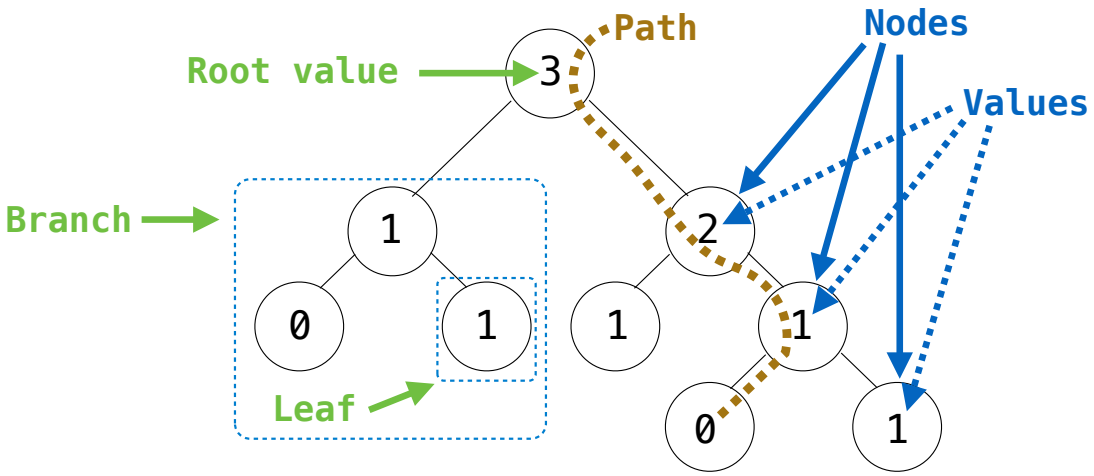
61A Lecture 19

Announcements

Tree Class

Tree Review



Recursive description (wooden trees):

A **tree** has a **root** value and a list of **branches**

Each branch is a **tree**

A tree with zero branches is called a **leaf**

Relative description (family trees):

Each location in a tree is called a **node**

Each **node** has a **value**

One node can be the **parent**/**child** of another

Tree Class

A Tree has a root value and a list of branches; each branch is a Tree

```
class Tree:
    def __init__(self, root, branches=[]):
        self.root = root
        for branch in branches:
            assert isinstance(branch, Tree)
        self.branches = list(branches)
```

```
def fib_tree(n):
    if n == 0 or n == 1:
        return Tree(n)
    else:
        left = fib_tree(n-2)
        right = fib_tree(n-1)
        fib_n = left.root + right.root
        return Tree(fib_n, [left, right])
```

```
def tree(root, branches=[]):
    for branch in branches:
        assert is_tree(branch)
    return [root] + list(branches)
def root(tree):
    return tree[0]
def branches(tree):
    return tree[1:]
```

```
def fib_tree(n):
    if n == 0 or n == 1:
        return tree(n)
    else:
        left = fib_tree(n-2)
        right = fib_tree(n-1)
        fib_n = root(left) + root(right)
        return tree(fib_n, [left, right])
```

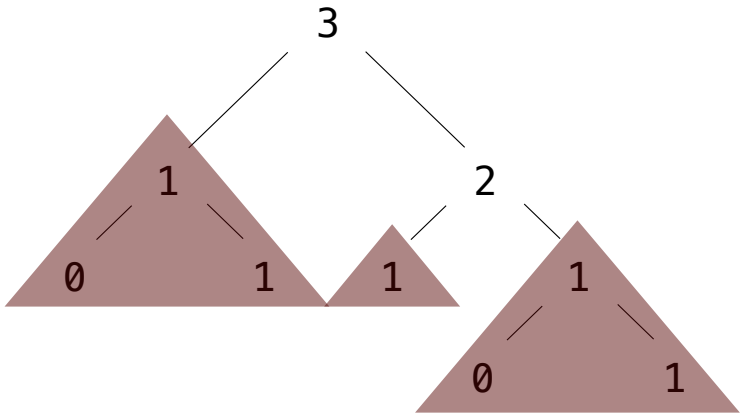
(Demo)

Tree Mutation

Example: Pruning Trees

Removing subtrees from a tree is called *pruning*

Prune branches before recursive processing




```
def prune(t, n):
    """Prune sub-trees whose root value is n."""
    t.branches = [_____b_____ for b in t.branches if _____b.root != n_____]
    for b in t.branches:
        prune(_____________b_____________, _____________n_____________)
```

(Demo)

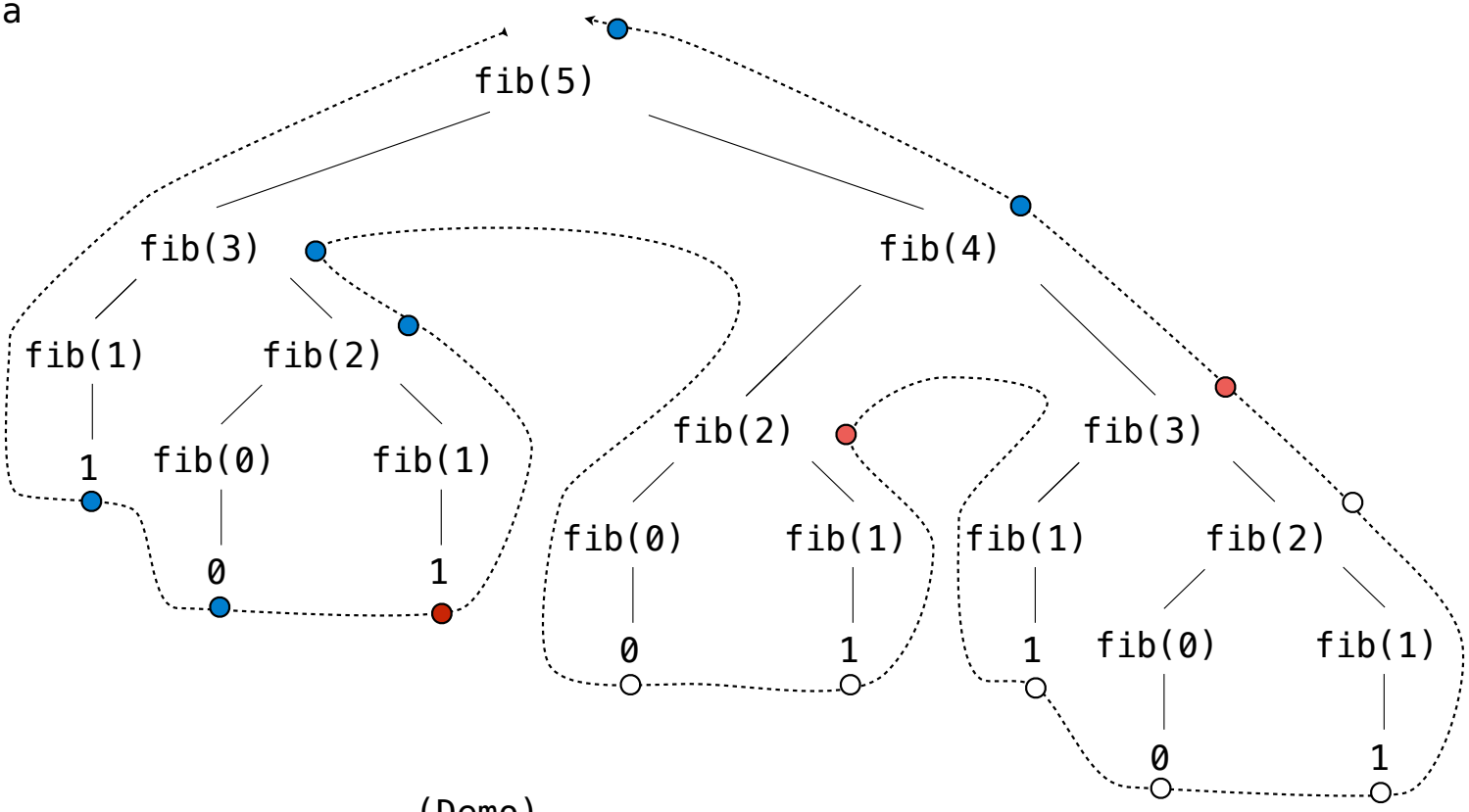
Example: Pruning Trees

Removing subtrees from a tree is called *pruning*

Prune branches before recursive processing

Memoization:

- Returned by fib
- Found in cache
- Skipped



(Demo)

Hailstone Trees

Hailstone Trees

Pick a positive integer n as the start

If n is even, divide it by 2

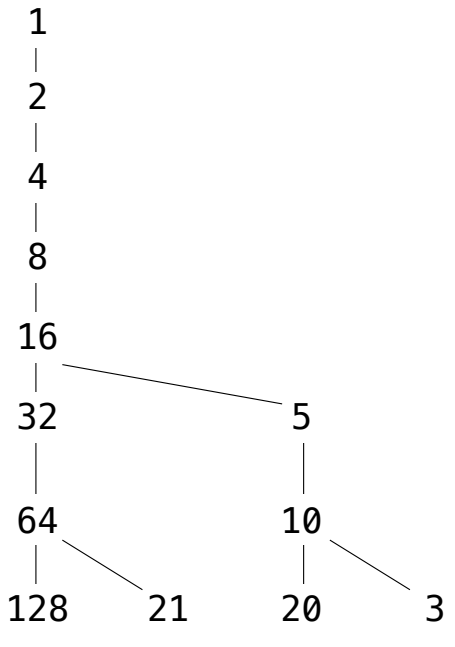
If n is odd, multiply it by 3 and add 1

Continue this process until n is 1

(Demo)

```
def hailstone_tree(k, n=1):
    """Return a Tree in which the paths from the
    leaves to the root are all possible hailstone
    sequences of length k ending in n."""
```

All possible n that start a length-8 hailstone sequence



(Demo)