Lecture #9: Still More on Functions

Announcements

- Sign up for advising (Piazza @706).
- Practice Midterm Tuesday from 5-7PM. Do be sure to check the practice exam out when you have time. It will be based on the Fa20 first test.
- Drop deadline coming up: 10 Feb (Wednesday).
- If you want the unit for CSM (Computer Science Mentors), you'll need to get it soon before the add deadline. Lots of mentoring spots still available (Piazza @580).
- Please submit exam conflict forms by Thursday (see Piazza @318).
- Ask questions on the Piazza thread for today's lecture (Piazza @719).

Exercise: Reversing Digits

- Problem: I want a function that reverses the digits in a number.
- For example, I'd like to have

```
reverse_digits(1234) == 4321
```

Exercise: Interleaving Digits

- Problem: I want a function that, given two numbers, A and B, containing the same number of digits, returns the result of interleaving the digits of A and B, starting with the first digit A, then the first digit of B, then the second digit of A, etc.
- For example, I'd like to have

```
interleave_digits(13579, 24680) == 1234567890
```

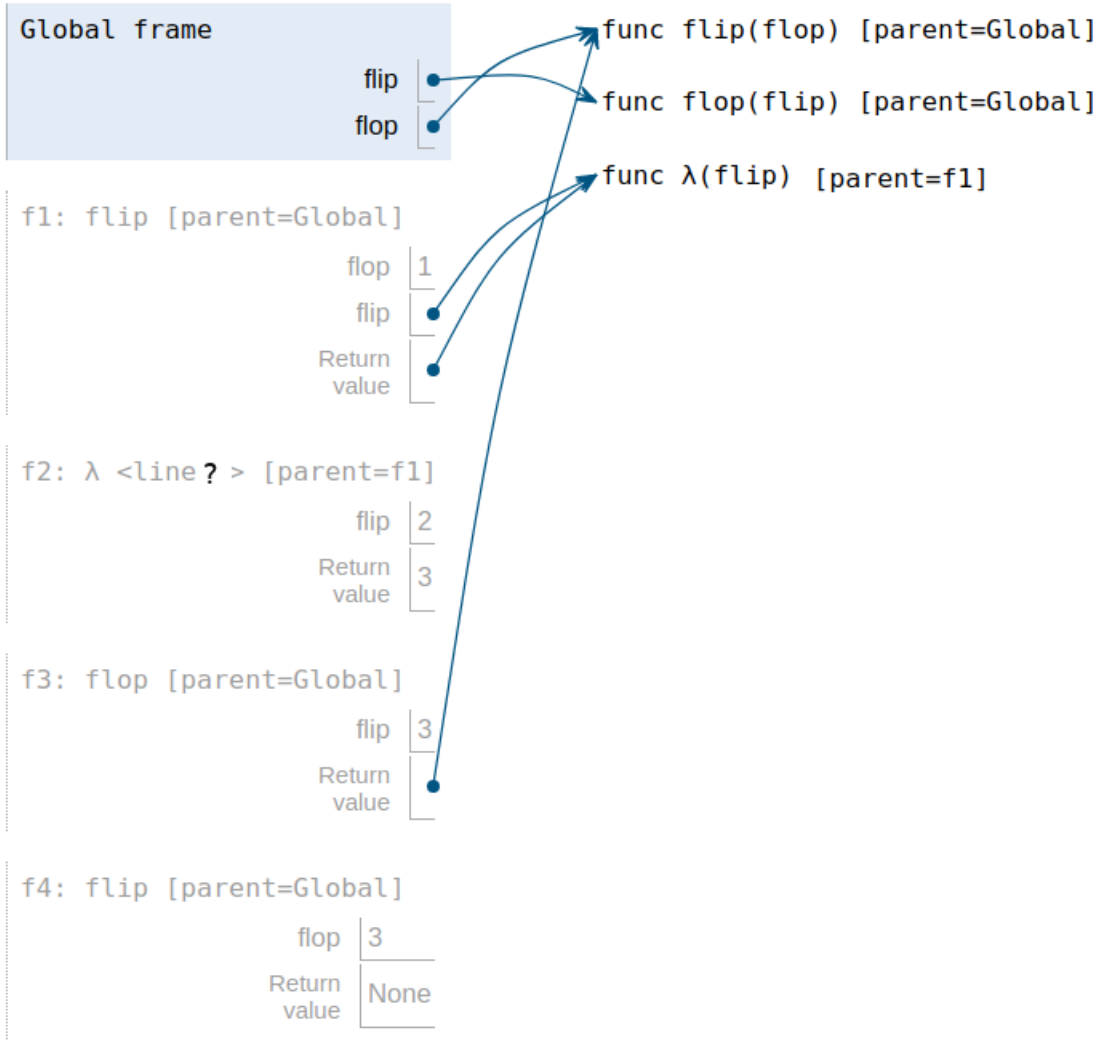
Environment Detective

```
def flip(flop):
    if _______:
        _______________
    flip = __________
    return flip

def flop(flip):
    return flop

_________________________

flip(_________)(3)
```



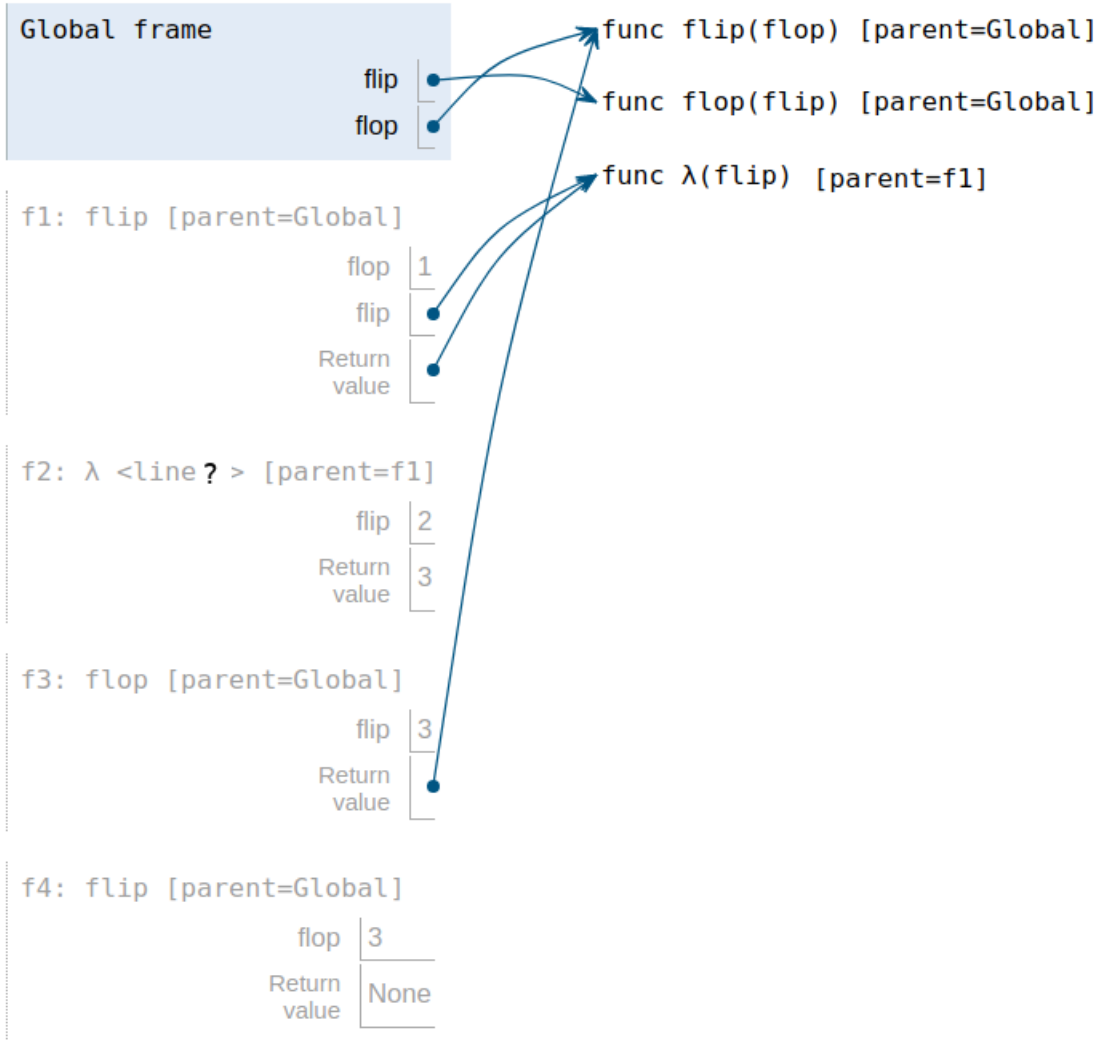
Environment Detective

```
def flip(flop):
    if _______:
        _______________
    flip = __________
    return flip

def flop(flip):
    return flop

flip, flop = flop, flip

flip(_________)(3)
```



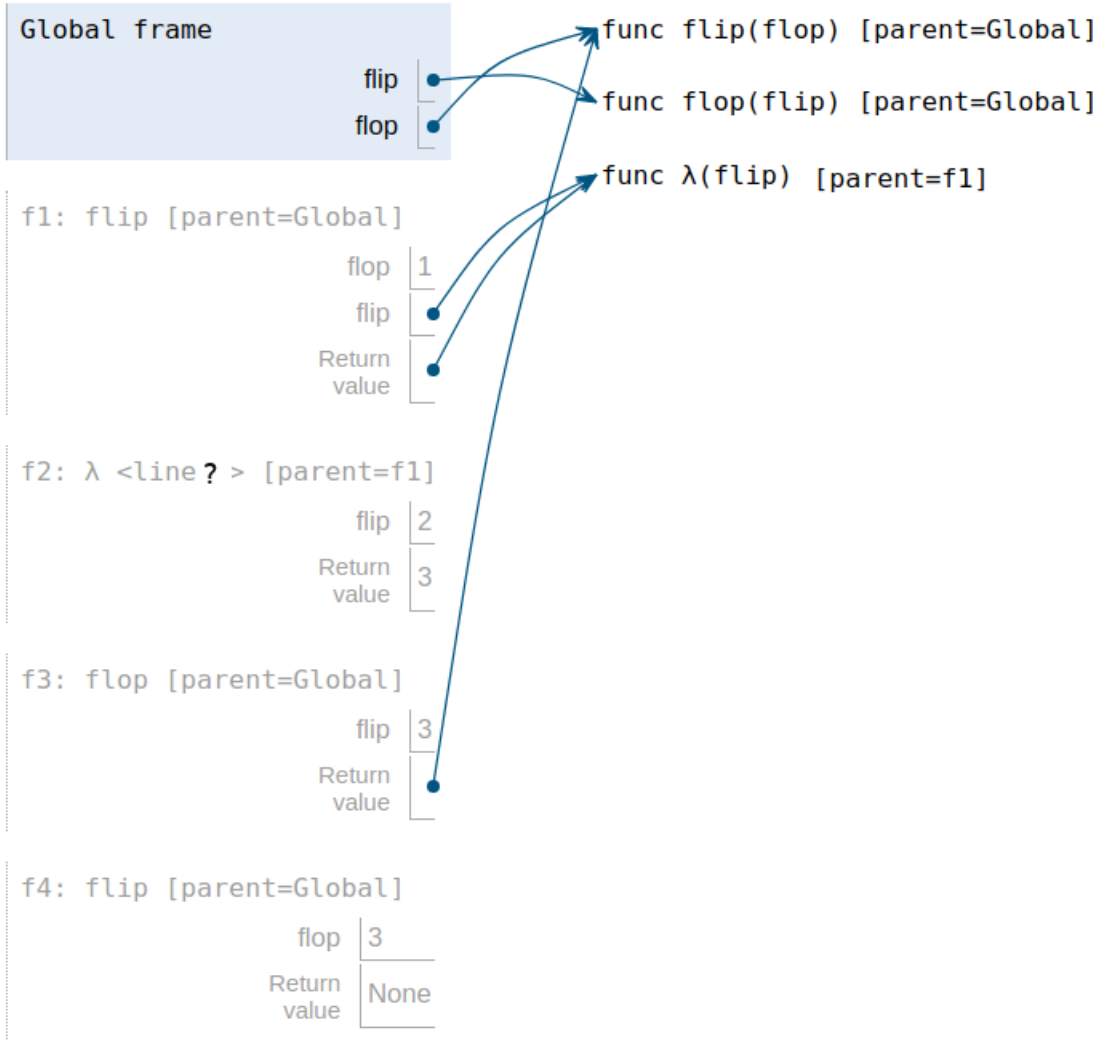
Environment Detective

```
def flip(flop):
    if _______:
        _______________
    flip = ___________
    return flip

def flop(flip):
    return flop

flip, flop = flop, flip

flip(flop(1)_______)(3)
```



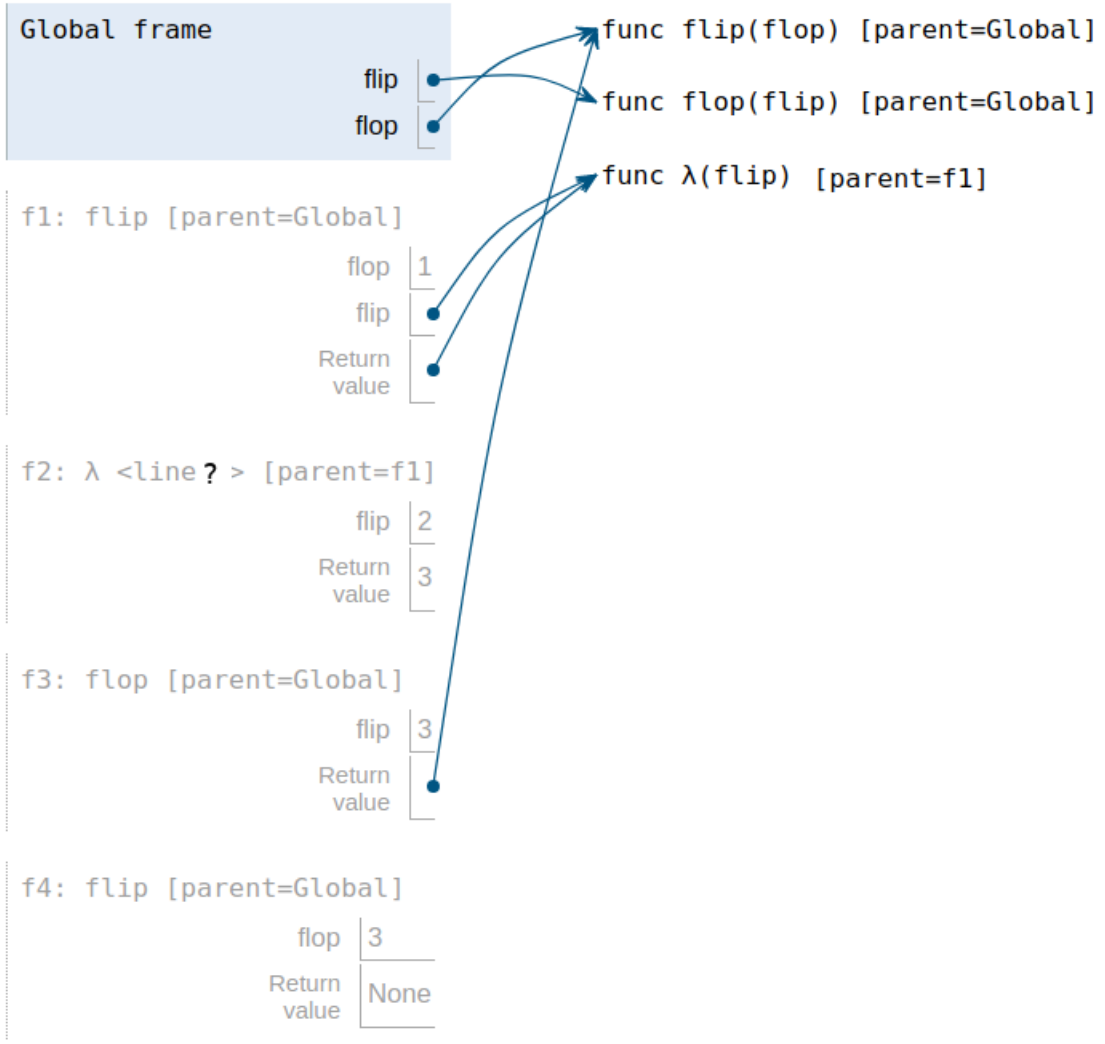
Environment Detective

```
def flip(flop):
    if _______:
        _______________
    flip = lambda flip: 3
    return flip

def flop(flip):
    return flop

flip, flop = flop, flip

flip(flop(1)_______)(3)
```



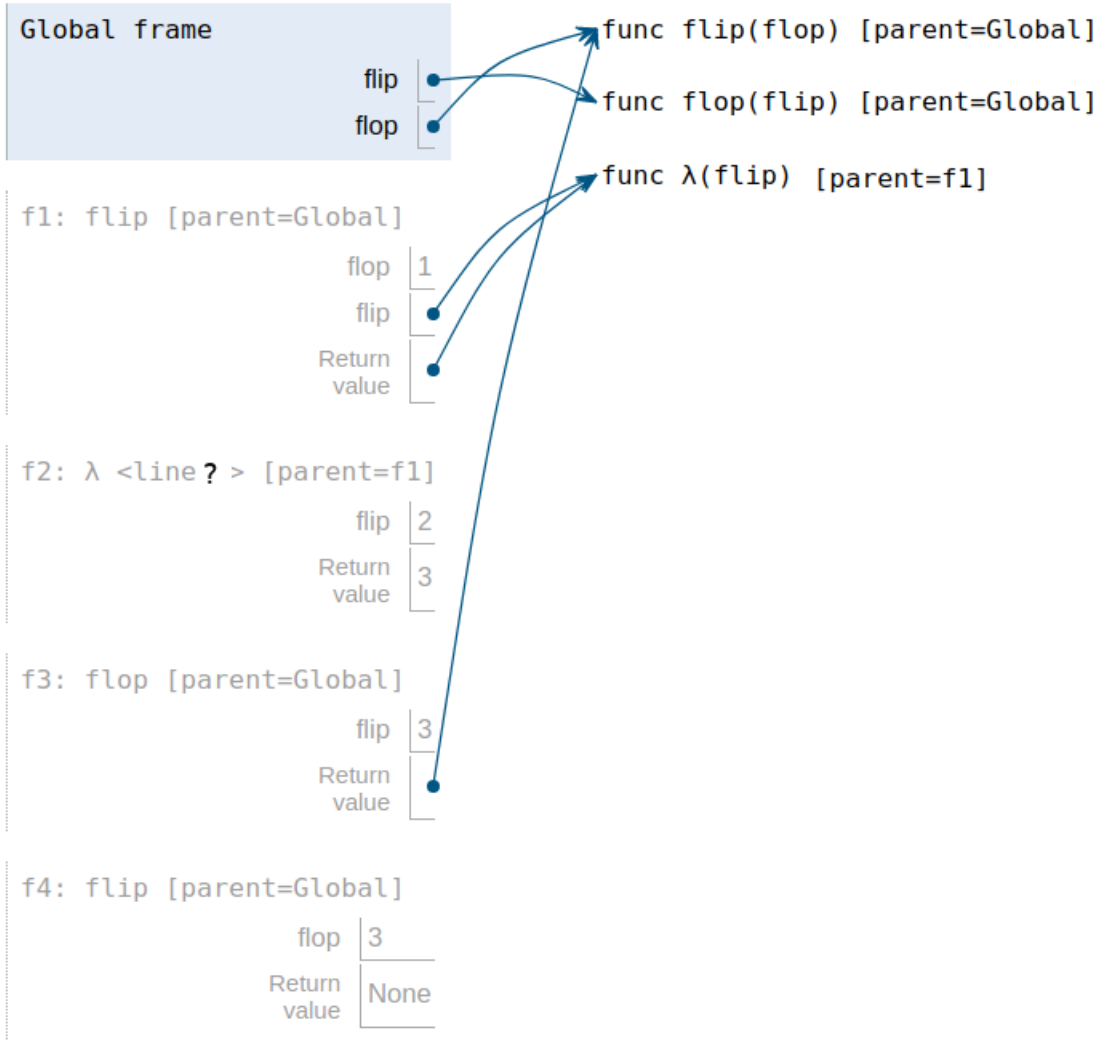
Environment Detective

```
def flip(flop):
    if _______:
        _______________
    flip = lambda flip: 3
    return flip

def flop(flip):
    return flop

flip, flop = flop, flip

flip(flop(1)(2))(3)
```



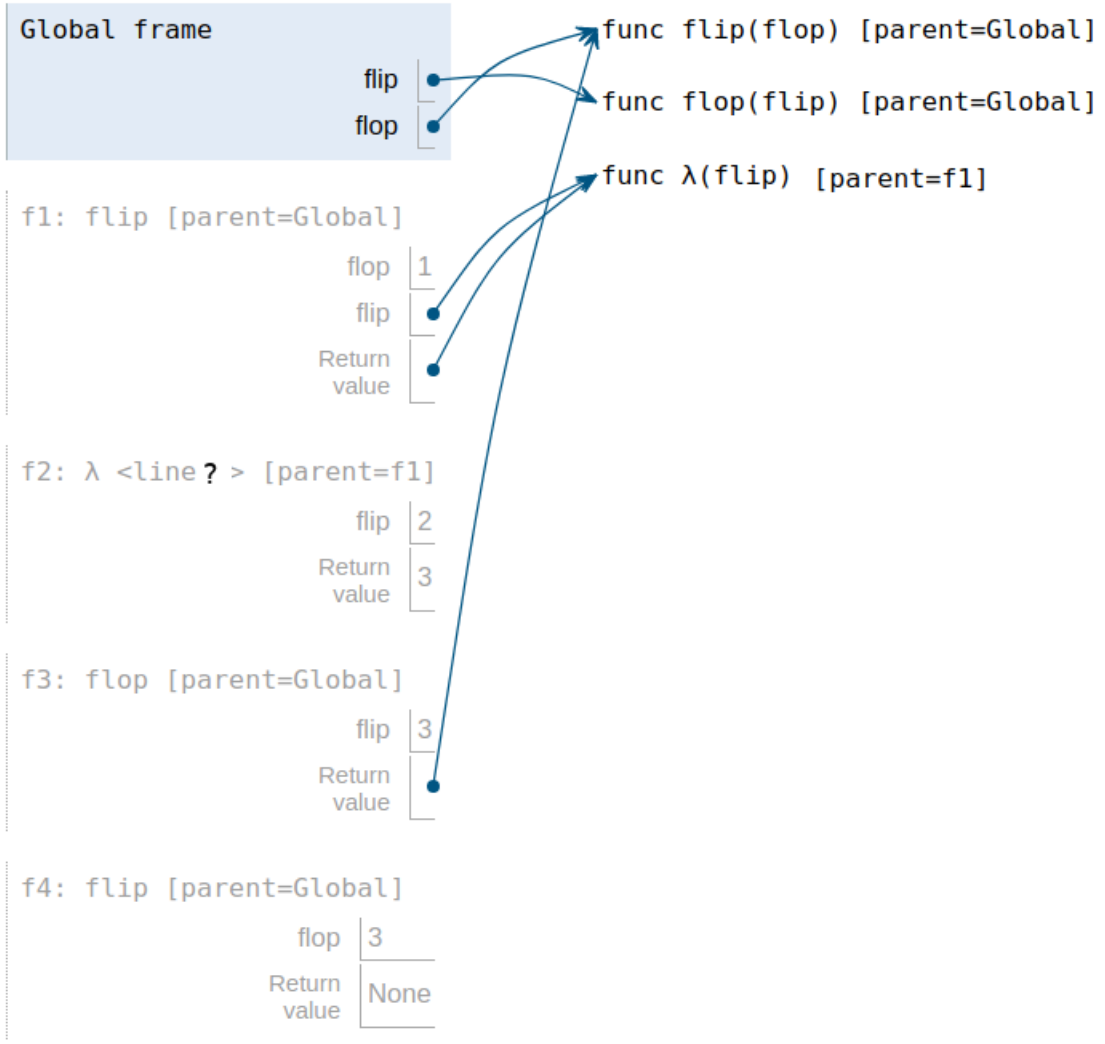
Environment Detective

```
def flip(flop):
    if flop == 3:
        ______________
    flip = lambda flip: 3
    return flip

def flop(flip):
    return flop

flip, flop = flop, flip

flip(flop(1)(2))(3)
```



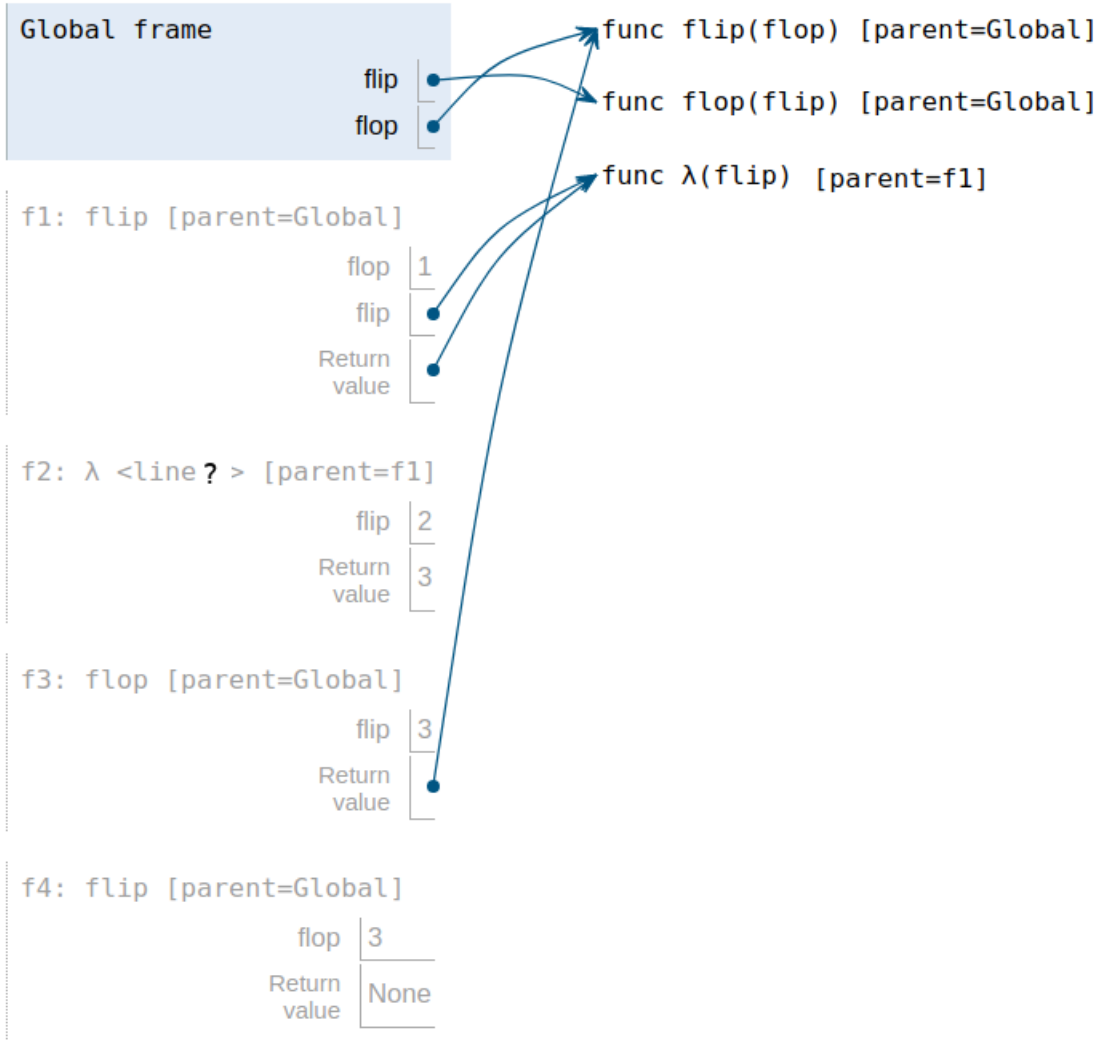
Environment Detective

```
def flip(flop):
    if flop == 3:
        return None
    flip = lambda flip: 3
    return flip

def flop(flip):
    return flop

flip, flop = flop, flip

flip(flop(1)(2))(3)
```



See this in the Python Tutor

Exercise: Tracing

- I'd like a function `trace1` that takes as its argument a one-argument function (say f) and returns a one-argument function that
  - Prints its argument, preceded by a '->'.
  - Prints the value of f applied to its argument, preceded by a '<-', and then returns that value.
- So,

```
>>> def square(x):
...       return x*2
...
>>> square(3) + square(4)
-> 3
<- 9
-> 4
<- 16
25
```

Decorators

- Python has an interesting feature—*decorators*—that exploits higher-order functions in a useful way.
- The notation

```
@ATTR
def aFunc(...):
    ...
```

  where `ATTR` is some expression, is essentially equivalent to

```
def aFunc(...):
    ...
aFunc = ATTR(aFunc)
```

- So, having defined `trace1`, we can now write

```
@trace1
def square(x):
    return x * x
```

  and see

```
>>> x = square(4)
-> 4
<- 16
>>> x
16
```

Why Do It That Way?

- What's wrong with this alternative way to trace?

```
def aFunc1(x):
    ...
aFunc = trace1(aFunc1)
```

Why Do It That Way?

- What's wrong with this alternative way to trace?

```
def aFunc1(x):
    ...
aFunc = trace1(aFunc1)
```

- Consider

```
def fib1(n):
    return 0 if n <= 0 else 1 if n == 1 else fib1(n-2) + fib1(n-1)
fib = trace1(fib1)
```

A call such as `fib(4)` will trace only the outer call, not the recursive inner calls.