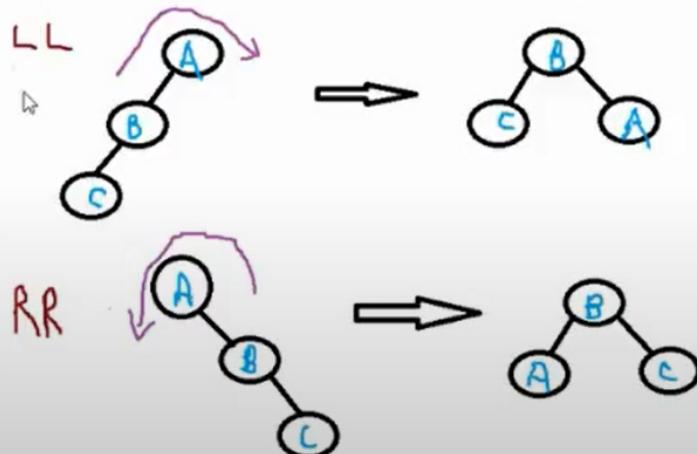
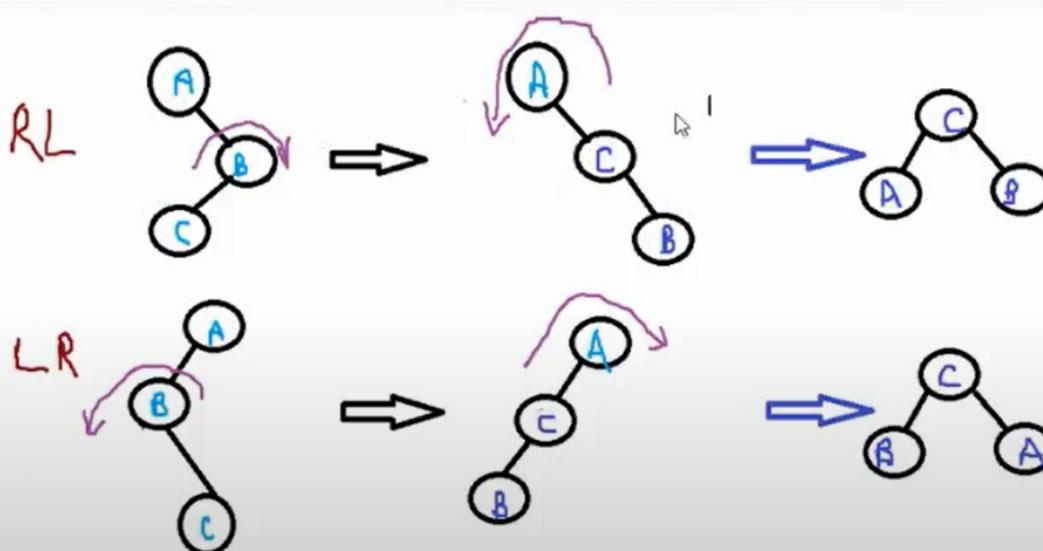


AVL Rotations



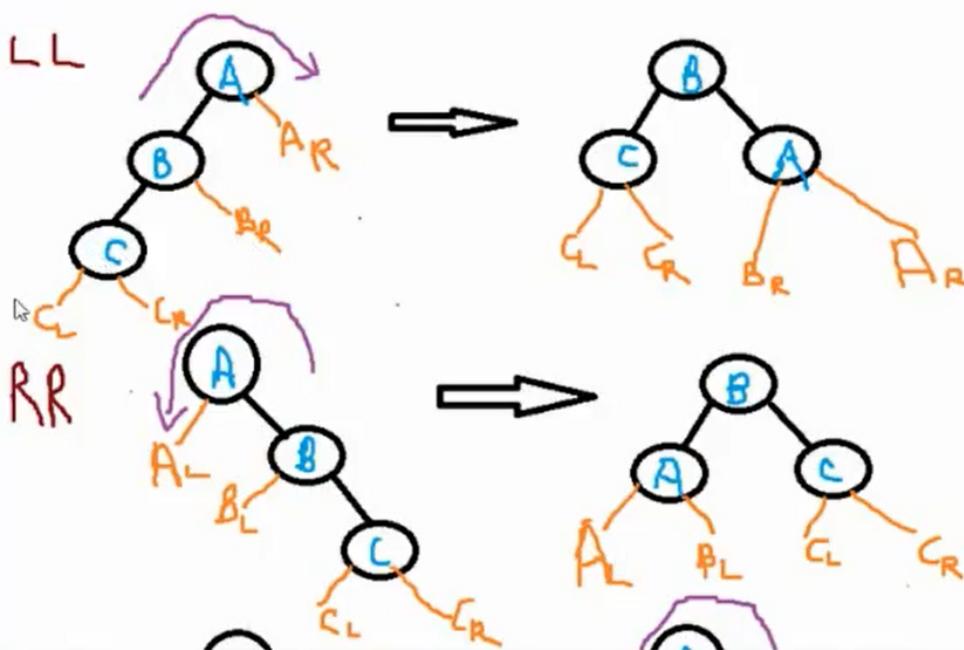
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AVL Rotations



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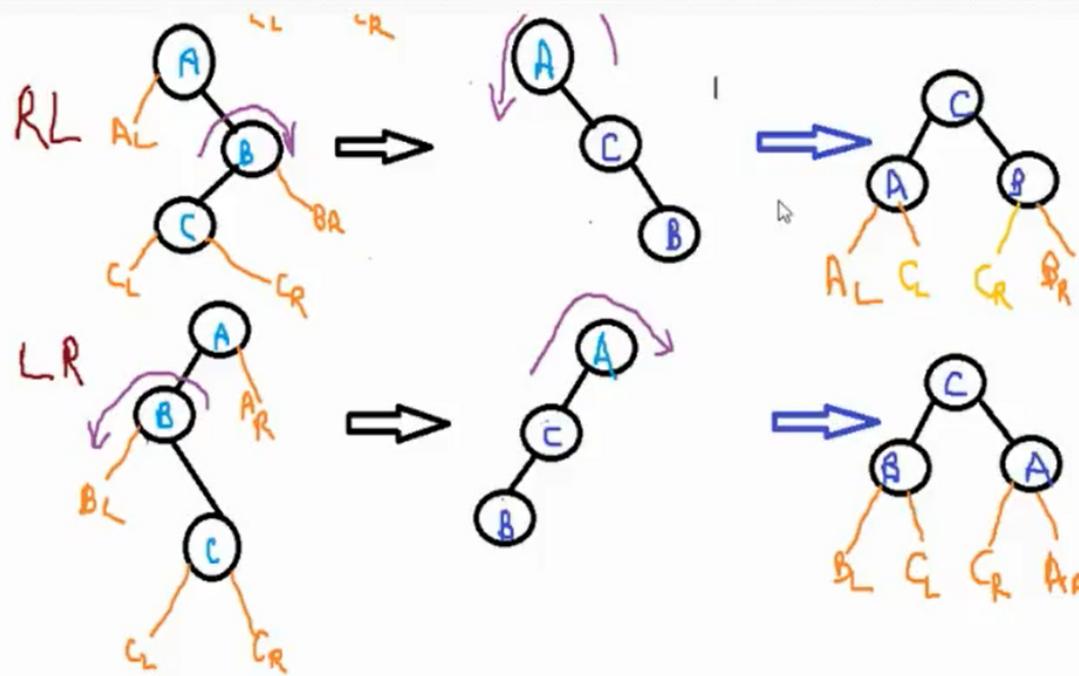
Avl tree with children



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Avl tree with children



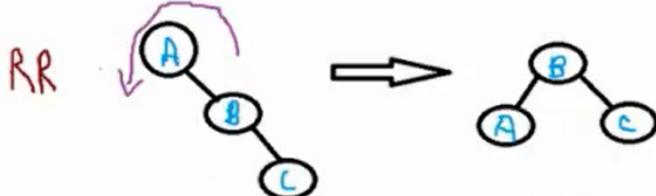
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Summarized

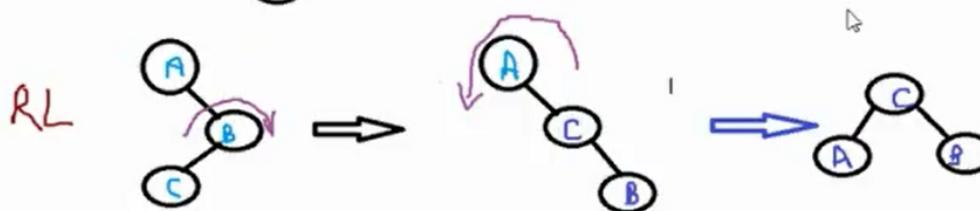
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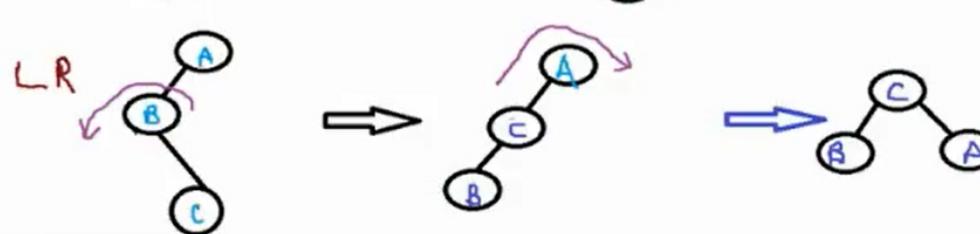
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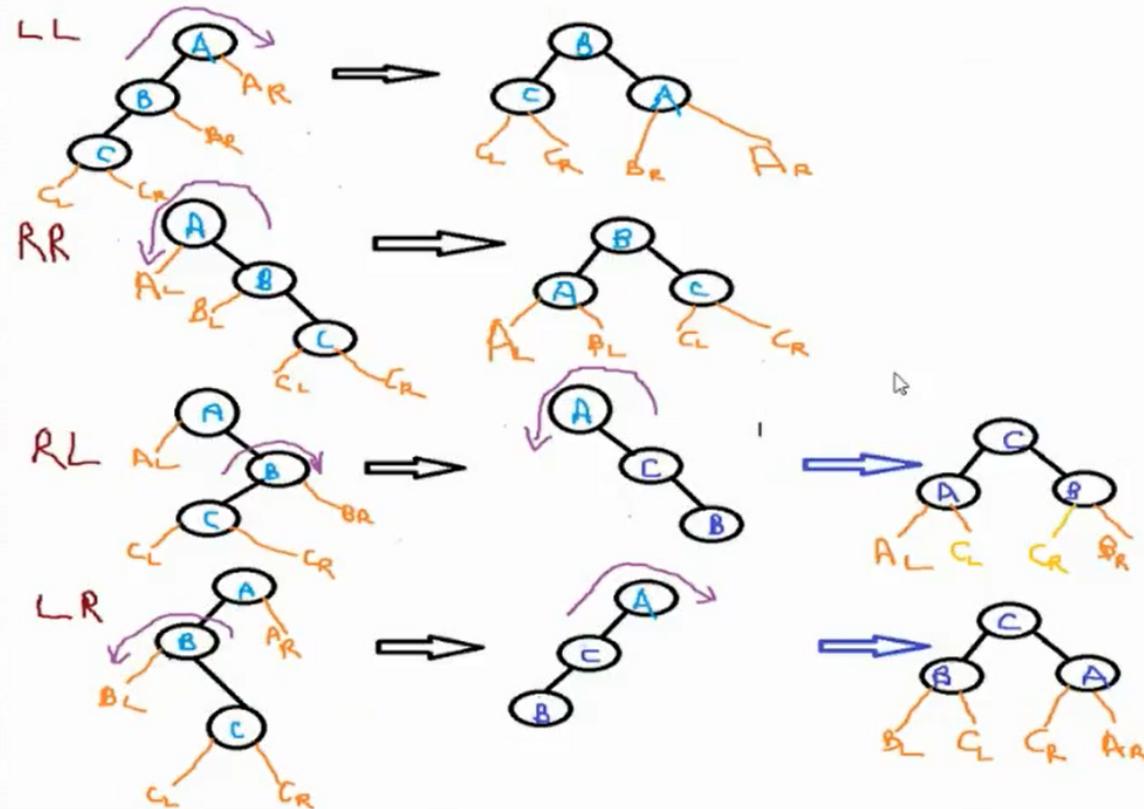


LR



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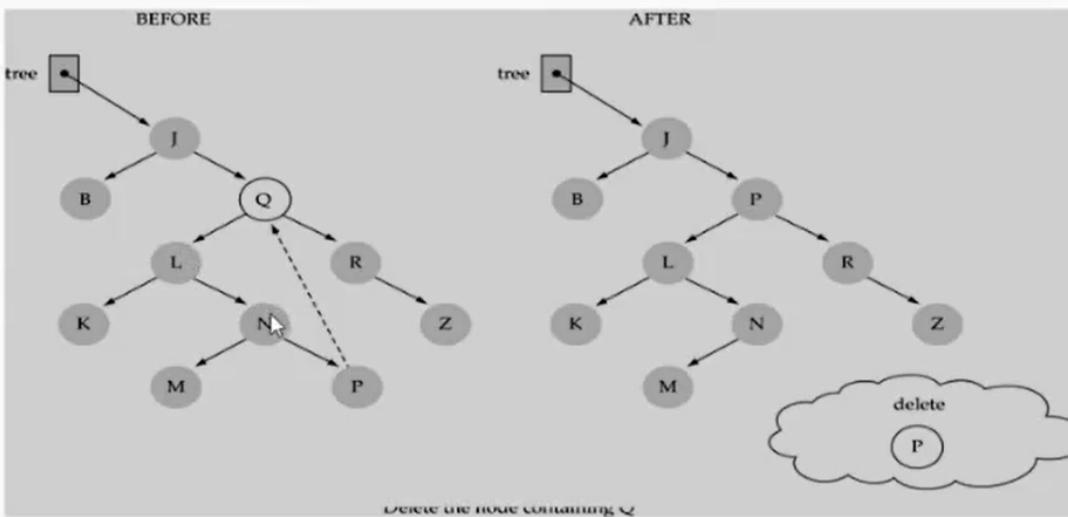
Summarized Special CAses



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Deletion in AVL

- Deletion in BST always result in deleting a leaf node or node with one child
- For instance, deleting Q results in deleting node p

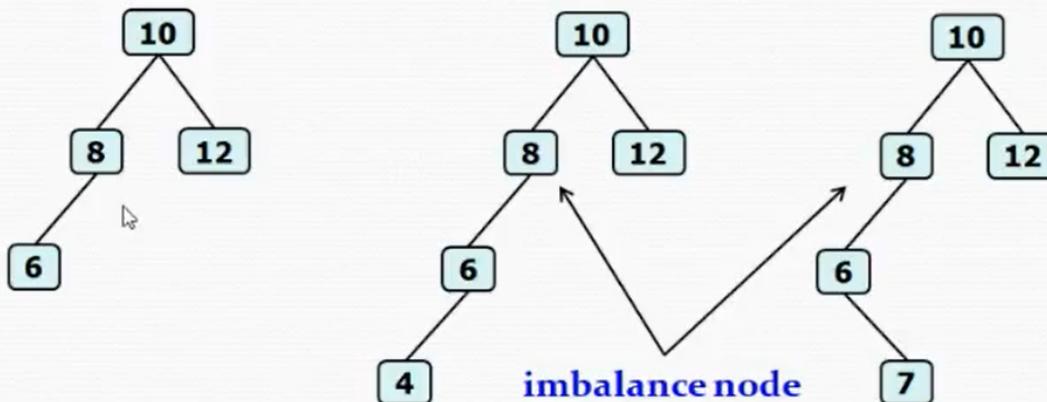


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Deletion in AVL (cont'd)

- In AVL, child of node with one child is a leaf node.
Because if that is not true, it is no longer an AVL tree



- Therefore, either a leaf or parent of leaf node is deleted

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Deletion in AVL (cont'd)

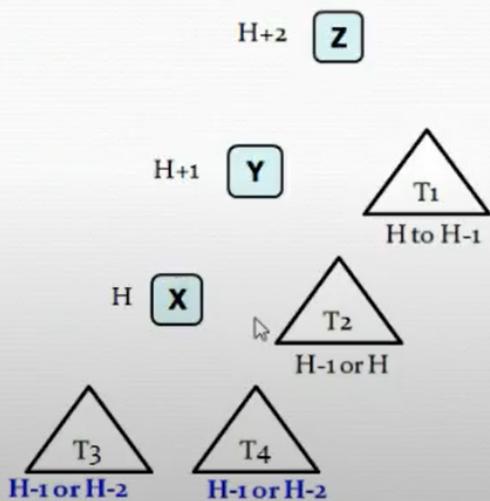
- Let w is the node deleted.
- Traverse bottom up in AVL tree up to root
- Let z is the first imbalance node. y be the child of z with larger height and x be the child of y with larger height.
- Make rotation(s) based on the arrangement between x , y and z .
- Rotation(s) can disturb the balance of ancestors of z . Hence keep checking for imbalance node as we move upward in AVL tree

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Deletion in AVL : Example(1)

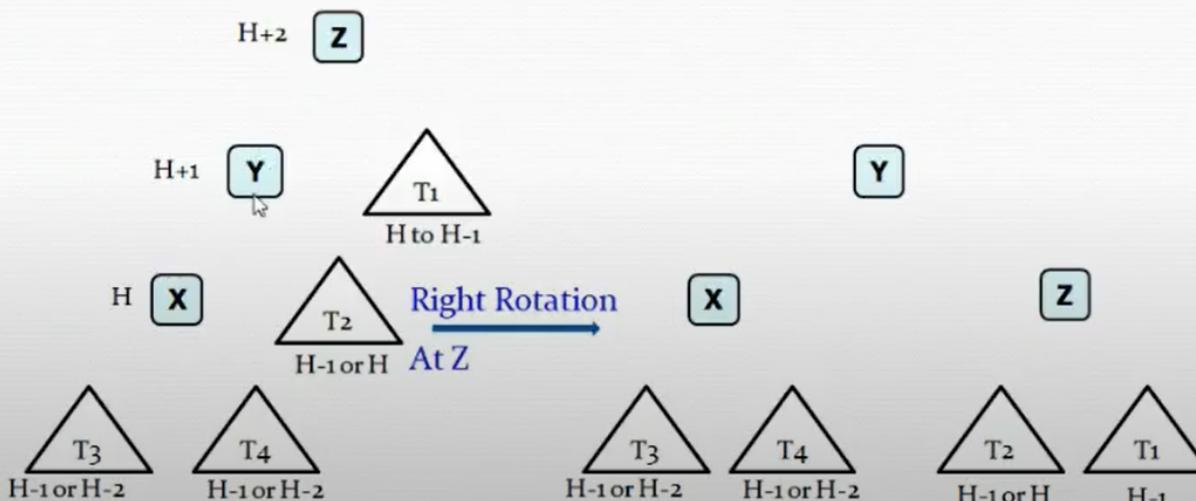
- Since x is balanced $ht(T_3)$ and $ht(T_4)$ are $H-1$ or $H-2$ but both can not have $H-2$.



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Deletion in AVL : Example(1) (cont'd)

- Since x is balanced $\text{ht}(T_3)$ and $\text{ht}(T_4)$ are $H-1$ or $H-2$ but both can not have $H-2$.



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Deletion in AVL : Example(1) (cont'd)

- Originally, the height of tree rooted at z was $H+2$.
- After rotation, sub-tree of height could be $H+1$ or $H+2$
- If height gets reduced, we will have to continue upwards to check imbalance



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