Trees
A New Math Type: tree

• A ubiquitous concept in computing is that of a tree
  – Often we are interested in a binary tree, a special case of a tree in which each node has at most two children

• An informal introduction (“node”? , “children”? ) follows, using pictures rather than any new mathematical notation
Recursive Structure

• A **tree** is made up of:
  – A **root node**
  – A string of zero or more **child nodes** of the root, each of which is the root of its own tree

• Since a tree may contain other trees, its structure is **recursive**

• Note: the following explanation of trees is adequate for present purposes but is not technically complete; details later…
Edges or Branches

B

K

A

R

C

L

T

G

S

H

E

P
root node (node B)
children of root node (or, of node B)
parent of node S (for example)
siblings of node $S$
Yes, it’s drawn upside down!
size of a tree is its total number of nodes; here, it is 12
Your Turn!

What’s the size of each of these 4 trees?
path from node B to node L; its length is 3
The height of a tree is the length of the longest path from its root; here, it is 4.
Your Turn!

What’s the **height** of each of these 4 trees?
A Tricky One?

What’s the height of this tree?
tree rooted at node B
subtree 0 of tree rooted at node B (or, of node B)
subtree 1 of tree rooted at node B (or, of node B)
subtree 2 of tree rooted at node B (or, of node B)
Notice the recursive structure: a root plus its subtrees.
Resources

• Wikipedia: Tree structure
  – http://en.wikipedia.org/wiki/Tree_structure