Data Structures & Algorithms
(PCC-CS 301)

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Topics Covered

1. Splay tree
    1.1. Introduction
    1.2. Data insertion and deletion
    1.3. Data searching

Splay Tree

- Introduction

  - This is a variant of Binary Search Tree
  - This is a self balancing tree like AVL or Red-black tree
  - Splay tree contains an additional feature as maintaining locality of reference for searching an element
  - The data searching process is faster in this tree sometimes better than other BSTs
    - The most frequently accessed data are kept near to root
  - The most recently searched element is set as the root of the tree
  - Average searching time in splay tree is $O(\log_2 n)$ [amortized time]

Splay Tree

- Introduction

  - In best case data searching can be performed in O(1)
    - If some specific data are frequently/repeatedly accessed which is set as the root of the tree
  - In most real-life applications, 20% of the stored data are frequently (80%) accessed
  - Splay tree is used in
    - Windows NT
    - GCC compiler in Linux
    - Networking modules

Splay Tree

- Data insertion
  - Follows the data insertion process similar to BST

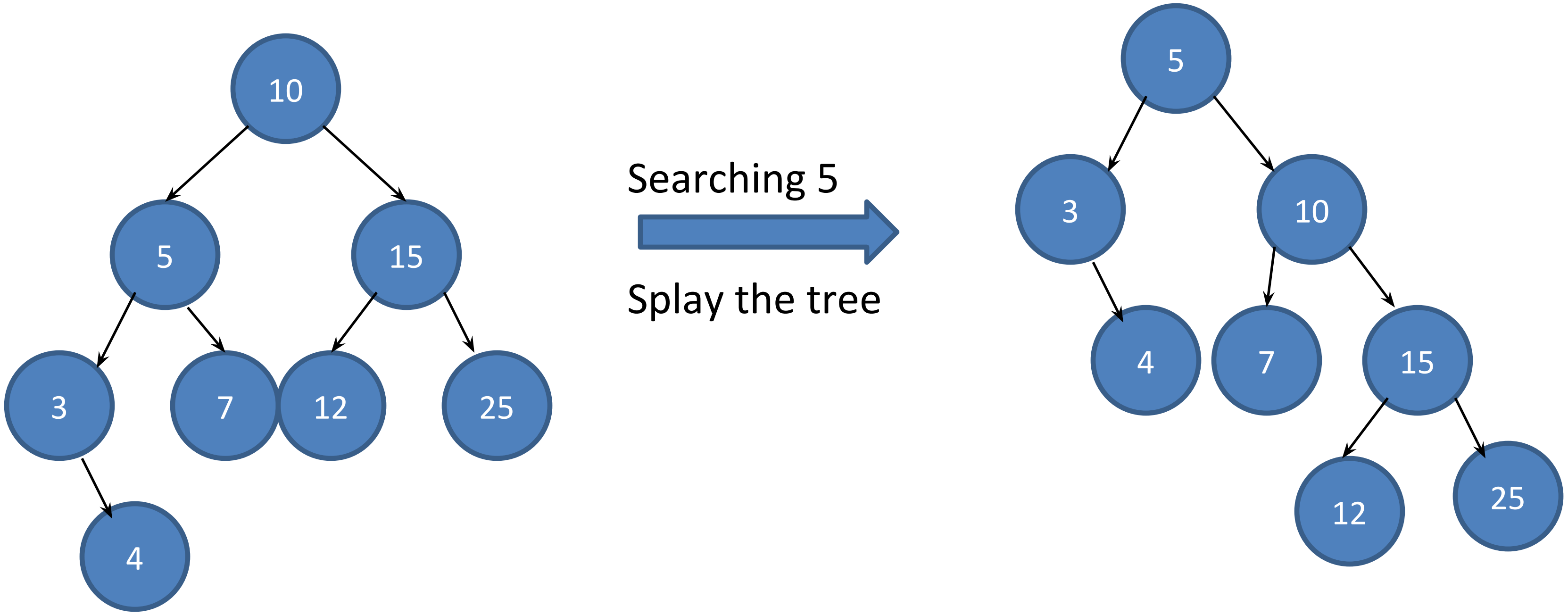
- Data deletion
  - Follows the data deletion process similar to BST (as **case-3**)
  - If we want to delete a node **X**
    - Delete **in-order successor** or **in-order predecessor** of **X** from the tree and replace the data with **X**

Splay Tree

- Data searching
  - Search the given data by following BST search
  - After searching tree is rotated to set the searched data into the root
  - Rotation can be performed in following ways
    - Zig (right rotation)
    - Zag (left rotation)
    - Zig-zig (right rotation -> right rotation)
    - Zag-zag (left rotation -> left rotation)
    - Zig-zag (right rotation -> left rotation)
    - Zag-zig (left rotation -> right rotation)

Splay Tree

- Data searching
  - Zig rotation
    - If the searched data is the left child of the root, needs a right rotation

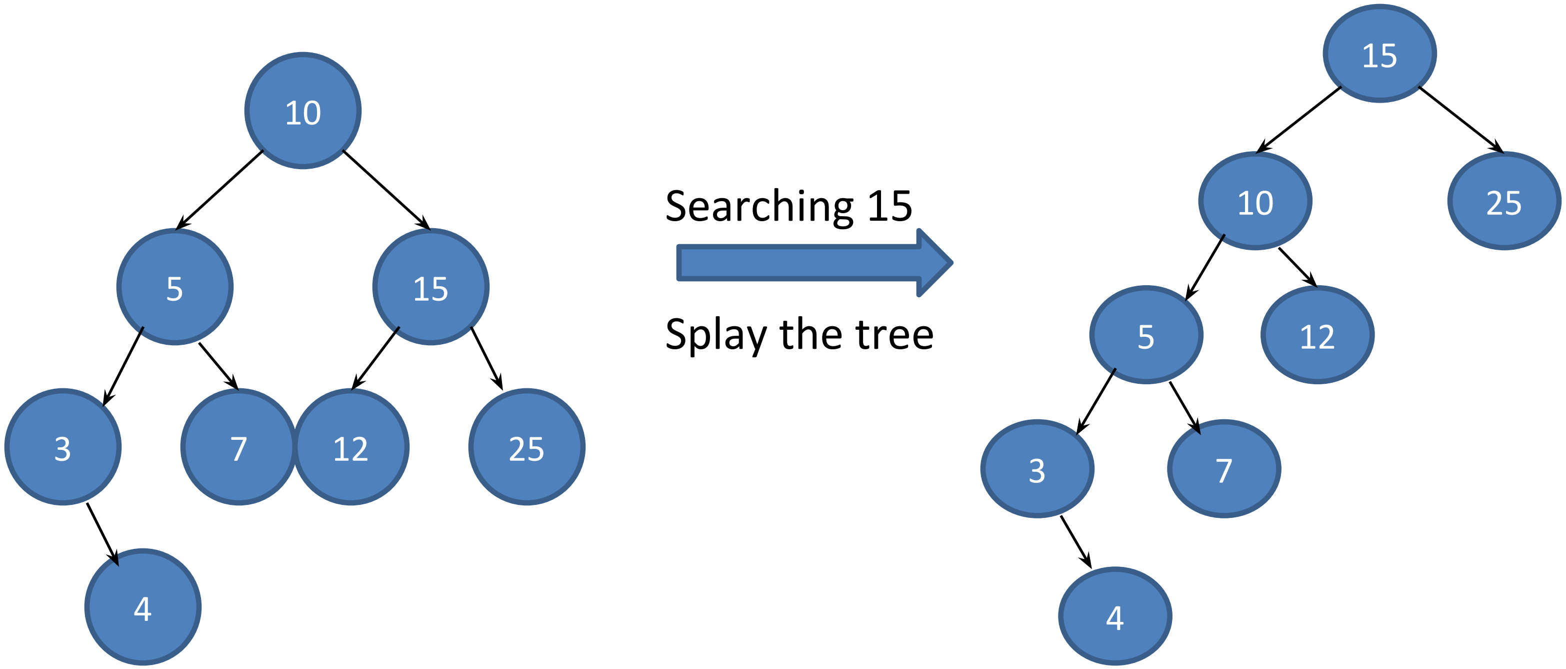


Searching 5

Splay the tree

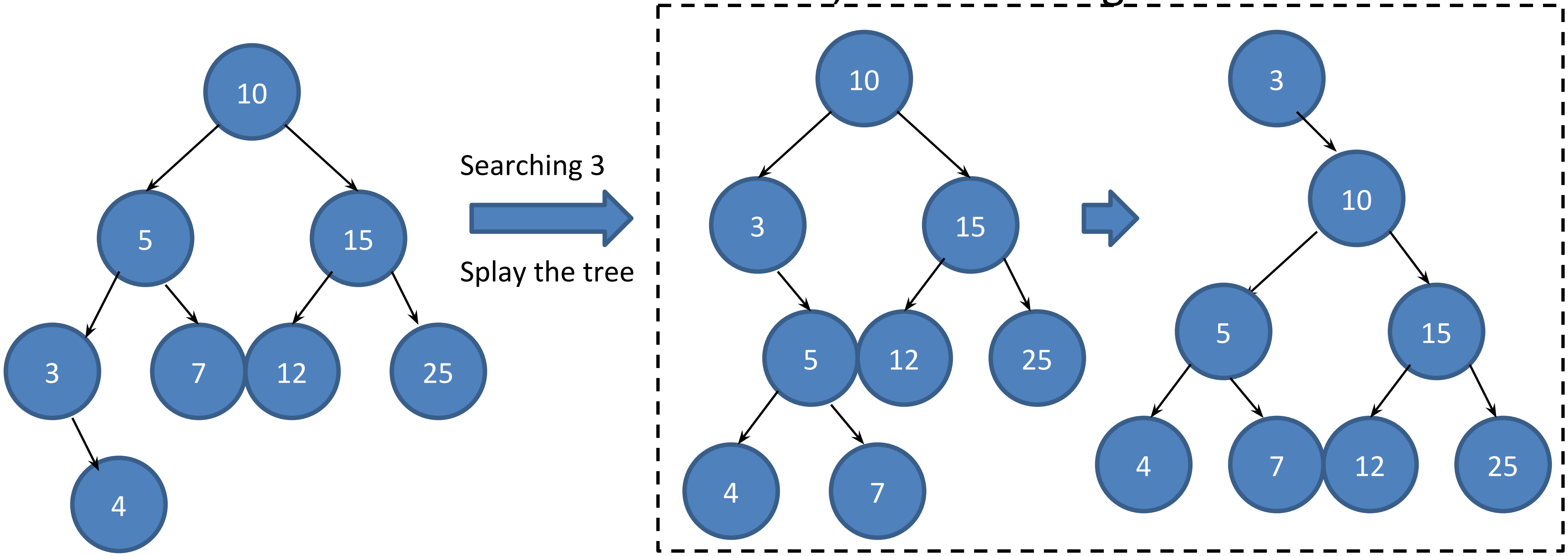
Splay Tree

- Data searching
  - Zag rotation
    - ○ If the searched data is the right child of the root, needs a left rotation



Splay Tree

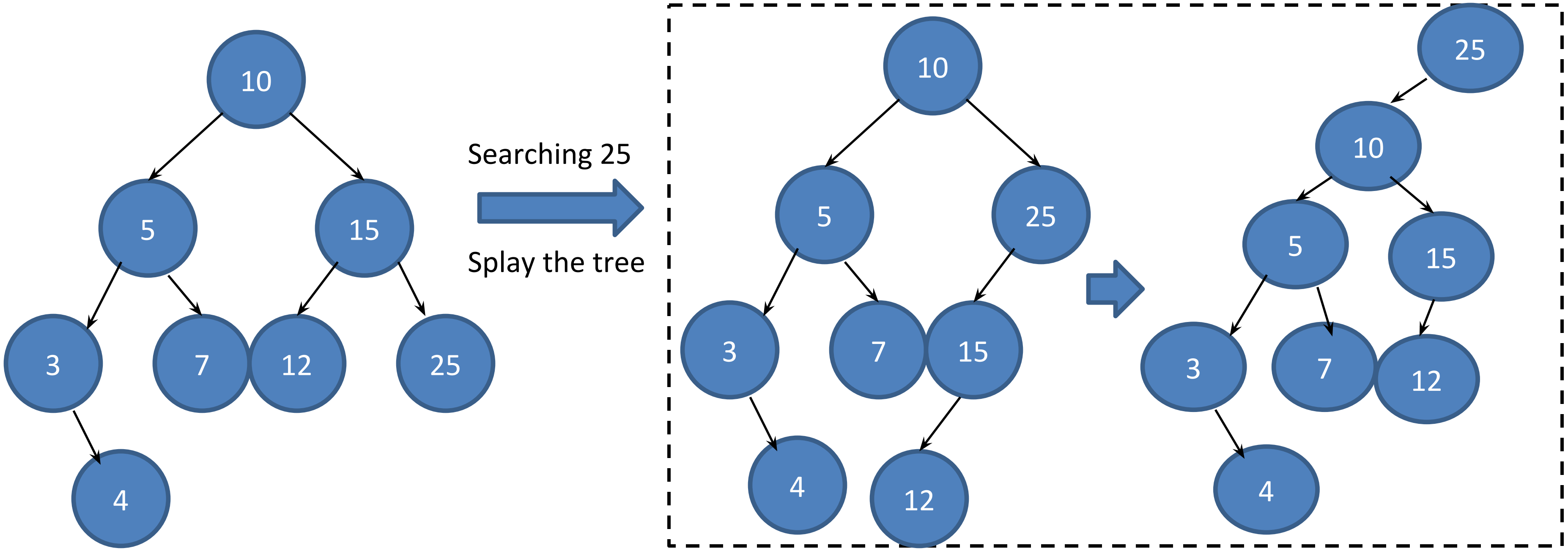
- Data searching
  - Zig-zig rotation
    - If the searched data has a parent and grand-parent and it is attached at the left sub-tree, needs two right rotations


Searching 3

Splay the tree

Splay Tree

- Data searching
  - Zag-zag rotation
    - If the searched data has a parent and grand-parent and it is attached at the right sub-tree, needs two left rotations

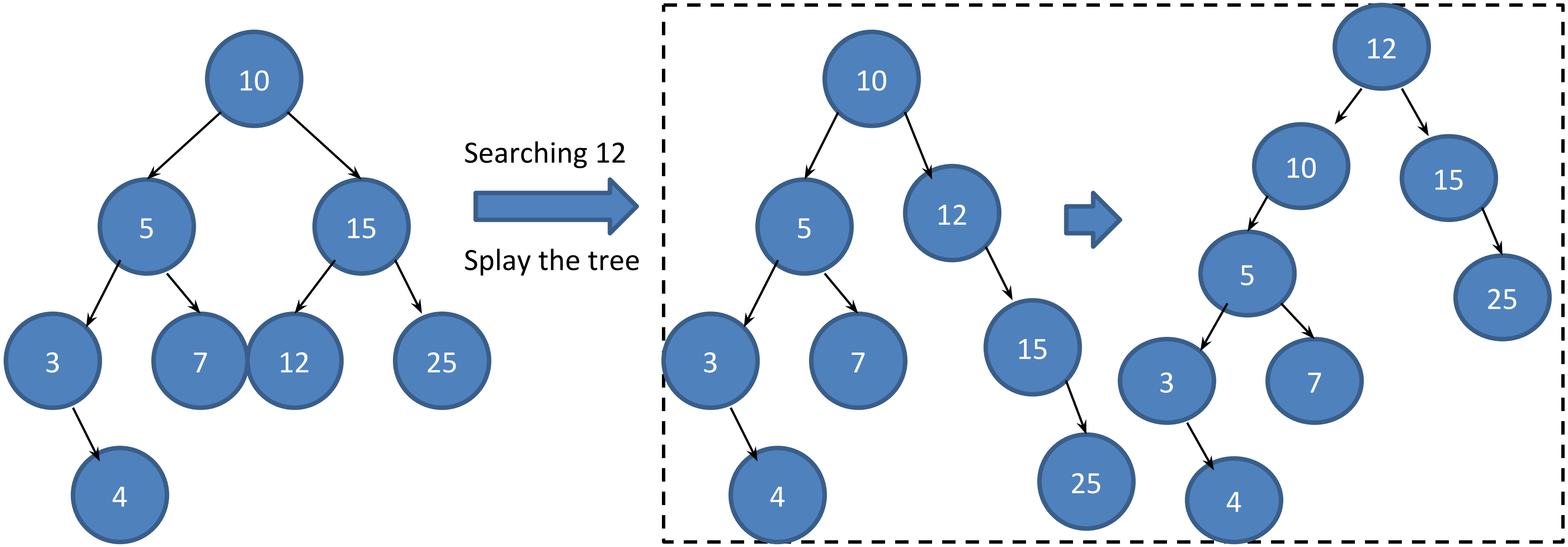


Searching 25

Splay the tree

Splay Tree

- Data searching
  - Zig-zag rotation
    - If the searched data has a parent and grand-parent and it is attached at the left to right sub-tree (right -> left rotation)

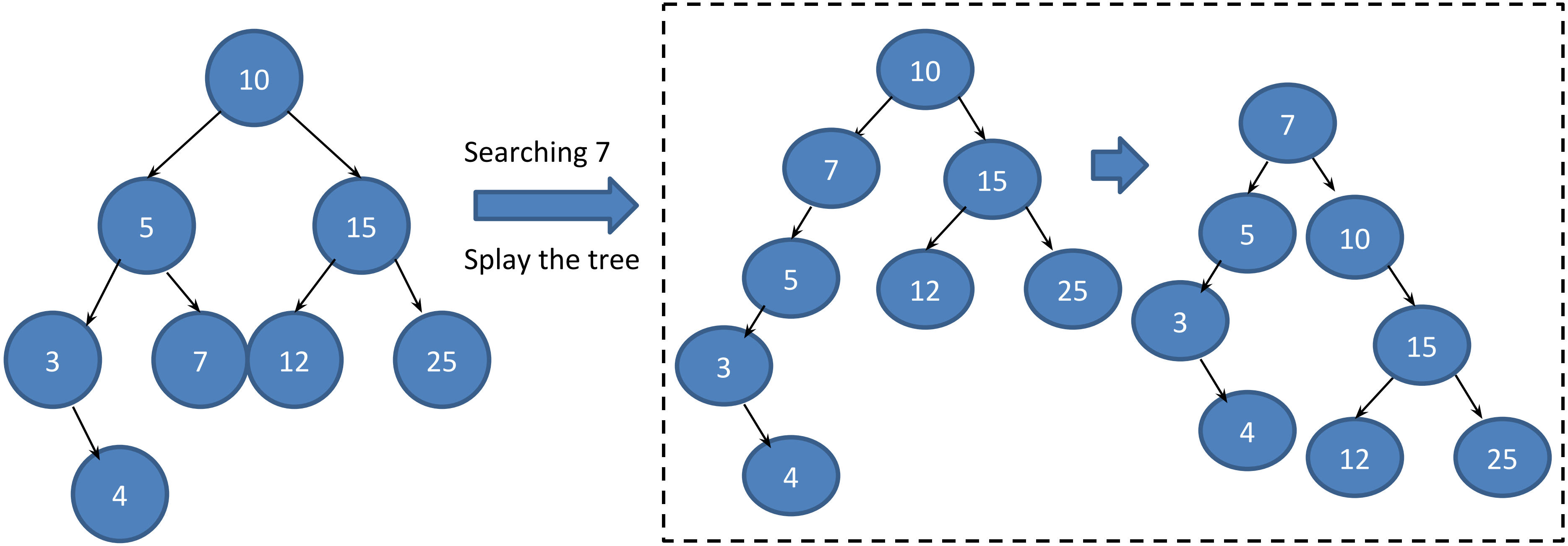


Searching 12

Splay the tree

Splay Tree

- Data searching
  - Zag-zig rotation
    - If the searched data has a parent and grand-parent and it is attached at the right to left sub-tree (left -> right rotation)



Queries?