Trees

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Example tree
Definition of a tree

• A tree is either:
  – empty, or
  – a root value connected to other trees, called subtrees

• Notice that the definition is recursive.
Terminology

- **Size**: Number of nodes in the tree.
- **Leaf**: A node with no subtrees.
- **Internal value**: A node with one or more subtrees.
- **Height**: Length of the longest path from the root to a leaf (counting items on the path).
- **Child, Parent**
- **Descendant, Ancestor**

Every node (except the root) has *one* parent.
Example tree
Uses for trees

- Representing anything with a hierarchical structure.
- The inheritance hierarchy in a program
- Relationships in an arithmetic expression, e.g.,
  \[(3 - (4 \times (6 - 8))) + (25 / 2)\]
- The structure of files and folders on your computer
A common pattern with trees

def f(self):
    if f.is_empty():
        ...
    else:
        ...
        for subtree in self._subtrees:
            ... subtree.f() ...
        ...

Writing recursive functions

1. Identify the recursive structure of the data
2. Implement the base case directly
3. Pick a concrete example that is larger.
4. Write down the relevant recursive calls and what they should return
5. Assuming they do return the correct thing, figure out how to combine those results