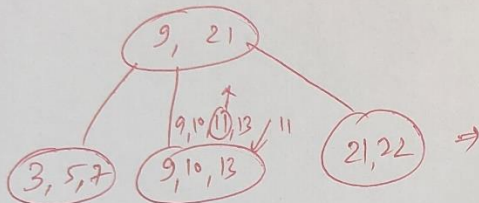
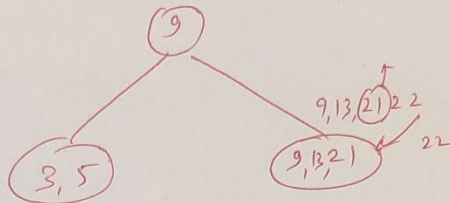
② (Right Bias)

(B⁺ - tree)

~~8, 8, 21, 8, 18, 22, 7, 10, 11, 14, 8, 16~~

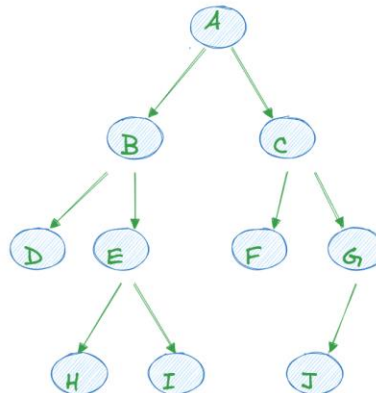


⇒



⇒

3. Given the following graph:



What would be the breadth first search (BFS) and depth first search (DFS) of the above graph while considering the starting vertex as A? If there is ever a decision between multiple neighbor nodes in the BFS and DFS algorithms, assume we always choose the letter closest to the beginning of the alphabet first.

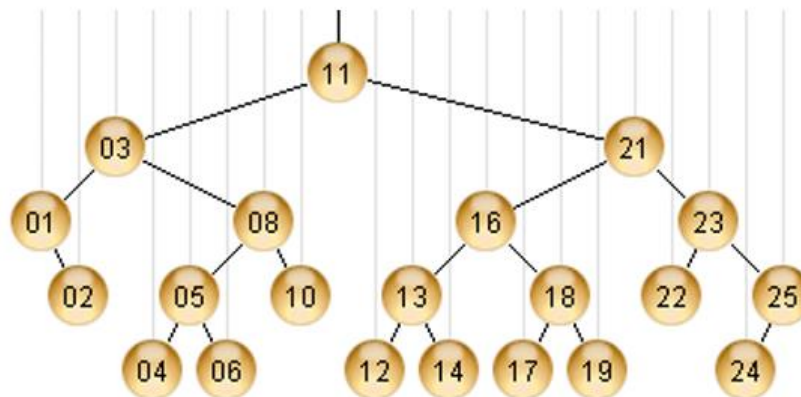
[3 Marks (BFS) + 3 Marks (DFS) = 6 Marks]

Answer:

BFS: A, B, C, D, E, F, G, H, I, J

DFS: A, B, D, E, H, I, C, F, G, J

4. What will be the resulting AVL tree if we delete 10 followed by 22 from the below AVL tree,

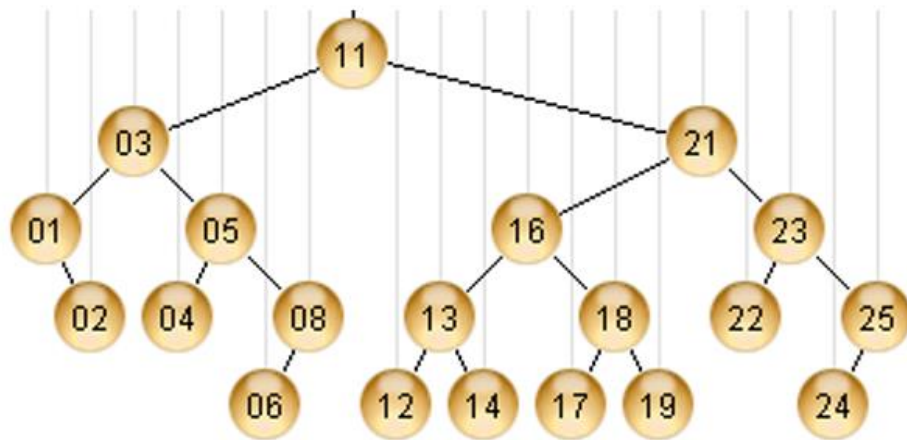


If the tree becomes unbalanced after deletion, balance the tree, and redraw the balanced tree after each deletion.

[2 Marks]

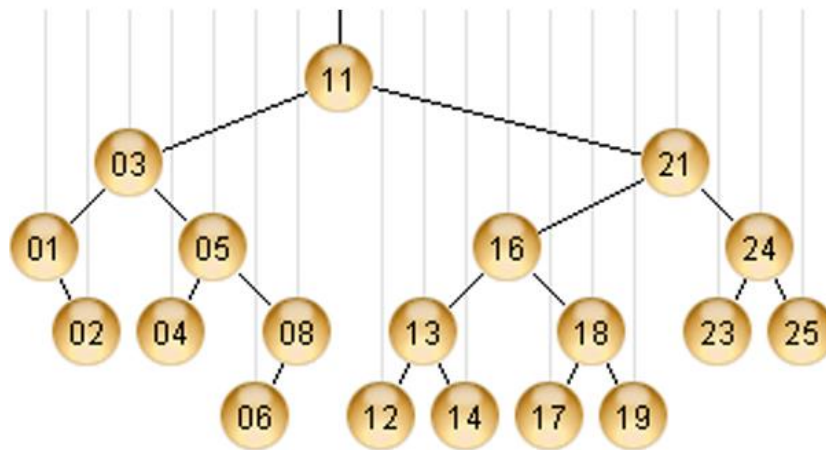
Answer:

After deleting 10 [left-left problem => right rotation]



[1 mark]

After deleting 22 [right-left problem => right rotation then left rotation]



[1 mark]

5. What is the maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0. **[0.5 Mark (formula) + 0.5 (height)]**

Answer:

$$\text{Height (H)} = \text{Height(H-1)} + \text{Height(H-2)} + 1$$

[0.5 marks]

$$\text{Height} = 3$$

[0.5 marks]