
CRICOS PROVIDER 00123M

School of Computer Science

# COMP SCI 1103/2103 Algorithm Design & Data Structure

## Binary Trees

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seek LIGHT

# Review - Graph

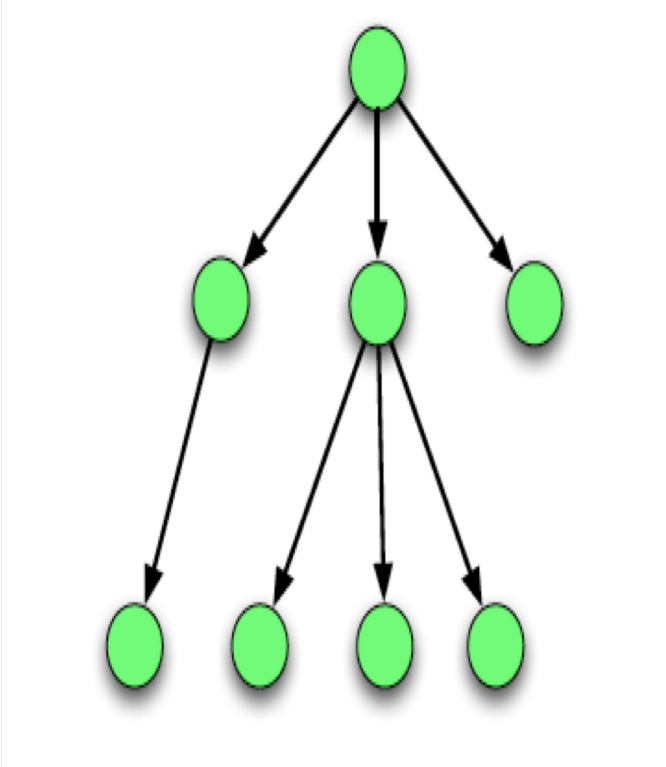
- A graph is a collection of points (vertices or nodes) where some of the points are connected by line segments (edges or arcs).
- Connected or not
- Can have cycles
- G= (V,E),
  - V={v1,v2,…,vn},
  - E={e1,e2,…,e_n},
  - ei= (vj,vk)
- Directed - Undirected

# Review - Trees

- Graphs with certain properties are called trees.
- Trees are a subset of Graphs.
  - Trees must have all of their nodes connected.
  - Trees cannot contain cycles.
  - In other words, trees are connected, acyclic graphs.
- A tree can be defined in several ways. One natural way to define a tree is using recursion.
- N nodes, n-1 edges

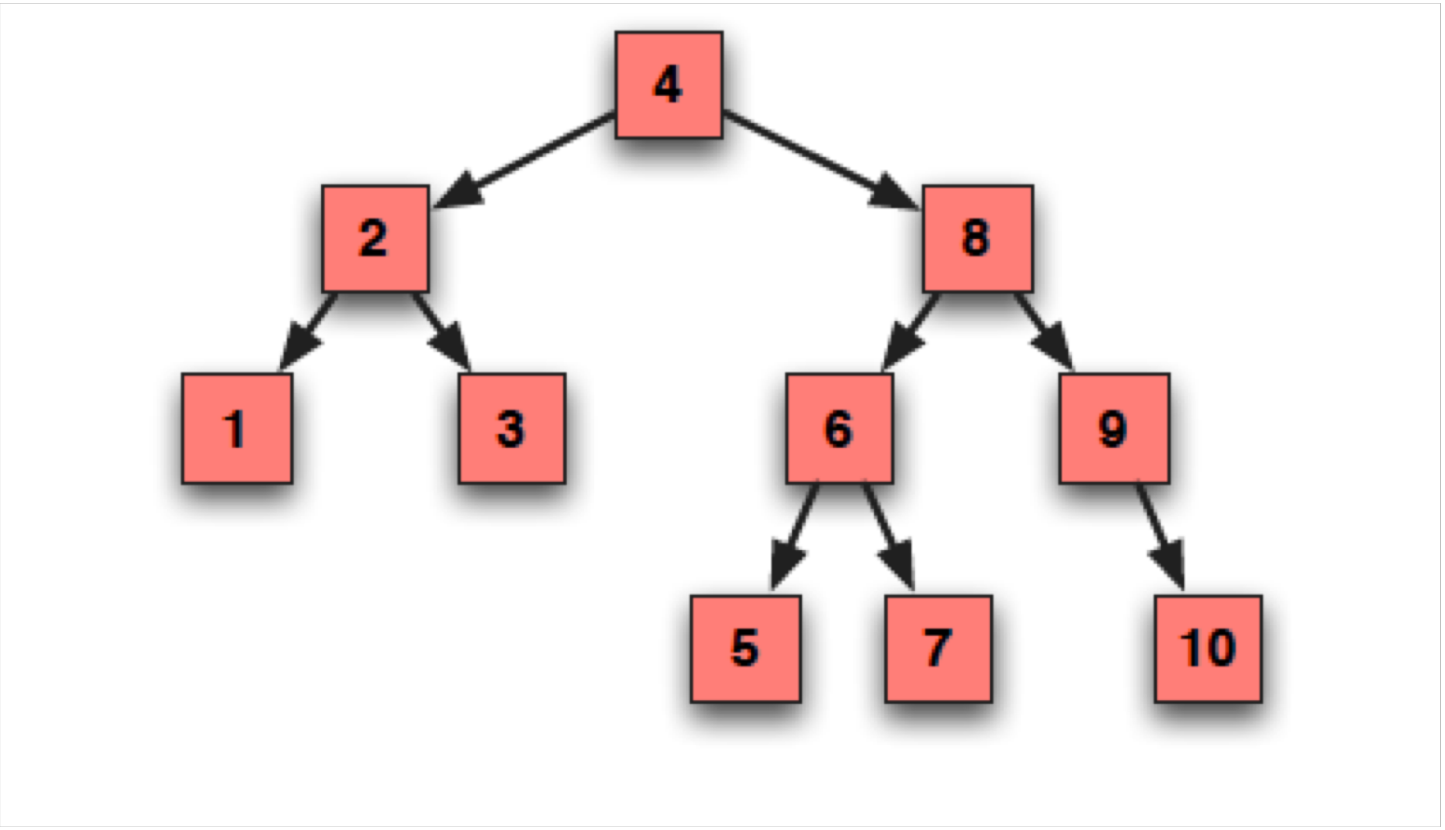
# Directed Rooted Tree Terminology

- Root
- Parent- child.
- leaf.
- Depth of a node (size of the path from root).
- Height of a node (size of the longest simple path to a leaf)
- Height of the tree height of the root.



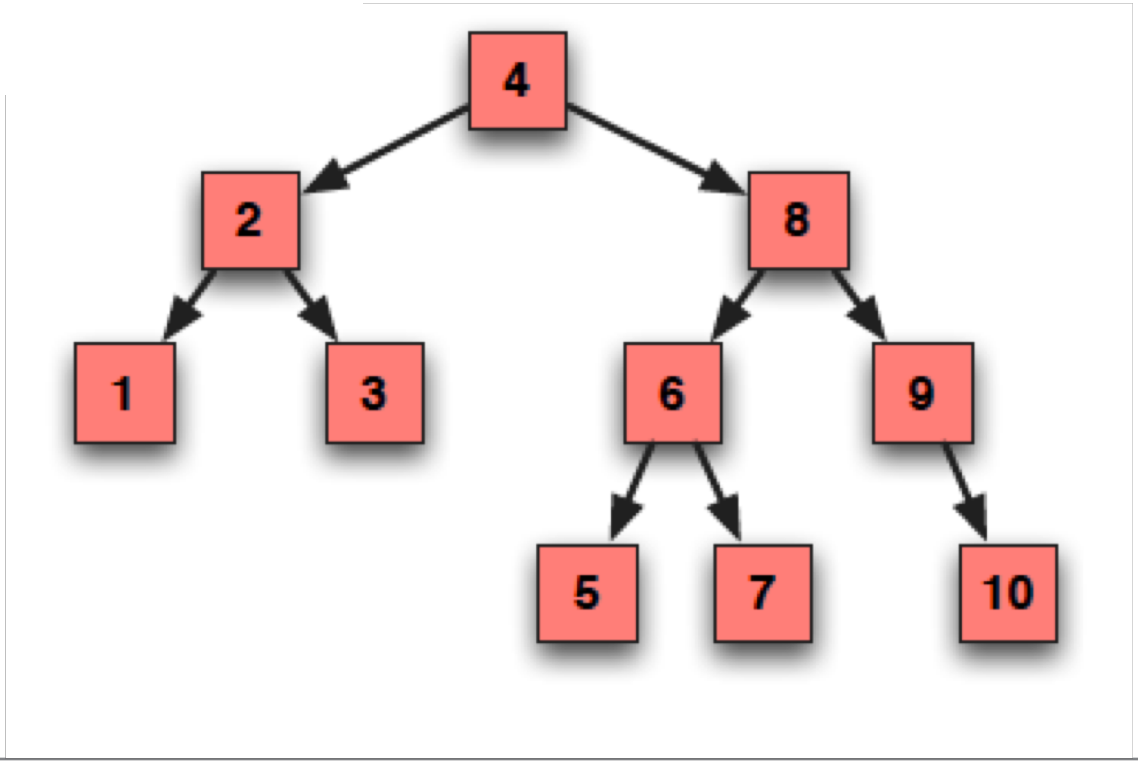
# Binary Trees

- Binary Trees are trees that have 0, 1 or 2 children.



# Traverse the tree

- Pre-order
- Post-order
- In-order



# Example of Binary Tree

- Expression Trees
  - The leaves of an expression tree are operands and other nodes contain operators.
  - The expression trees can be binary tree since most operators are unary or binary.
- We can evaluate an expression tree T by applying the operator at the root to the values obtained by recursively evaluating the left and right subtrees.

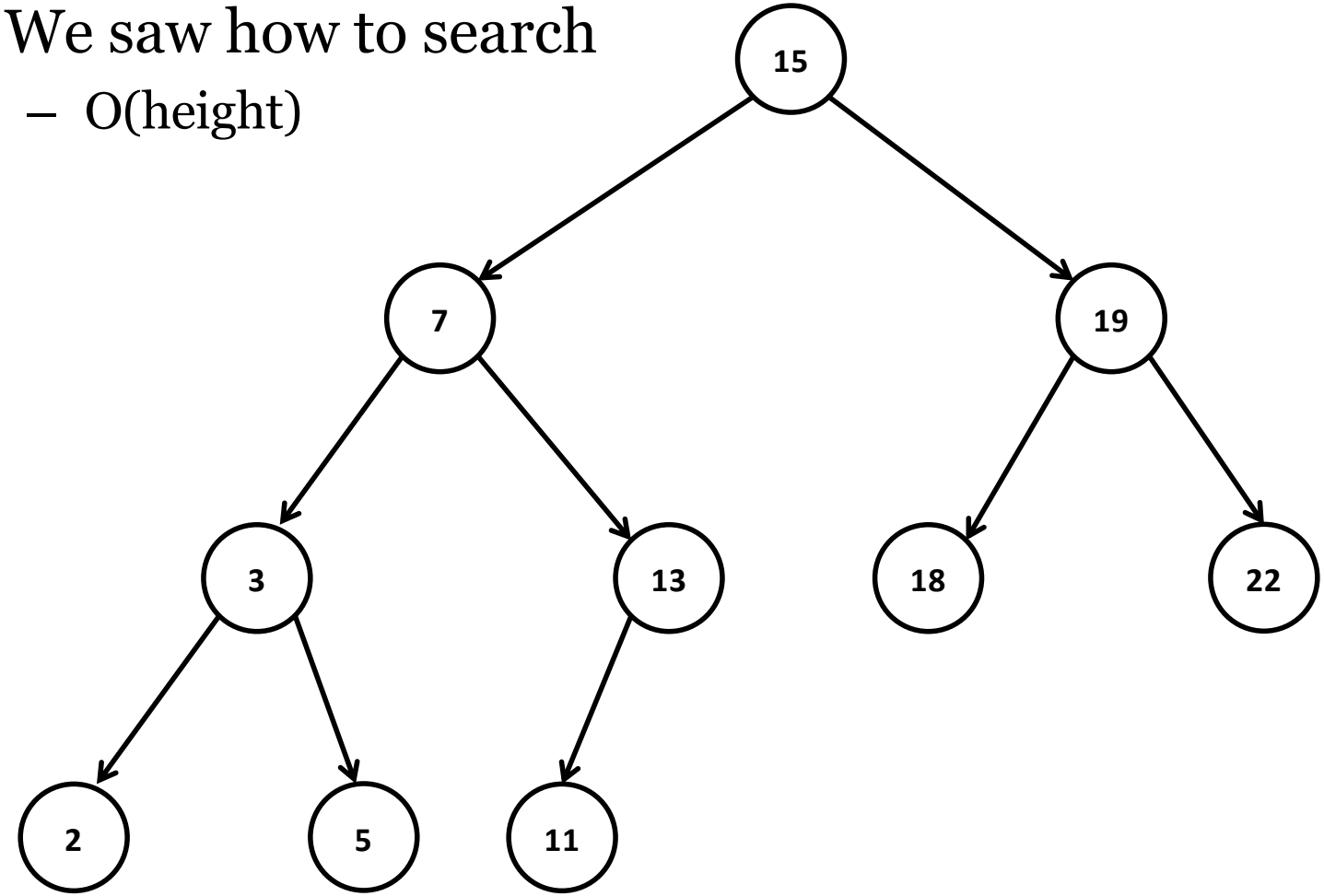
- In-order, pre-order and post-order traverse on this tree gives us in-fix, pre-fix, and post-fix representation of arithmetic expressions
  - Find it confusing? Name the subtrees and find them recursively

# Example of Binary Tree

- Expression Trees
  - Given a post-fix expression, build the tree
    - Remember how you could find the result of that expression by means of an stack?
    - Use a stack for pointers to subtrees this time.

# Ordered Binary Treem (Binary Search Tree)

- Subtrees are also binary search trees.
- We saw how to search
  - O(height)

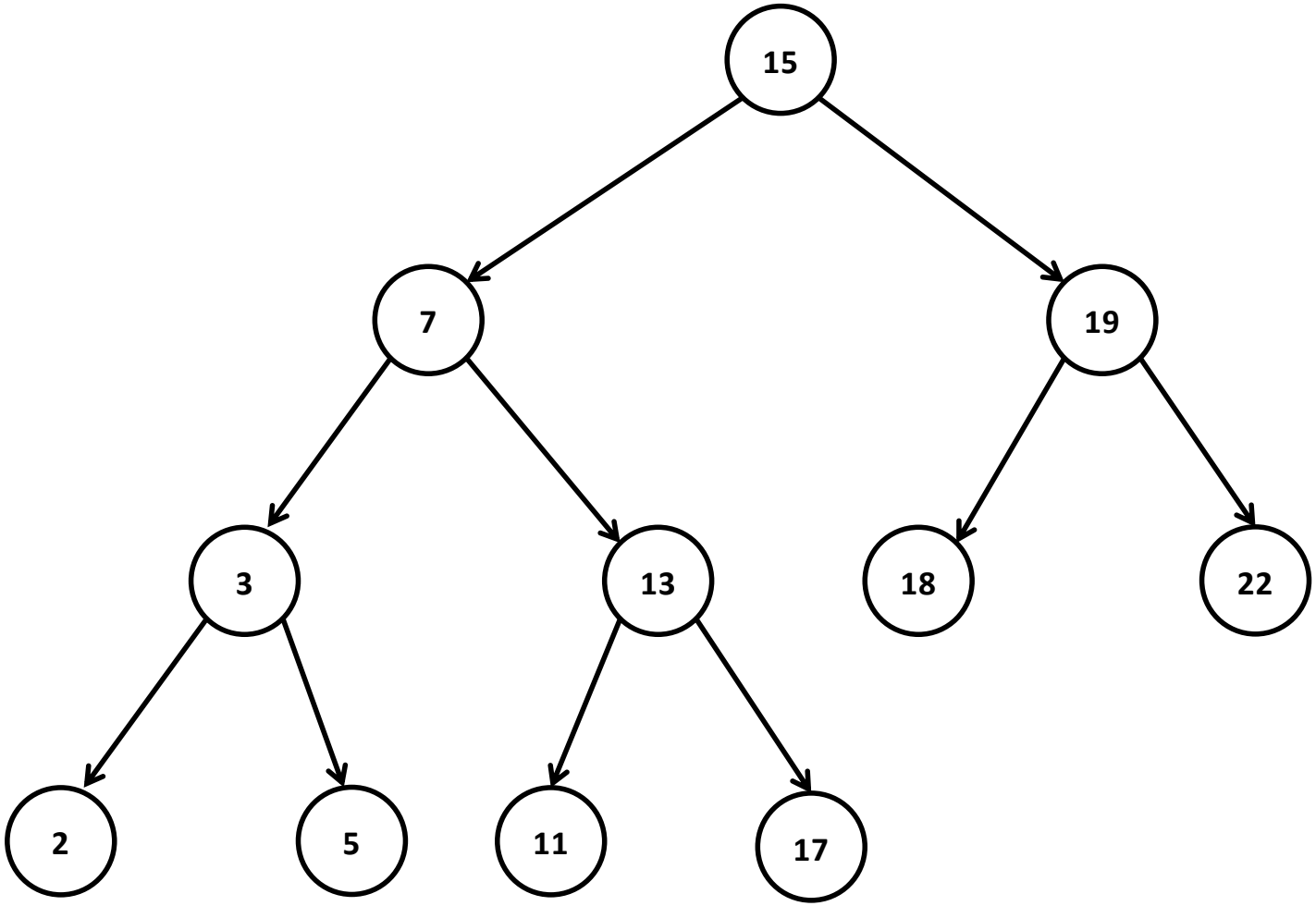


# Binary Search Tree

- A binary search tree (BST) is a binary tree with the following properties:
  - Node values are distinct and comparable
  - The left subtree of a node contains only values that are *less than* the node's own value.
  - The right subtree of a node contains only values that are *greater than* the node's own value.

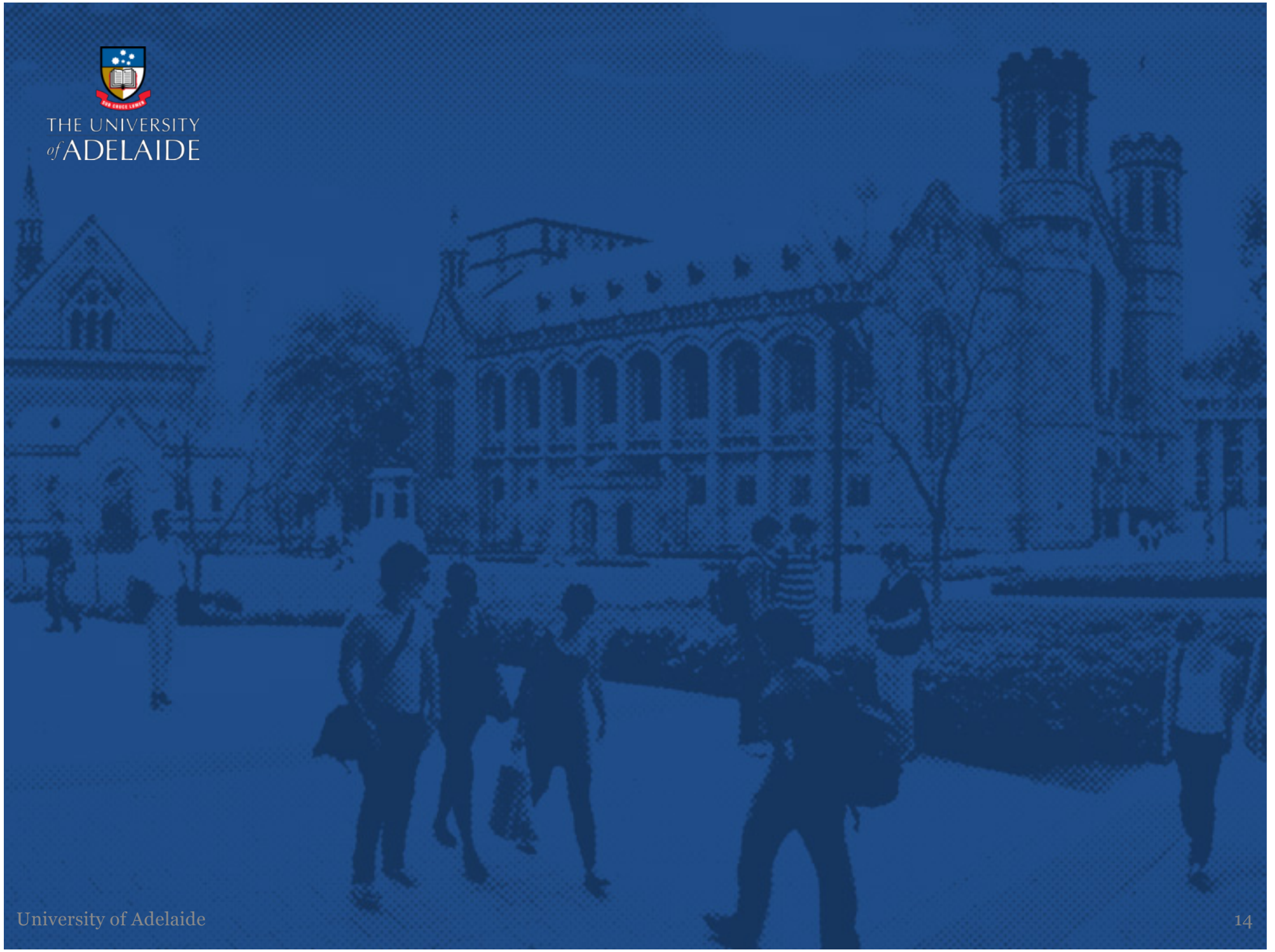
# Binary Search Tree

- Is this tree a BST?



# Binary Search Tree

- How to make this tree?
  - First think about adding a new node to it
  - We assume that the values are distinct and comparable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