iOS Development Accelerator FINAL SESION

- Binary Search Trees
- Final Review
- Group Projects

Binary Search Tree

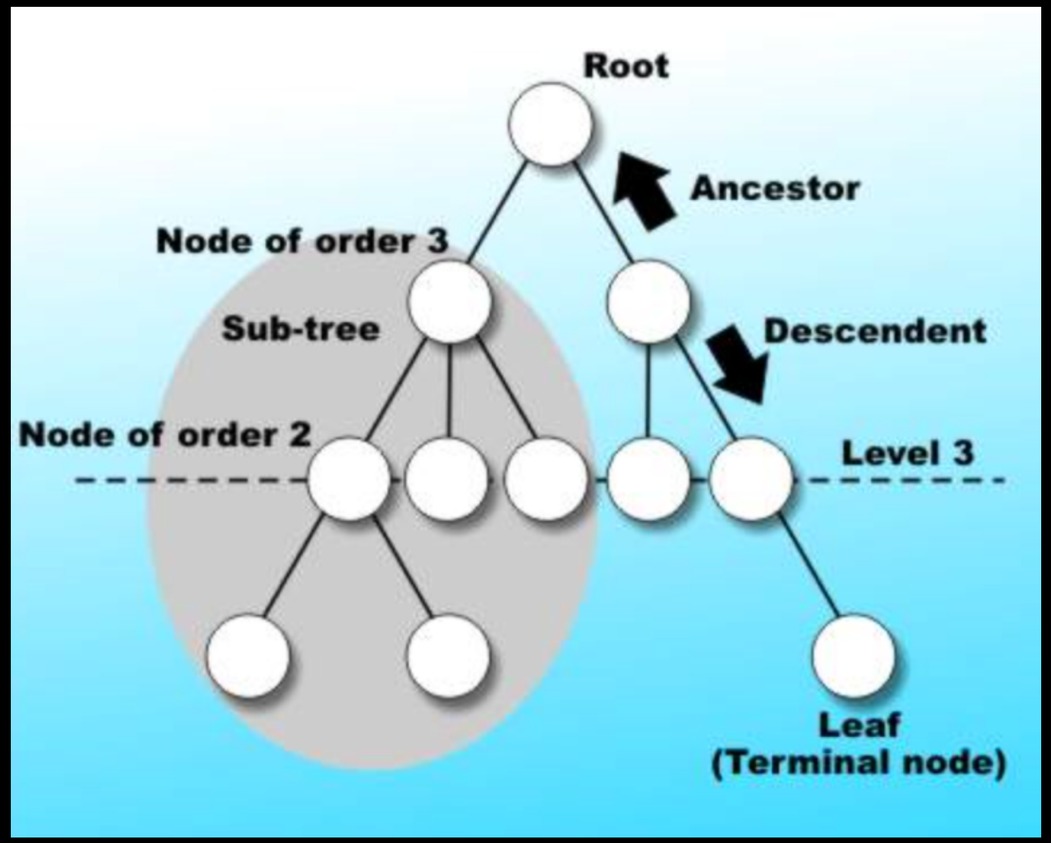
- “A binary search tree is a binary tree where each node has a comparable key and satisfies the restriction that the key in any node is larger than all keys in all nodes in that node’s left subtree, and smaller than the keys in all nodes in that nodes right subtree”

-princeton.edu

Lets dissect that definition a bit

Binary Search Tree

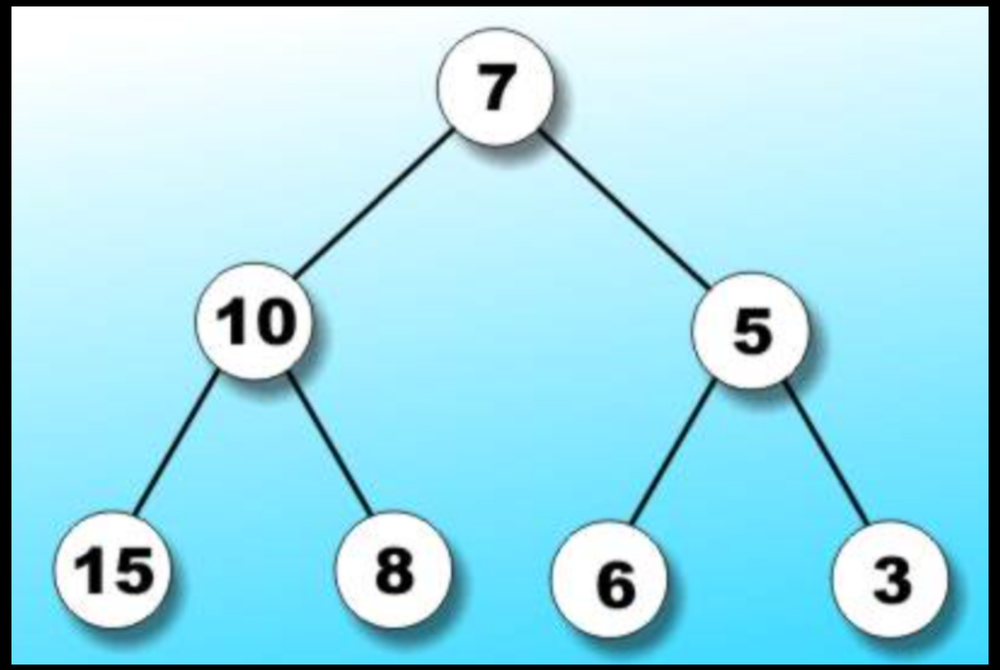
- A binary search tree is a binary **tree**



- A tree is a data structure consisting of nodes organized as a hierarchy

Binary Search Tree

- A binary search tree is a **binary tree**



- A binary tree is a tree in which each node has at most two descendants
- Each node can have zero,one,or two descendants, but no more than two

Tree terminology

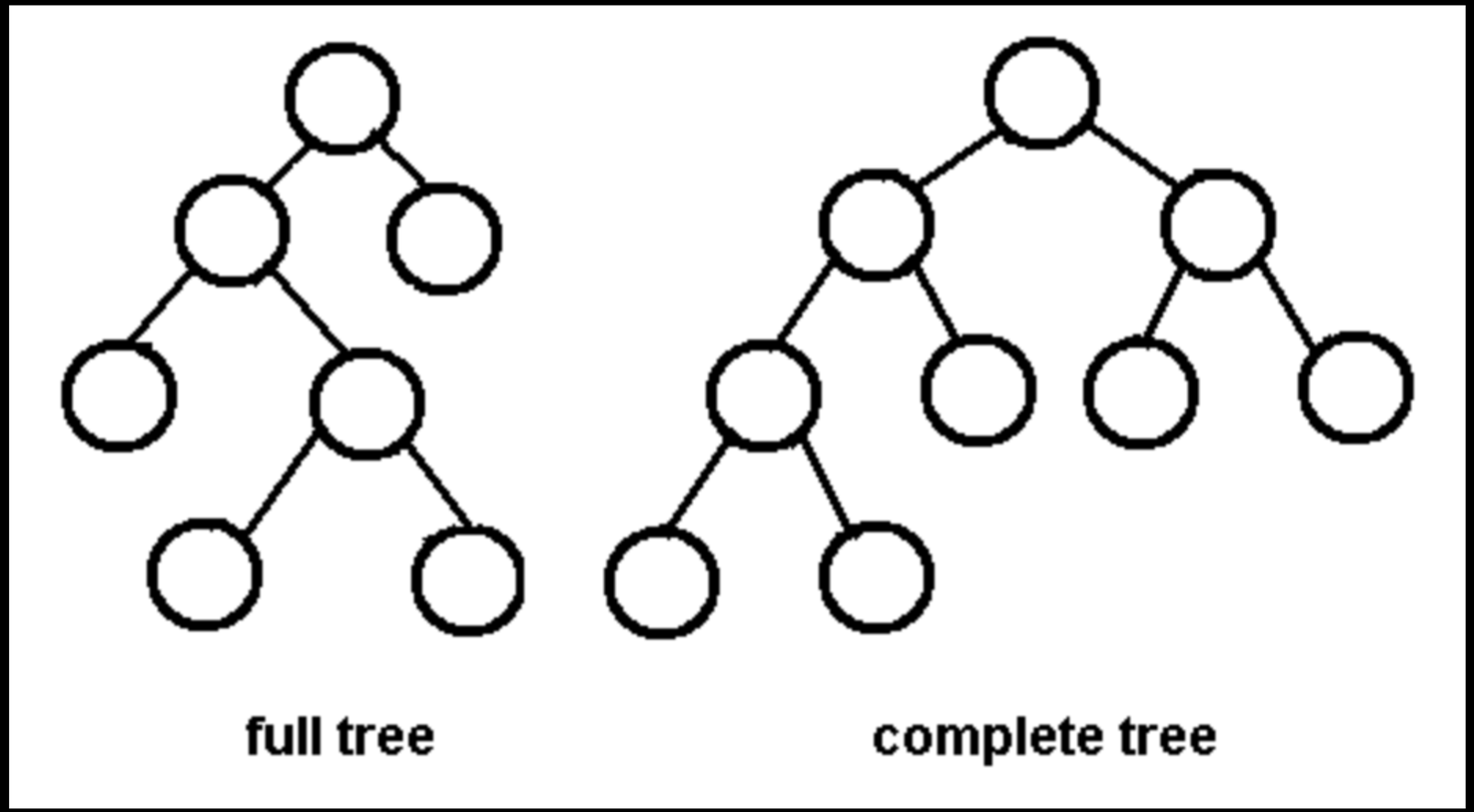
- In a tree data structure, and its different types (like binary), the root node is the topmost node
- In a binary tree, each node contains a left and right reference and a data element
- Every node is connected by a directed edge from exactly one other node. That node is considered the parent.
- The left and right references a node can have are considered that node's children
- Nodes without any children are considered leaves (or sometimes external nodes)
- Nodes with the same parent are considered siblings

Tree terminology cont.

- The depth of a node is the number of edges from the root to the node
- The height of a node is the number of edges from the node to its deepest leaf
- The height of a tree is the height of its root node

Binary Tree types

- A full binary tree is a binary tree in which each node has exactly zero or two children
- A complete binary tree is a binary tree which is completely filled, with the possibly exception of the bottom level, which is filled from left to right



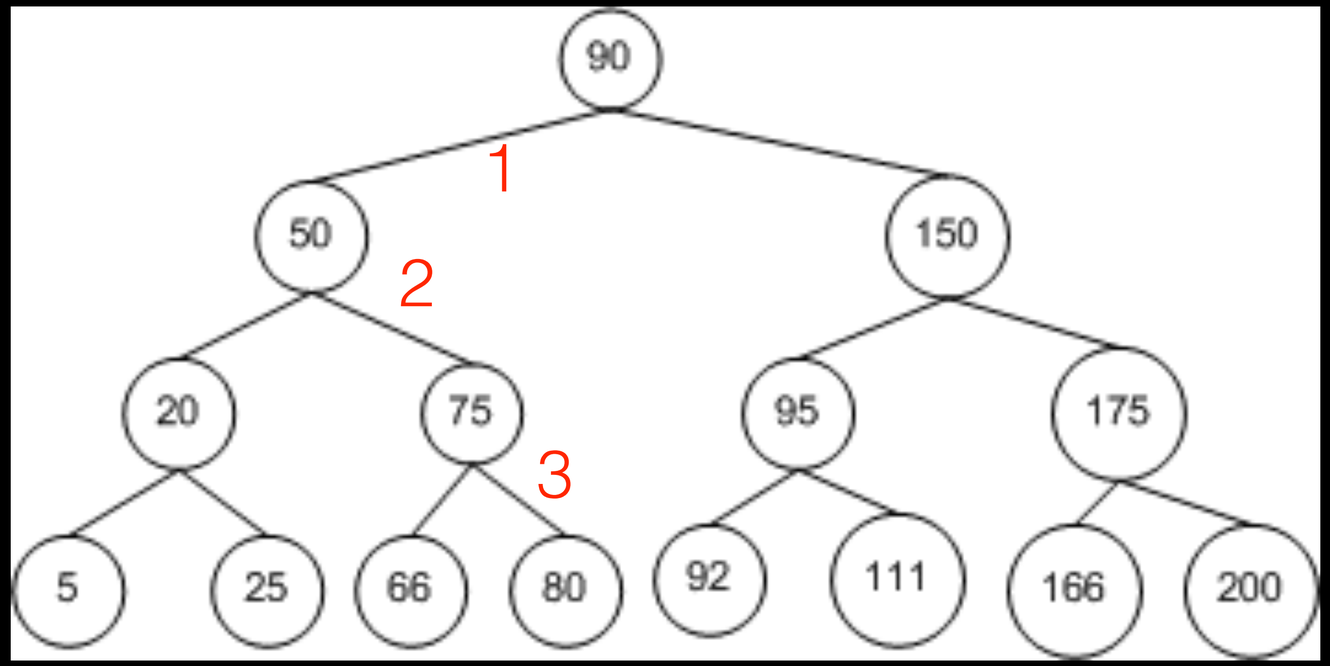
Complete Tree

- A complete tree is a very awesome tree, because it provides the best ratio between number of nodes and height
- The height h of a complete binary tree with N nodes is at most O(log n)
- Thats amazing!

n = 15

log(2) * 15 = 3.9

Which means you only need to traverse 3 edges to get to the most bottom leaf

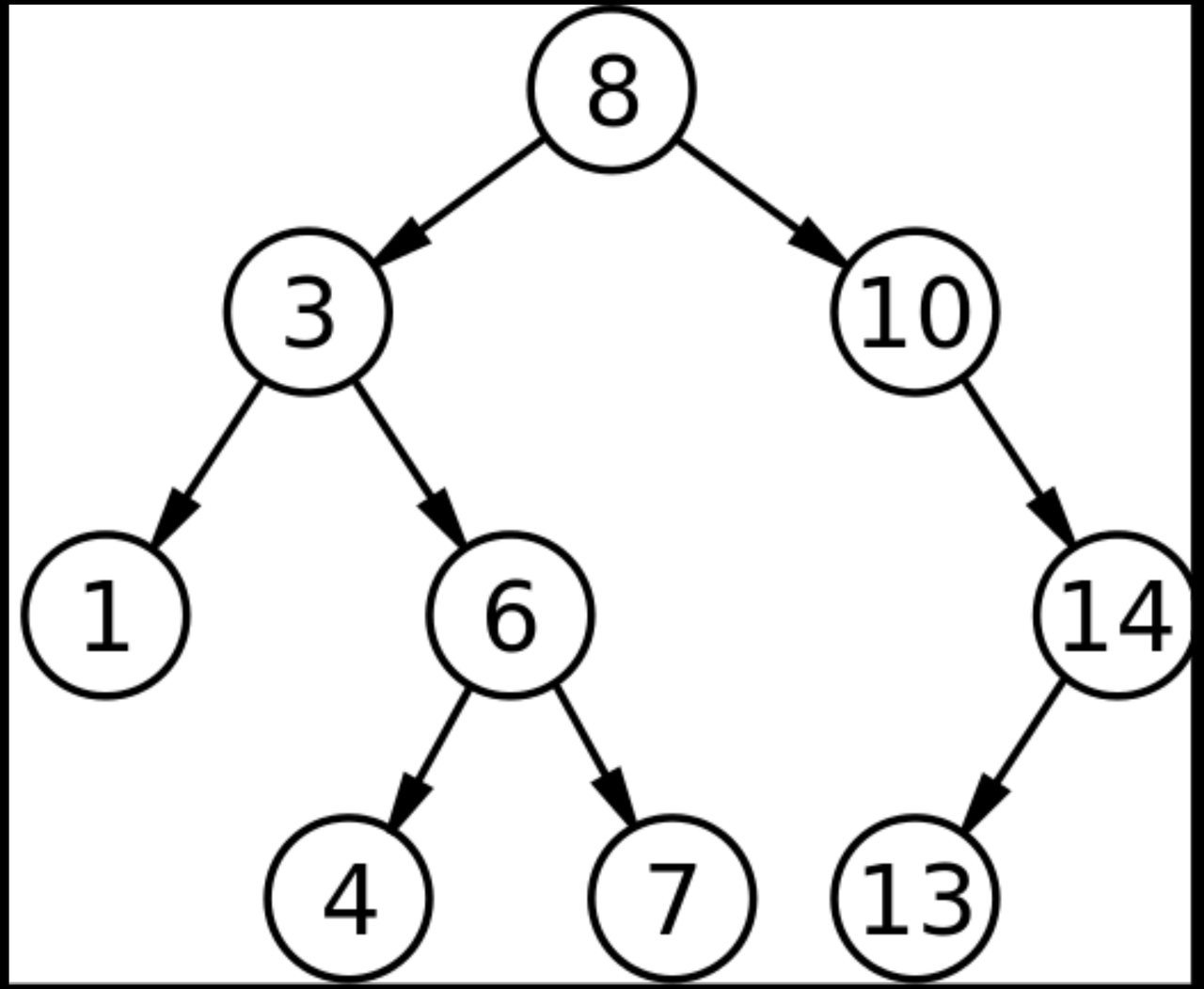


Binary Search Tree

Back to that definition:

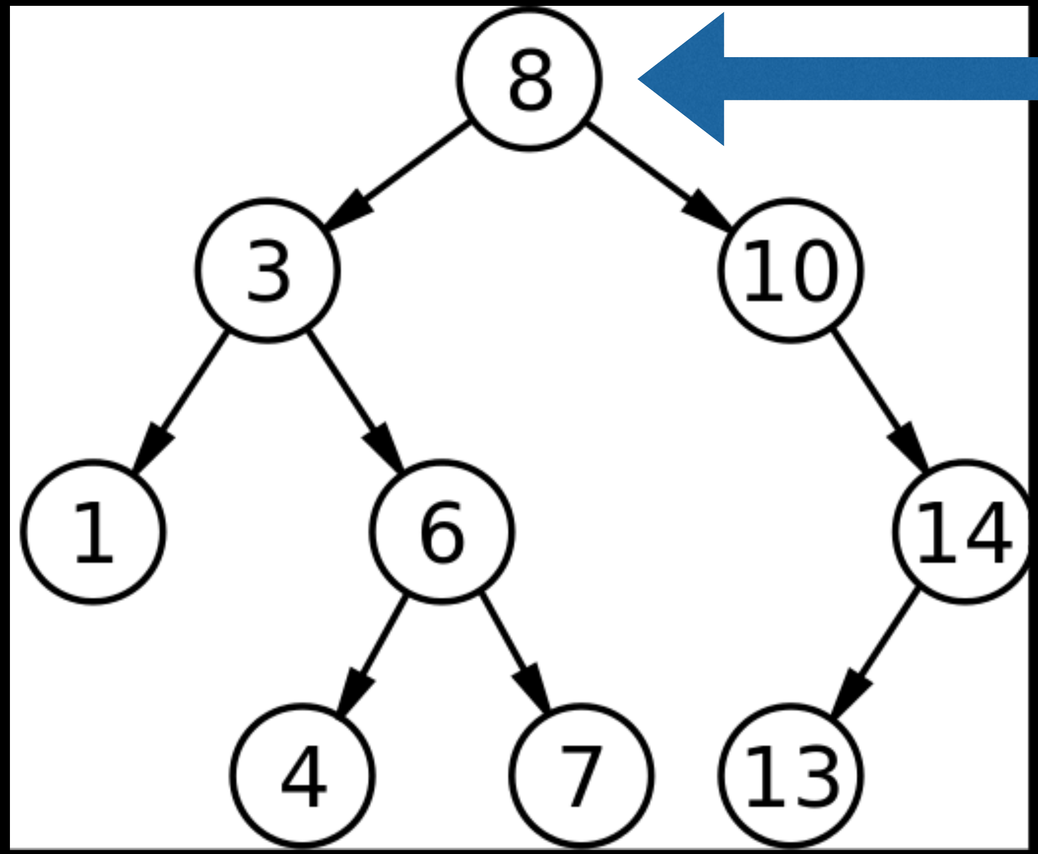
- “A binary search tree is a binary tree where each node has a comparable key and satisfies the restriction that **the key in any node is larger than all keys in all nodes in that node’s left subtree, and smaller than the keys in all nodes in that nodes right subtree**”

Binary Search Tree



Binary Search Tree

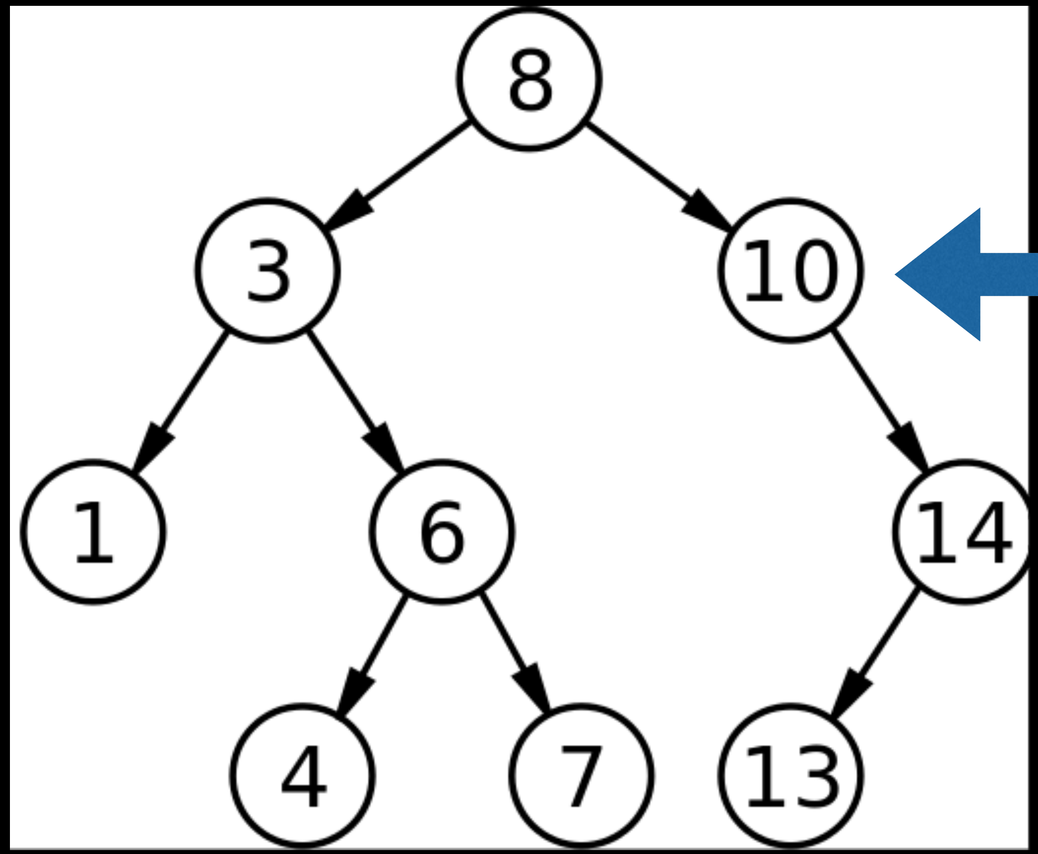
What if wanted to insert 15 into this tree?



We first try to insert it at the root, 15 is larger than 8, and 8 already has a right child, so…

Binary Search Tree

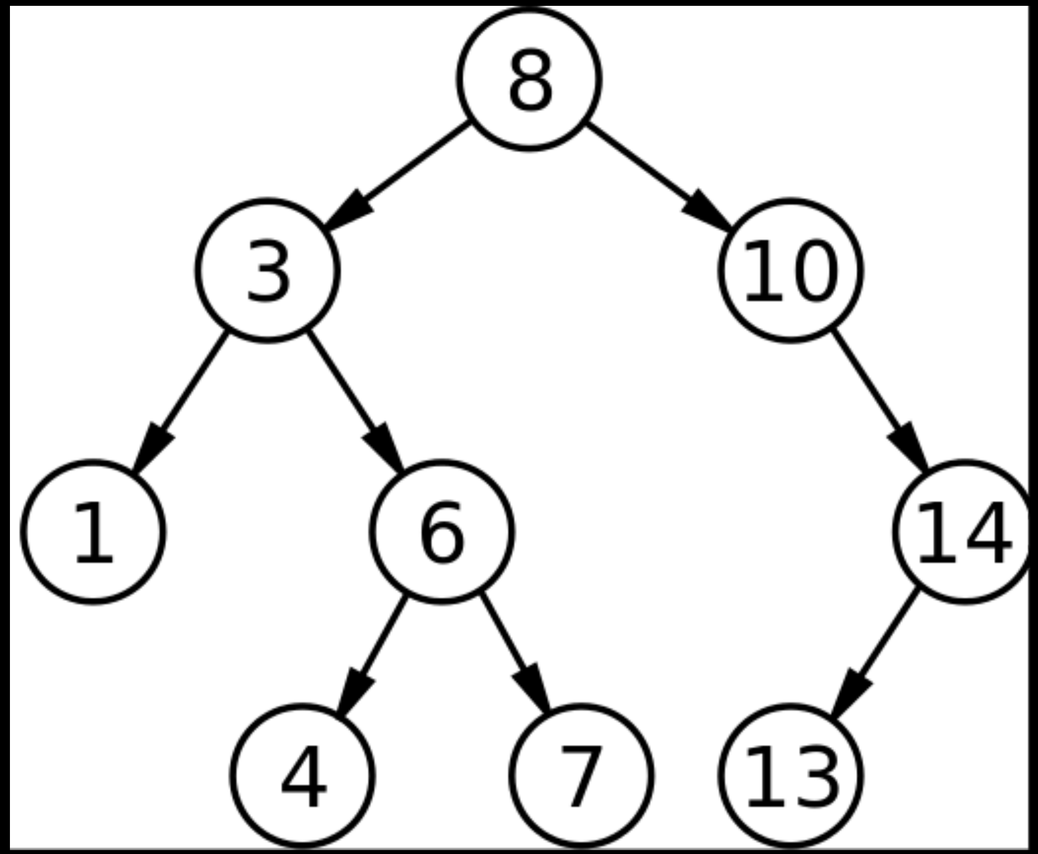
What if wanted to insert 15 into this tree?



We now ask 10, 15 is greater than 10, and 10 node already has a right child, so….

Binary Search Tree

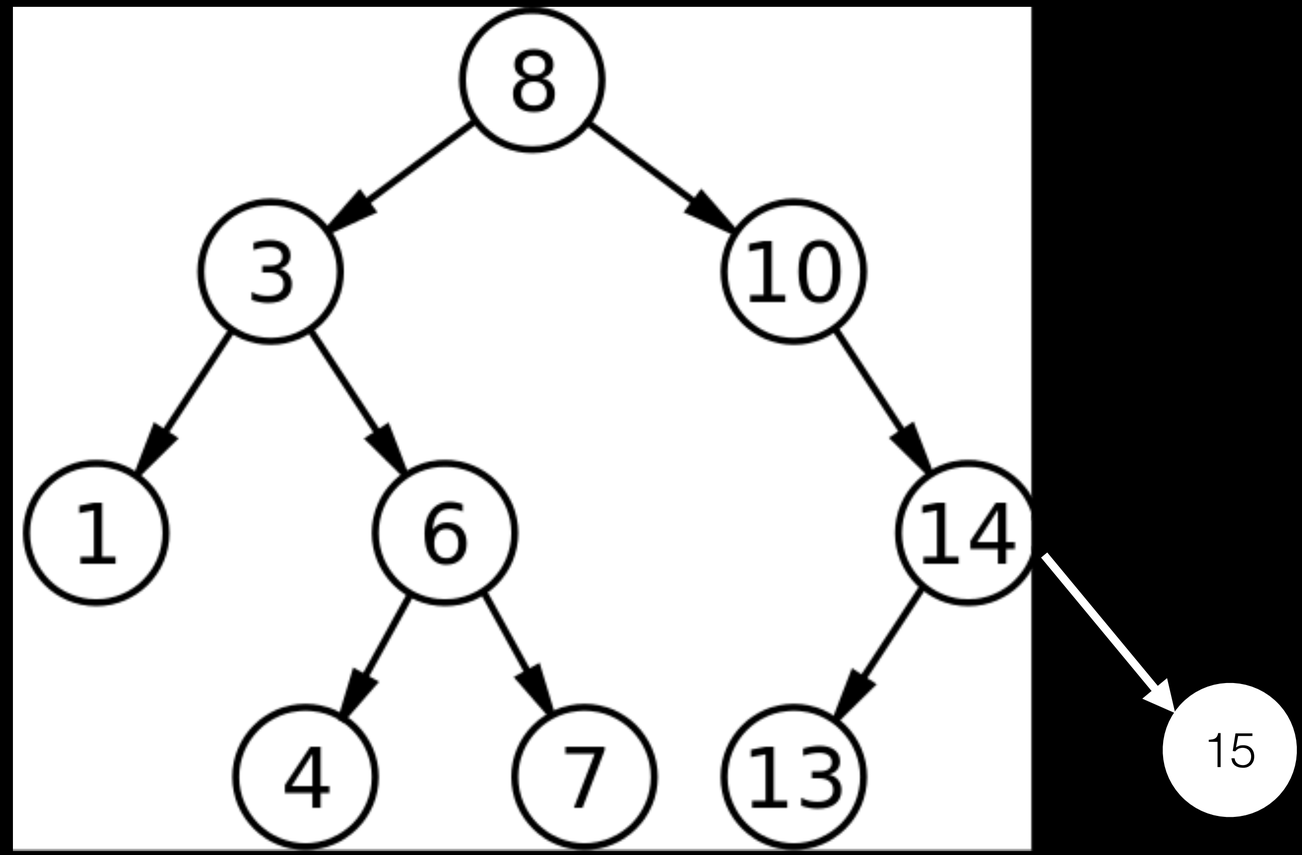
What if wanted to insert 15 into this tree?



We now ask the 14 node. 15 is greater than 14, and 14 has no right child node!

Binary Search Tree

What if wanted to insert 15 into this tree?



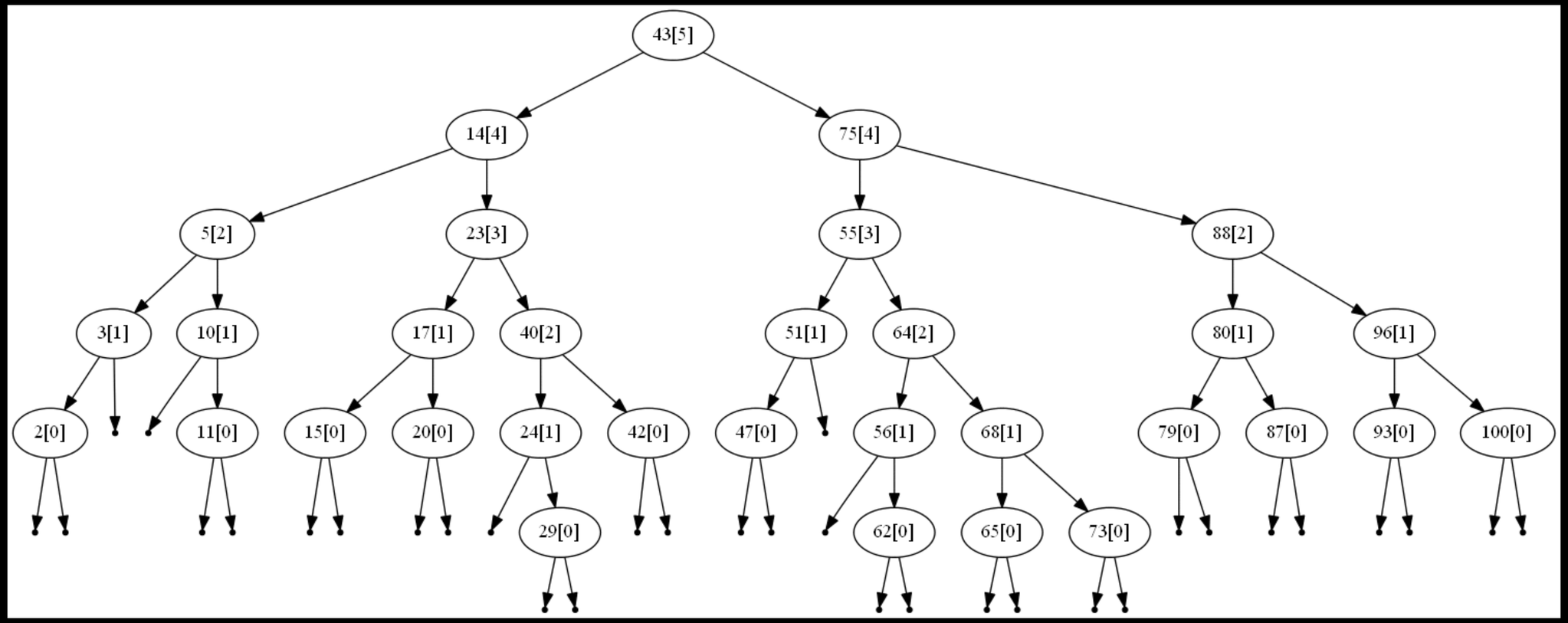
15 now takes it right rightful place in the BST

So why is a binary search tree such a commonly used data structure?

- Because it rocks.
- Specifically, it rocks for searching.
- BST's have a BigO of O(log n) for search, thats great!
- Lets take a look

Search

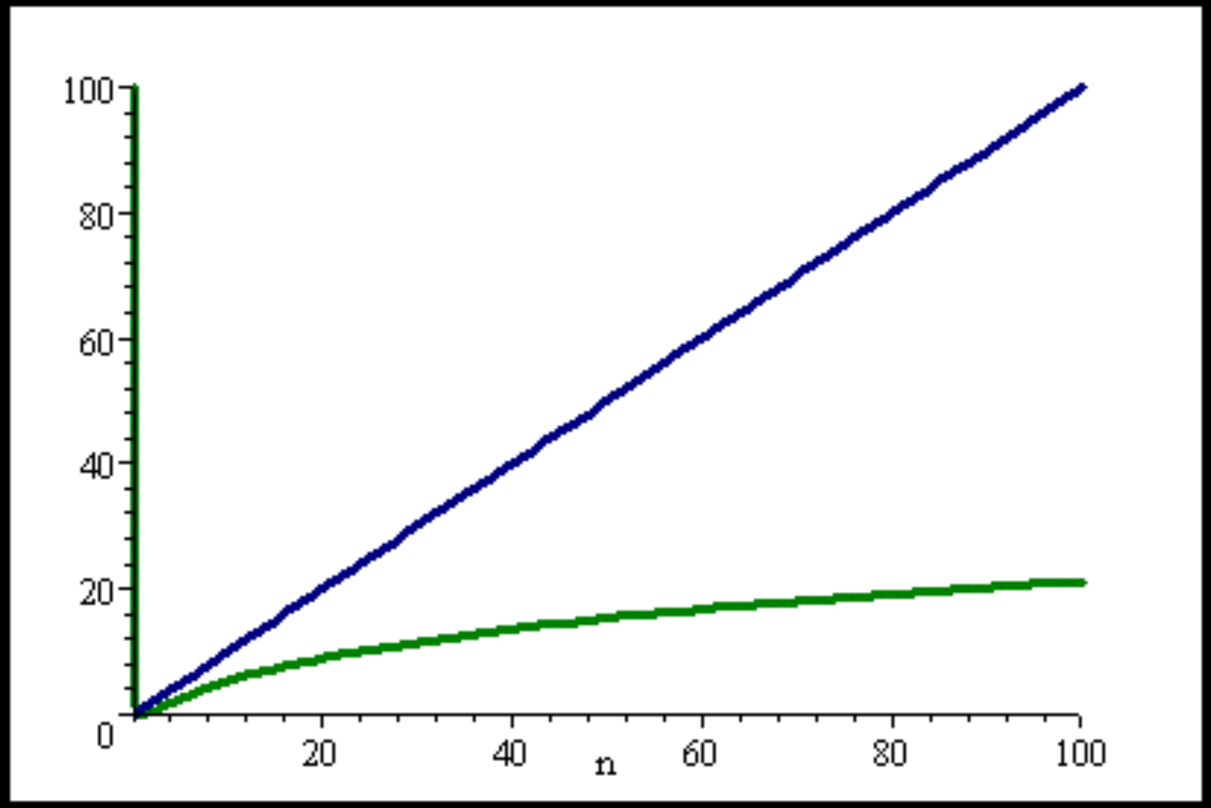
Heres a large looking BST. It has 32 nodes.



log(2) * 32 = 5. At most if would take us 5 traversals, or steps, through this BST to find what we are looking for.

O(log(n)) vs O(n)

Look how slowly log (n) rises compared to the blue (n)



- If your input size n is one million, the big o of n is 1000000, while log(n) is 19.93
- lol

BST and log(n)

- So a Binary search tree with 1 million nodes takes at most 20 steps to find what you are looking for
- Doubling the node count to 2 million, only increases the necessary steps by 1. Thats so good.

Implementing a BST

- When implementing a BST, you can do it a number of different ways.
- I prefer to do it by creating both a binary search tree class, and then a node class to go along with it.

BinarySearchTree Class

- Your Binary search tree class can be pretty simple
- The only property it needs is a node property called root. This is your root node!
- Just like a linked list, as long as you have a strong reference to the root node, the rest of the tree stays alive
- And like a linked list, you will need to come up with ways to traverse the tree.
- The minimum functionality your BST needs is to add a value, find a value, and delete a value

Demo

Week 7 Wrap up

Important Frameworks

- AFNetworking
- Grand Central Dispatch
- All the possibilities with CocoaPods!!!

Important Concepts

- Proper Error Handling
- OAuth in a Web View
- Custom Container View Controllers
- KVC and KVO
- Manual-Retain-Release
- ARC
- Run Loops
- Objective-C Runtime

Course Wrap Up