CE205 Data Structures

Week-4

Tree Data Structure Types and Applications (Binary Tree, Tree Traversals, Heaps)

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Outline

- Graph Representation Tools
- Tree Structures and Binary Tree and Traversals (In-Order, Pre-Order, Post-Order)
- Heaps (Max, Min, Binary , Binomial, Fibonacci, Leftist, K-ary) and Priority Queue
- Heap Sort
- Huffman Coding

Graph Representation Tools

- Microsoft Automatic Graph Layout
  - https://www.microsoft.com/en-us/download/details.aspx?id=52034
  - https://github.com/microsoft/automatic-graph-layout
- Graphviz
  - https://graphviz.org/resources/
- Plantuml
  - https://ucoruh.github.io/ce204-object-oriented-programming/week-5/ce204-week-5/#calling-plantuml-from-java_1

Tree - Terminology

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/tree-terminology.html

Tree Representations

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/tree-representations.html

Binary Tree Datastructure

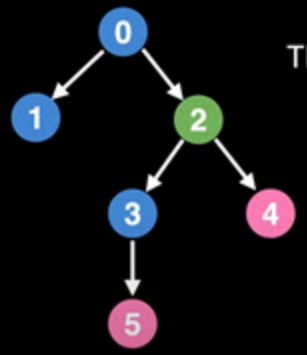
1. Construction and Conversion
2. Checking and Printing
3. Summation
4. Longest Common Ancestor

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/binary-tree.html
- William Fiset
  - https://www.youtube.com/watch?v=sD1IoalFomA&ab_channel=WilliamFiset

Longet Common Ancestor

Definition

The **Lowest Common Ancestor** (LCA) of two nodes `a` and `b` in a **rooted tree** is the deepest node `c` that has both `a` and `b` as descendants (where a node can be a descendant of itself)

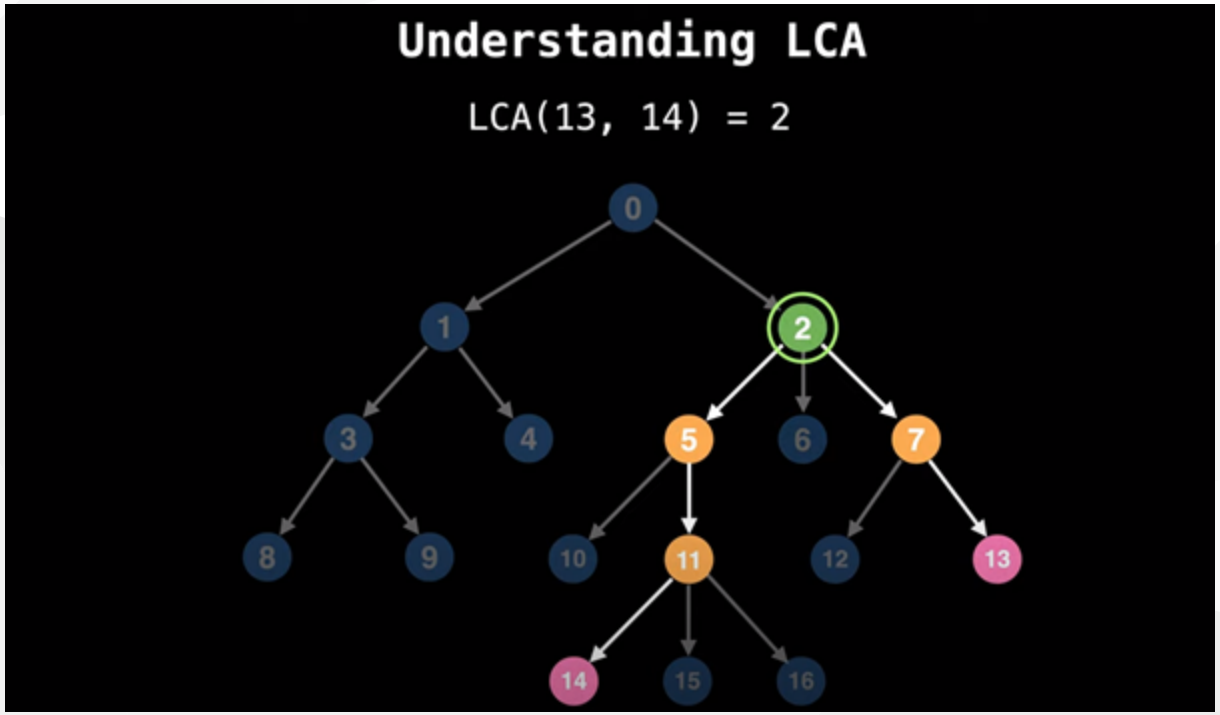


LCA(5, 4) = 2

The LCA problem has several applications in Computer Science, notably:

- Finding the distance between two nodes
- Inheritance hierarchies in OOP
- As a subroutine in several advanced algorithms and data structures
- etc…

Longet Common Ancestor



Binary Tree Representations

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/binary-tree-representations.html

Binary Tree Traversals

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/binary-tree-traversals.html
    - In-Order
    - Pre-Order
    - Post-Order

Threaded Binary Trees

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/threaded-binary-trees.html

Max Priority Queue

- Btech Smart Class
  - http://www.btechsmartclass.com/data_structures/max-priority-queue.html
- William Fiset
  - https://www.youtube.com/watch?v=wptevk0bshY&t=0s&ab_channel=WilliamFiset
  - https://github.com/williamfiset/Algorithms/tree/master/src/main/java/com/williamfiset/algorithms/datastructures/priorityqueue

Heap Data Structure

- Heap Sort
  - https://ucoruh.github.io/ce100-algorithms-and-programming-II/week-4/ce100-week-4-heap/

Heap Data Structure

- Programiz
  - https://www.programiz.com/dsa/heap-data-structure
- Btech Smart Class
  - Max-Heap
    - http://www.btechsmartclass.com/data_structures/max-heap.html
- Geeks for Geeks
  - Binary Heap
    - https://www.geeksforgeeks.org/binary-heap/?ref=lbp
    - https://www.geeksforgeeks.org/difference-between-binary-heap-binomial-heap-and-fibonacci-heap/?ref=rp

Heap Data Structure

- Binomial Heap
  - Geeks for Geeks
    - https://www.geeksforgeeks.org/binomial-heap-2/

Heap Data Structure

1. Structure of Fibonacci Heaps
2. Mergeable-heap operations

- Fibonacci Heap
  - William Fiset
    - https://github.com/williamfiset/Algorithms/tree/master/src/main/java/com/williamfiset/algorithms/datastructures/fibonacciheap
  - Geeks for Geeks
    - https://www.geeksforgeeks.org/fibonacci-heap-set-1-introduction/?ref=lbp

Heap Data Structure

1. Decreasing a key and deleting a node
2. Bounding the maximum degree

- Heap Operations
  - https://www.geeksforgeeks.org/fibonacci-heap-insertion-and-union/?ref=lbp
  - https://www.geeksforgeeks.org/fibonacci-heap-deletion-extract-min-and-decrease-key/?ref=lbp

Heap Data Structure

- Leftist Heap
  - Geeks for Geeks
    - https://www.geeksforgeeks.org/leftist-tree-leftist-heap/?ref=lbp
  - Toronto
    - https://www.dgp.toronto.edu/public_user/JamesStewart/378notes/10leftist/

Heap Data Structure

- Geeks for Geeks
  - https://www.geeksforgeeks.org/k-ary-heap/?ref=lbp

Heap Data Structure

- Heap Sort
  - https://ucoruh.github.io/ce100-algorithms-and-programming-II/week-4/ce100-week-4-heap/

Heap Data Structure

- Huffman Coding
  - https://ucoruh.github.io/ce100-algorithms-and-programming-II/week-9/ce100-week-9-huffman/
  - Geeks for Geeks
    - https://www.geeksforgeeks.org/difference-between-binary-heap-binomial-heap-and-fibonacci-heap/?ref=rp

$$End - Of - Week - 4$$