Discussion 05

Sequences, Data Abstraction, Trees

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Slides available at `teaching.aditbala.com`

Announcements 📣

- Project 2: Cats is due Friday 9/30.
  - Bonus point for submitting by Thursday 9/29.
  - Project party Wednesday 9/28 5pm-7:30pm

Q1, Q2

Trees

`Tree`

- What are they?
  - Data structure for hierarchies of data
- What should we know
  - Recursion!
  - Every subtree is also a `Tree`

Tree Terminology

- Parent Node
  - A node that has branches
- Child Node
  - A node with a parent
  - Can only have one parent
- Root
  - The top node in a tree
  - There is only one root for a tree
- Label
  - The value of a node

cred to @Poggenkemper

More Tree Terminology

- Leaf
  - A node with no branches
- Branch
  - A subtree of the root
  - All branches are also trees
- Depth
  - How far away a node is from the root
- Height
  - The depth of the lowest leaf

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ADT `tree` Implementation

```
def tree(label, branches=[]):
    """Construct a tree with the given label value and a list of branches."""
    return [label] + list(branches)

def label(tree):
    """Return the label value of a tree."""
    return tree[0]

def branches(tree):
    """Return the list of branches of the given tree."""
    return tree[1:]

def is_leaf(tree):
    """Returns True if the given tree's list of branches is empty, and False
    otherwise.
    """
    return not branches(tree)
```

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`tree`

- Initializing a `Tree`
  - `tree(label, branches=[])`
  - `t = tree(1, [tree(2), tree(3)])`
- Accessing branches of a `tree`
  - `branches(t)` -> `[tree(2), tree(3)]`
- Checking if a `tree` is a leaf
  - `is_leaf(t)` -> `False`
  - `is_leaf(branches(t)[0])` -> `True`
- Getting label of a `Tree`
  - `label(t)` -> `1`

Manipulating Trees

`for b in branches(t)`

- What is this?
  - IMPORTANT line for dealing with a `tree`
- Why use this?
  - Allows us to iterate through branches of a `tree`
  - Useful for calling recursive functions on all branches of a `tree`
- Can also be a base case
  - The for loop does not run if there are no branches to iterate over

How do I use this? (Recursion for trees)

1. Base Case
   - Smallest Input
   - Usually a leaf
2. Recursive Calls
   - Call recursive function on branches
3. Putting it together
   - Use recursive calls to solve problem
   - Can use `max`, `min`, `sum`, `any`, `all` on lists

Thank you

Anon Feedback -> https://tinyurl.com/adit-anon