

# 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
```

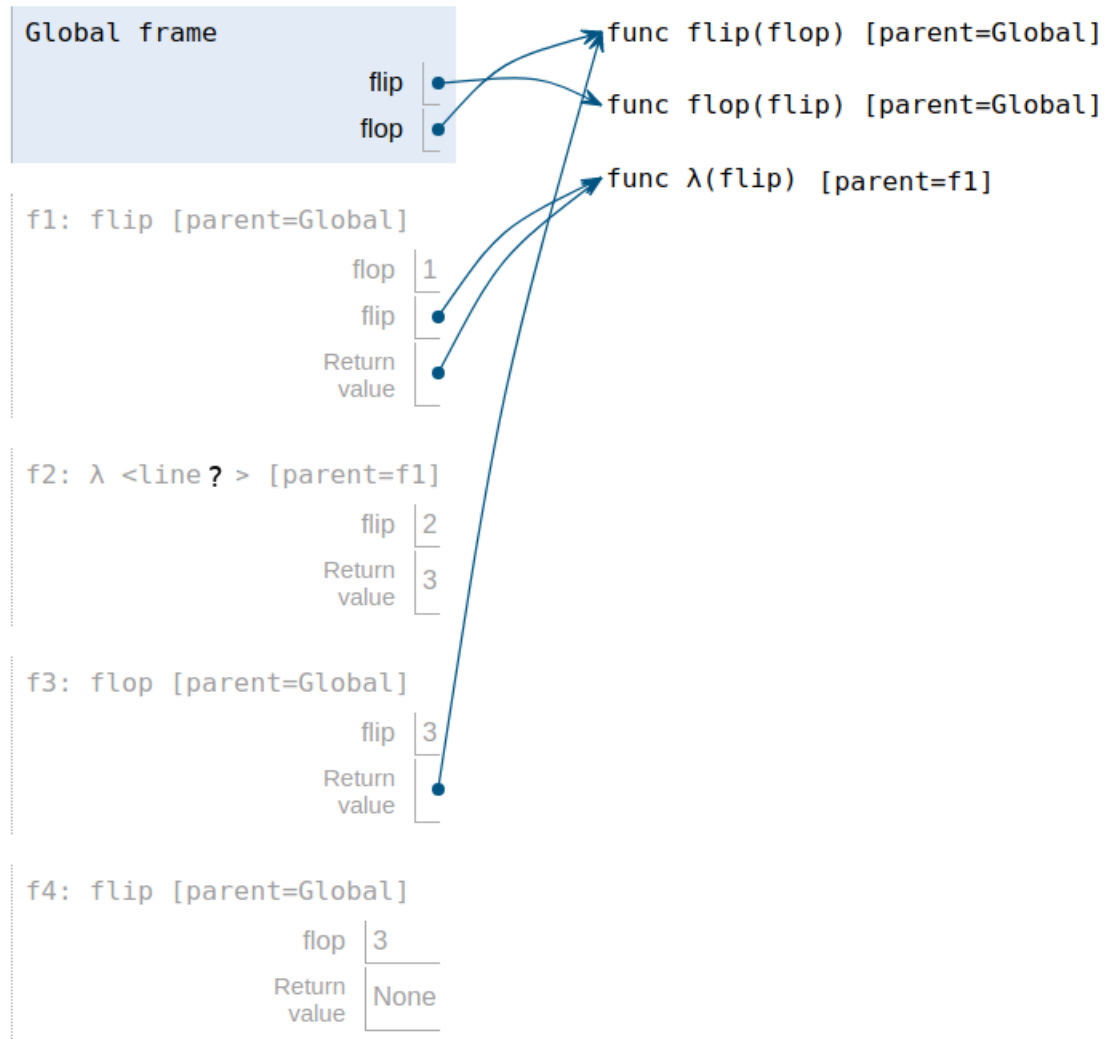
# Environment Detective

```
def flip(flop):
    if _____:
        _____
        flip = _____
    return flip

def flop(flip):
    return flop

_____

flip(_____) (3)
```



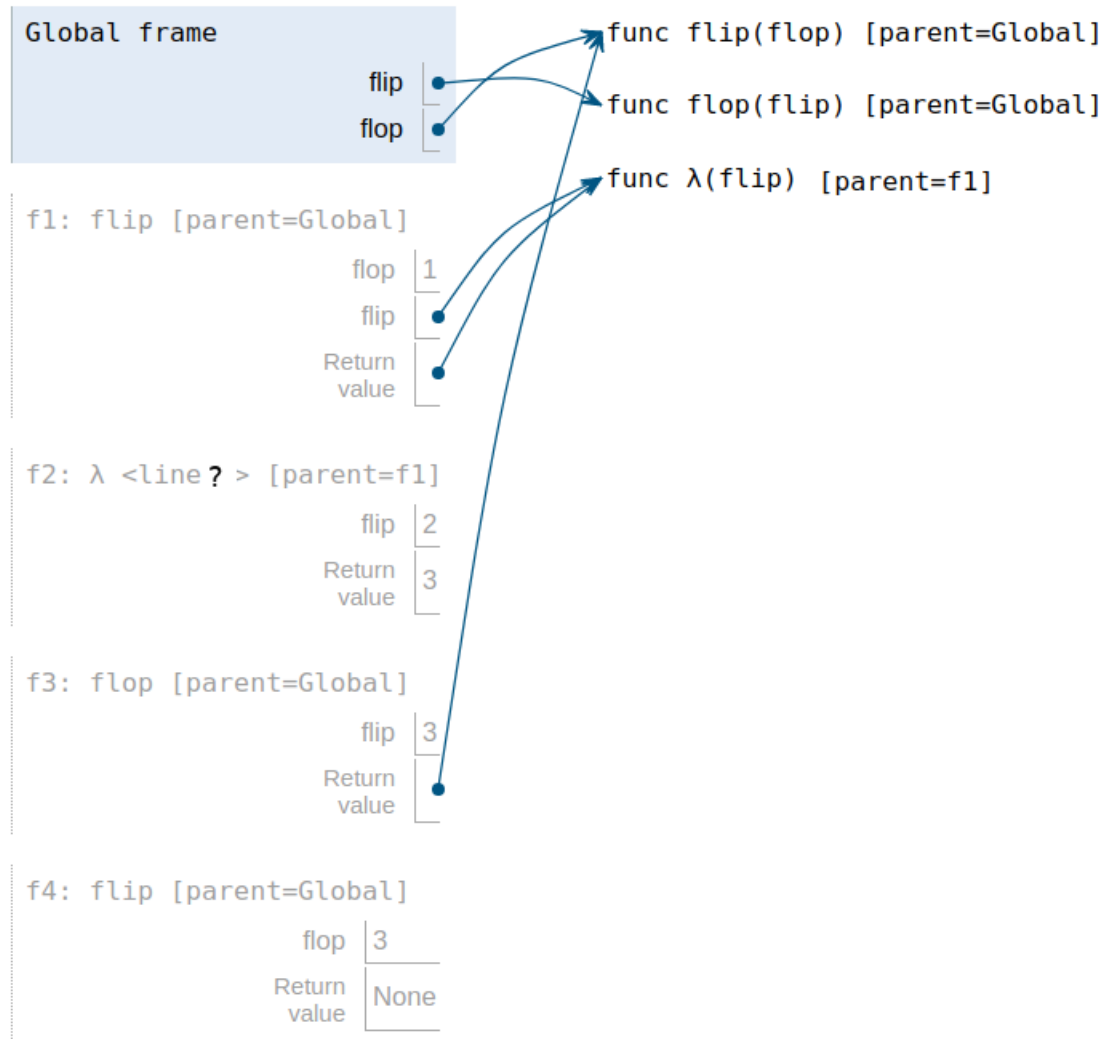
# Environment Detective

```
def flip(flop):
    if _____:
        _____
    flip = _____
    return flip

def flop(flip):
    return flop
```

```
flip, flop = flop, flip
```

```
flip(_____)(3)
```



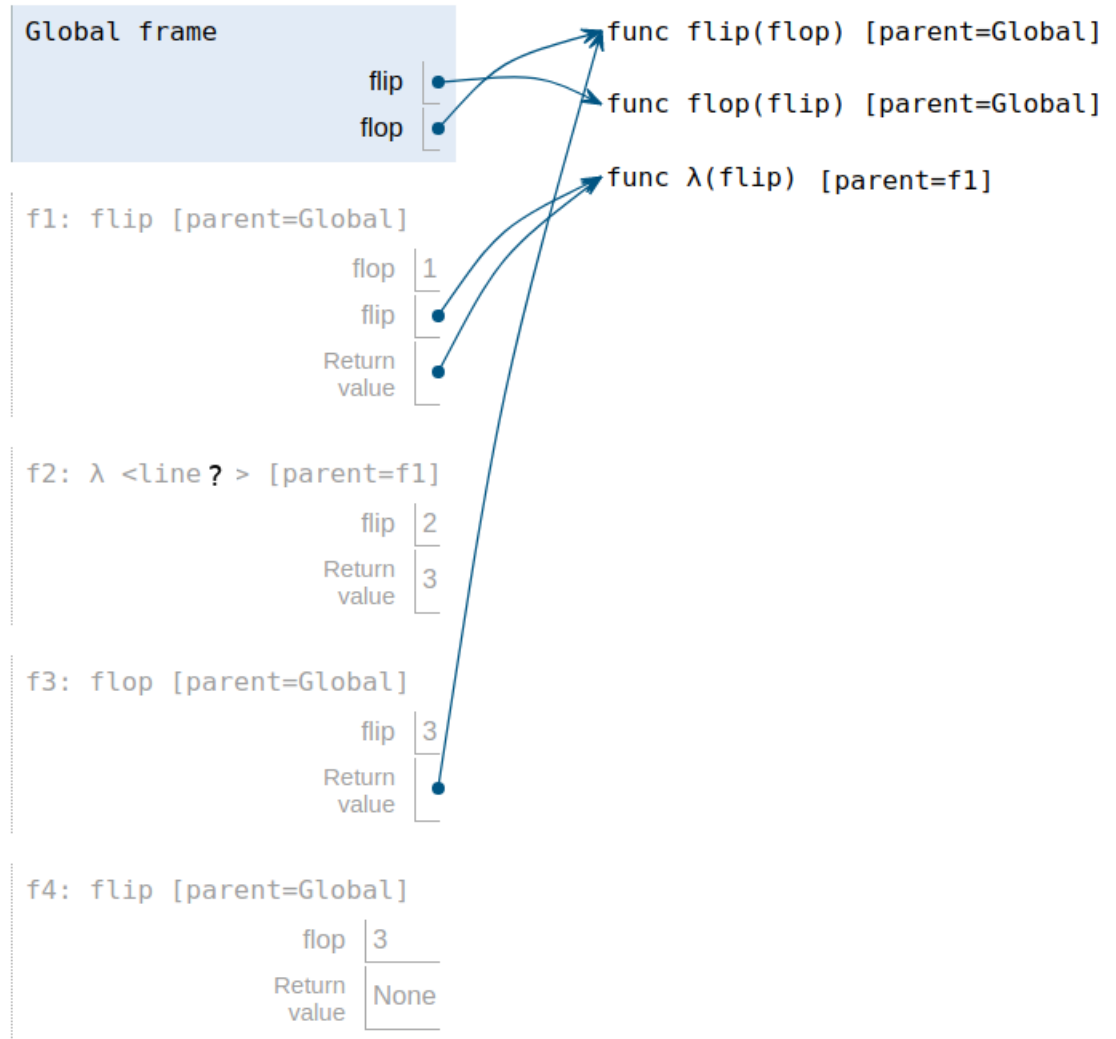
# Environment Detective

```
def flip(flop):
    if _____:
        _____
    flip = _____
    return flip
```

```
def flop(flip):
    return flop
```

```
flip, flop = flop, flip
```

```
flip(flop(1)_____)(3)
```



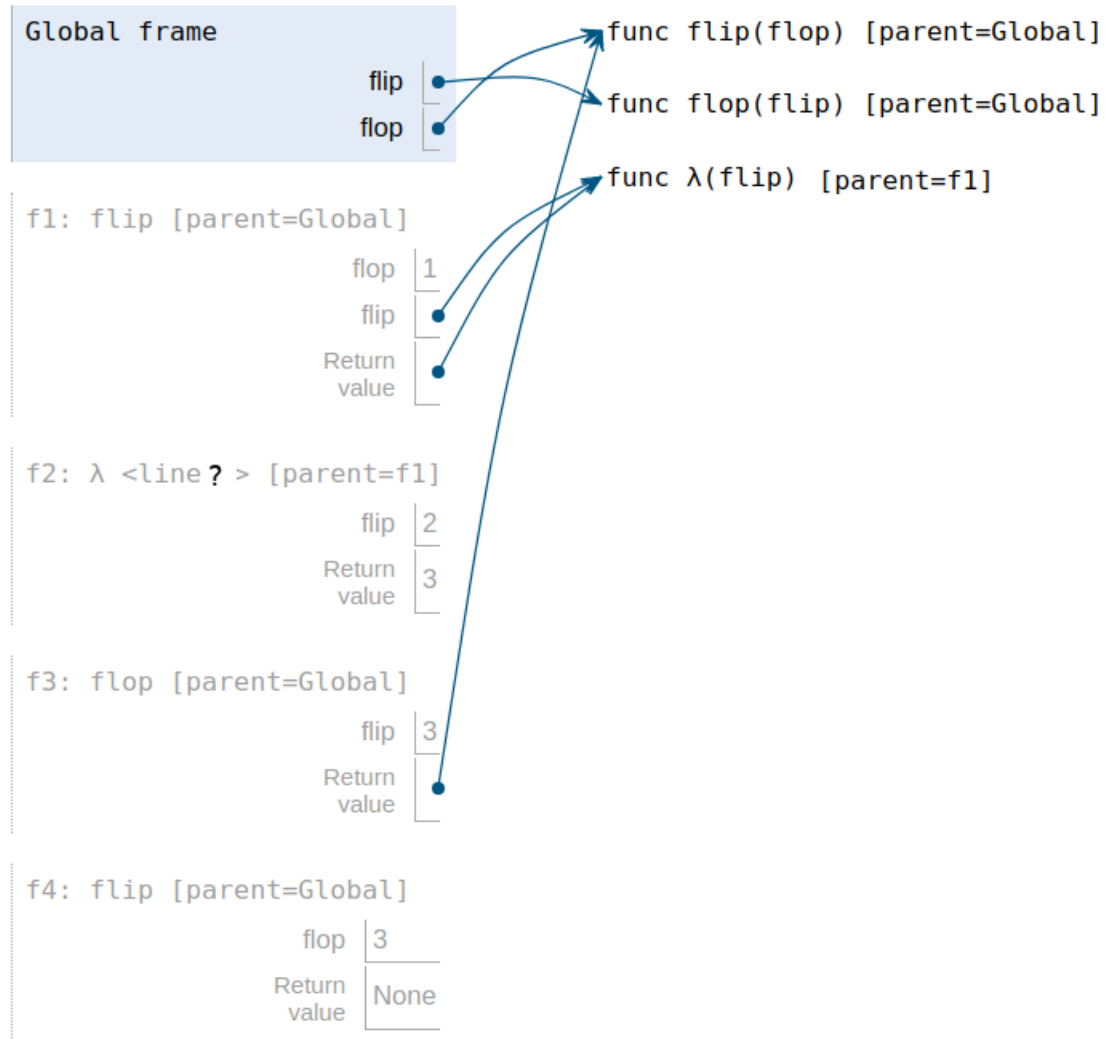
# Environment Detective

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

def flop(flip):
    return flop

flip, flop = flop, flip

flip(flop(1)_____)(3)
```





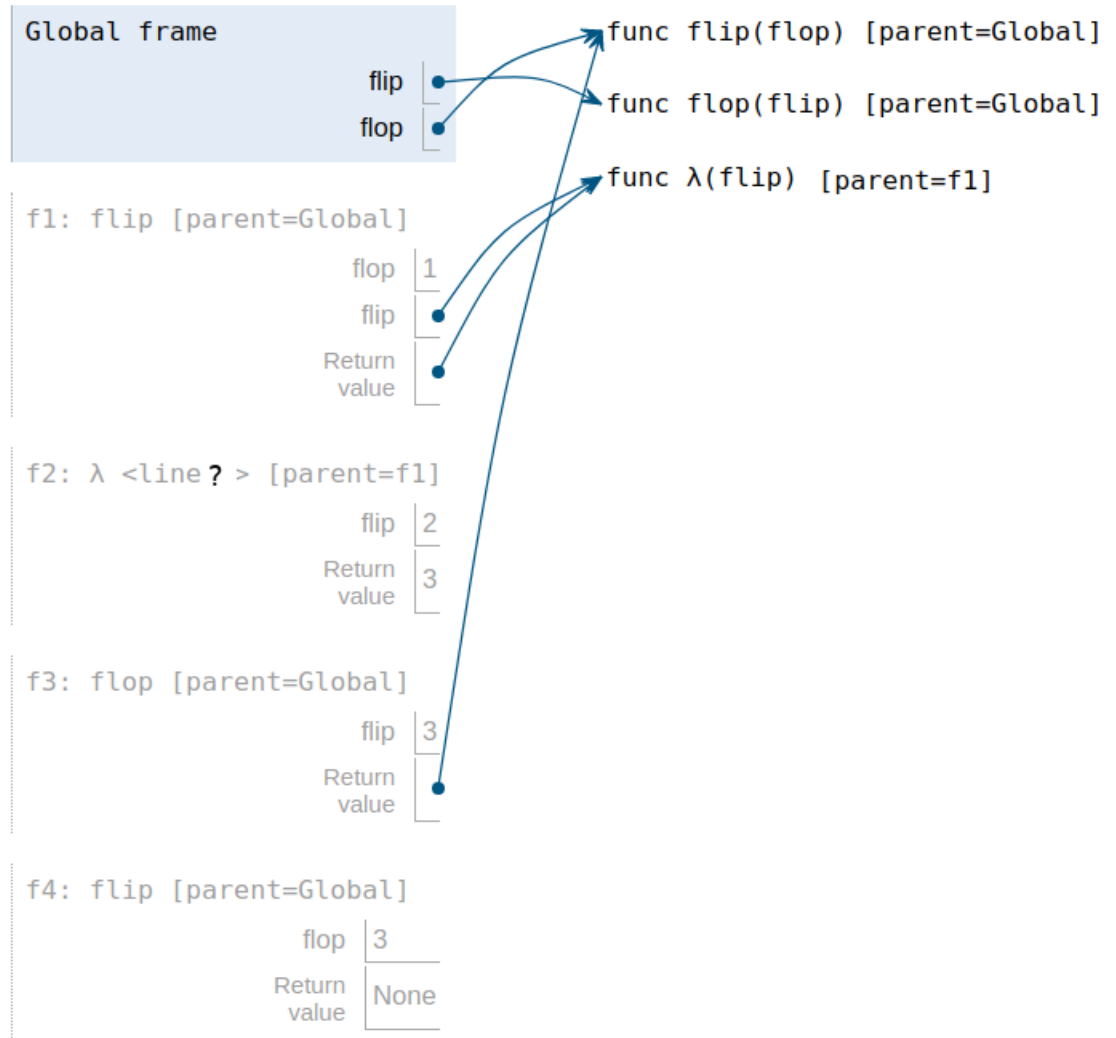
# Environment Detective

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

```
def flop(flip):
    return flop
```

```
flip, flop = flop, flip
```

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



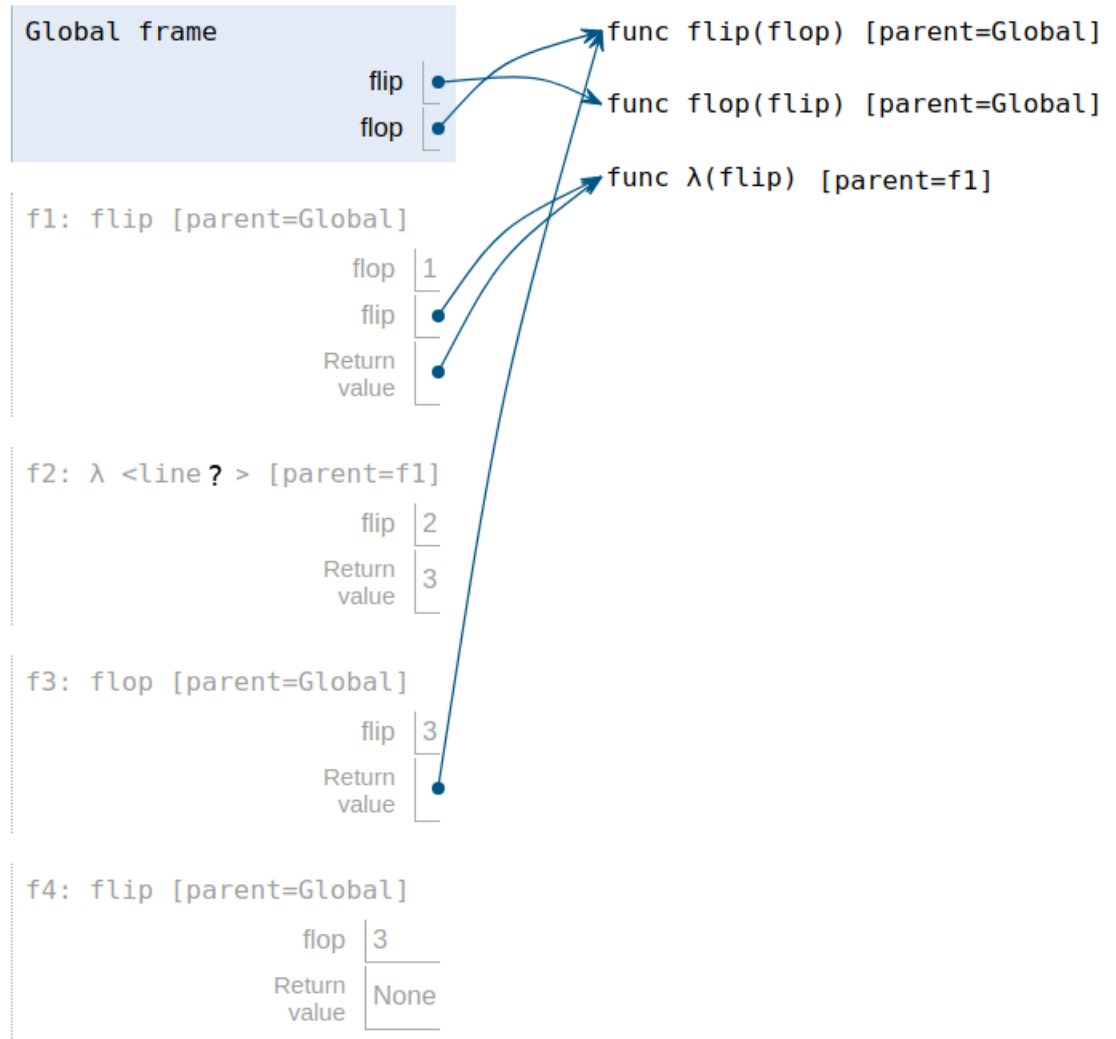
# Environment Detective

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

```
def flop(flip):
    return flop
```

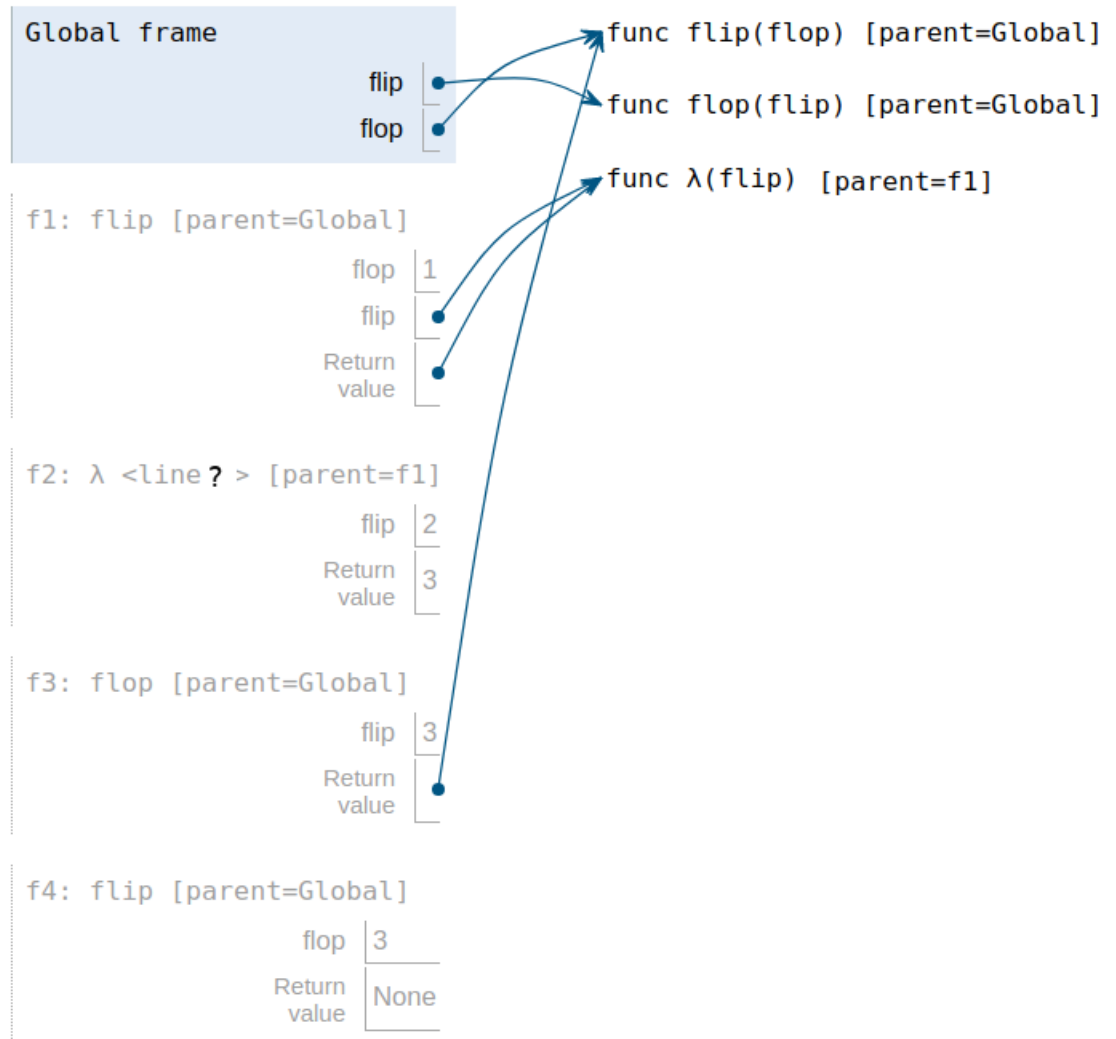
```
flip, flop = flop, flip
```

```
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.