Lab 4: Recursion, Tree Recursion, Python Lists

Gabe Classon’s CS 61A lab

9:30–11:00 a.m. Wednesday, Feb. 15, 2023

Question of the day

As a child, what were your most and least favorite piece of playground equipment?

Announcements

- Cats released!
- Office hours: use them!
- Ask questions in lab!

Lab 04

- Q1: Foundational tree recursion principles
- Q2: Using recursive helper functions
- Q3: Tree Recursion (counting)
- Q4: Lists

Translating iteration into recursion w/ a helper

```
def count(n):
    i = 1
    while i <= n:
        print(i)
        i += 1
count(5)
```

Python tutor demo

```
def count(n):
    def helper(i):
        if i <= n:
            print(i)
            i += 1
            helper(i)
    helper(1)
count(5)
```

Python tutor demo

Translating iteration into recursion

- Iterative loop variables become *parameters* in a recursive helper function
- The condition in your while loop is the opposite of your base case condition
- Instead of changing your loop variables at the end of your loop, you call another recursive function
- Remember to call your helper function!!!!!

Tree recursive functions

A tree recursive function makes multiple recursive calls

```
def virfib_sq(n):
    print(n)
    if n <= 1:
        return n
    return (virfib_sq(n - 1) + virfib_sq(n - 2)) ** 2
```

Recursive function design

- Base case: What's the simplest version of this problem?
- Recursive call: How can I break this down into a smaller version of the same problem?
- Solving the larger problem

Tree recursive function design

- Base case: What's the simplest version of this problem?
- Recursive call: How can I break this down into multiple smaller versions of the same problem? (Often hinges on a choice)
- Solving the larger problem: How can I combine my multiple solutions into a larger solution?

Choices in tree recursive calls

Often, you can break down a problem into smaller problems by considering the outcome of a choice. In a counting problem, you will often add these results

For example: I go to school every day by foot or by bus. There are 9 ways to go by foot and 10 ways to go by bus. How many ways do I have to get to school?

In order to do Z, I have to do X or Y (but I cannot do both). There are 9 ways for me to do Z with X and 10 ways for me to do Z with Y. In how many ways can I do Z?

In order for me to navigate to the upper righthand corner of a grid, I have to take my first step either upward or rightward. There are p ways for me to proceed after I have taken a step upward and q ways to proceed after I have taken a step to the right. In how many ways can I get to the upper righthand corner of the grid?