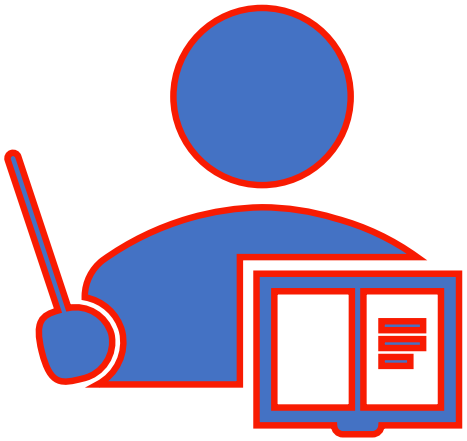
CMP 313
DATA STRUCTURE AND ALGORITHM



INSTRUCTOR

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INTRODUCTION TO DATA STRUCTURE

TOPIC 3

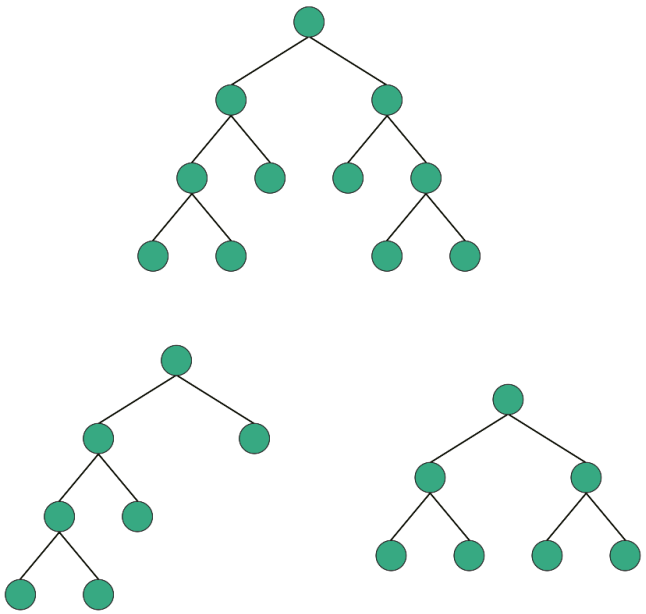
TYPES OF BINARY TREE

Full Binary Tree
Complete Binary Tree
Perfect Binary Tree
Balanced Binary Tree
Degenerate (or pathological) Binary Tree

Full Binary Tree

- **Full Binary Tree** : A Tree is a full binary tree if every node has 0 or 2 children. A full binary tree is a BT in which all nodes except leaf nodes have two children.

Valid structure



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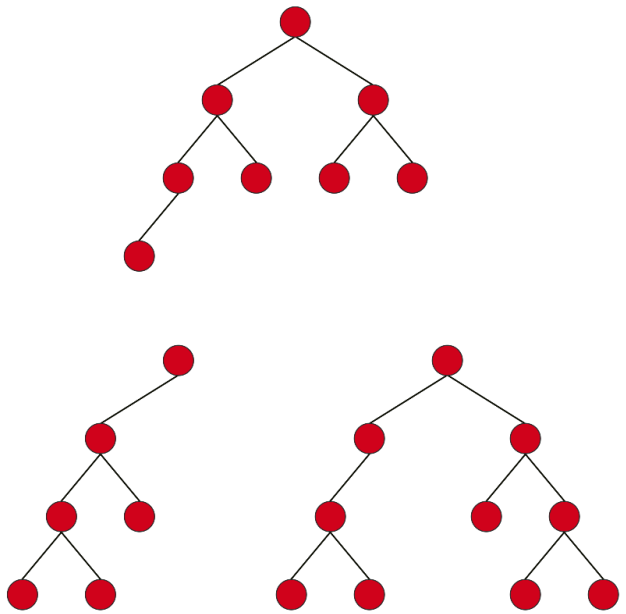
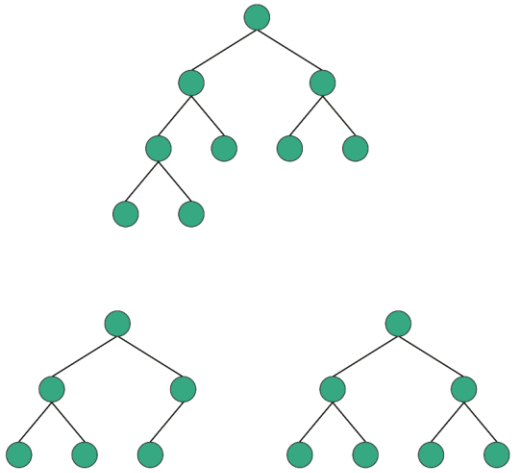


Example of FBT

Complete Binary Tree:

Complete Binary Tree A Binary Tree is a complete Binary Tree if all the levels are completely filled except possibly the last level and the last level has all keys as left as possible

Valid structure



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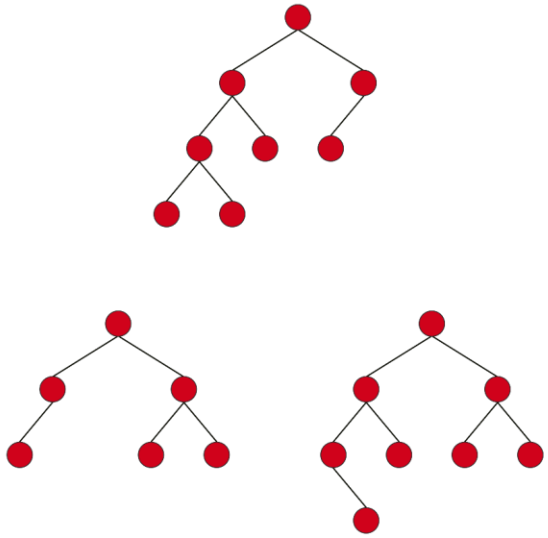

Example of CBT

Perfect Binary Tree

A Binary tree is a Perfect Binary Tree in which all the internal nodes have two children and all leaf nodes are at the same level.

Interesting Fact: *Total number of nodes in a Perfect Binary Tree with height h is* ***2^h — 1***

Valid structure

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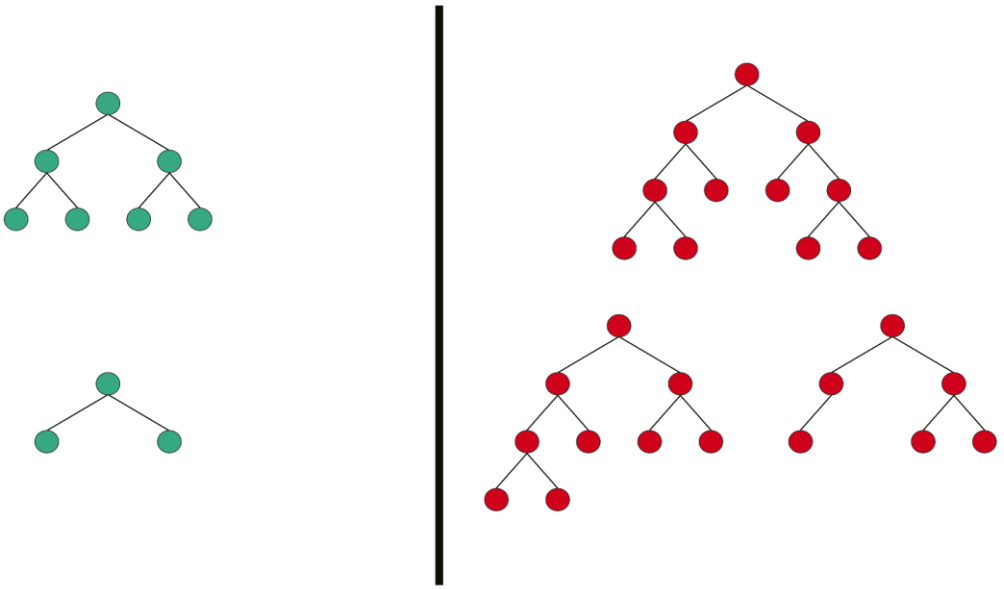

Example of PBT

Balanced Binary Tree

- **Balanced Binary Tree** is a Binary tree in which height of the left and the right sub-trees of every node may differ by at most 1
- A binary tree is balanced if the height of the tree is O(Log n) where n is the number of nodes. For Example, the AVL tree maintains O(Log n) height by making sure that the difference between the heights of the left and right subtrees is almost 1. Red-Black trees maintain O(Log n) height by making sure that the number of Black nodes on every root to leaf paths is the same and there are no adjacent red nodes. Balanced Binary Search trees are performance-wise good as they provide O(log n) time for search, insert and delete

Valid structure

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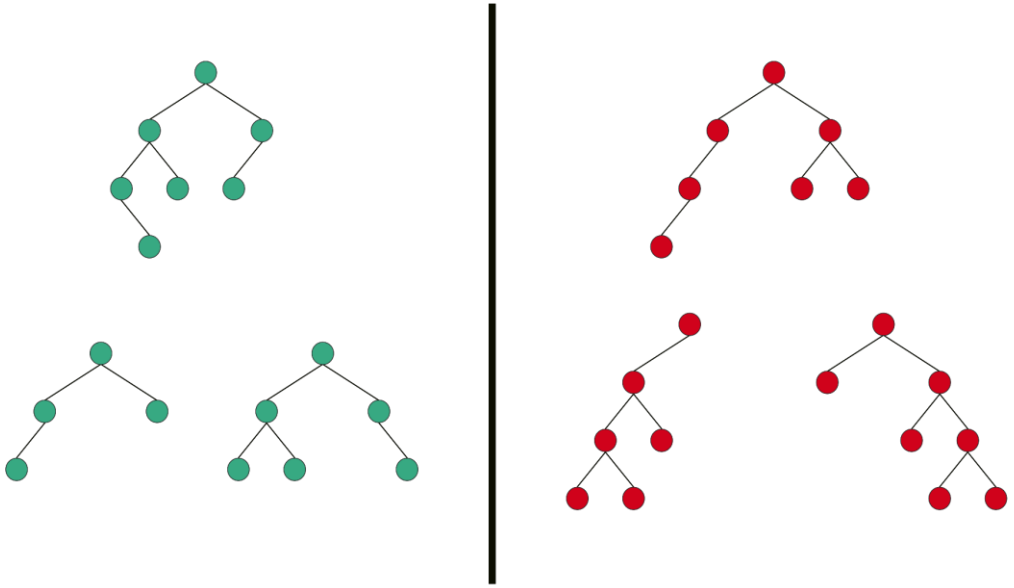
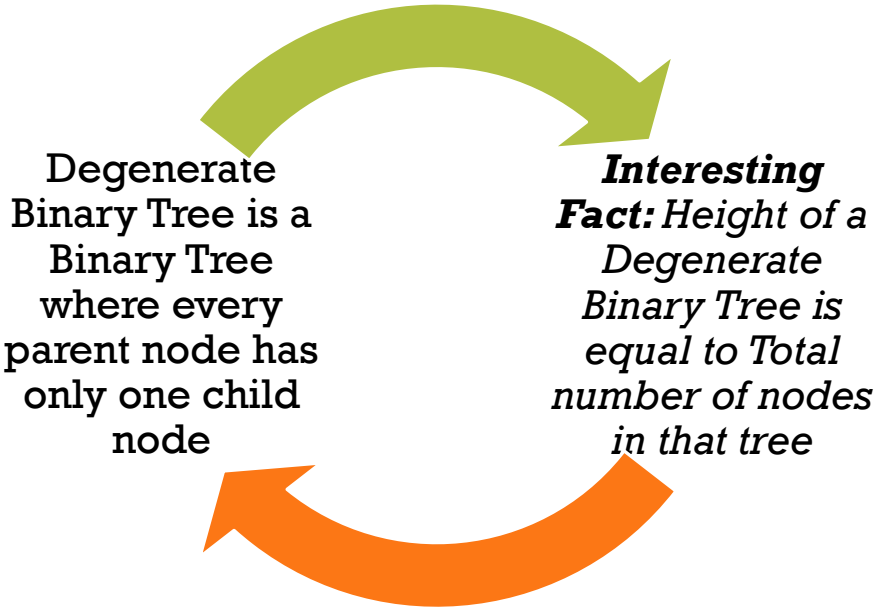


Example of BBT

Degenerate Binary Tree



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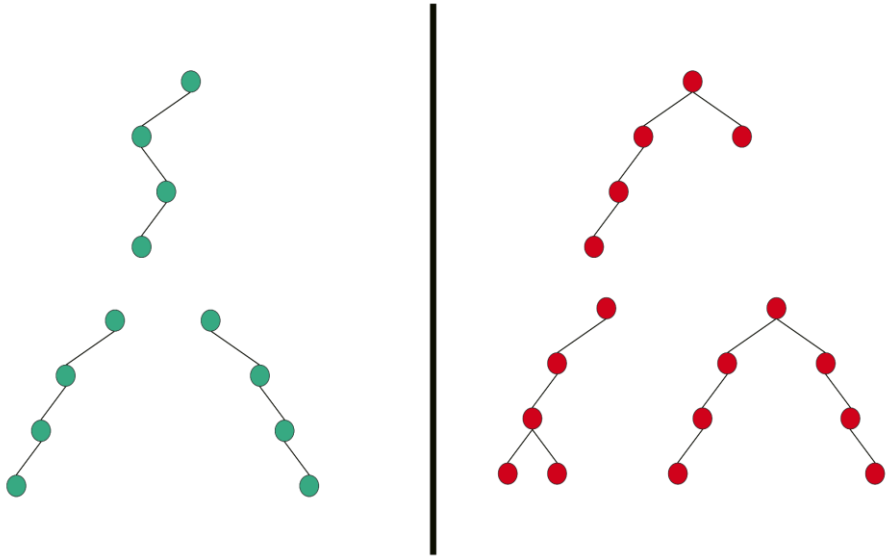

Example of DBT