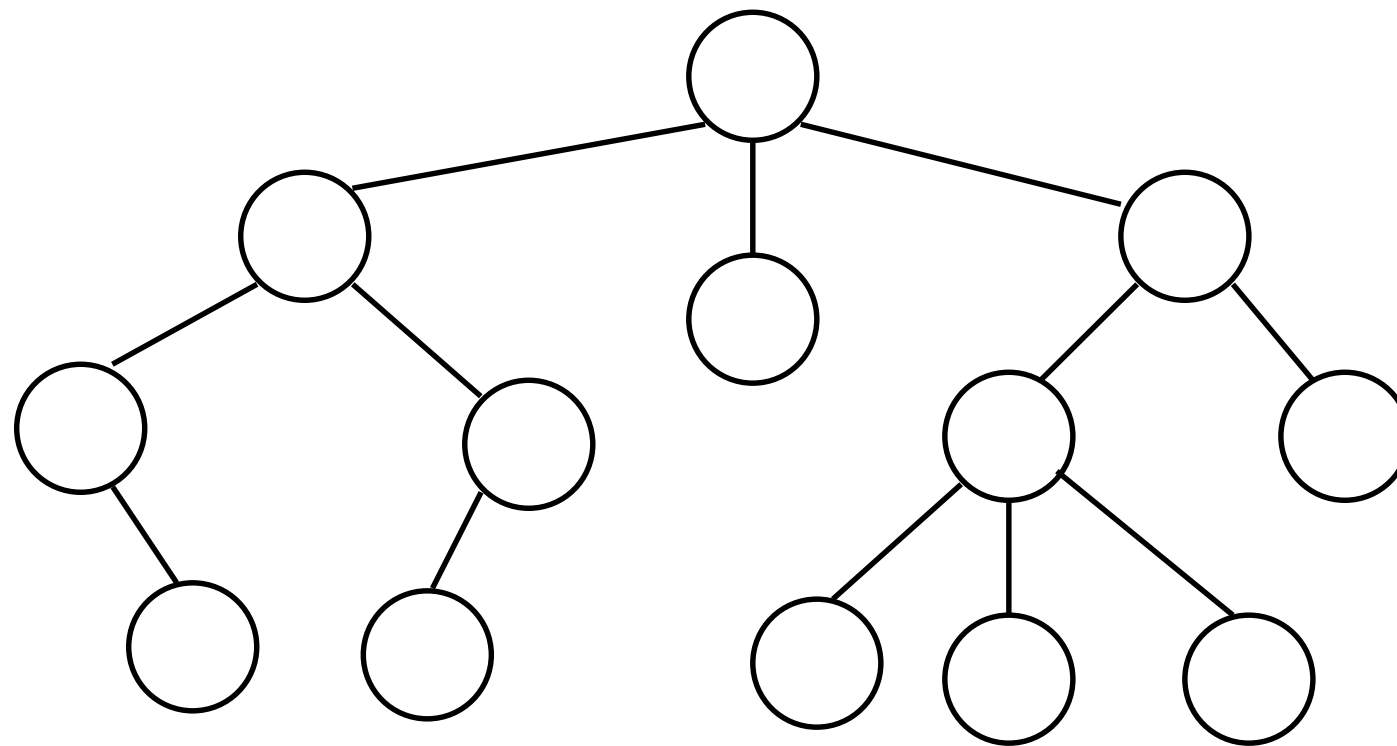


# Pre-reading

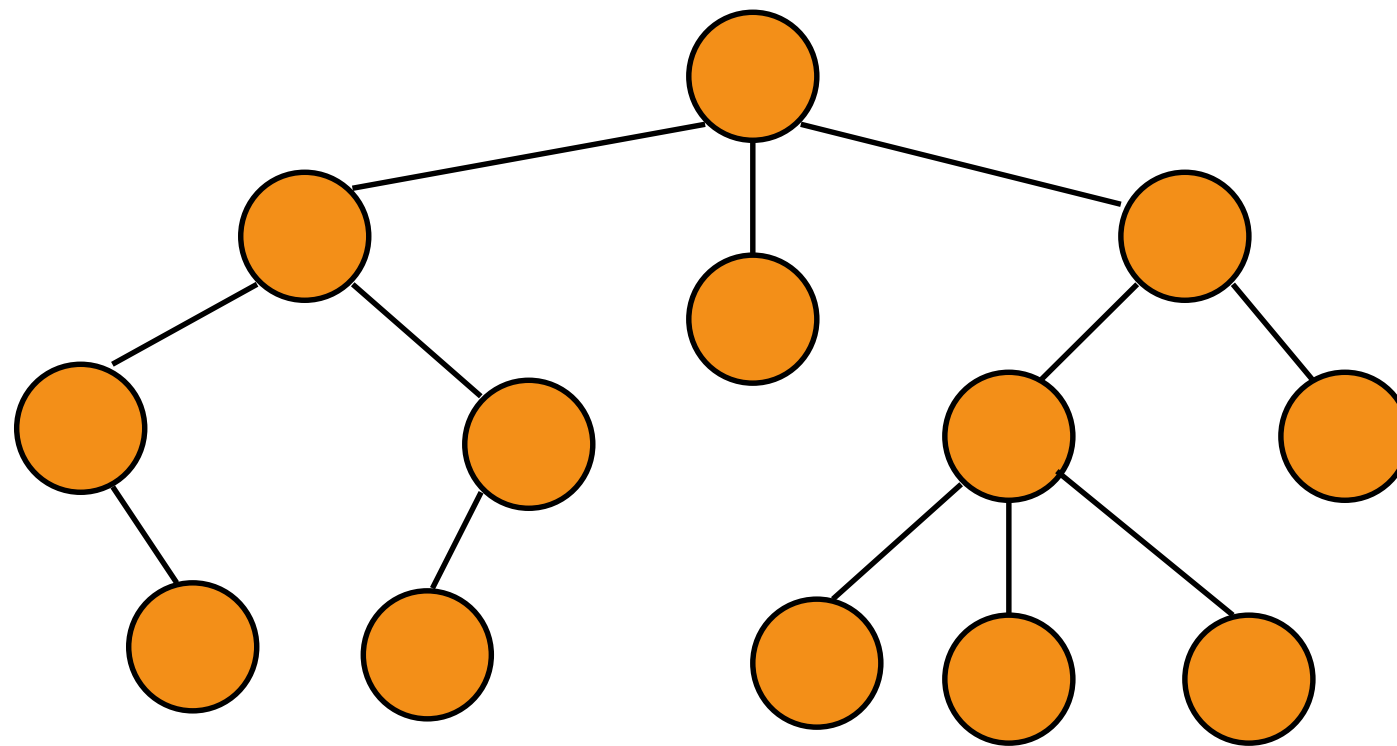
## Lecture 32

# Tree Terminology

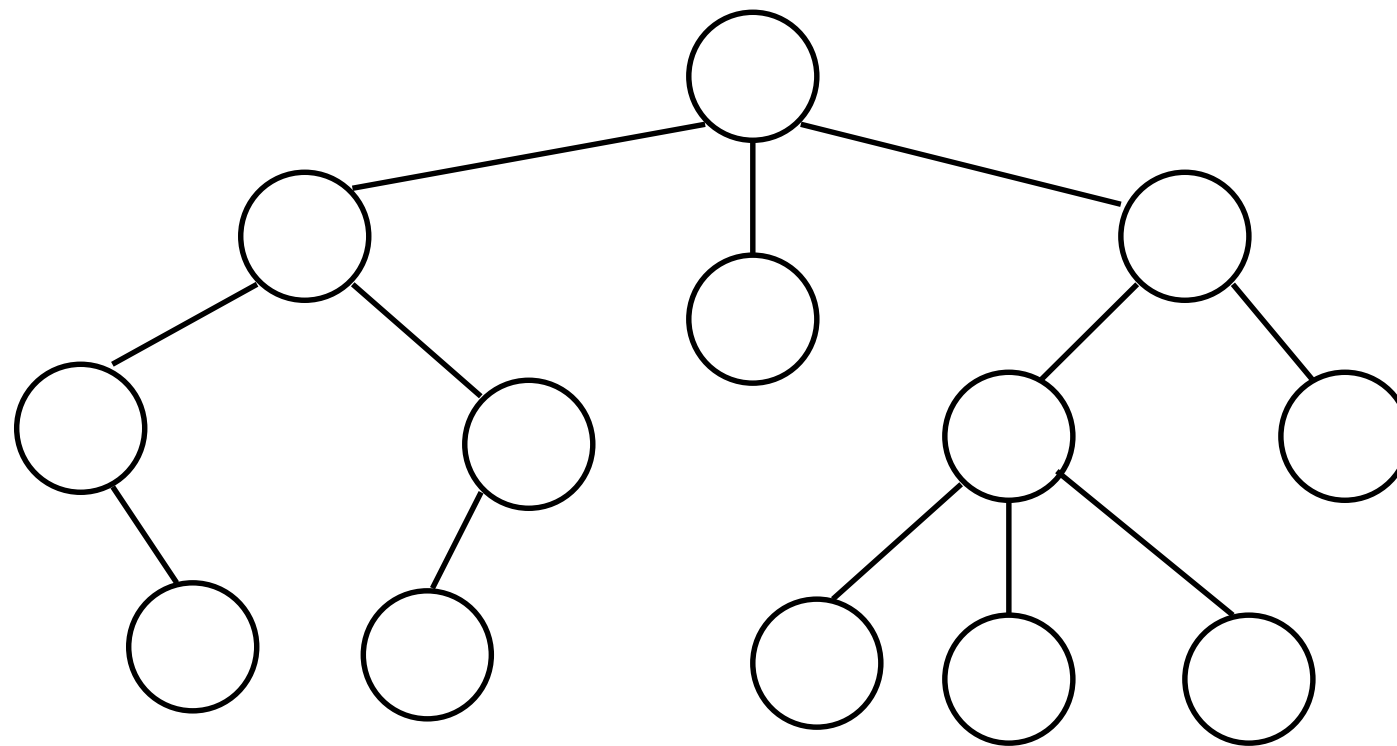


# Tree Terminology

**Nodes**

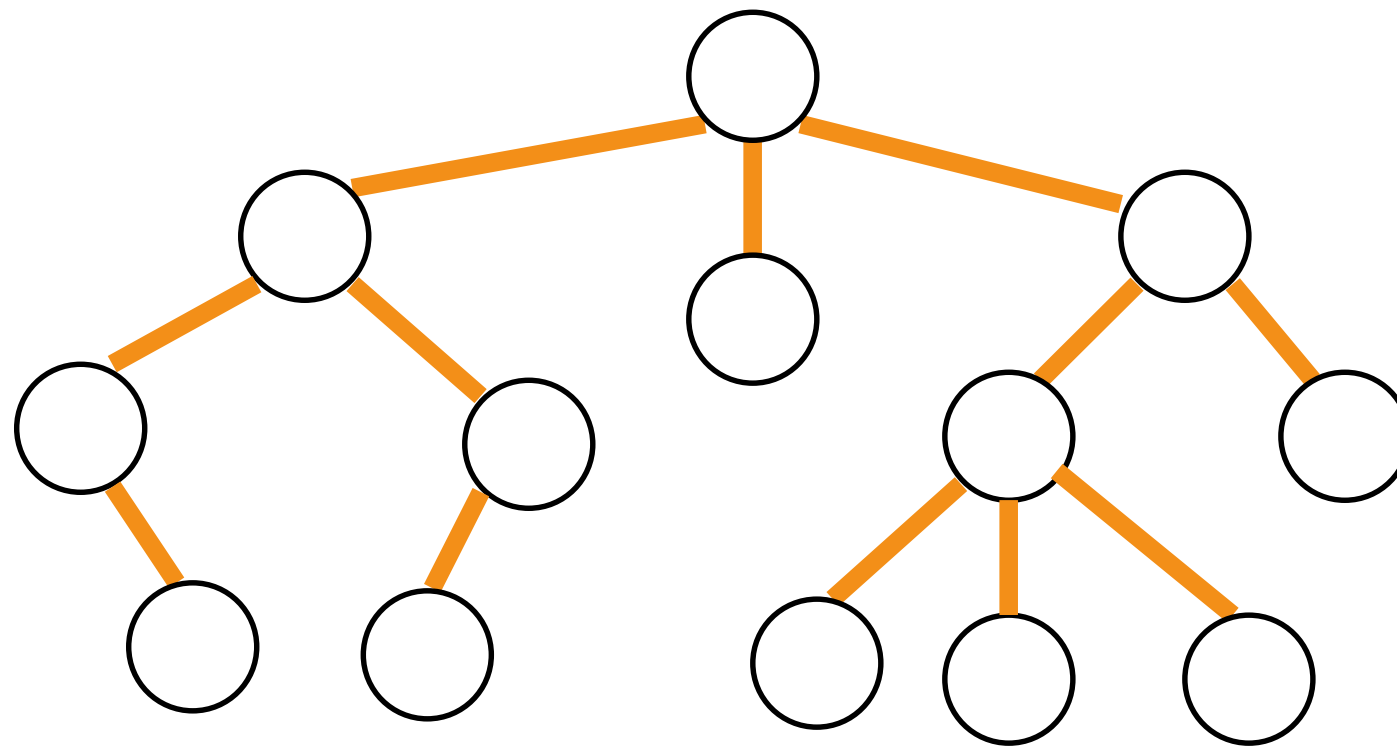


# Tree Terminology



# Tree Terminology

Edges

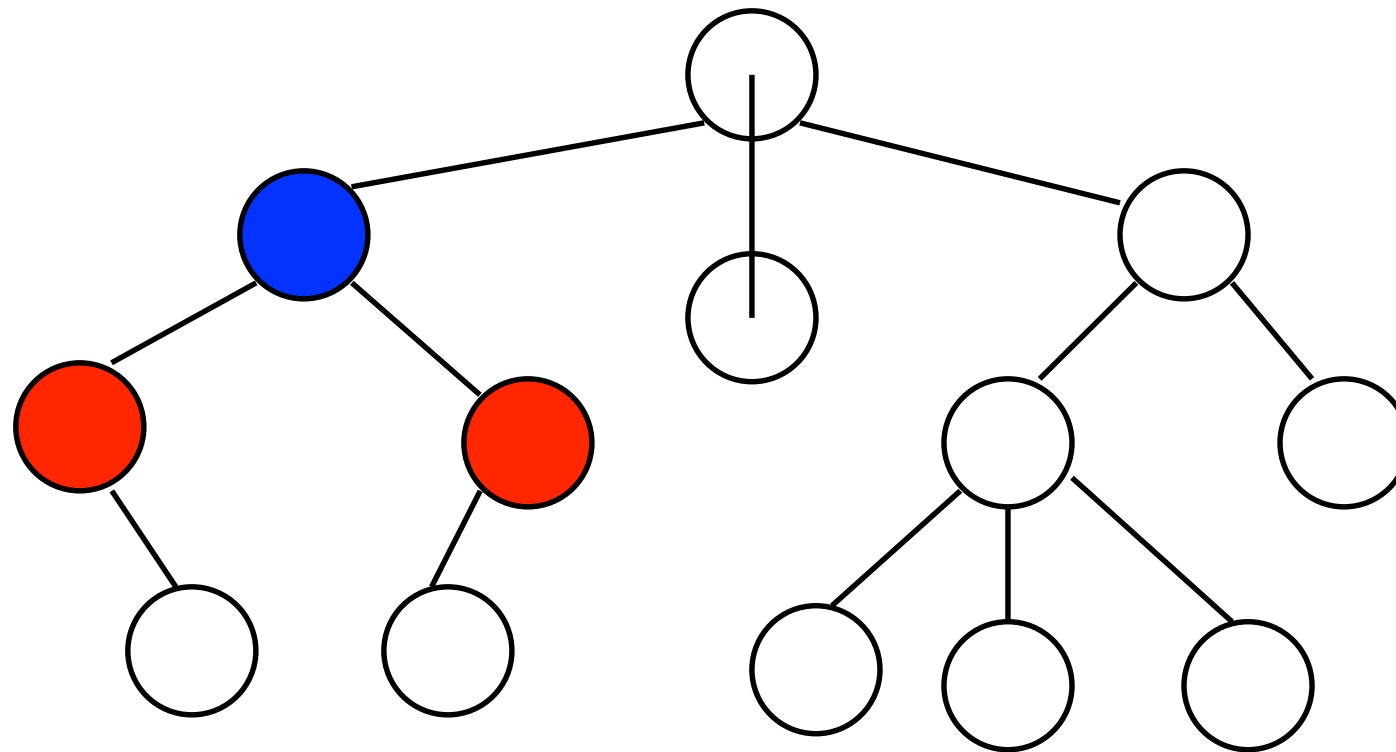


For **simplicity**: Draw undirected edges...  
they are actually directed.

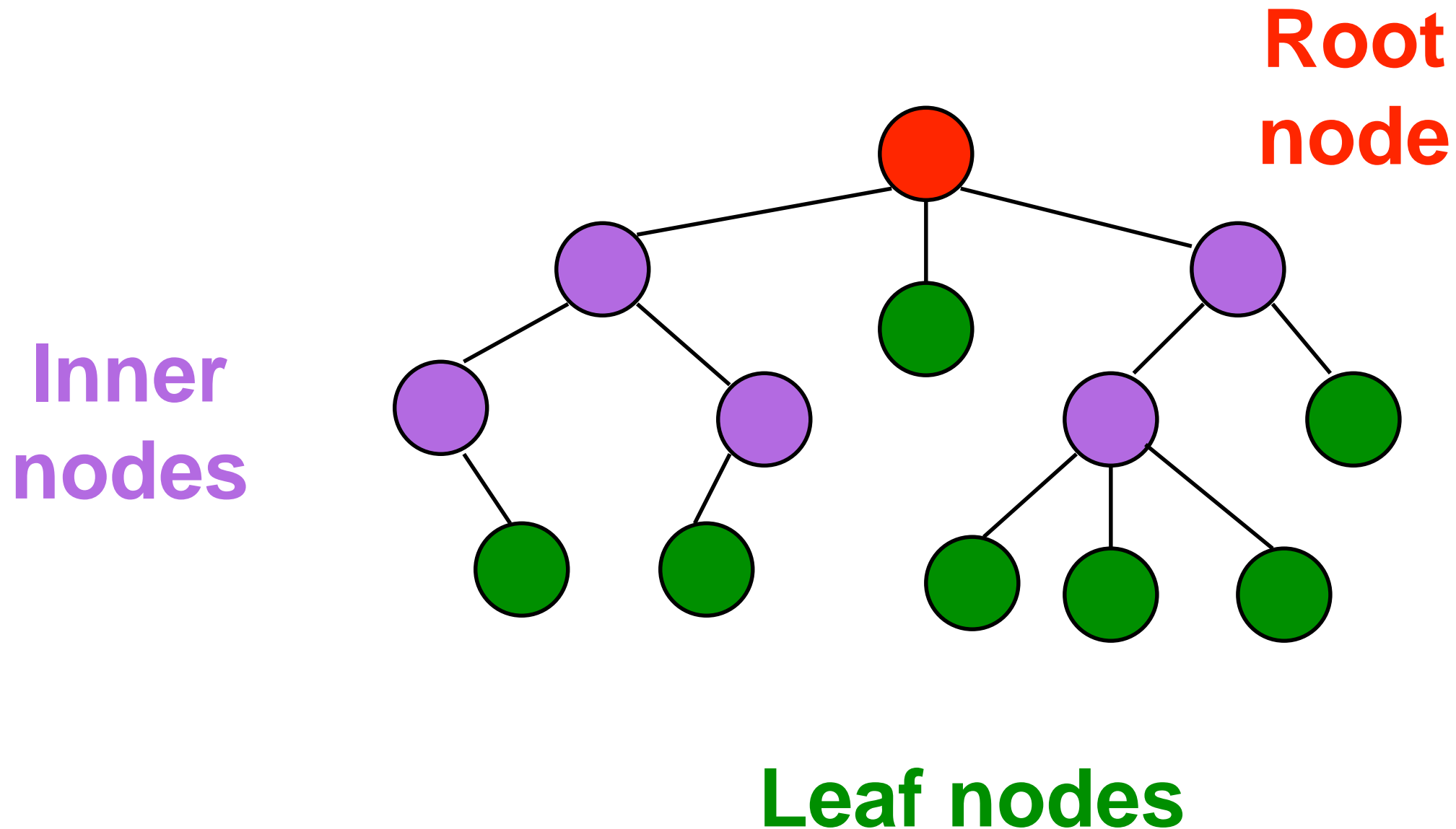
# Tree Terminology

**Parent**

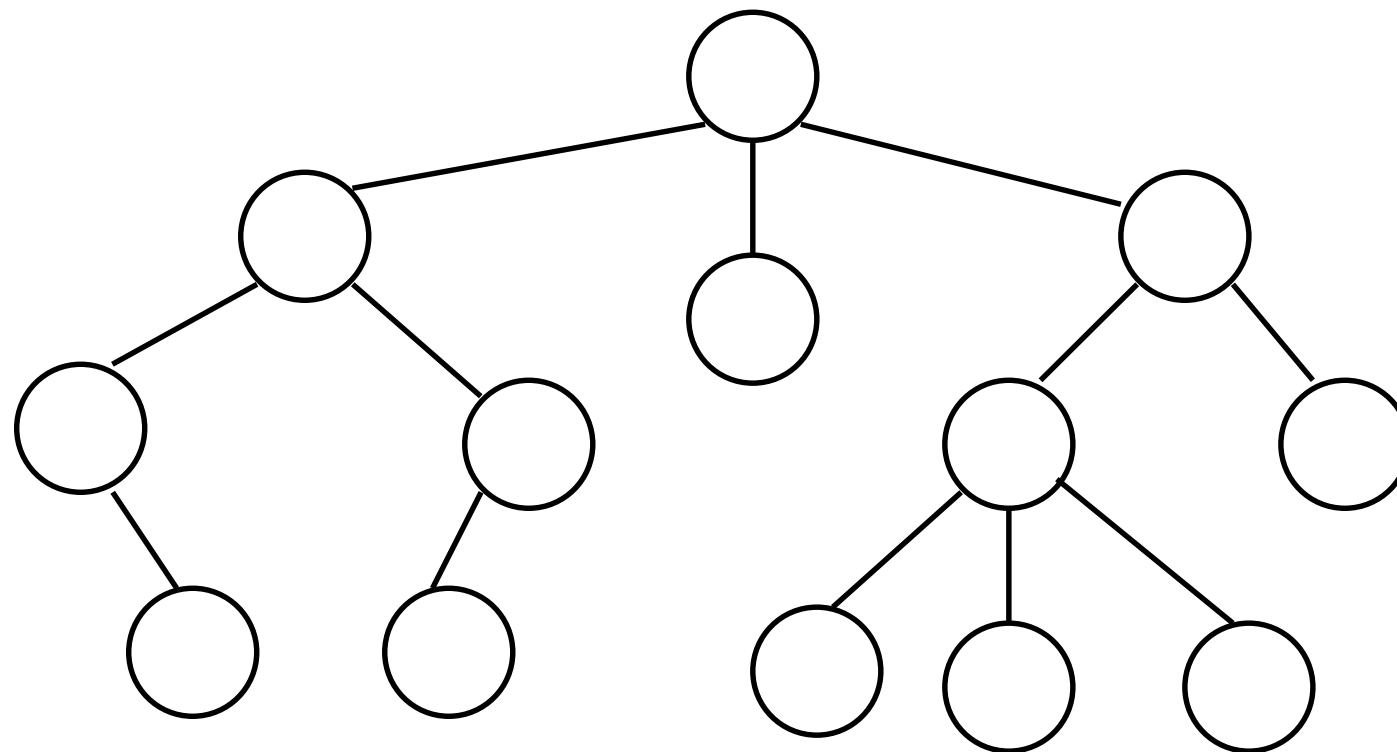
**Children**



# Tree Terminology

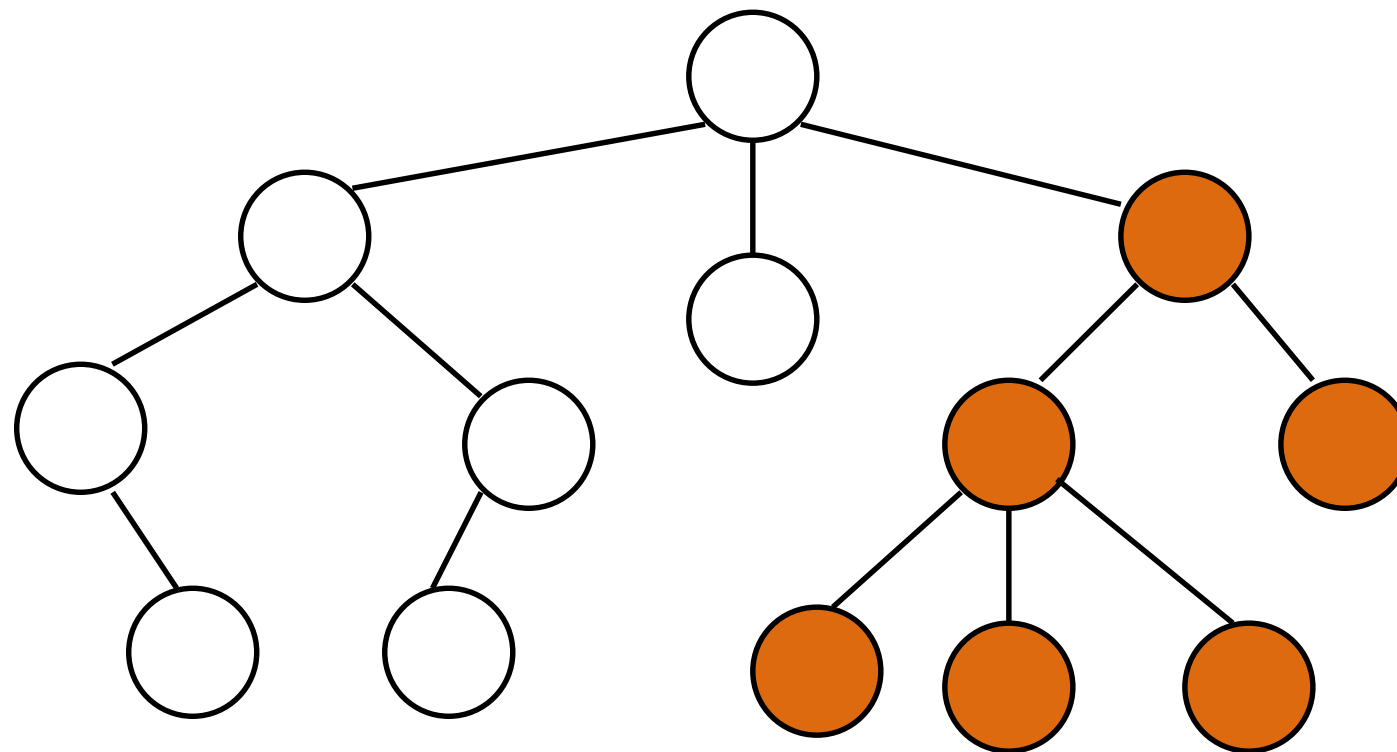


# Tree Terminology



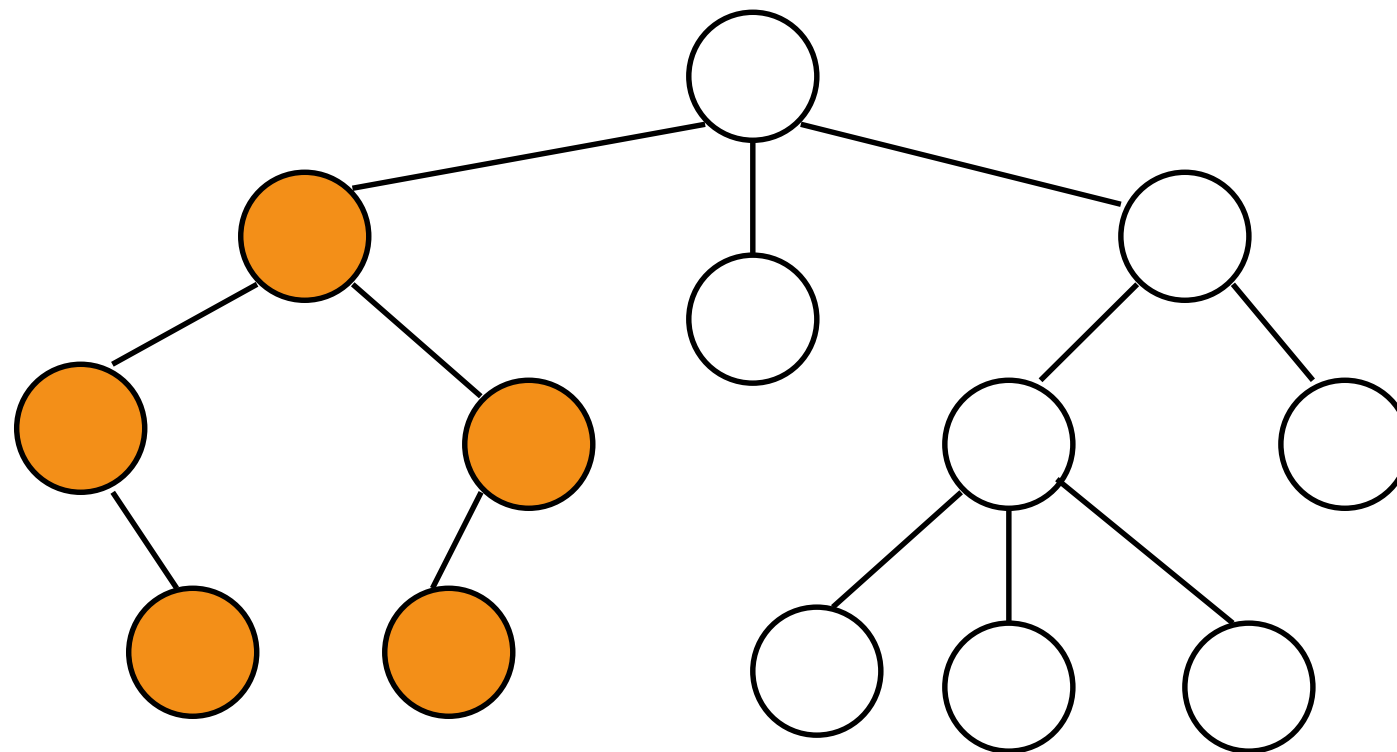


# Tree Terminology



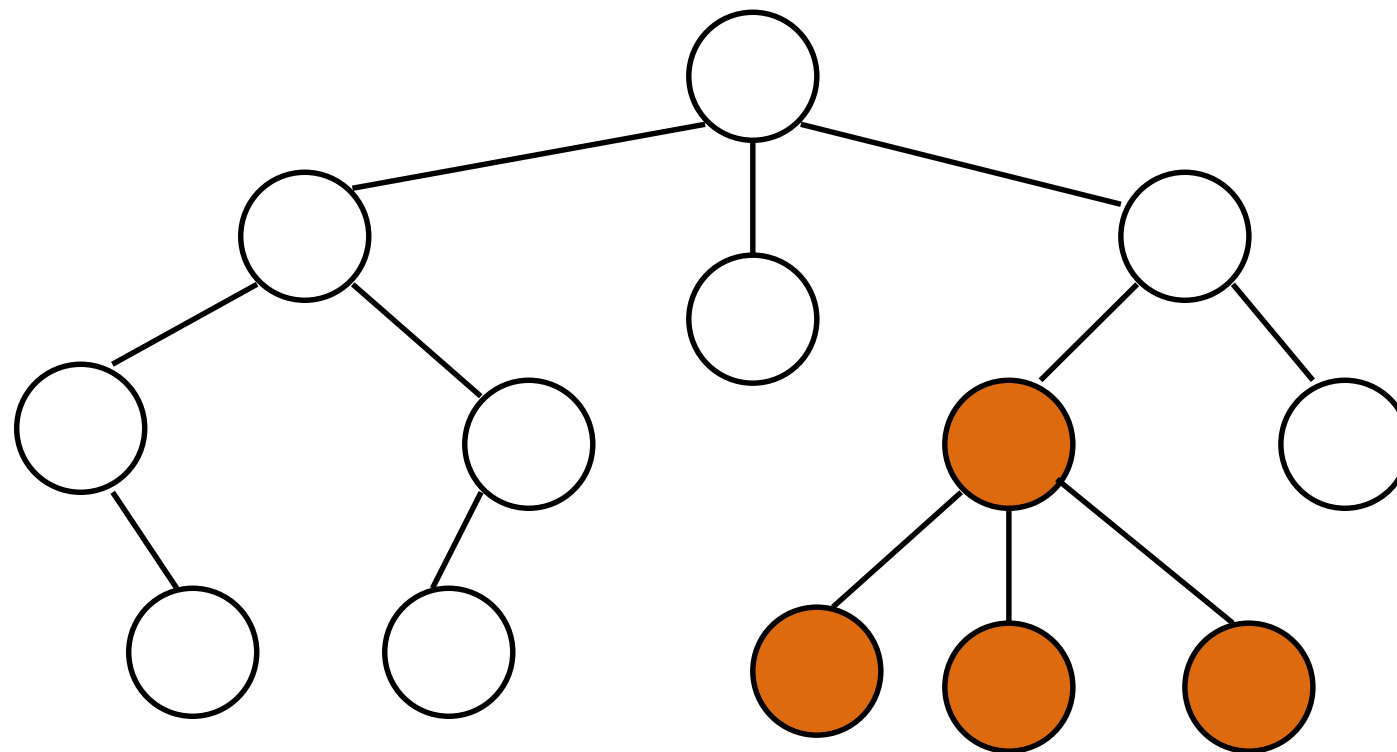
**Subtree**

# Tree Terminology



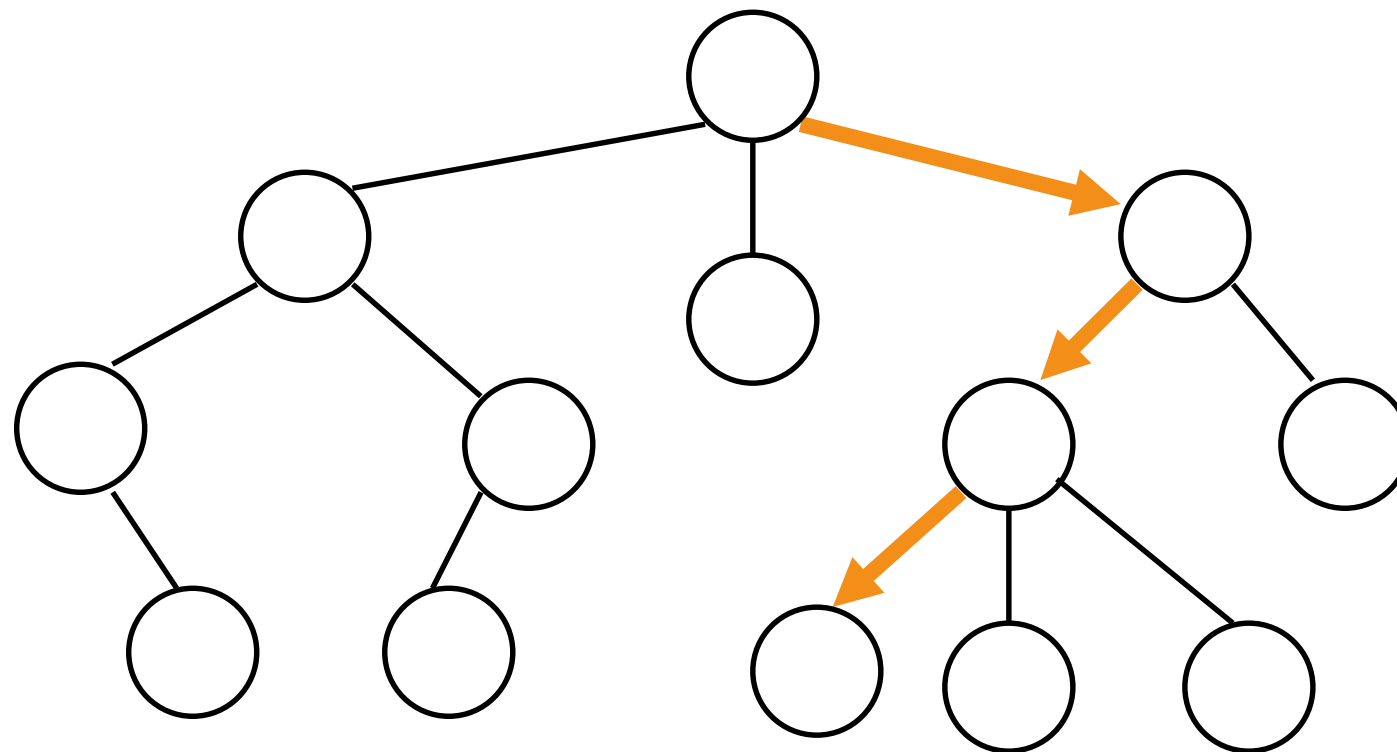
**Subtree**

# Tree Terminology



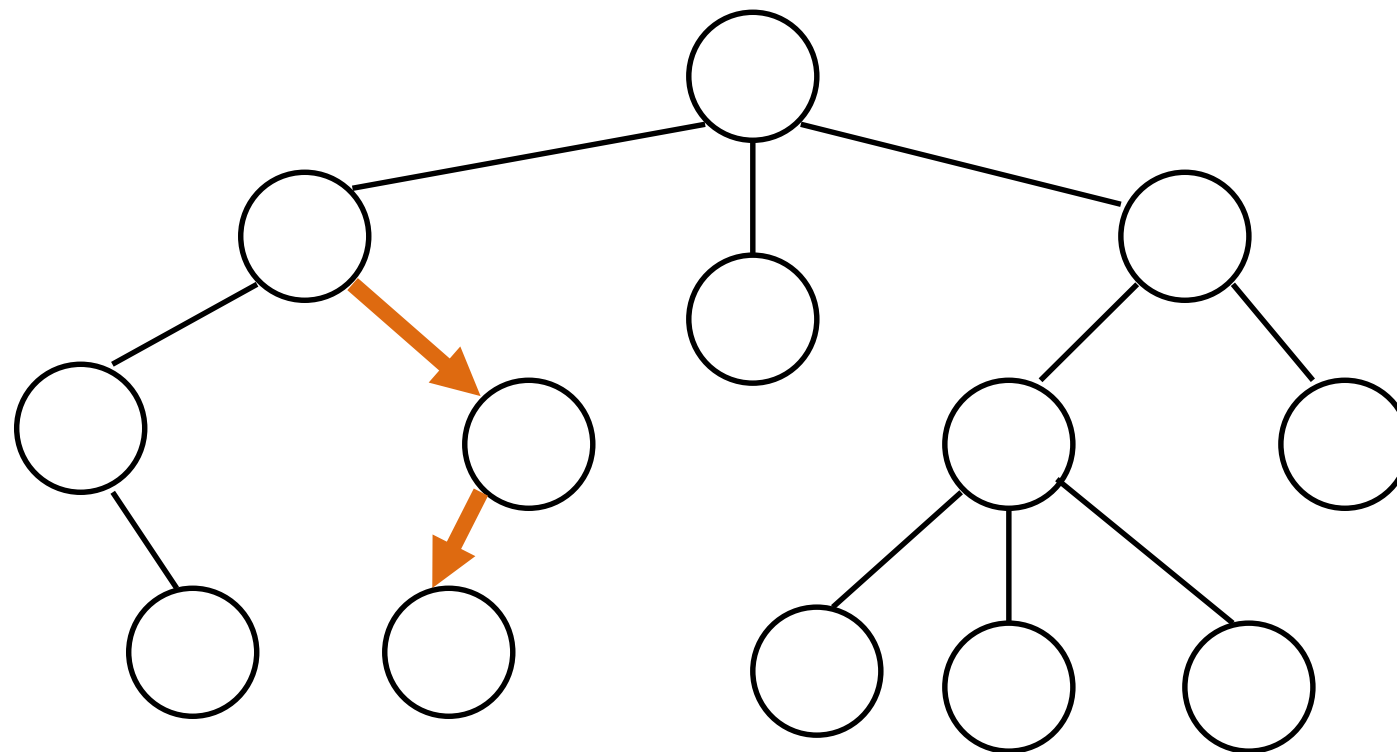
**Subtree**

# Tree Terminology



**Path of length 3**

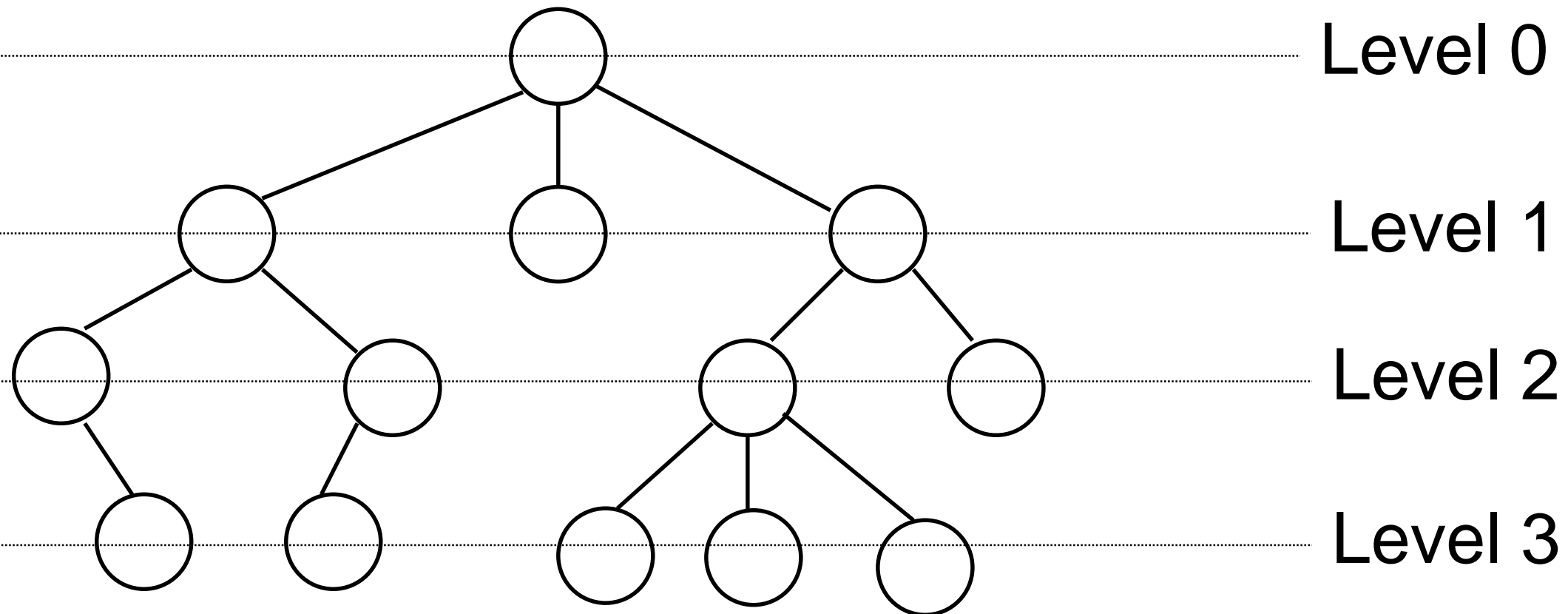
# Tree Terminology



**Path of length 2**

# Tree Terminology

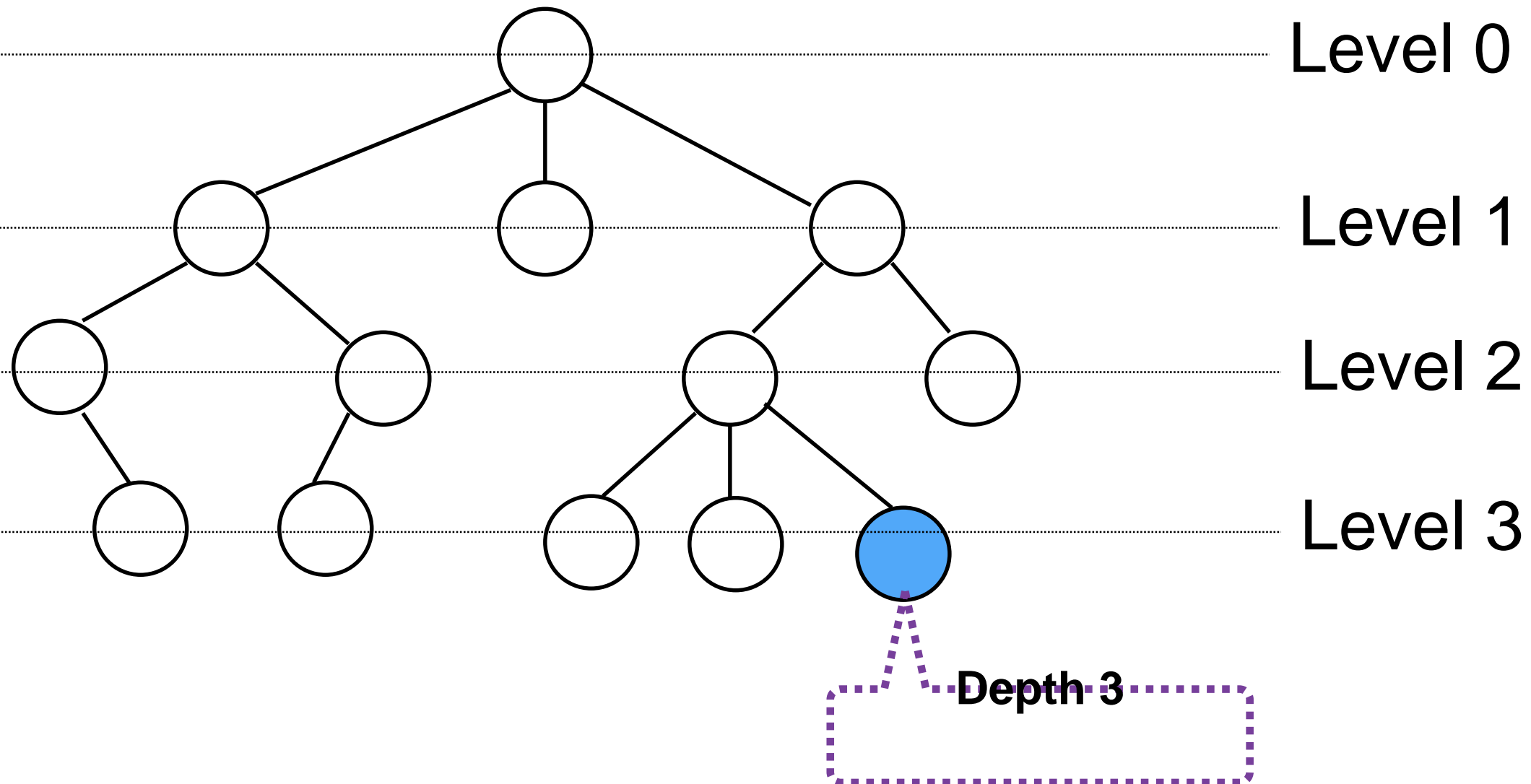
## Levels



(determined by length of path from root node)

# Tree Terminology

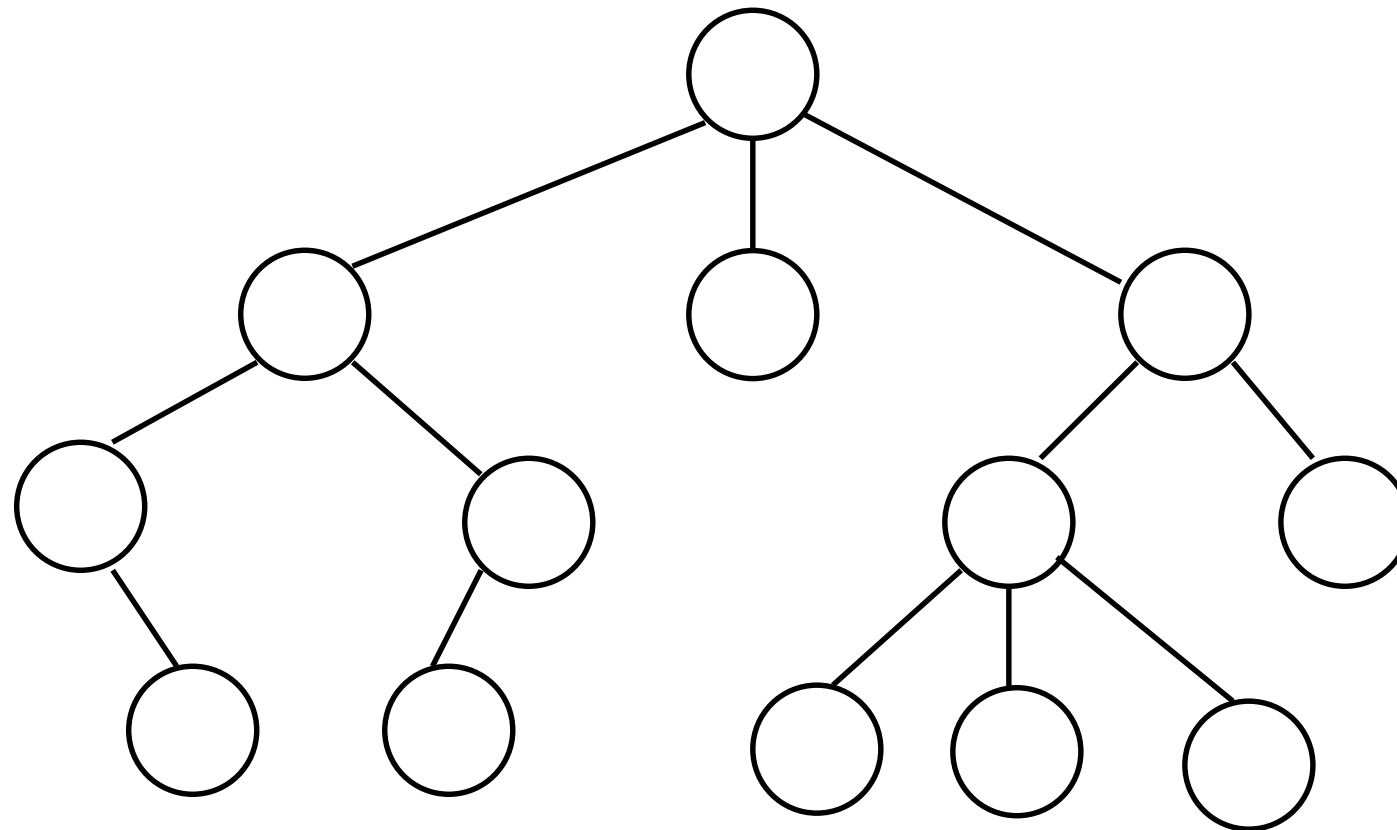
## Depth of a node



Equal to its level.

# Tree Terminology

## Depth/Height of a tree

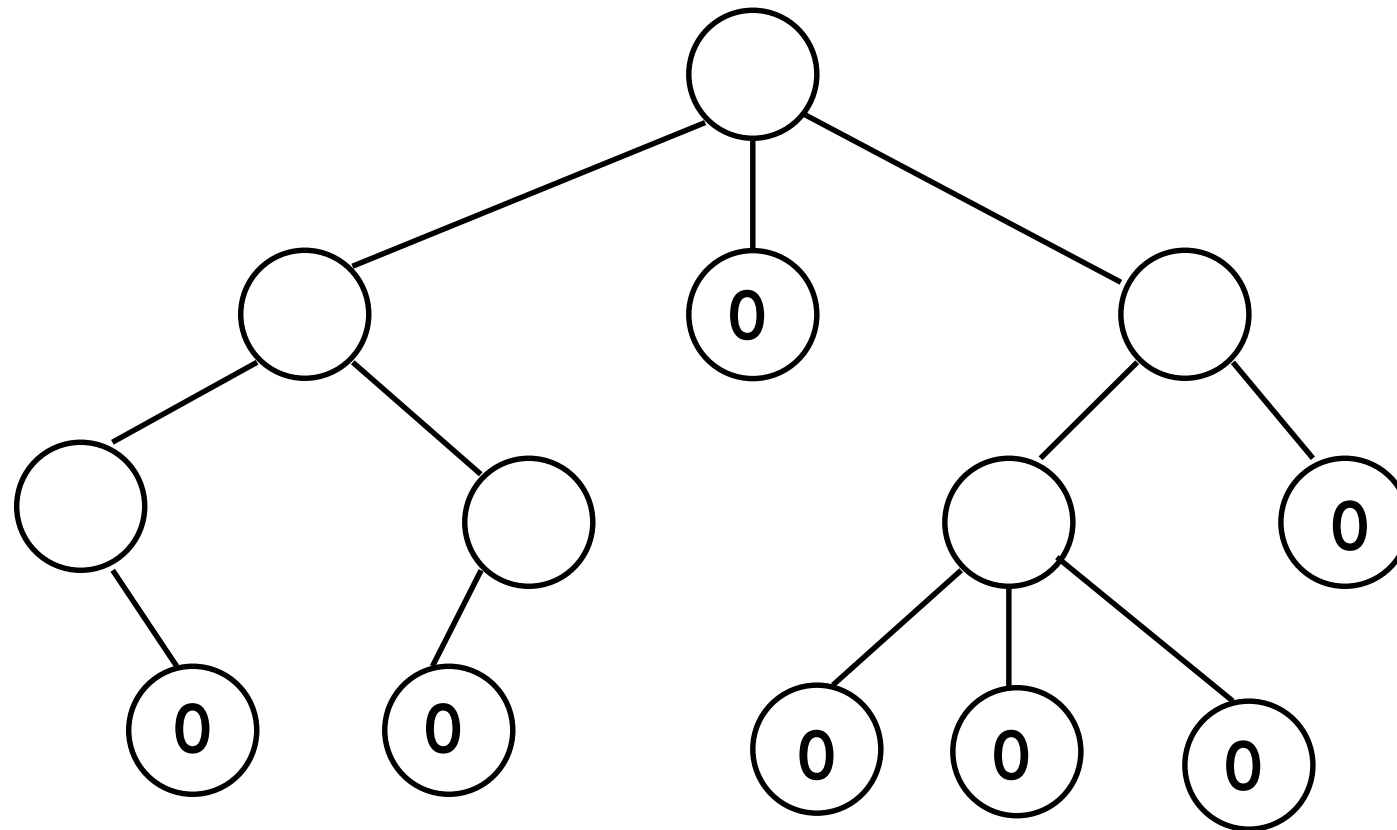


Length of a path from the root to the deepest node.



# Tree Terminology

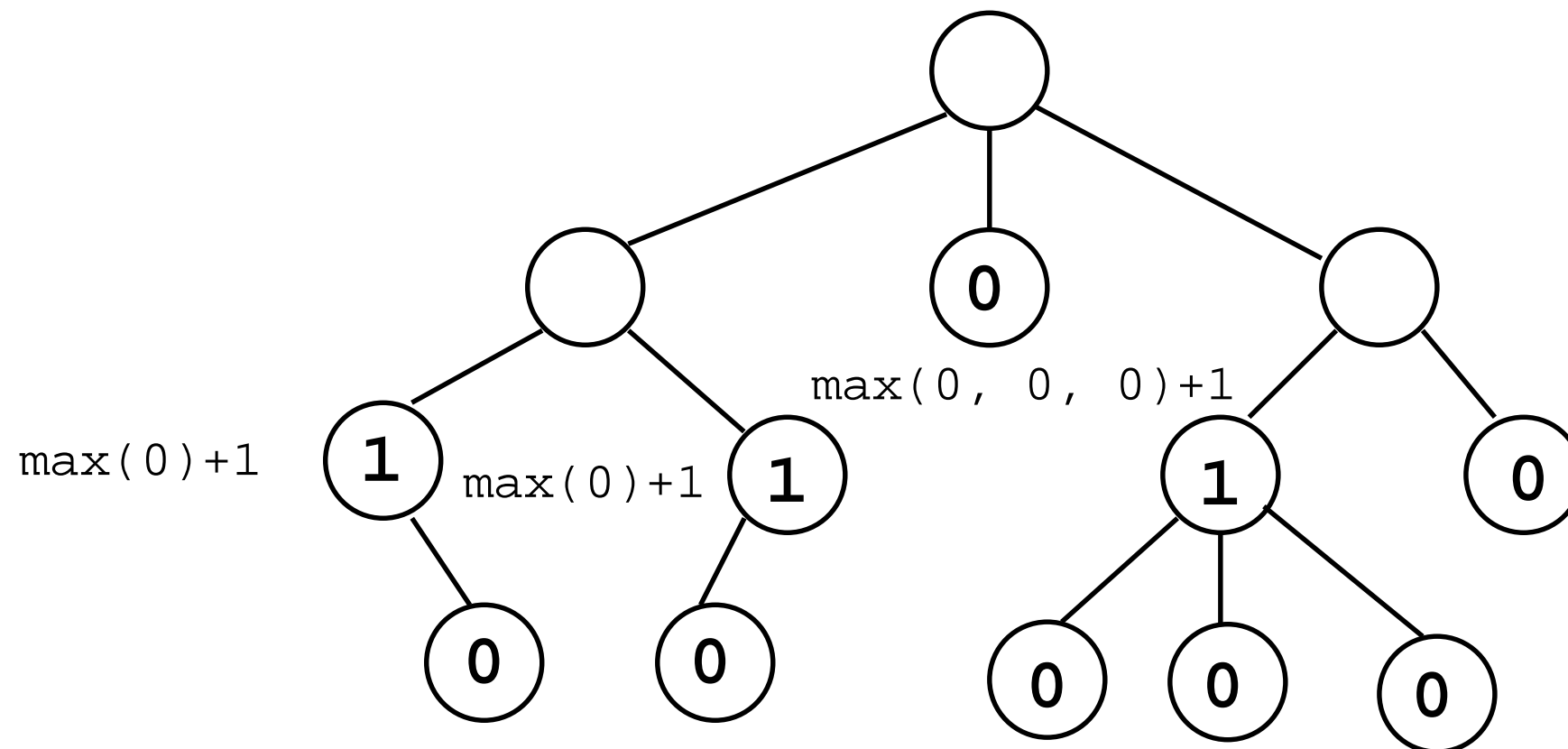
## Depth/Height of a tree



Length of a path from the root to the deepest node.

# Tree Terminology

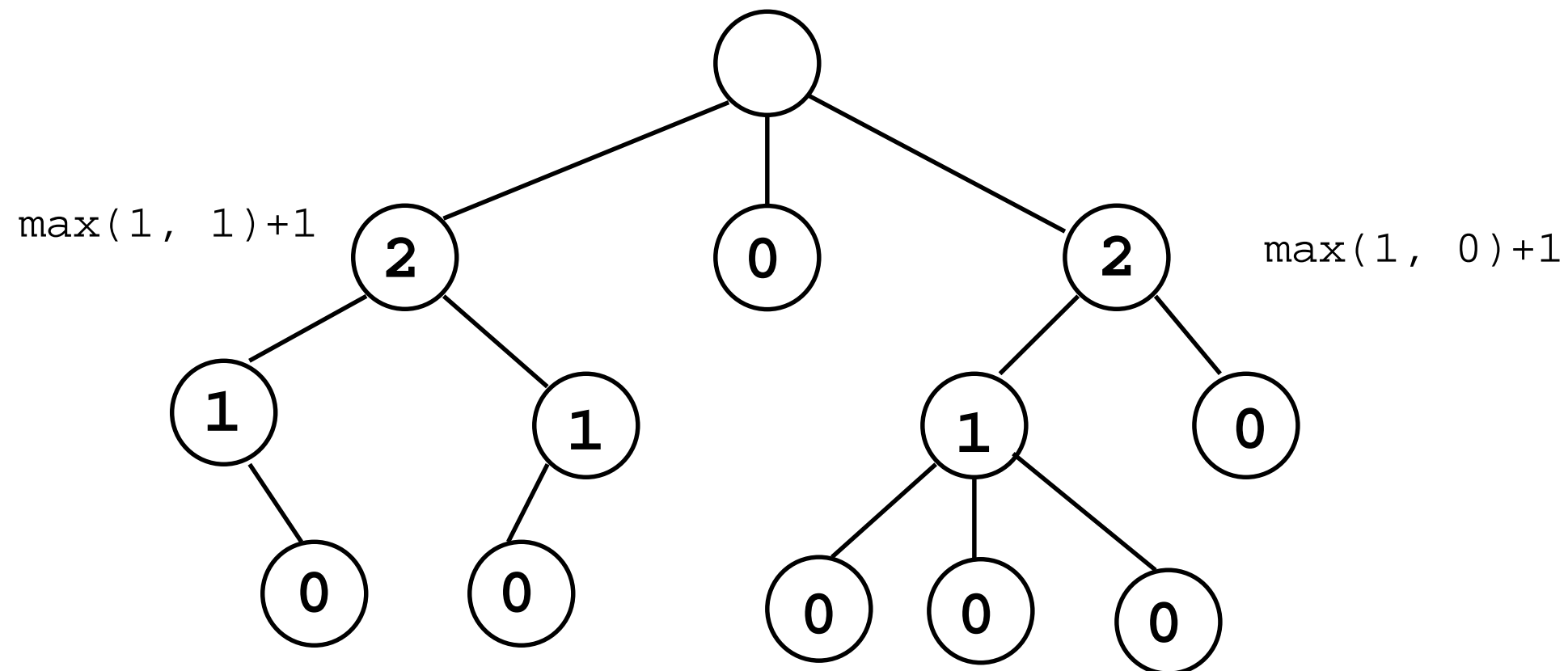
## Depth/Height of a tree



Length of a path from the root to the deepest node.

# Tree Terminology

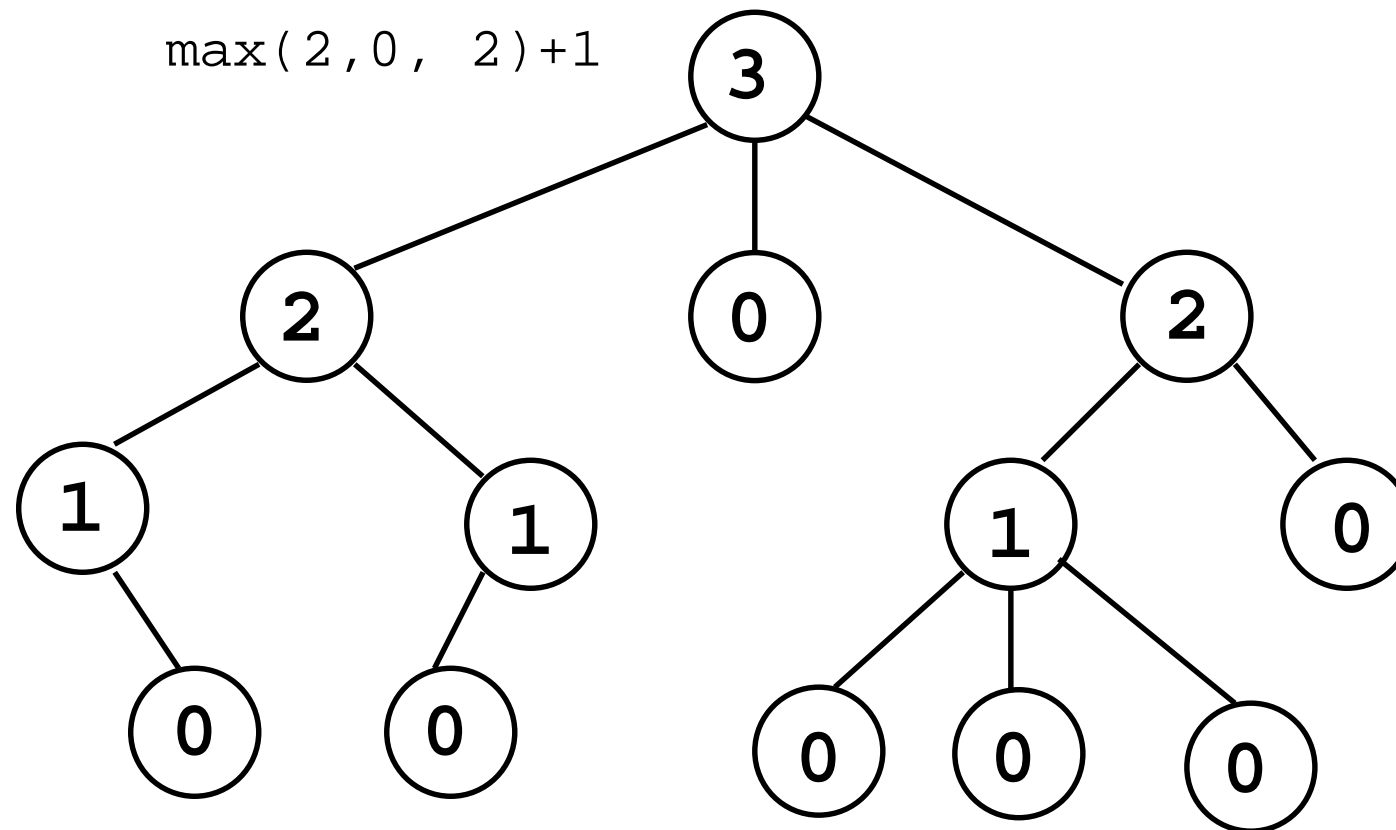
## Depth/Height of a tree



Length of a path from the root to the deepest node.

# Tree Terminology

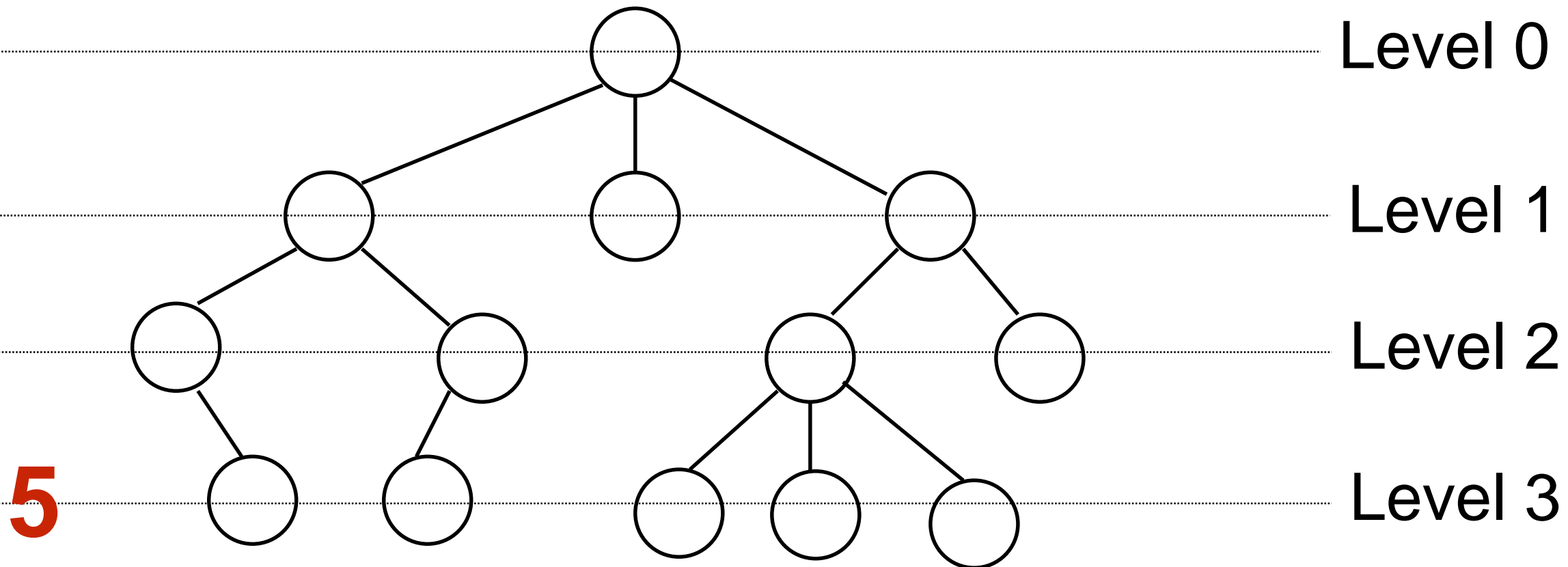
## Depth/Height of a tree



Length of a path from the root to the deepest node.

# Tree Terminology

**Width of a tree**



Number of nodes in the level with most nodes.

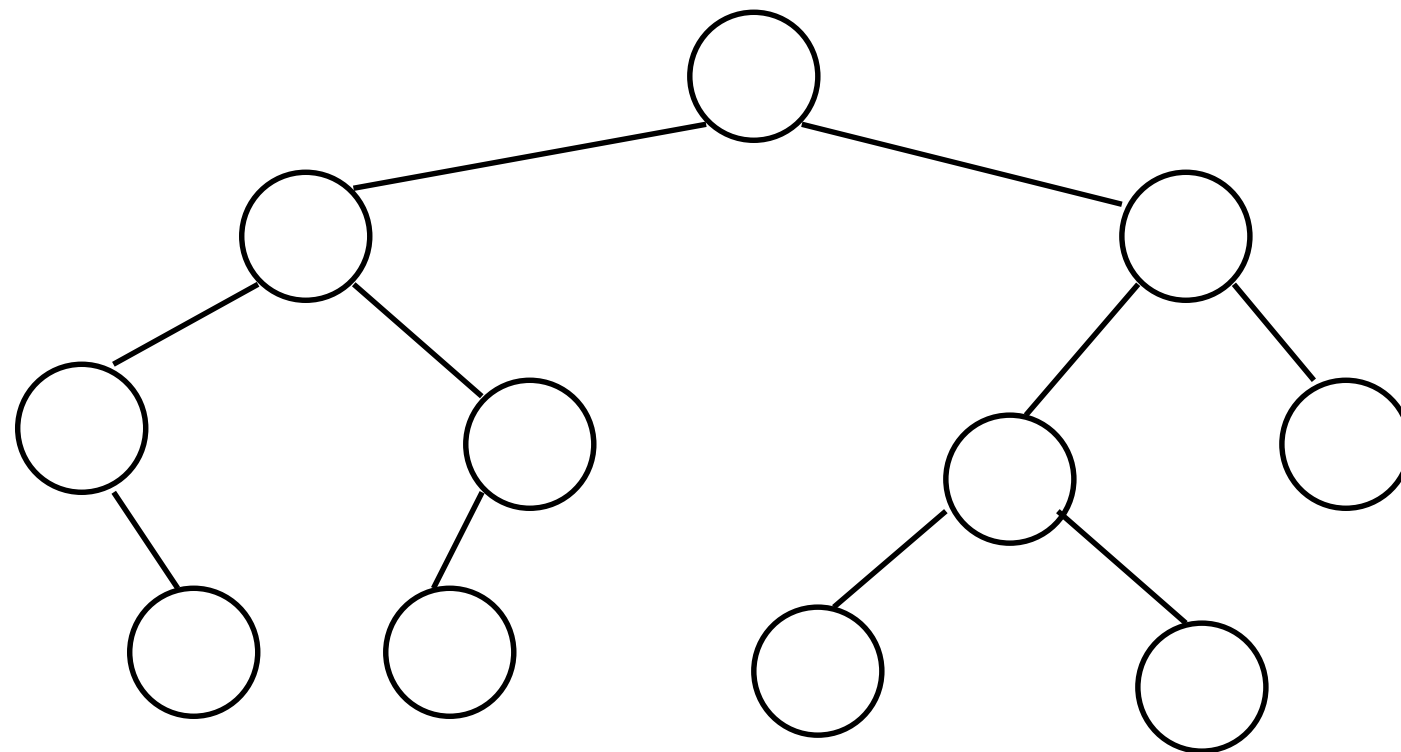
# Summary of Tree Notation

- The node with no parent is the **root** (one per tree)
- A node with no child is a **leaf**
- Each node is either an **inner** node, or it is a root and/or leaf
- Every node that is not a leaf is a **parent** node
- Every node is the root node of its **subtree**
- Every node except the root is a **child**
- **Height/Depth** of a tree is also its **maximum level**
- **Width**: number of nodes in the level with the highest number of nodes

We will only talk about binary  
trees

# Binary tree

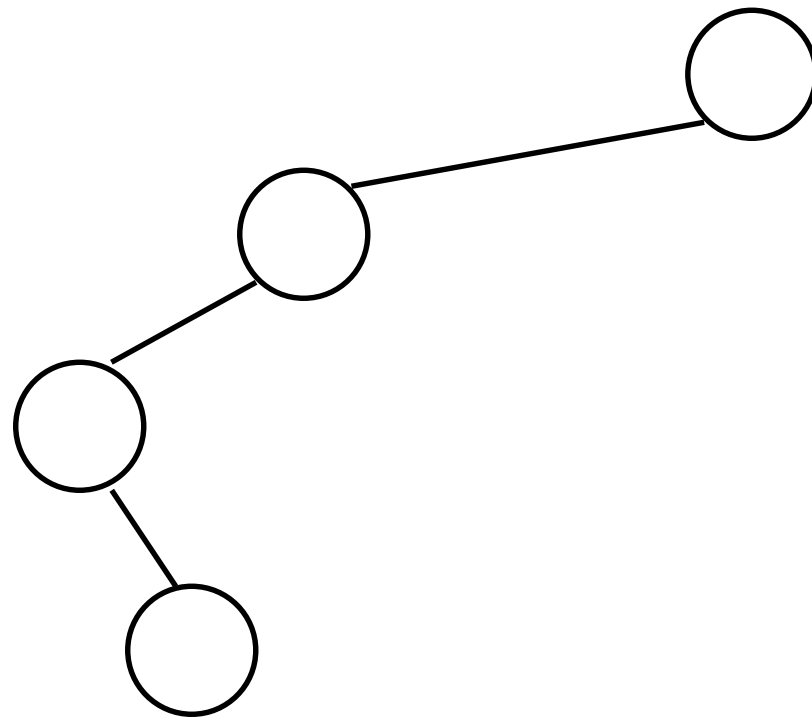
Every node has **at most** two children.



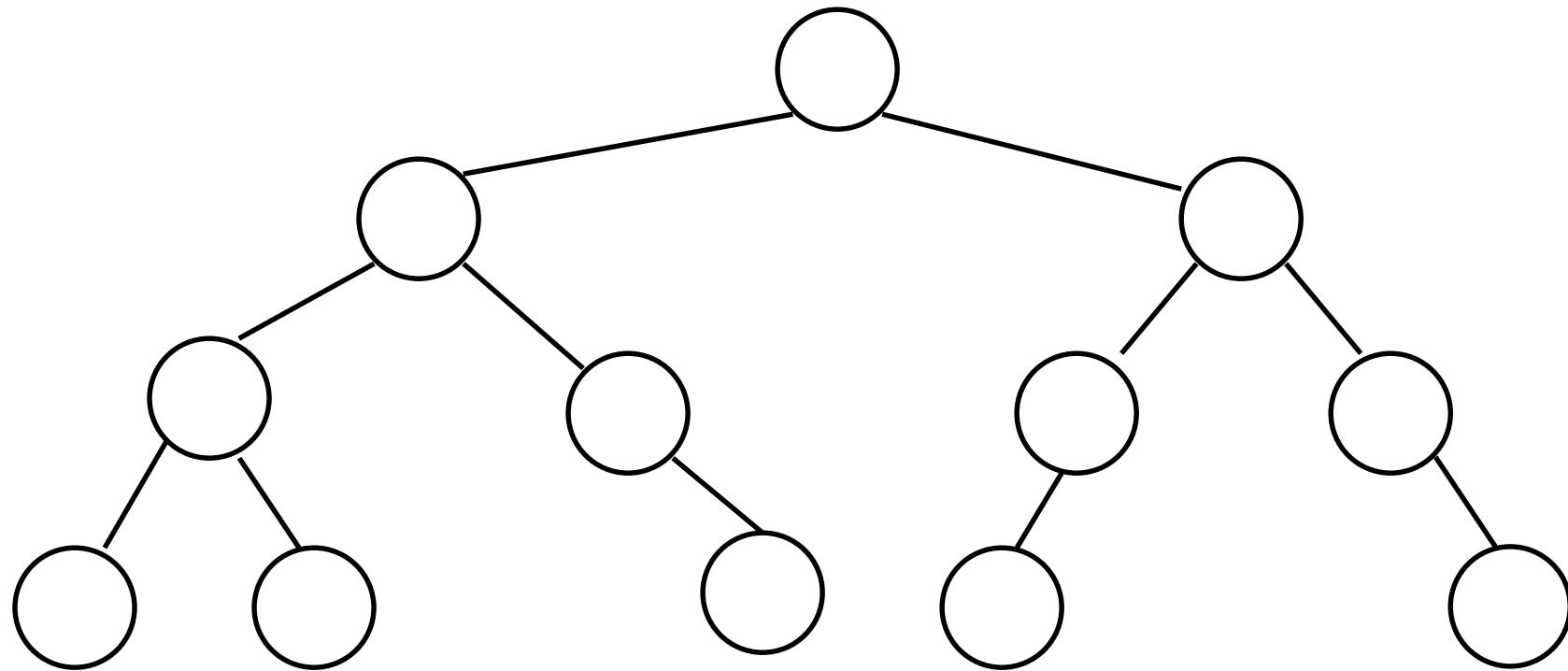
Note: Every subtree is a Binary Tree



# Unbalanced Binary Tree



# Balanced Binary Tree



For every node

$$|\text{height}(\text{left subtree}) - \text{height}(\text{right subtree})| \leq 1$$