Lecture Slides on Binary Tree and Applications

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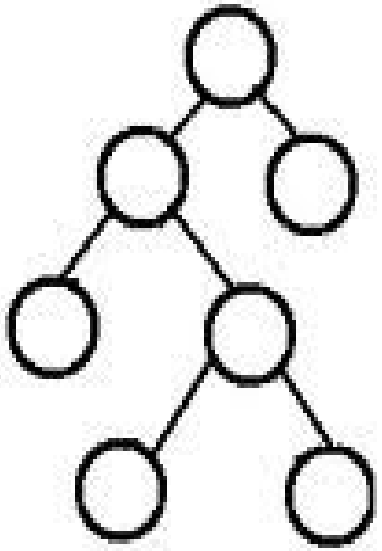
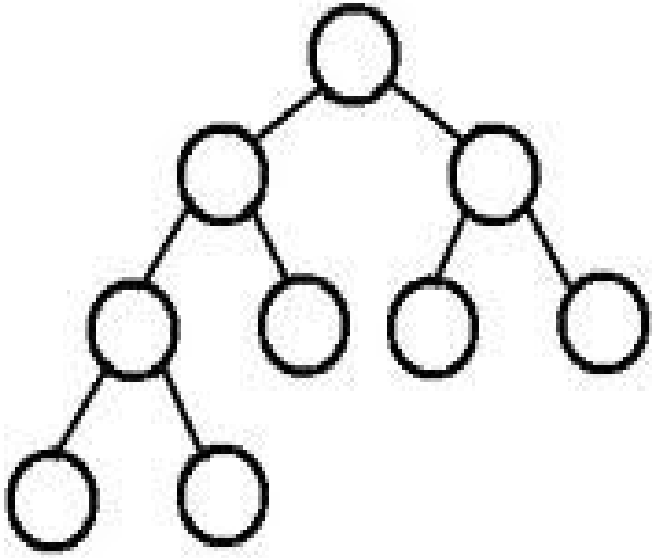
Binary Trees

- Binary tree is either empty or consists of a node called the root together with at most two binary (sub)trees, namely the left subtree and the right subtree.
- Full binary tree – if each internal node possesses exactly two child nodes
- Perfect binary tree – Full binary tree + all leaf nodes must be at the same level
- Complete binary tree – Except last level, all levels must be full and the nodes in last level must be as far left as possible

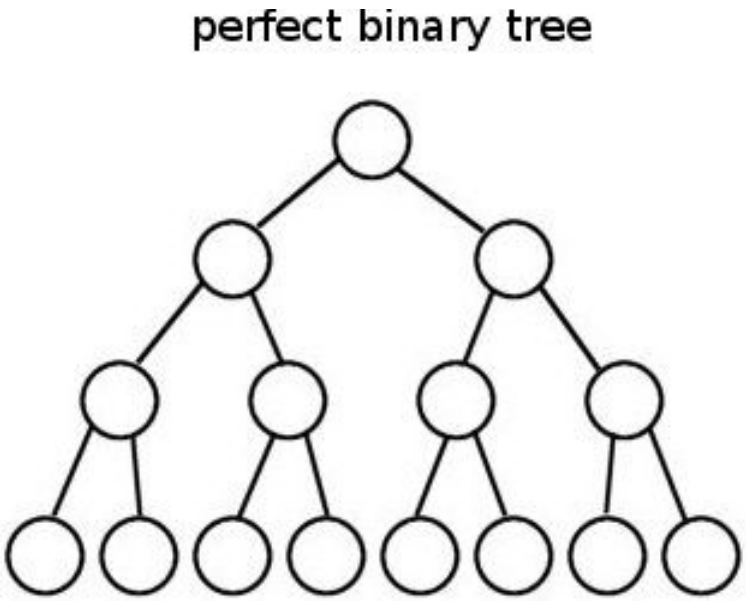
Full / Complete / Perfect



full tree



complete tree



Properties

- In *a* perfect binary tree of height ***h***
  - Number of nodes $n=2^{h+1}-1$
  - Number of leaf nodes $l=2^{h}$
  - Number of nodes $n=2*l-1$
- A binary tree of height h – min no. of nodes $n=h+1$
- In *a* non empty binary tree, *no. of leaf nodes* = *no. internal nodes of degree 2* + *1*
- In *a* binary tree with N nodes – no. of levels is *at* least CEIL(log (N + 1))

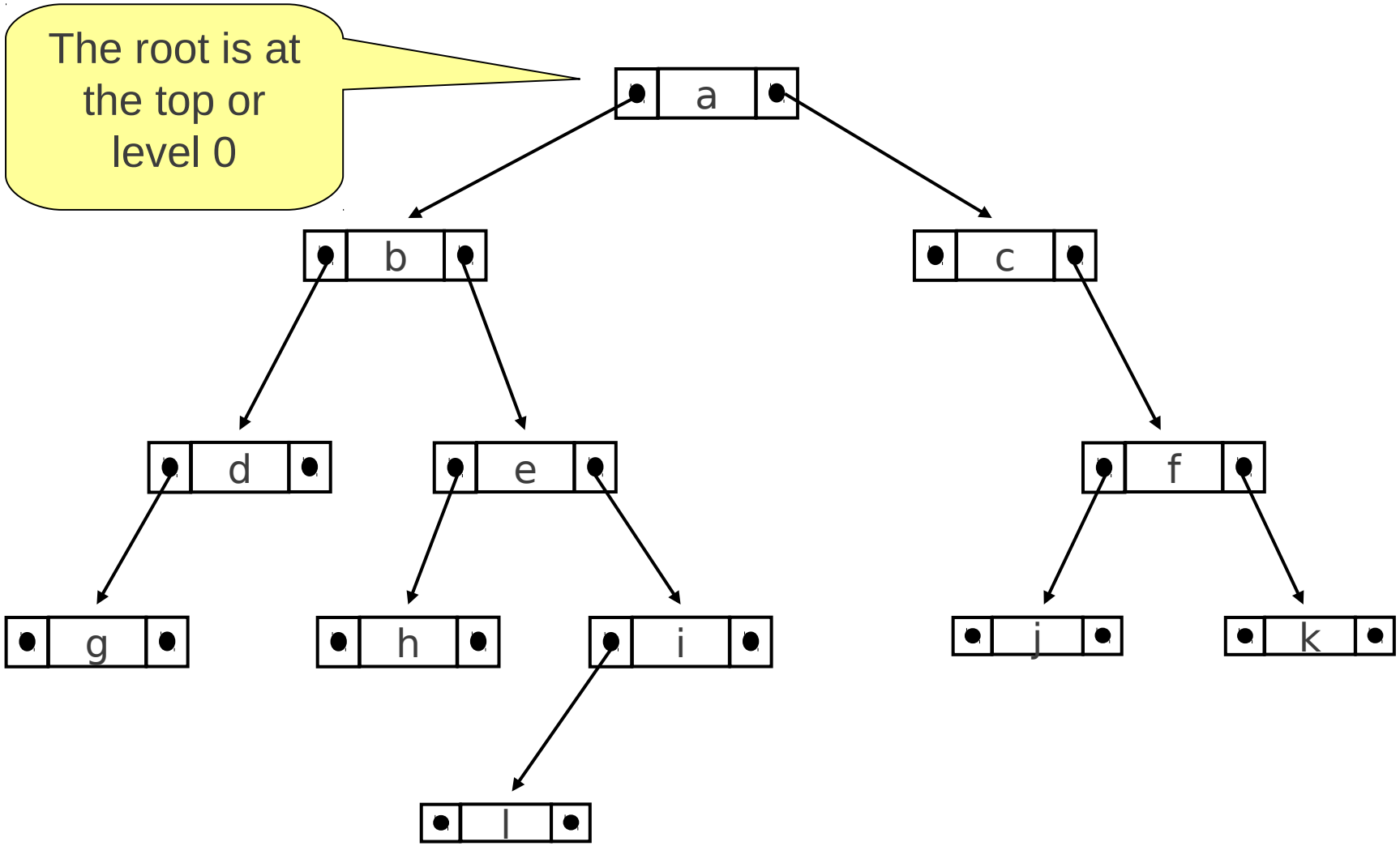
(Cont.)

- Traversal Pre / Post /In / Level order traversals
- Preorder (n: node)
  - If n == NULL return
  - Print n^id; Preorder (n^lchild); Preorder (n^rchild)
- Postorder (n: node)
  - If (n == NULL) return;
  - Postorder (n^lchild); Postorder (n^rchild); Print n^id
- Inorder (n: node)
  - If (n == NULL) return
  - Inorder(n^lchild); Print n^id; Inorder(n^rchild)

(Cont.)

- Level Order
  - All nodes in the same level are visited from left to right
  - Requires Queue for implementation
- Algo
  - enQueue (Root)
  - while (Q not empty)
    - n = front(); deQueue(); print n
    - for each child c of node n
      - enQueue(c)
    - end for
  - end while

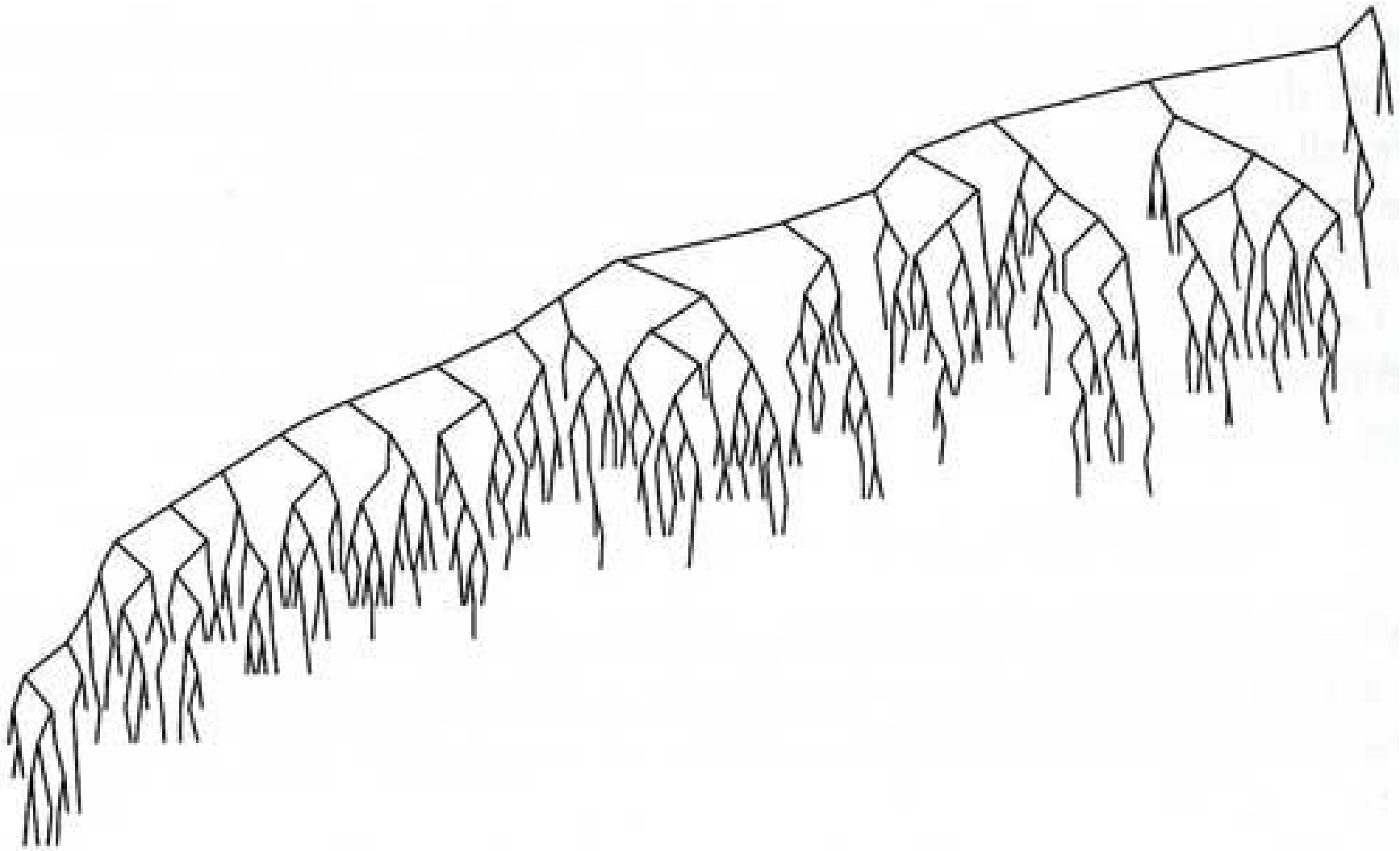
Binary Tree Representation – Multi linked Structures



Binary Serach Trees

- Binary Search Tree is a binary tree with a constratint
  - LST <= ROOT < RST
- Operations
  - Search (elementType) : Position
  - Insert (elementType) : Boolean
  - Delete (elementType)
  - Height (nodeType)
  - Retrieve (nodeType)
  - FindMin () : elementType

General Behaviour - Skewed



As there is no constraint on height, height of a BST tend to grow towards O(N) rather than restricted to O(log N), where N is its size, in asymptotic time.

- Under construction