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**Data Structures**

**Summary: Module 9: Trees**

A Tree is an abstract model of a hierarchical structure. It is a data structure where a node can have zero or more children. Each node contains a value. The connection between nodes is called edges. Tree data structure is used on databases to perform quick searches. This data structure is called tree because it resembles a tree and it starts with a root node and branch off with its descendants and finally, there are leaves.

* The topmost node is called root.
* A height of the tree is the distance (edge count) between the farthest leaf to the root.
* Depth or level of a node is the distance between the root and the node in the tree.

A tree node is just a data structure with a value and links to its descendants. The real-life example of tree is a company organization structure chart. When tree has at the most two children, it is called binary tree. Depending on how nodes are arranged in binary tree, it can be full, complete and perfect.

* Full binary tree: each node has exactly 0 or 2 children (but never 1).
* Complete binary tree: when all levels except the last one are full with nodes.
* Perfect binary tree: When all the levels (including the last one) are full of nodes.

A perfect tree is always complete and full but a complete tree is not always full and a full tree is not always complete and perfect.

* A binary search trees are a particular application of binary trees. It has most at two nodes however, the values are so that the left children value must be less than the parent, and the right children must be higher. Nodes can have at most only two children: left and right.
* Nodes values has to be ordered as left < parent < right.

Tree traversal is the process of visiting all the nodes of a tree and performing an operation at each node.

* An in-order traversal visits all the nodes of a Binary search tree in an ascending, meaning it will visit the nodes from the smallest to the largest. An application of in order traversal would be to sort a tree.
* Pre order traversal visits the node prior to its descendants. An application of pre order traversal could be to print a structured document.
* Post order traversal visits the node after it visits its descendants. An application of post order traversal could be computing the space used by a file in a directory an dits subdirectories.