Tree Traversals

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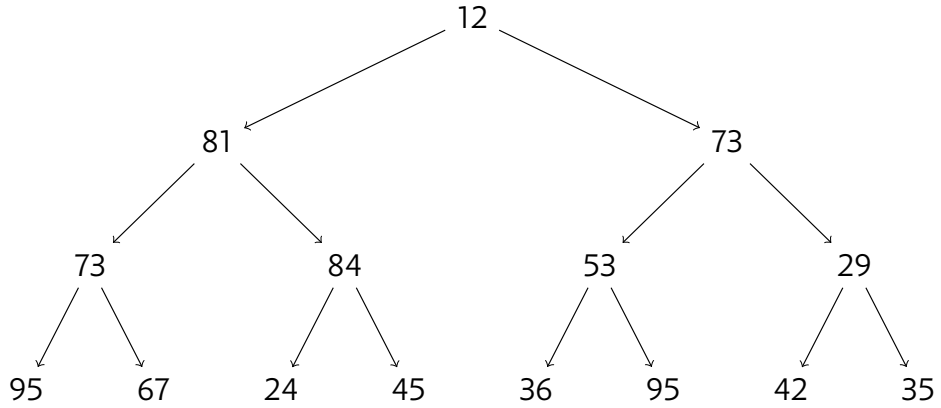
Objectives

You should be able to...

- Know two of the most common tree search patterns:
  - Depth First Search
  - Breadth First Search
- Know five tree traversal algorithms:
  - Preorder
  - Postorder
  - Inorder
  - Next
  - Previous

Looking for the Answer to the Ultimate Question

Suppose we have the following binary tree, and we want to search it for something.

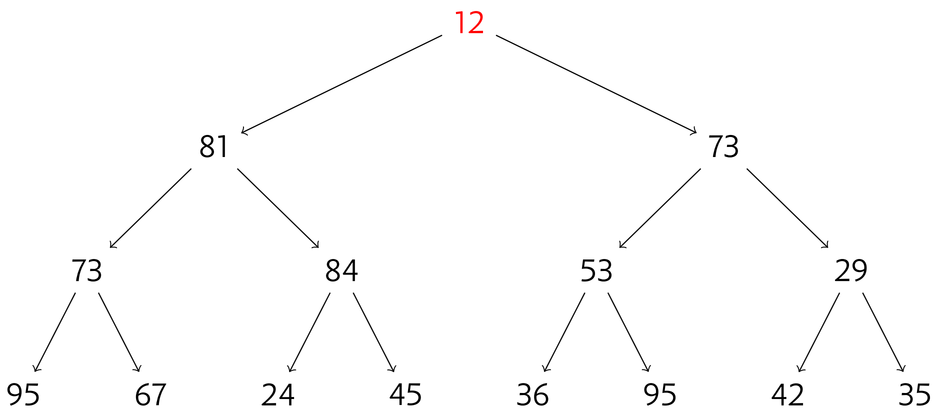


Depth First Search

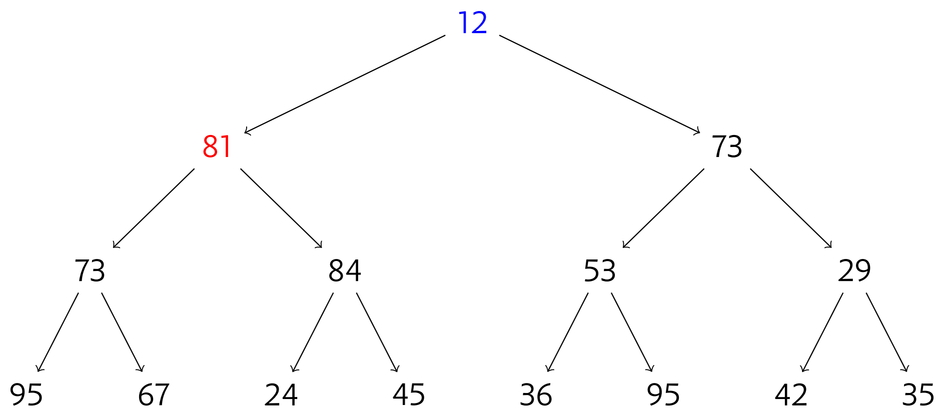
DFS Algorithm

- Check the Current Node
- Recursively Search the Left
- Recursively Search the Right

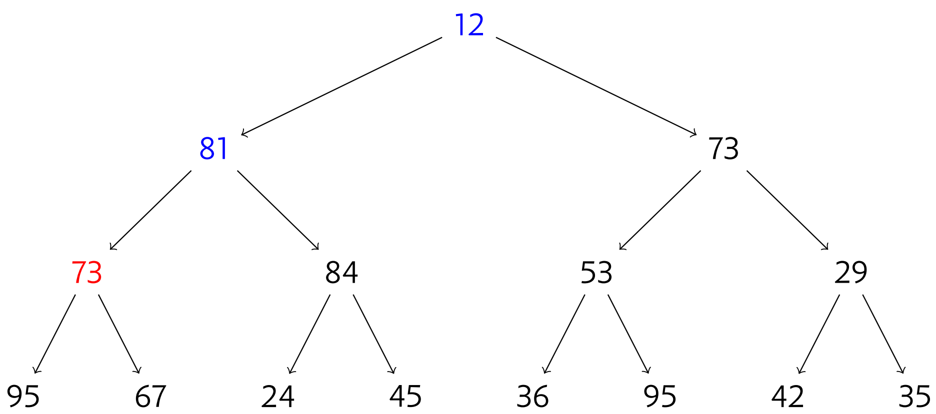
Searching via DFS



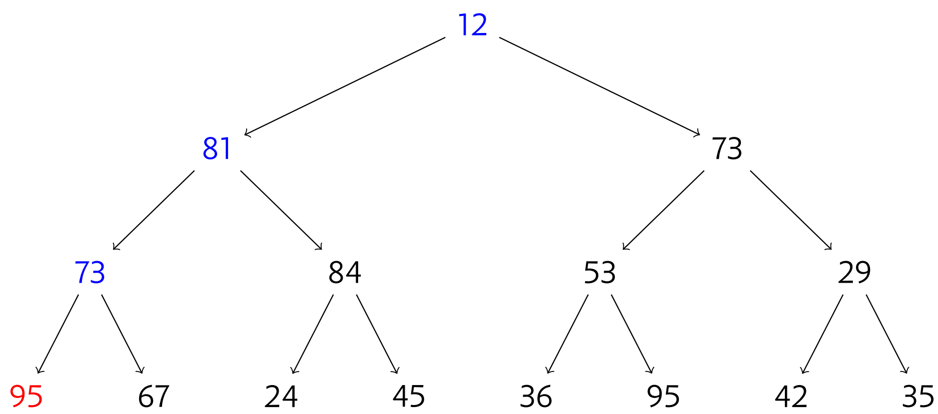
Searching via DFS



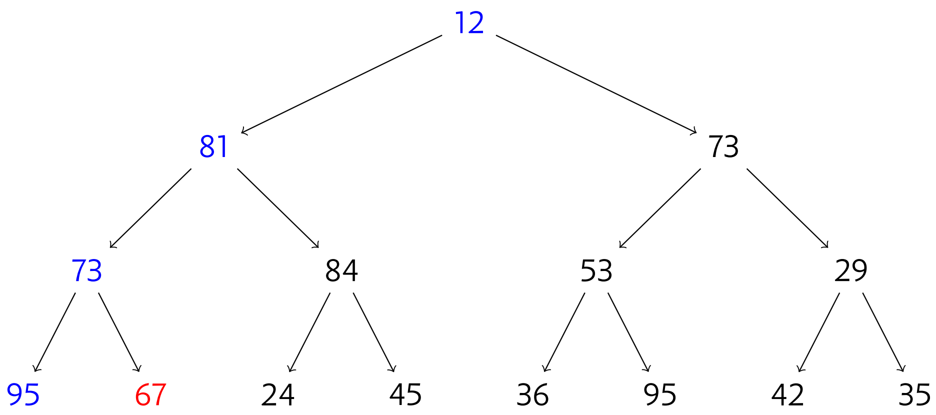
Searching via DFS



Searching via DFS



Searching via DFS



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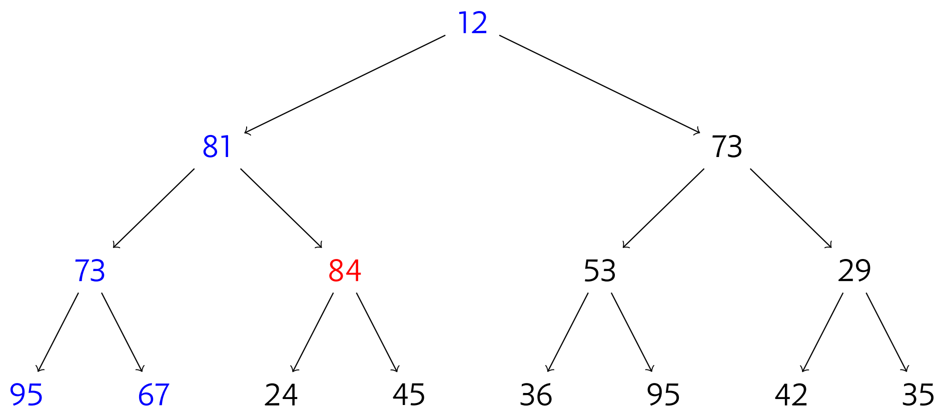

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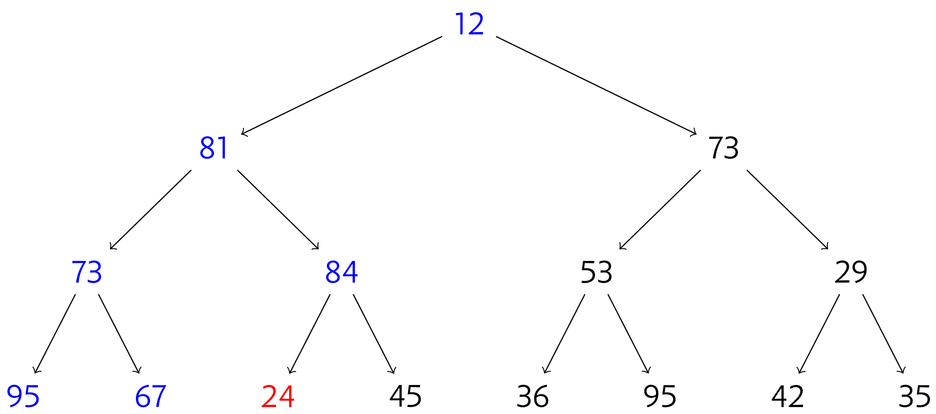

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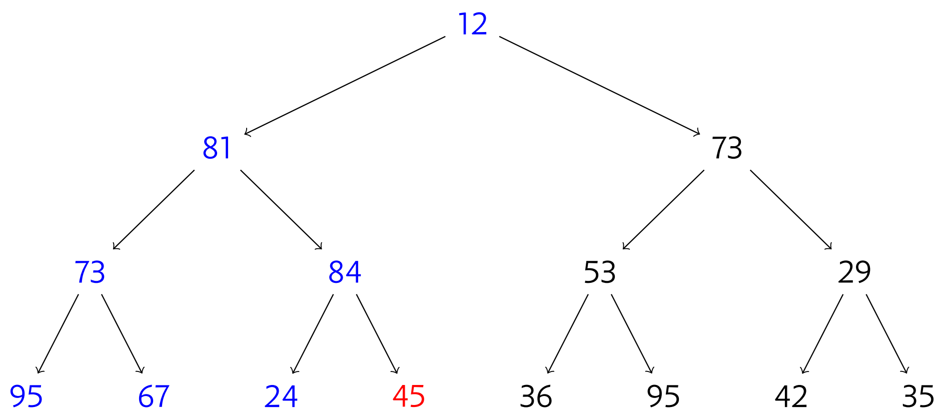

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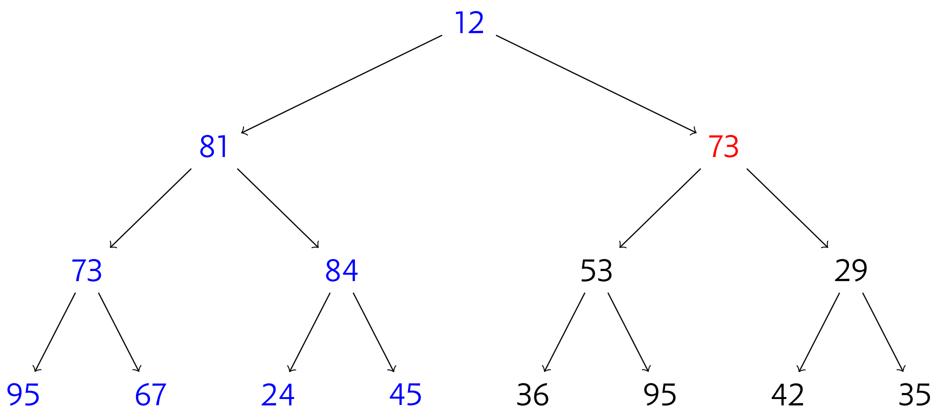

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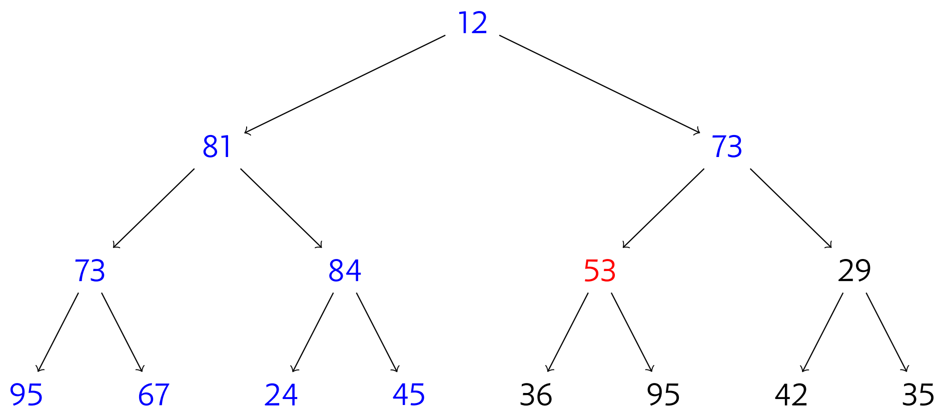

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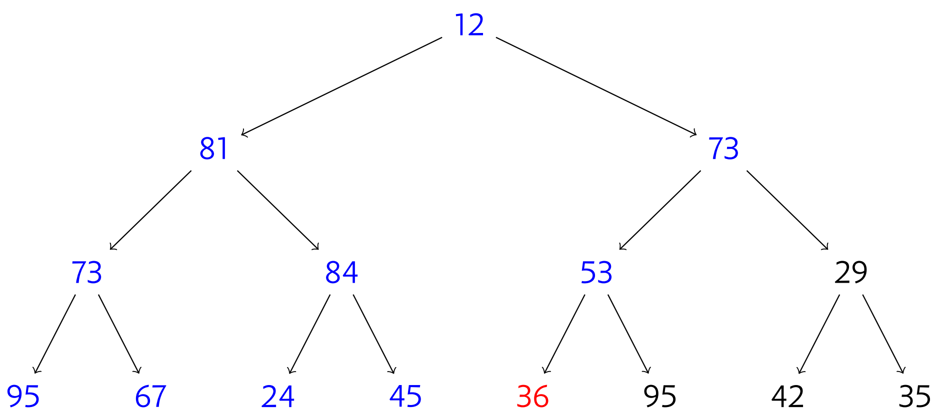
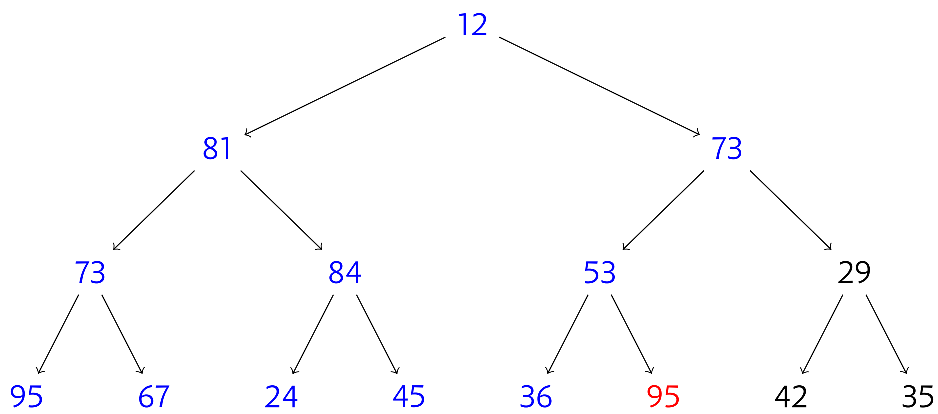


Searching via DFS



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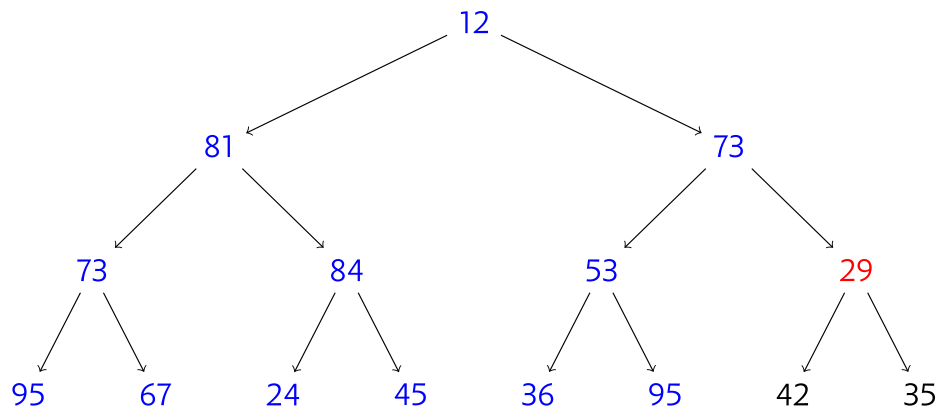

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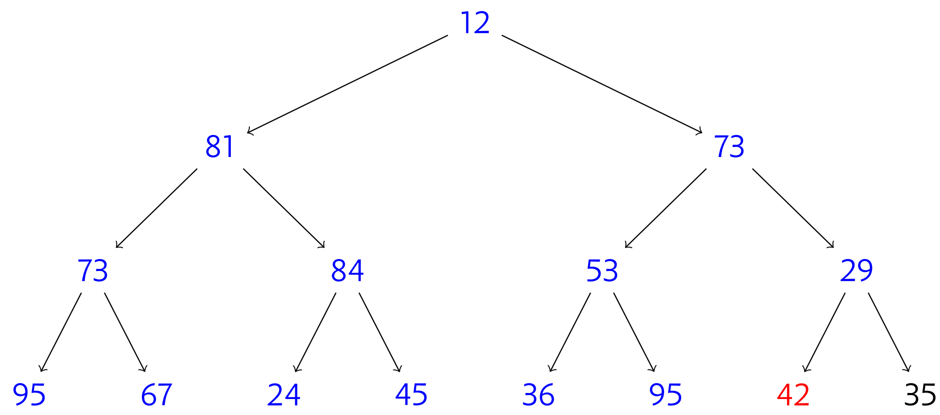
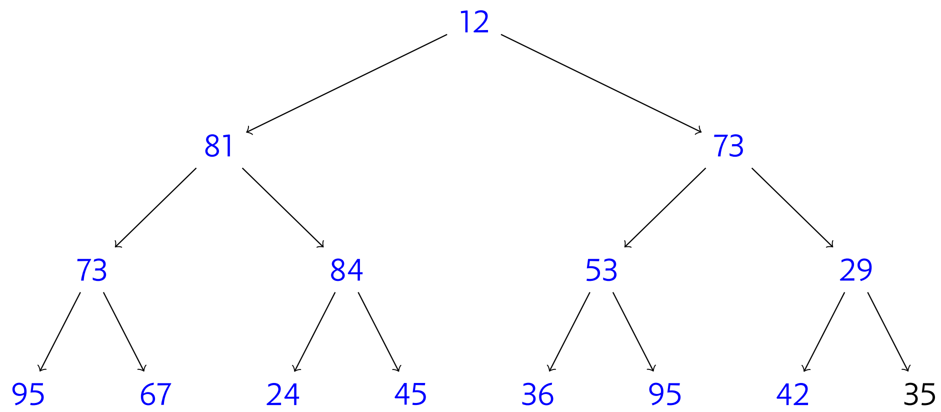


Searching via DFS



Things to know.

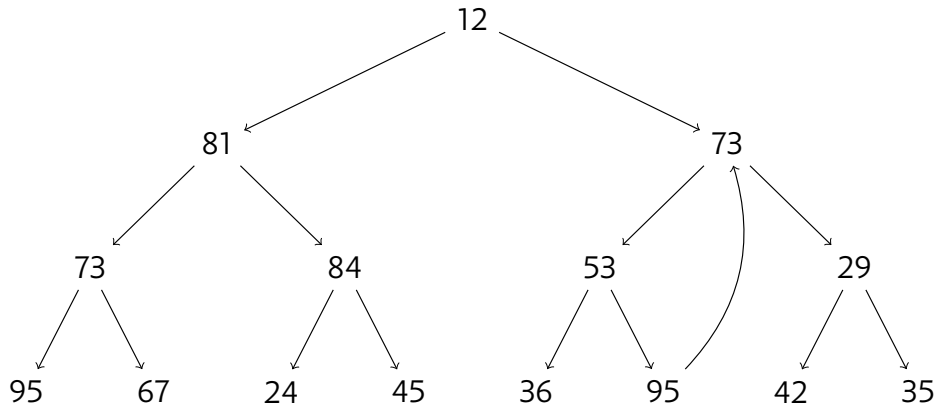
Pros

- Very easy to write this.
- Uses very little memory. (How much?)

Cons

- Does not handle back-edges well.
- Does not handle infinite trees at all.

A Back Edge

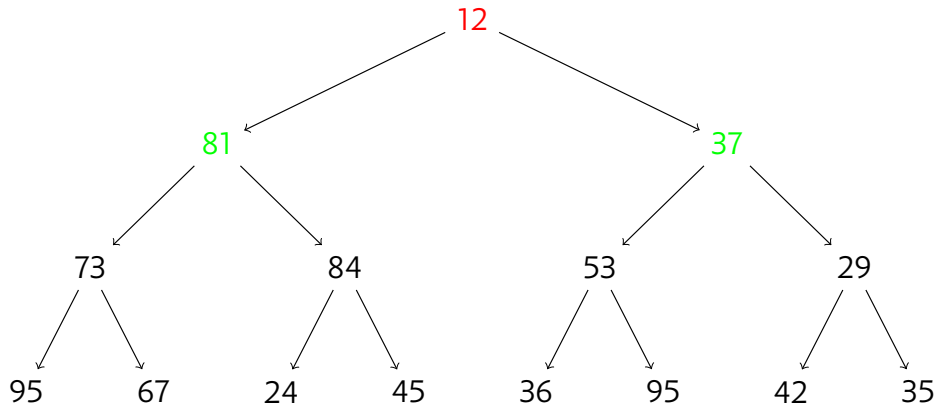


Breadth First Search

BFS Algorithm

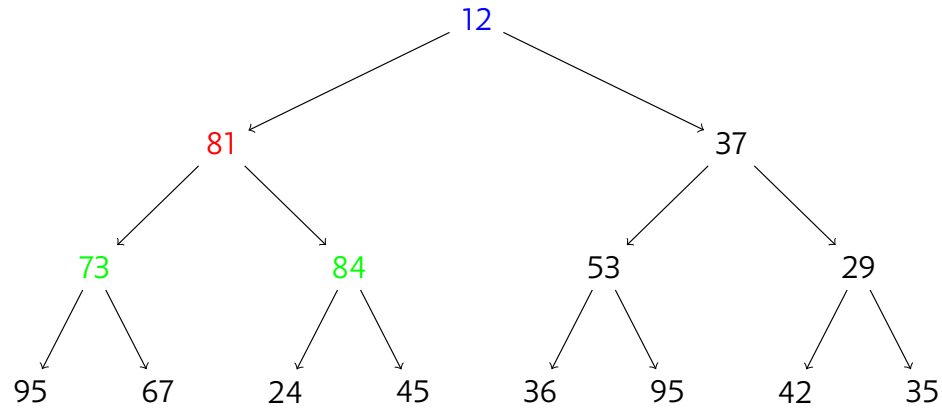
- Enqueue the Root
- Then...
  - Dequeue a Node
  - Check Node
  - Enqueue Children

Searching via BFS



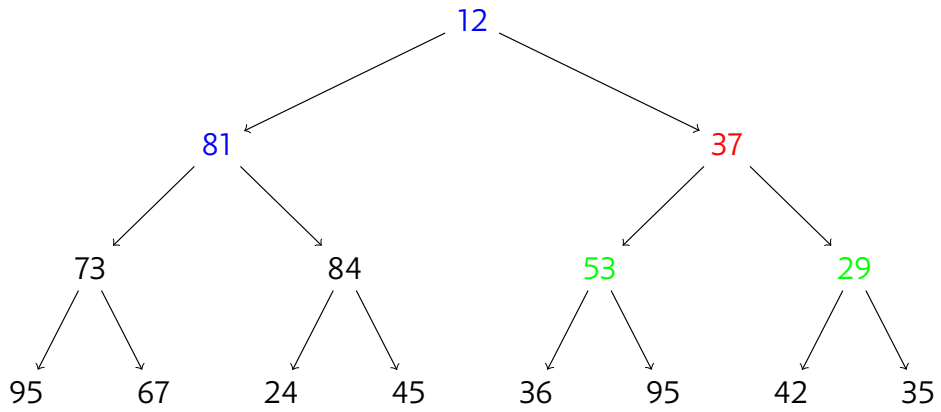
Queue: 81 37

Searching via BFS



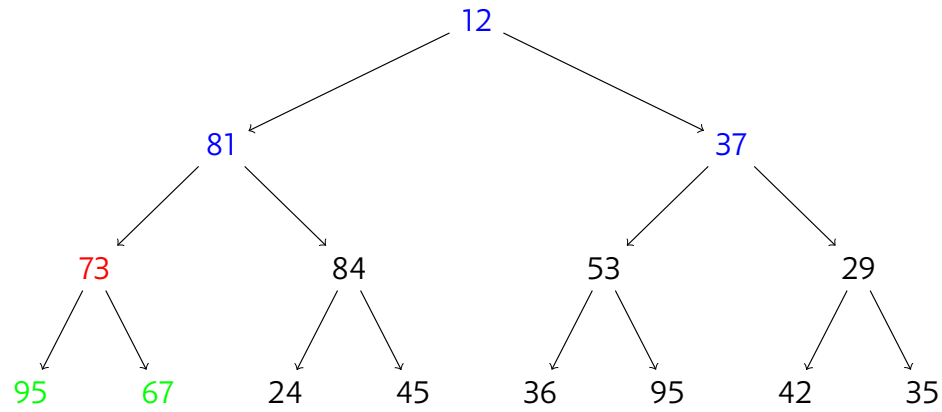
Queue: 37 73 84

Searching via BFS



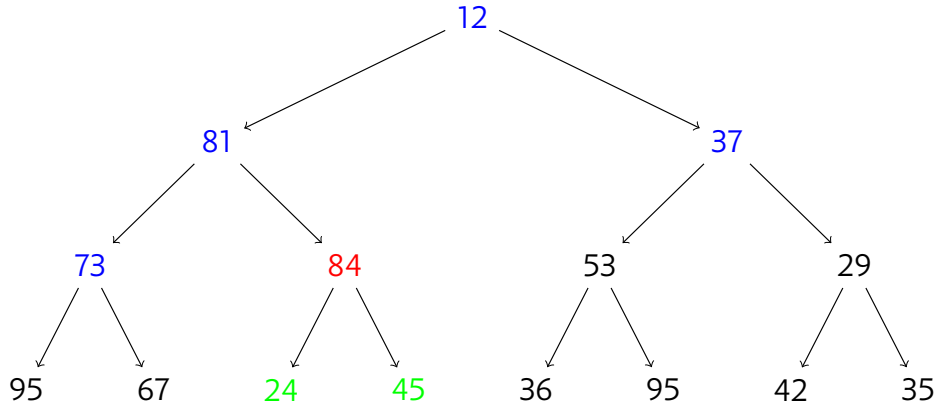
Queue: 73 84 53 29

Searching via BFS



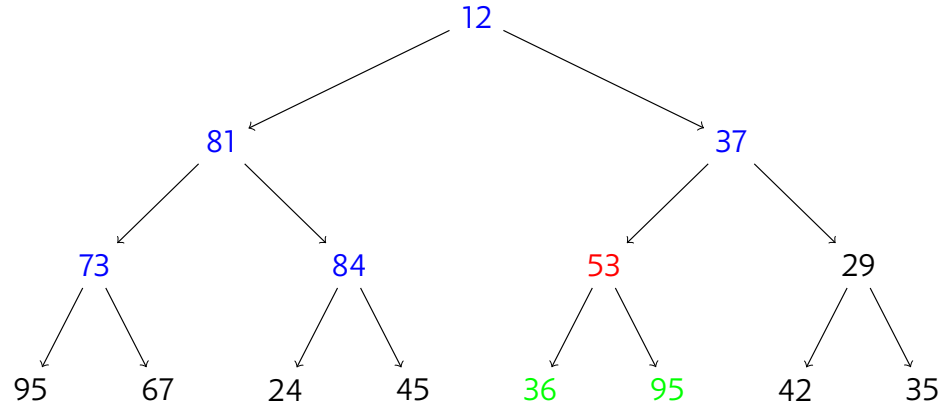
Queue: 84 53 29 95 67

Searching via BFS



Queue: 53 29 95 67 24 45

Searching via BFS



Queue: 29 95 67 24 45 36 95

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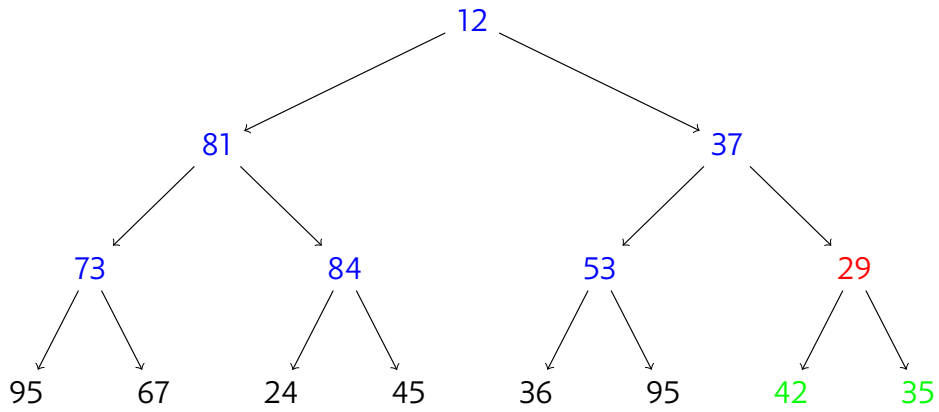
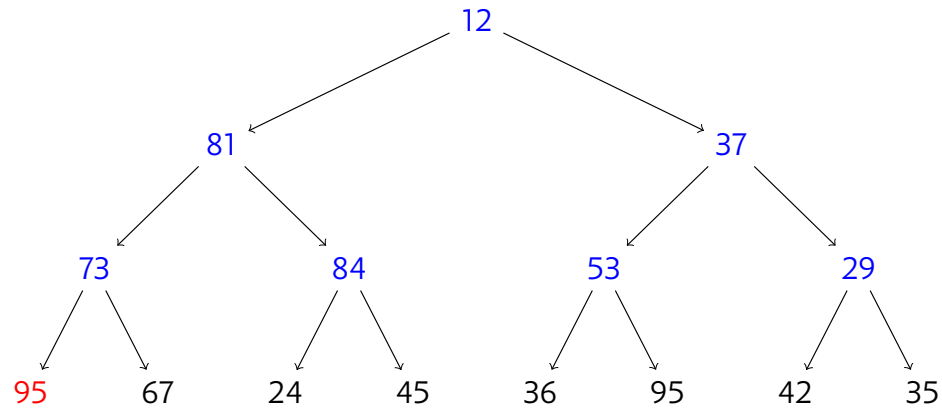


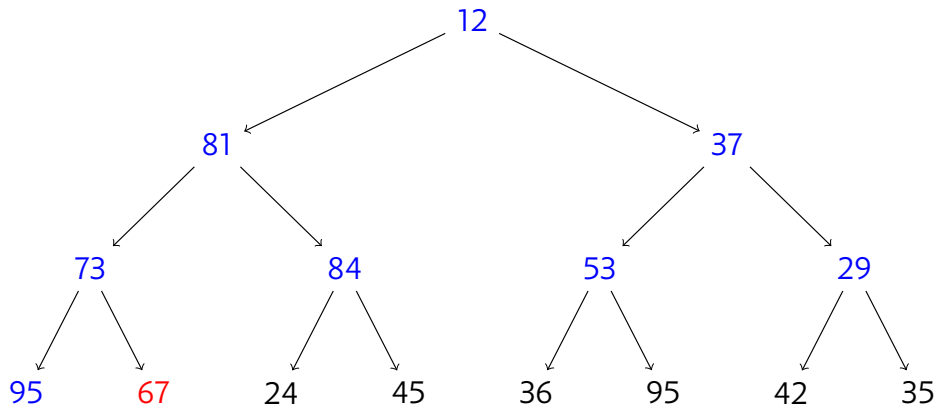
Queue: 95 67 24 45 36 95 42 35

Searching via BFS



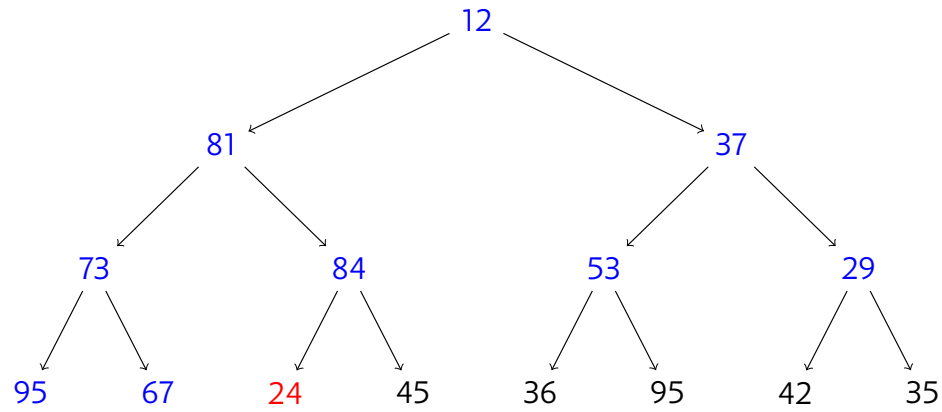
Queue: 67 24 45 36 95 42 35

Searching via BFS



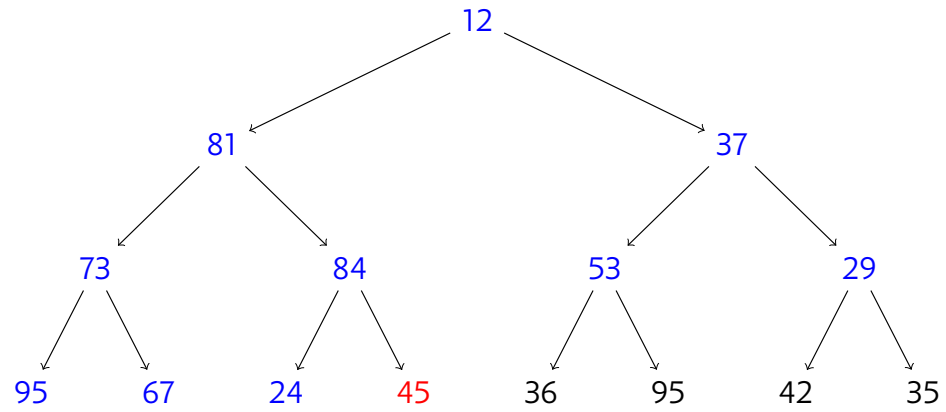
Queue: 24 45 36 95 42 35

Searching via BFS



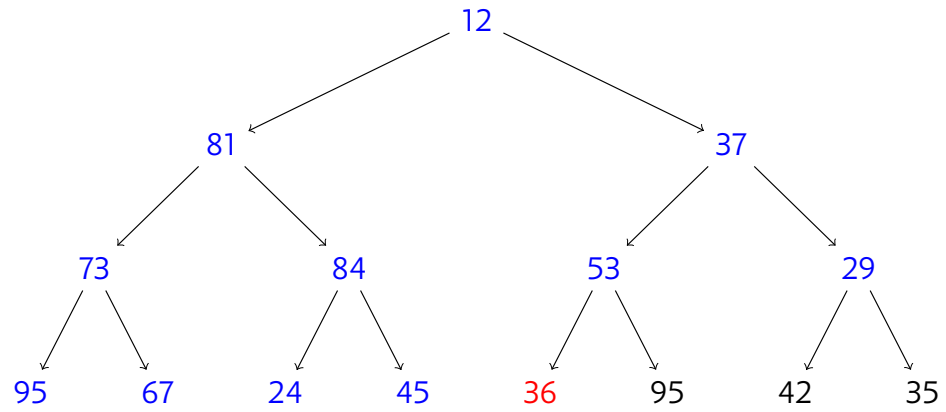
Queue: 45 36 95 42 35

Searching via BFS



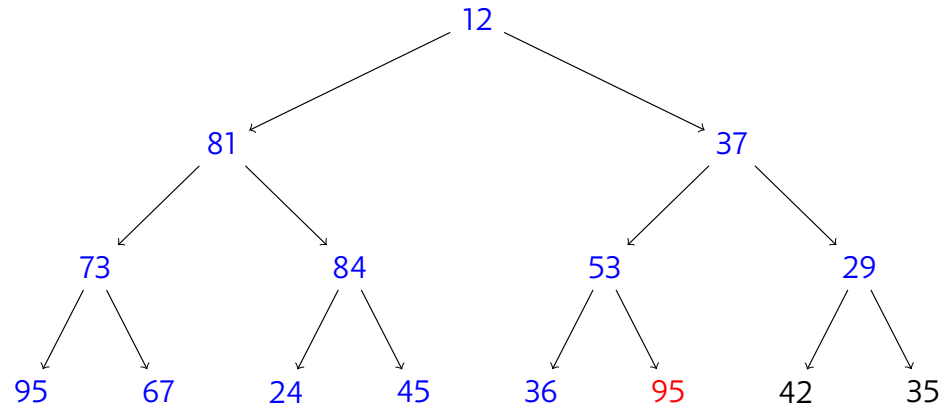
Queue: 36 95 42 35

Searching via BFS



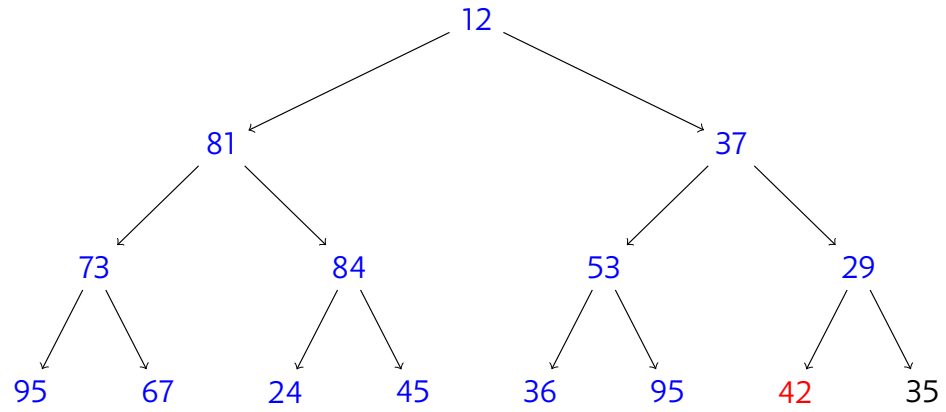
Queue: 95 42 35

Searching via BFS



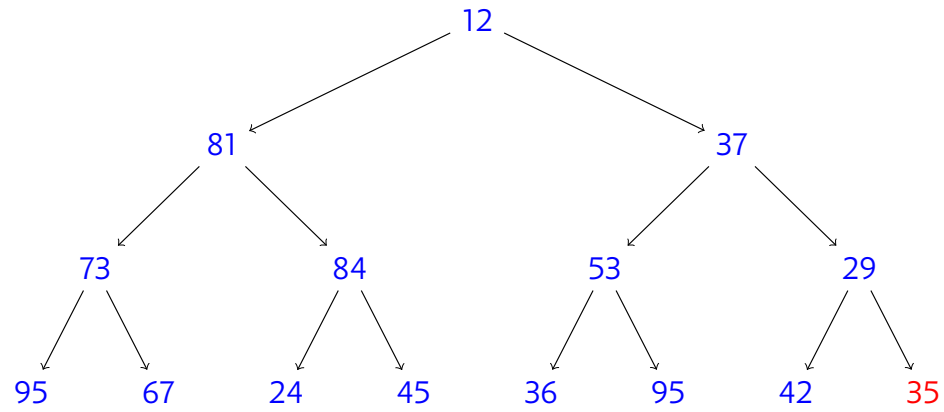
Queue: 42 35

Searching via BFS



Queue: 35

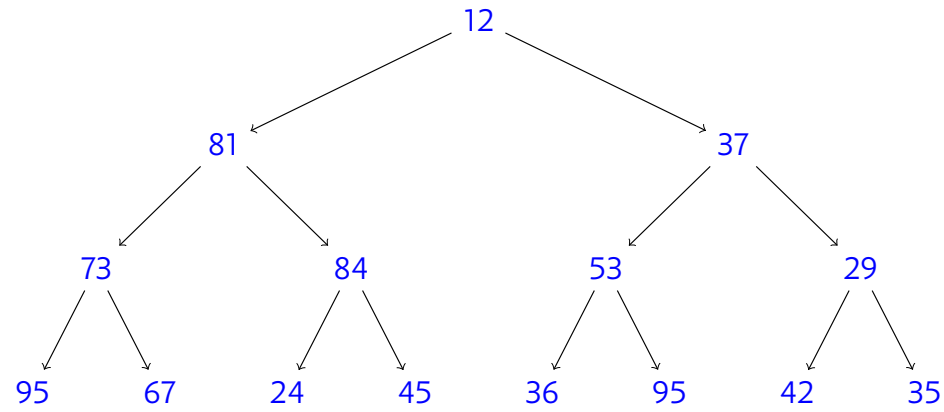
Searching via BFS



Queue:

Introduction Searching Traversals

Searching via BFS



Queue:

Introduction Searching Traversals

Things to know.

Pros

- Finds node closest to root.
- Handles infinite trees and back edges.

Cons

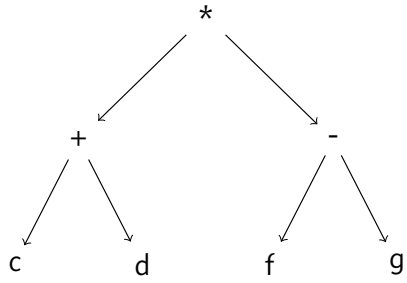
- Can use a lot of memory. (How much?)
- Usually takes a bit longer to write.

- BFS is also called “level order traversal”.

Introduction Searching Traversals

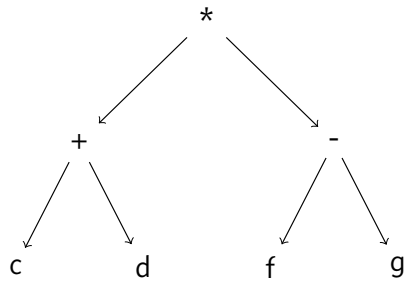
Three Kinds

- There are three kinds of traversals you should know.



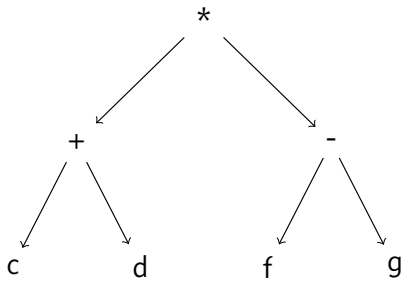
- Preorder: * + c d - f g — used by Scheme and Lisp
- Inorder: c + d * f - g — used by scientific calculators
- Postorder: c d + f g - * — used by Reverse Polish Notation

Preorder



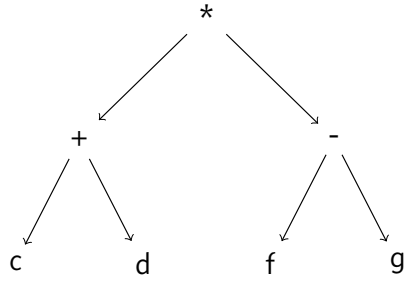
- Preorder: * + c d - f g — used by Scheme and Lisp
- How can you code this traversal scheme?
- Note: if you can distinguish leaves from nodes, you can reconstruct the tree from the traversal!

Postorder



- Postorder: c d + f g - * — used by Reverse Polish Notation
- How can you code this traversal scheme?
- Note: if you can distinguish leaves from nodes, you can reconstruct the tree from the traversal!

Inorder



- Inorder: c + d * f - g — used by scientific calculators

This one is tricky! Consider: can you reconstruct the tree given the string?