

# Chapter 10: Elementary Data Structures

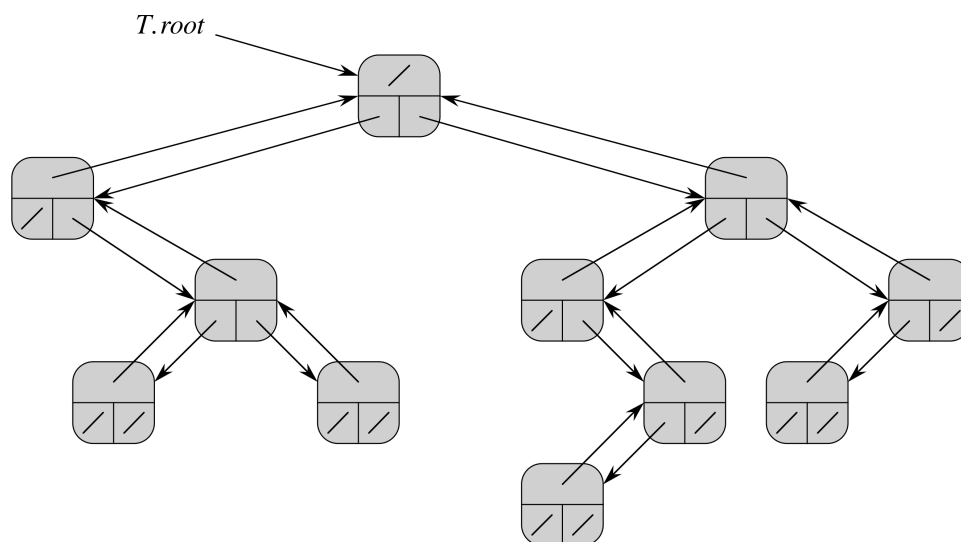
## Section 10.4: Representing Rooted Trees

- Trees are composed by tree nodes.
- Each tree node has a key field and some other pointer fields pointing to other nodes. Number of pointer fields in a tree node may be different for different types of trees.
- A tree  $T$  has an attribute  $\text{root}[T]$ : a pointer to the root of the tree.

### Binary Trees

For each node  $x$ , there are 3 pointer fields and one data field

- $x.p$  is a pointer to  $x$ 's parent.
- $x.\text{left}$  is a pointer to  $x$ 's left child.
- $x.\text{right}$  is a pointer to  $x$ 's right child.
- $x.\text{data}$  is a pointer to  $x$ 's satellite data



## Rooted Tree with Bounded Branches

We can represent a general tree that has a bounded number of branches by using an array of pointers. Let the bound be  $r$ . A node in such a tree will have the following fields:

- $x.p$  is a pointer to  $x$ 's parent.
- $x.child[1..r]$  is a pointer to  $x$ 's children, up to  $r$  of them.
- $x.data$  is a pointer to  $x$ 's satellite data

In general, this would be space inefficient as most of the child pointers will be NIL. But it provides an easy and fast way to access the  $i$  child of any node.

## Rooted Trees with Unbounded Branches

- Each node can have any number of children.
- Using left-child, right-sibling representation allows us to represent an arbitrary tree using only three pointers per node.
- 3 pointer fields for each node  $x$ .
  - $p[x]$  is a pointer to  $x$ 's parent.
  - $left[x]$  is a pointer to  $x$ 's left-most child.
  - $right[x]$  is a pointer to the sibling of  $x$  immediately to the right.

