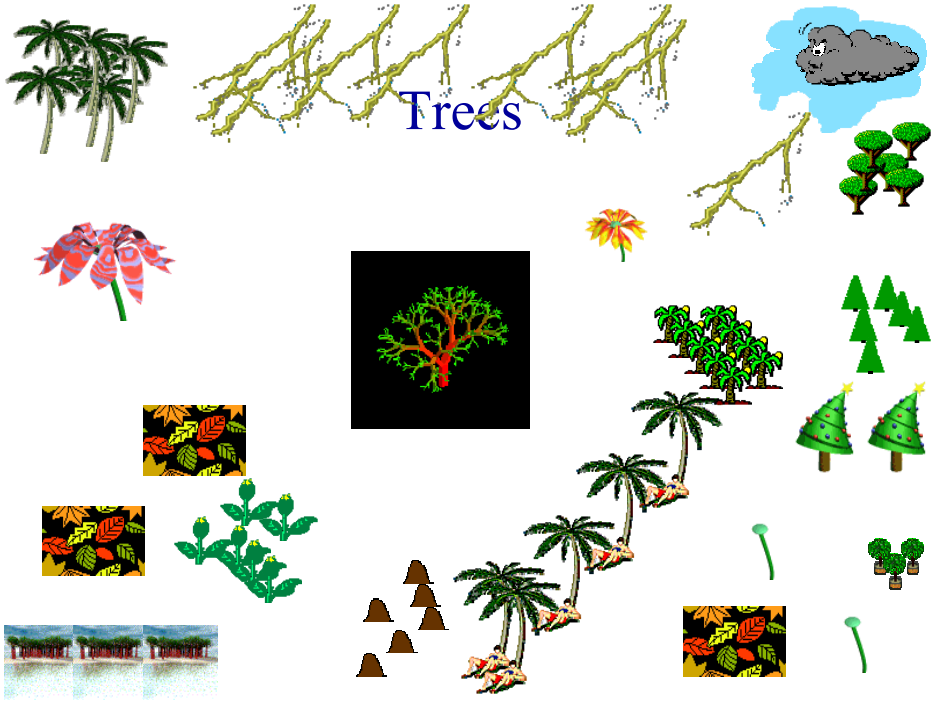
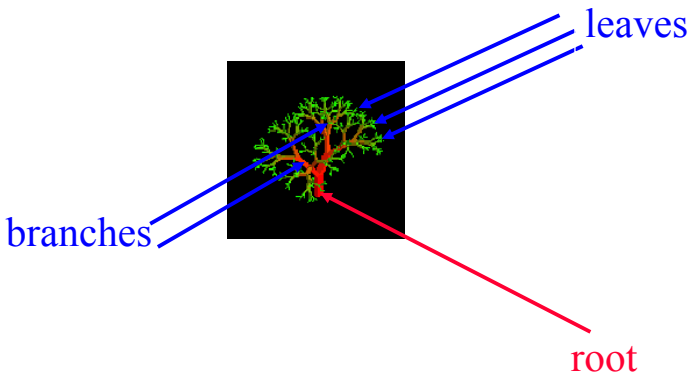
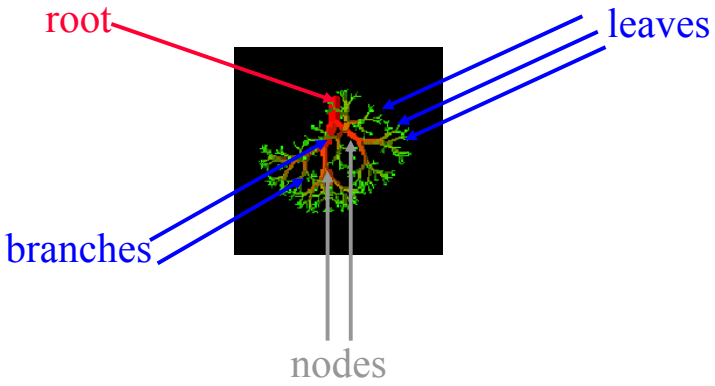
Trees



Nature Lover's View Of A Tree



Computer Scientist's View



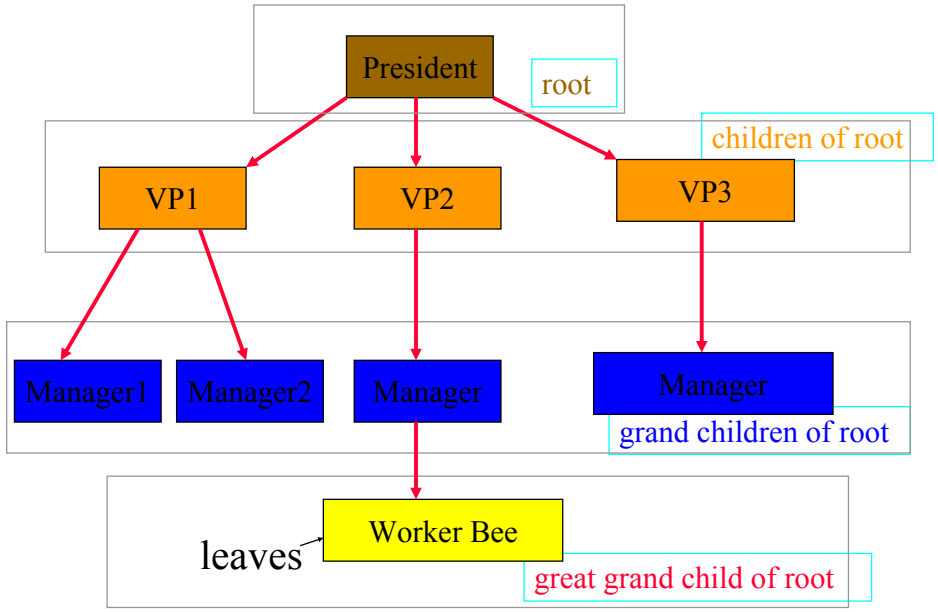
Linear Lists And Trees

- Linear lists are useful for serially ordered data.
  - $(e_0, e_1, e_2, \ldots, e_{n-1})$
  - Days of week.
  - Months in a year.
  - Students in this class.
- Trees are useful for hierarchically ordered data.
  - Employees of a corporation.
    - President, vice presidents, managers, and so on.

Hierarchical Data And Trees

- The element at the top of the hierarchy is the root.
- Elements next in the hierarchy are the children of the root.
- Elements next in the hierarchy are the grandchildren of the root, and so on.
- Elements that have no children are leaves.

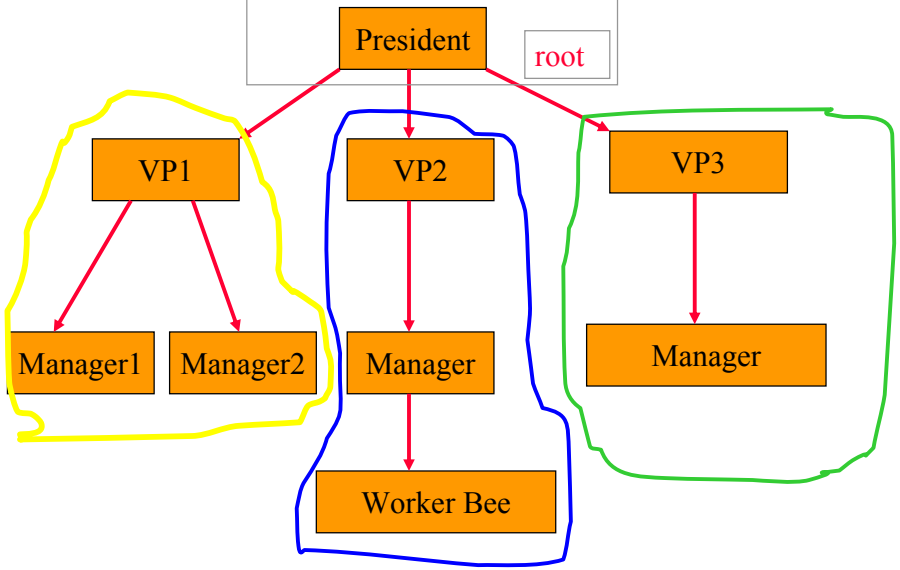
Example Tree



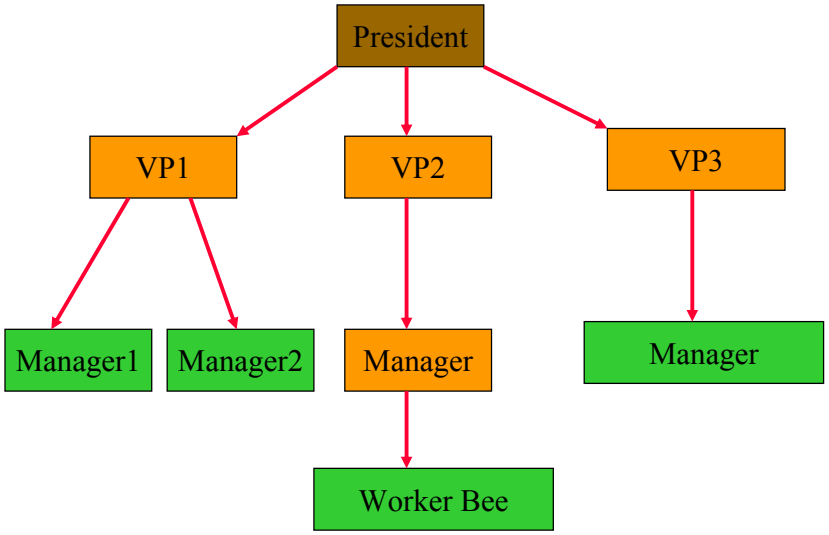
Definition

- A tree t is a finite nonempty set of elements.
- One of these elements is called the root.
- The remaining elements, if any, are partitioned into trees, which are called the subtrees of t.

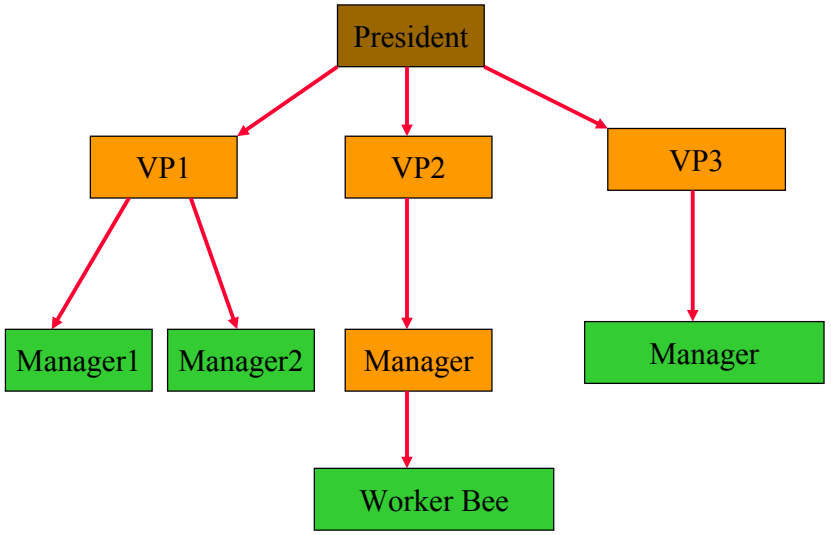
Subtrees



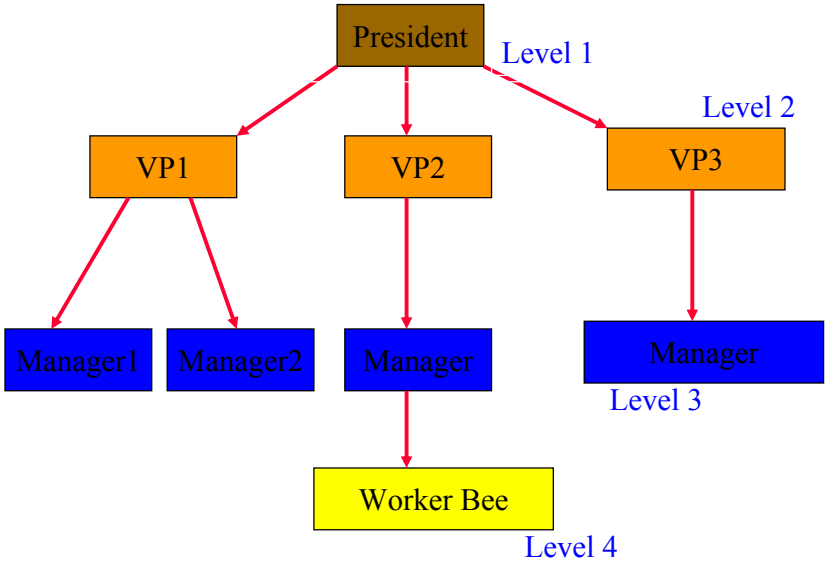
Leaves



Parent, Grandparent, Siblings, Ancestors, Descendants



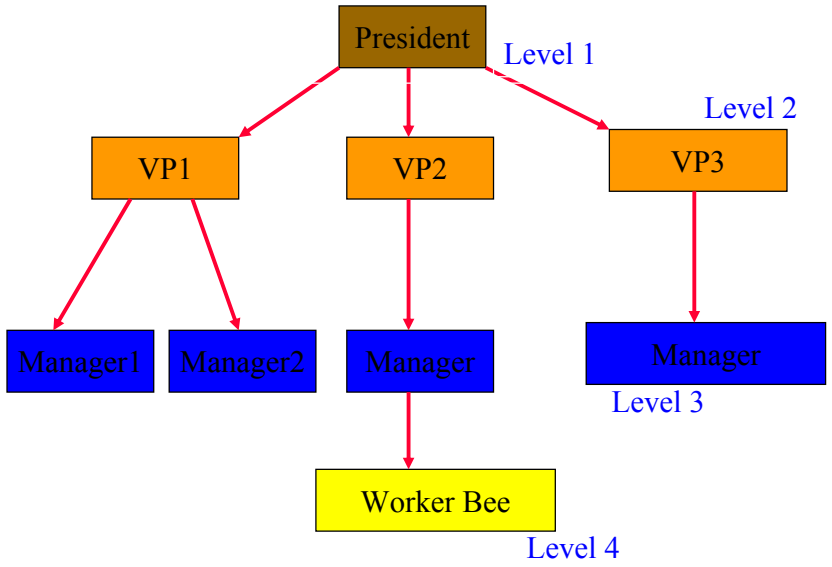
Levels



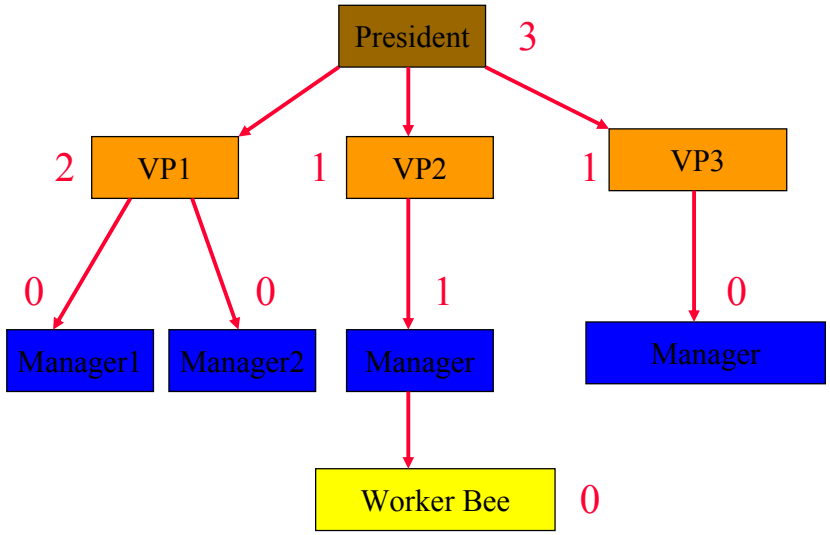
Caution

- Some texts start level numbers at 0 rather than at 1.
- Root is at level 0.
- Its children are at level 1.
- The grand children of the root are at level 2.
- And so on.
- We shall number levels with the root at level 1.

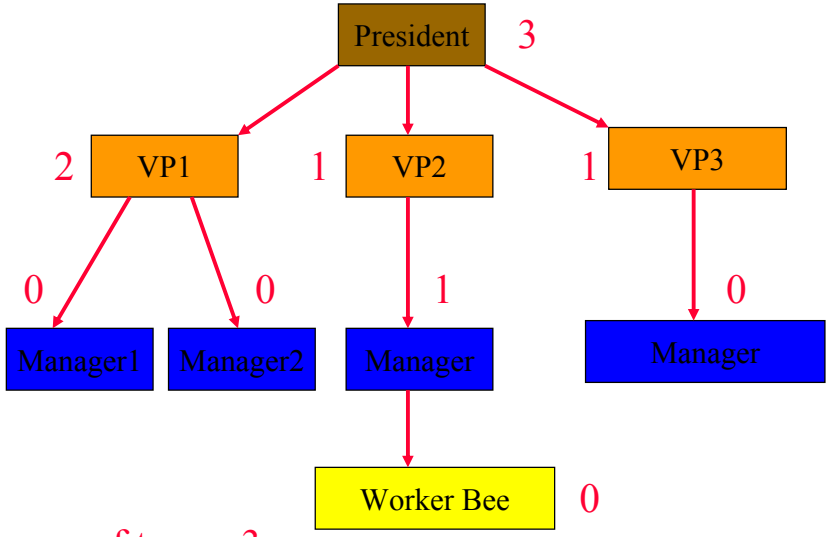
height = depth = number of levels



Node Degree = Number Of Children



Tree Degree = Max Node Degree



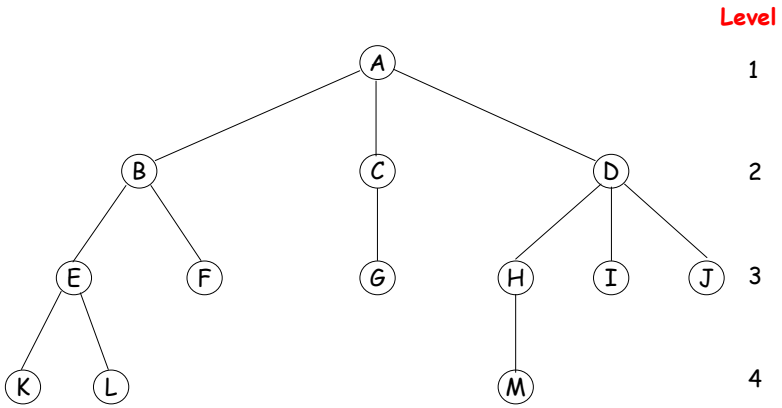
Degree of tree = 3.

Representation of Trees

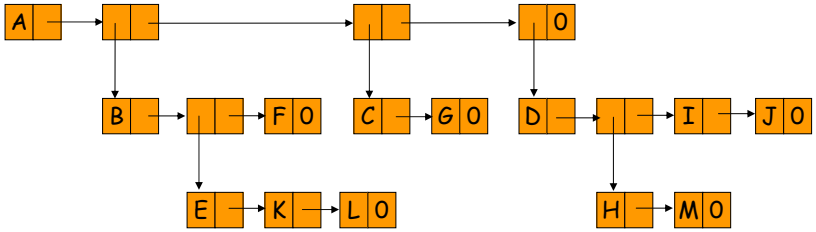
- List Representations
- Left child- right Sibling Representation
- Binary tree (Degree-two) tree

List Representations

- Each tree can be represented as a list.
  - (A(B(E(K,L),F),C(G),D(H(M),I,J)))



List Representation of Trees



Possible Node Structure For A Tree of Degree

- Lemma 5.1: If T is a k-ary tree (i.e., a tree of degree k) with n nodes, each having a fixed size as in Fig. 5.4, then n(k-1) + 1 of the nk child fileds are 0, n ≥ 1. Wasting memory!

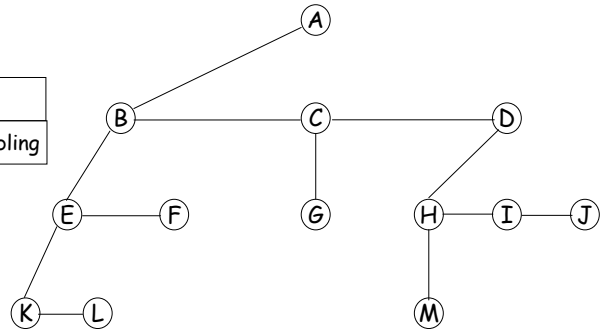
Data	Child 1	Child 2	Child 3	Child 4	...	Child k

Fig. 5.4

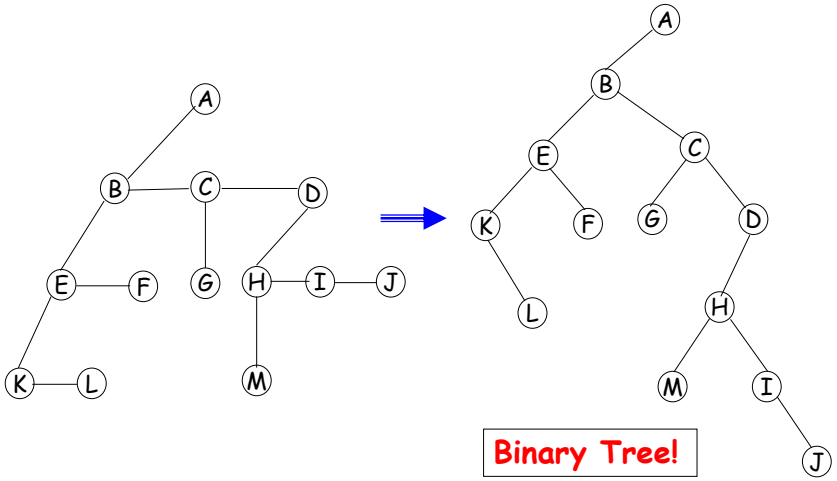
Representation of Trees

- Left Child-Right Sibling Representation
  - Each node has **two** links (or pointers).
  - Each node only has one leftmost child and one closest sibling.

data	
left child	right sibling



Degree Two Tree Representation



Binary Tree!

Homework

- Convert the tree by the
  - List Representations
    - (Fig 5.3@ P247)
  - Left child- right Sibling Representation
    - (Fig. 5.6@P248)