# Function Examples

# Announcements

# Hog Contest Rules

cs61a.org/proj/hog_contest

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- Up to two people submit one entry;
  Max of one entry per person

cs61a.org/proj/hog_contest

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**Fall 2011 Winners**

Keegan Mann
Yan Duan & Ziming Li
Brian Prike & Zhenghao Qian
Parker Schuh & Robert Chatham

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**Fall 2014 Winners**

Alan Tong & Elaine Zhao
Zhenyang Zhang
Adam Robert Villaflor & Joany Gao
Zhen Qin & Dian Chen
Zizheng Tai & Yihe Li

# Hog Contest Winners

**Spring 2015 Winners**

Sinho Chewi & Alexander Nguyen Tran
Zhaoxi Li
Stella Tao and Yao Ge

**Fall 2015 Winners**

Micah Carroll & Vasilis Oikonomou
Matthew Wu
Anthony Yeung and Alexander Dai

**Spring 2016 Winners**

Michael McDonald and Tianrui Chen
Andrei Kassiantchouk
Benjamin Krieges

**Fall 2016 Winners**

Cindy Jin and Sunjoon Lee
Anny Patino and Christian Vasquez
Asana Choudhury and Jenna Wen
Michelle Lee and Nicholas Chew

Your name could be here FOREVER!

**Fall 2017 Winners**

Alex Yu and Tanmay Khattar
James Li
Justin Yokota

**Spring 2018 Winners**

Eric James Michaud
Ziyu Dong
Xuhui Zhou

**Fall 2018 Winners**

Rahul Arya
Jonathan Bodine
Sumer Kohli and Neelesh Ramachandran

**Fall 2019 Winners**

# Currying

# Function Currying

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```
def make_adder(n):
    return lambda k: n + k
```

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```
def make_adder(n):
    return lambda k: n + k
```

```
>>> make_adder(2)(3)
5
>>> add(2, 3)
5
```

# Function Currying

```
def make_adder(n):
    return lambda k: n + k
```

```
>>> make_adder(2)(3)
5
>>> add(2, 3)
5
```

There's a general relationship between these functions

# Function Currying

```
def make_adder(n):
    return lambda k: n + k
```

```
>>> make_adder(2)(3)
5
>>> add(2, 3)
5
```

There's a general relationship between these functions

(Demo)

# Function Currying

```
def make_adder(n):
    return lambda k: n + k
```

```
>>> make_adder(2)(3)
5
>>> add(2, 3)
5
```

There's a general relationship between these functions

(Demo)

**Curry:** Transform a multi-argument function into a single-argument, higher-order function

# Decorators

# Function Decorators

(Demo)

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```
@trace1
def triple(x):
    return 3 * x
```

# Function Decorators

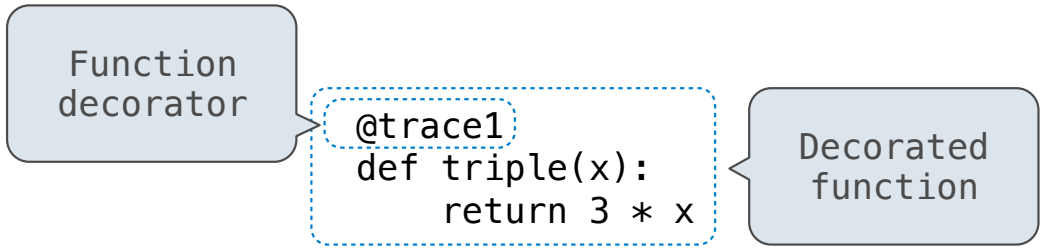
(Demo)

Function decorator

```
@trace1
def triple(x):
    return 3 * x
```

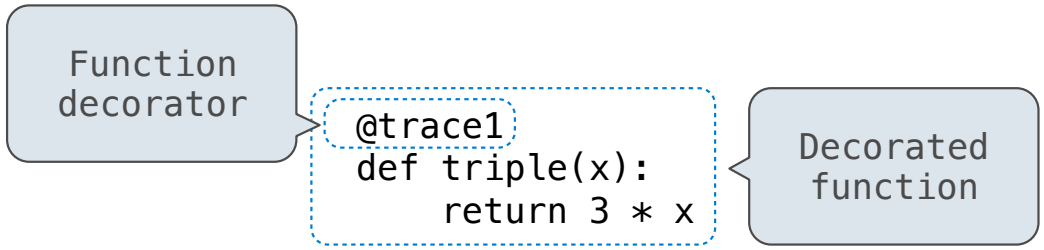
# Function Decorators

(Demo)



# Function Decorators

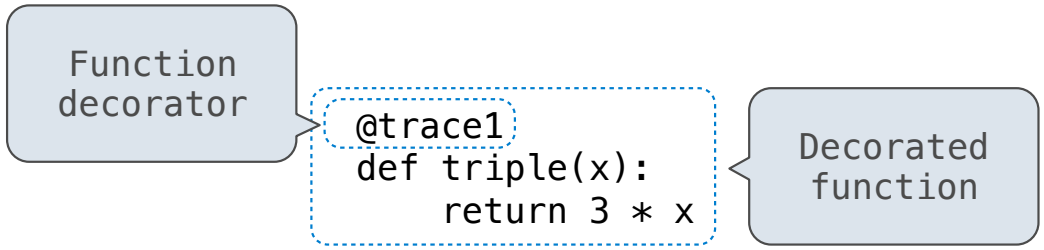
(Demo)




*is identical to*

# Function Decorators

(Demo)




*is identical to*

```
def triple(x):
    return 3 * x
triple = trace1(triple)
```

# Function Decorators

(Demo)

Function decorator

```
@trace1
def triple(x):
    return 3 * x
```

Decorated function

*is identical to*

Why not just use this?

```
def triple(x):
    return 3 * x
triple = trace1(triple)
```

# Review

# What Would Python Display?

## What Would Python Display?

```
The print function returns None.  It also displays its arguments
(separated by spaces) when it is called.
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The print function returns None.  It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
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```
from operator import add, mul
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```

| This expression | Evaluates to | Interactive Output |
| --- | --- | --- |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
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```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| `5` | 5 | 5 |
| `print(5)` | | |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

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from operator import add, mul
def square(x):
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```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |

# What Would Python Display?

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```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) | | |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
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```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) | | |

None

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
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```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | | 5 <br> None |

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```
from operator import add, mul
def square(x):
    return mul(x, x)
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```
def delay(arg):
    print('delayed')
    def g():
        return arg
    return g
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
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def delay(arg):
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```

Names in nested def statements can refer to their enclosing scope

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

A function that takes any argument and returns a function that returns that arg

```
def delay(arg):
    print('delayed')
    def g():
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```

Names in nested def statements can refer to their enclosing scope

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5 <br> None |
| delay(delay)()(6)() | | |

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| 5 | 5 | 5 |
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|---|---|---|
| 5 | 5 | 5 |
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| delay(delay)()(6)() | | |

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Names in nested def statements can refer to their enclosing scope

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) | None | 5<br>None |
| None | | |
| delay(delay)()(6)() | | delayed |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5 <br> None |
| delay(delay)()(6)() | | delayed <br> delayed |

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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5 <br> None |
| delay(delay)()(6)() | | delayed <br> delayed <br> 6 |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

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|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5 <br> None |
| delay(delay)()(6)() | 6 | delayed <br> delayed <br> 6 |

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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5 <br> None |
| delay(delay)()(6)() | 6 | delayed <br> delayed <br> 6 |
| print(delay(print)()(4)) | | |

# What Would Python Display?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

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from operator import add, mul
def square(x):
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```

Names in nested def statements can refer to their enclosing scope

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5 <br> None |
| delay(delay)()(6)() | 6 | delayed <br> delayed <br> 6 |
| print(delay(print)()(4)) | | delayed |

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def square(x):
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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5<br>None |
| delay(delay)()(6)() | 6 | delayed<br>delayed<br>6 |
| print(delay(print)()(4)) | | delayed<br>4 |

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The print function returns None. It also displays its arguments (separated by spaces) when it is called.

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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5<br>None |
| delay(delay)()(6)() | 6 | delayed<br>delayed<br>6 |
| print(delay(print)()(4)) | | delayed<br>4<br>None |

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The print function returns None. It also displays its arguments (separated by spaces) when it is called.

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| This expression | Evaluates to | Interactive Output |
|---|---|---|
| 5 | 5 | 5 |
| print(5) | None | 5 |
| print(print(5)) <br> None | None | 5<br>None |
| delay(delay)()(6)() | 6 | delayed<br>delayed<br>6 |
| print(delay(print)()(4)) | None | delayed<br>4<br>None |

## What Would Python Print?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

| This expression | Evaluates to | Interactive Output |
| --- | --- | --- |

# What Would Python Print?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

| This expression | Evaluates to | Interactive Output |
| --- | --- | --- |

```
def pirate(arggg):
    print('matey')
    def plunder(arggg):
        return arggg
    return plunder
```

# What Would Python Print?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

```
def pirate(arggg):
    print('matey')
    def plunder(arggg):
        return arggg
    return plunder
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| `add(pirate(3)(square)(4), 1)` | | |

# What Would Python Print?

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```
from operator import add, mul
def square(x):
    return mul(x, x)
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| `add(pirate(3)(square)(4), 1)` | | |

```
def pirate(arggg):
    print('matey')
    def plunder(arggg):
        return arggg
    return plunder
```

A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.

# What Would Python Print?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

```
from operator import add, mul
def square(x):
    return mul(x, x)
```

A function that always returns the identity function

```
def pirate(arggg):
    print('matey')
    def plunder(arggg):
        return arggg
    return plunder
```

| This expression | Evaluates to | Interactive Output |
|---|---|---|
| `add(pirate(3)(square)(4), 1)` | | |

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# What Would Python Print?

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A function that always returns the identity function

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def pirate(arggg):
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| This expression | Evaluates to | Interactive Output |
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| `add(pirate(3)(square)(4), 1)` | | |

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*func square(x)*

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| add(pirate(3)(square)(4), 1) | | Matey |
| *func square(x)* | | |
| *16* | | |

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| add(pirate(3)(square)(4), 1) | 17 | Matey<br>17 |

*func square(x)*

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| pirate(pirate(pirate))(5)(7) | | |

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def horse(mask):
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mask = lambda horse: horse(2)

horse(mask)
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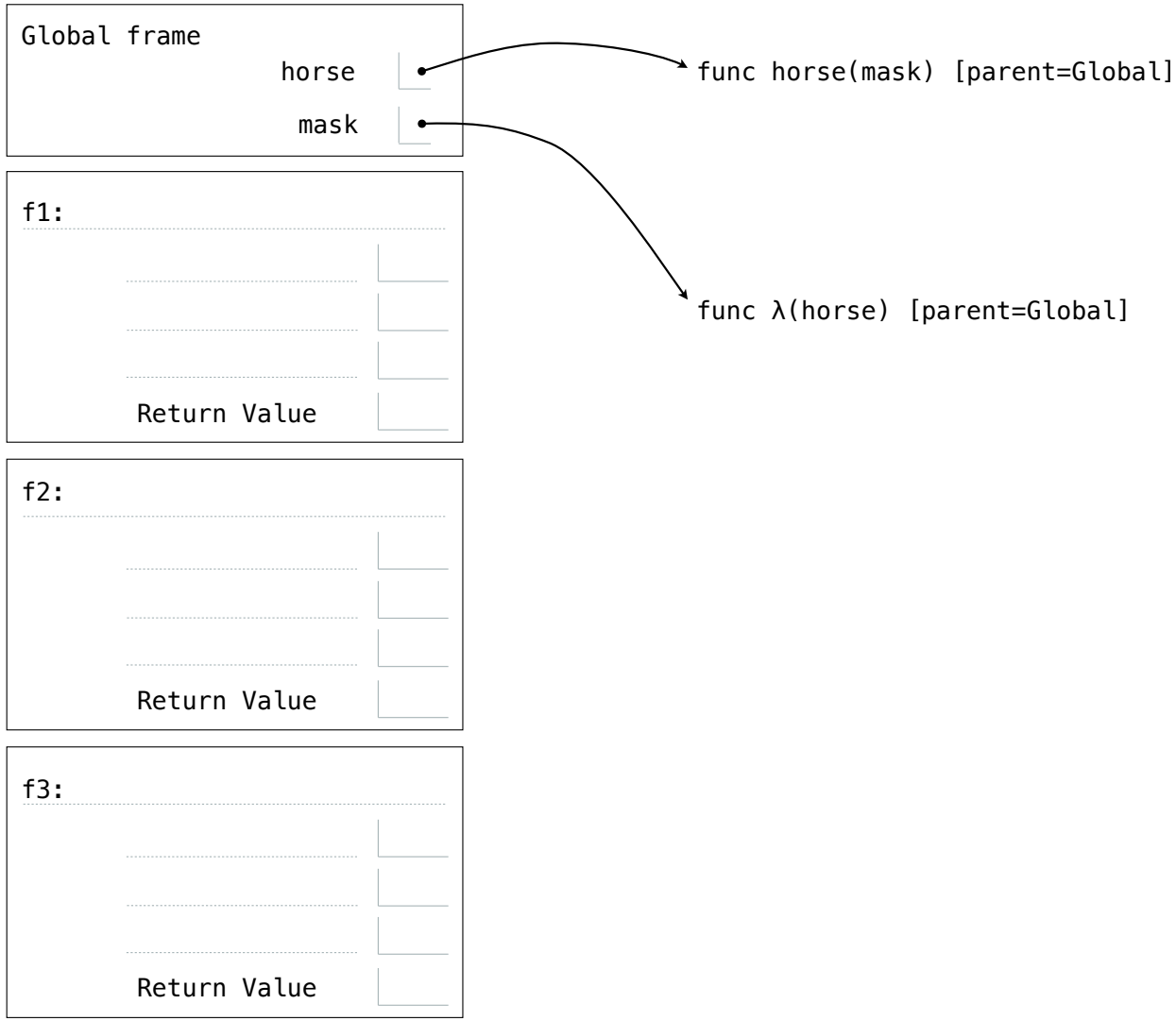

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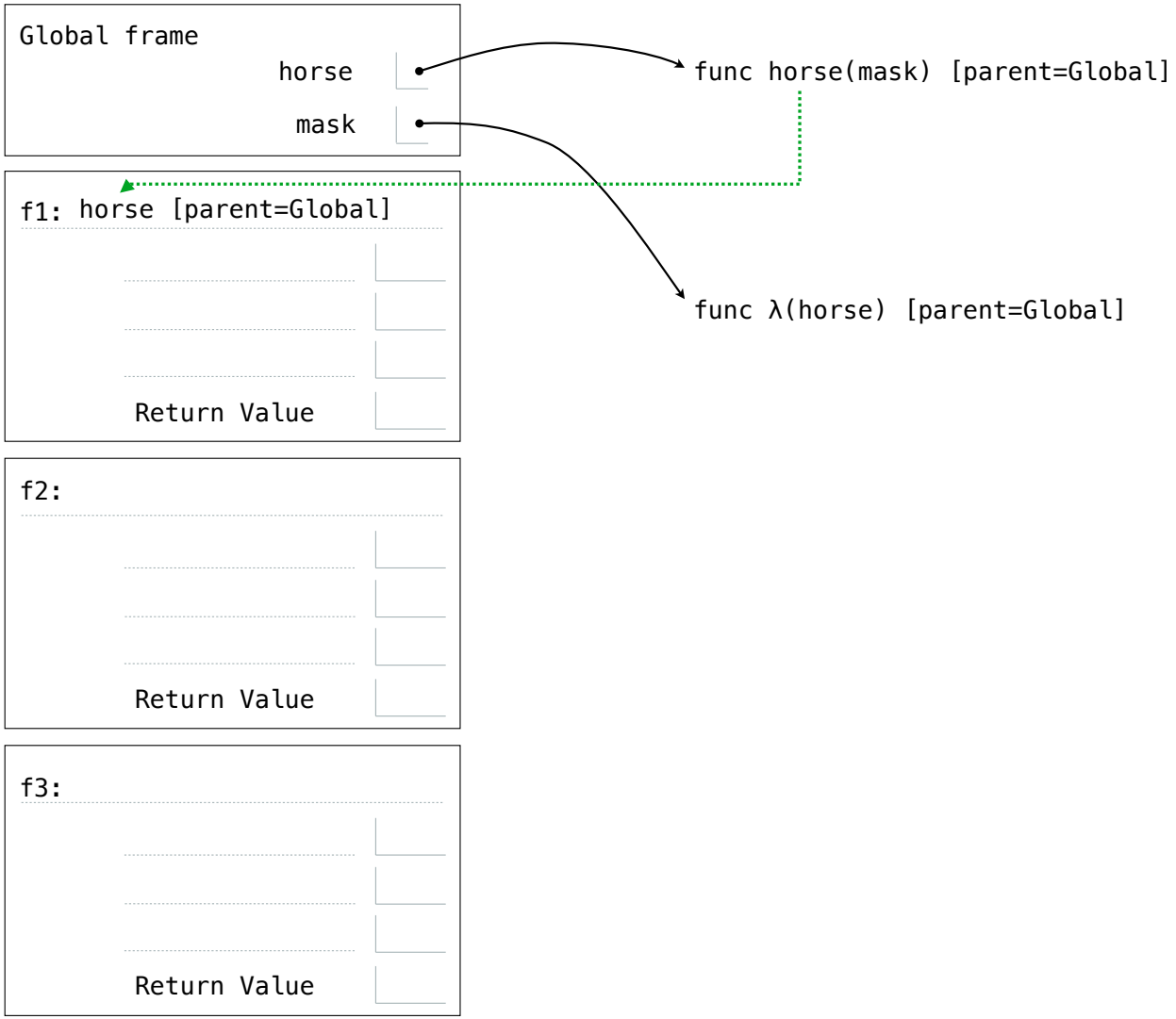

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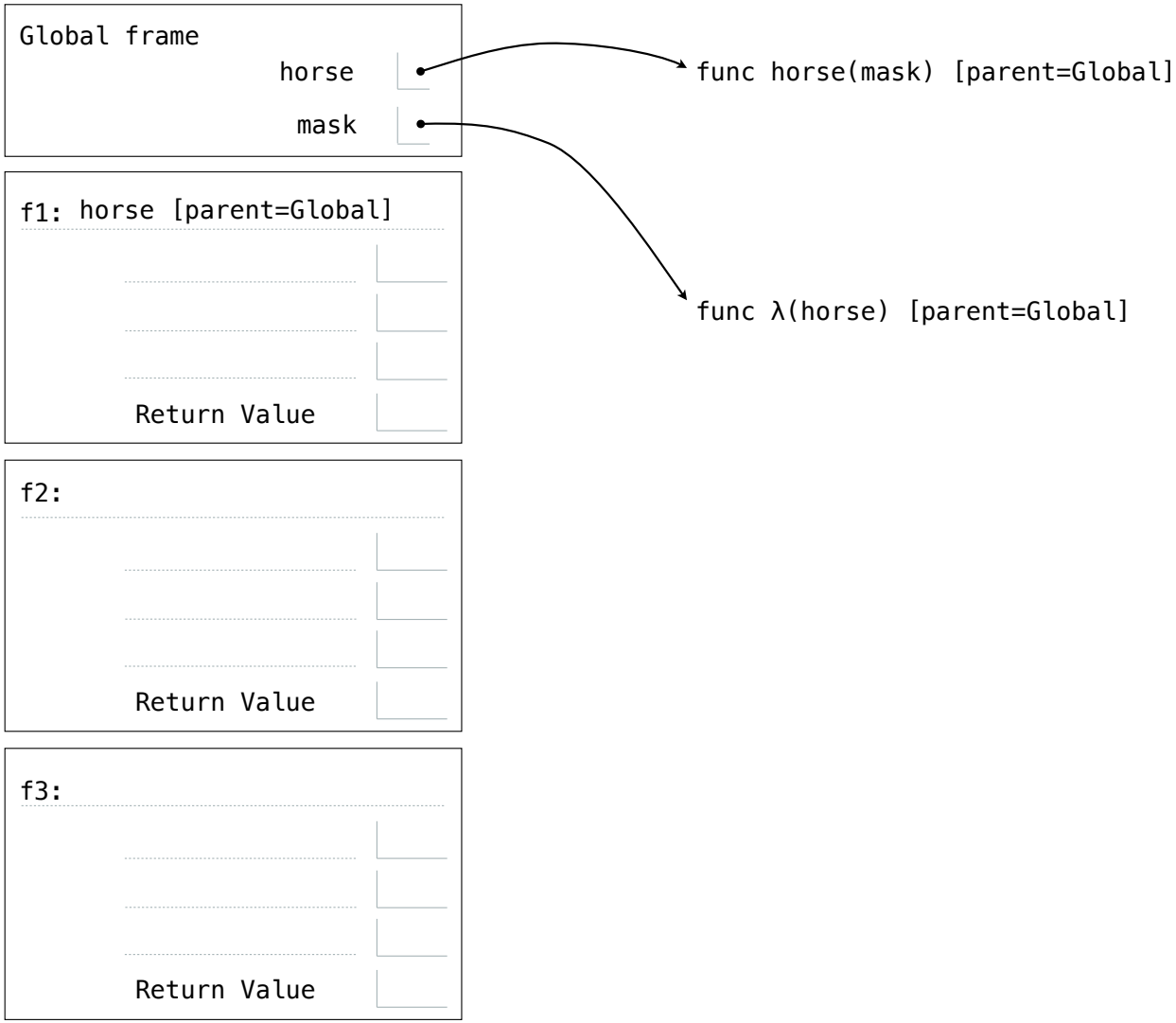

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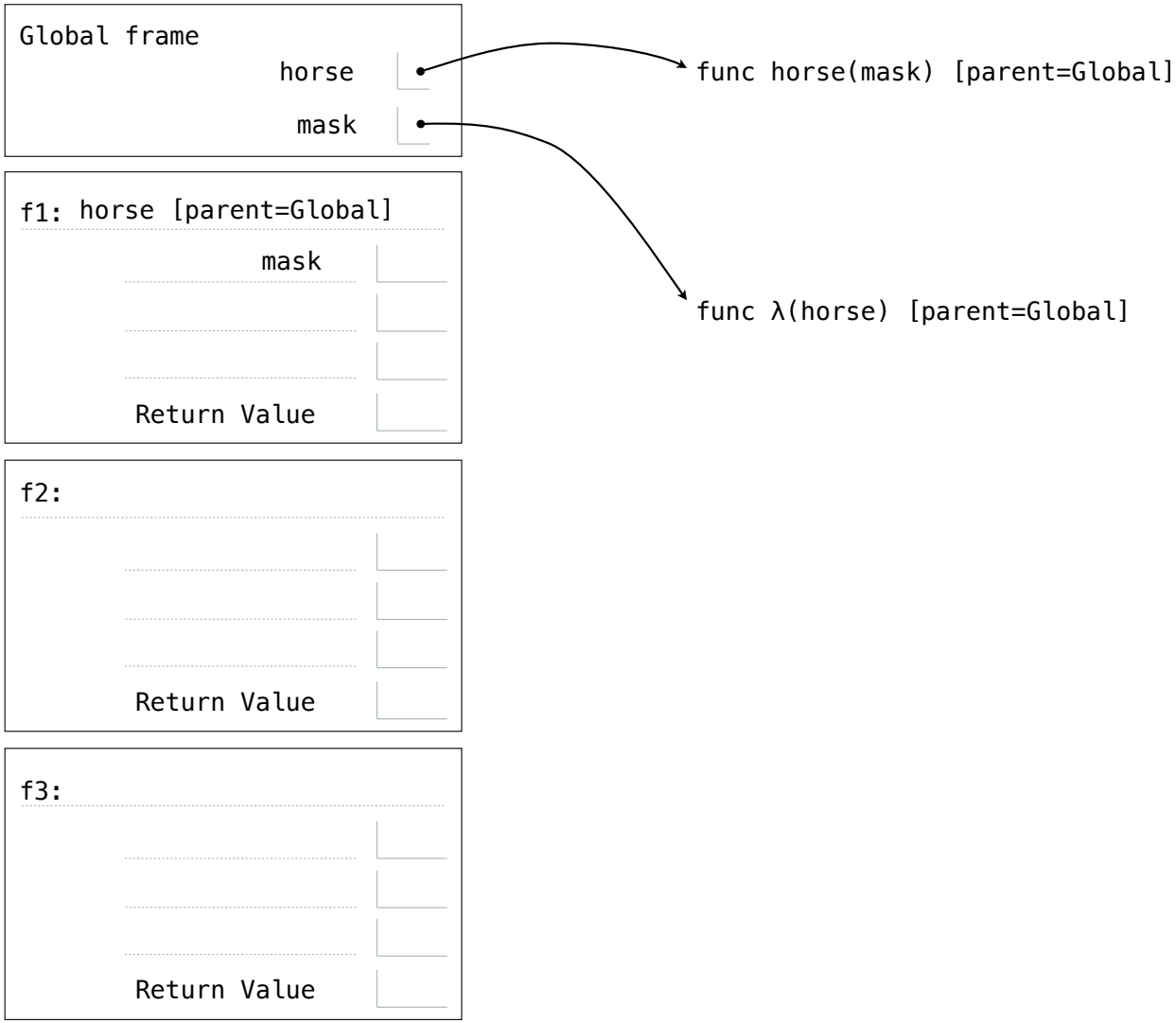

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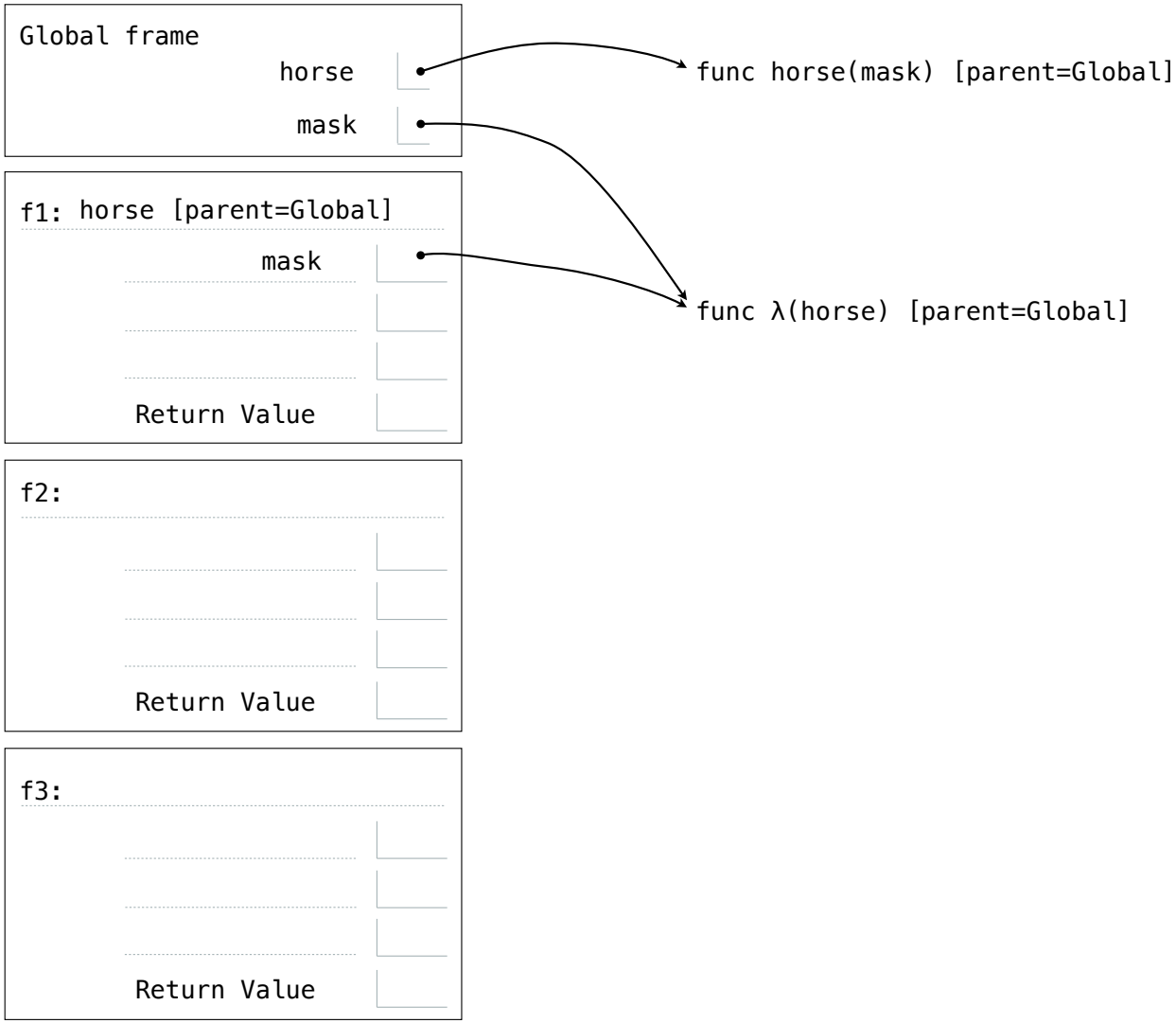

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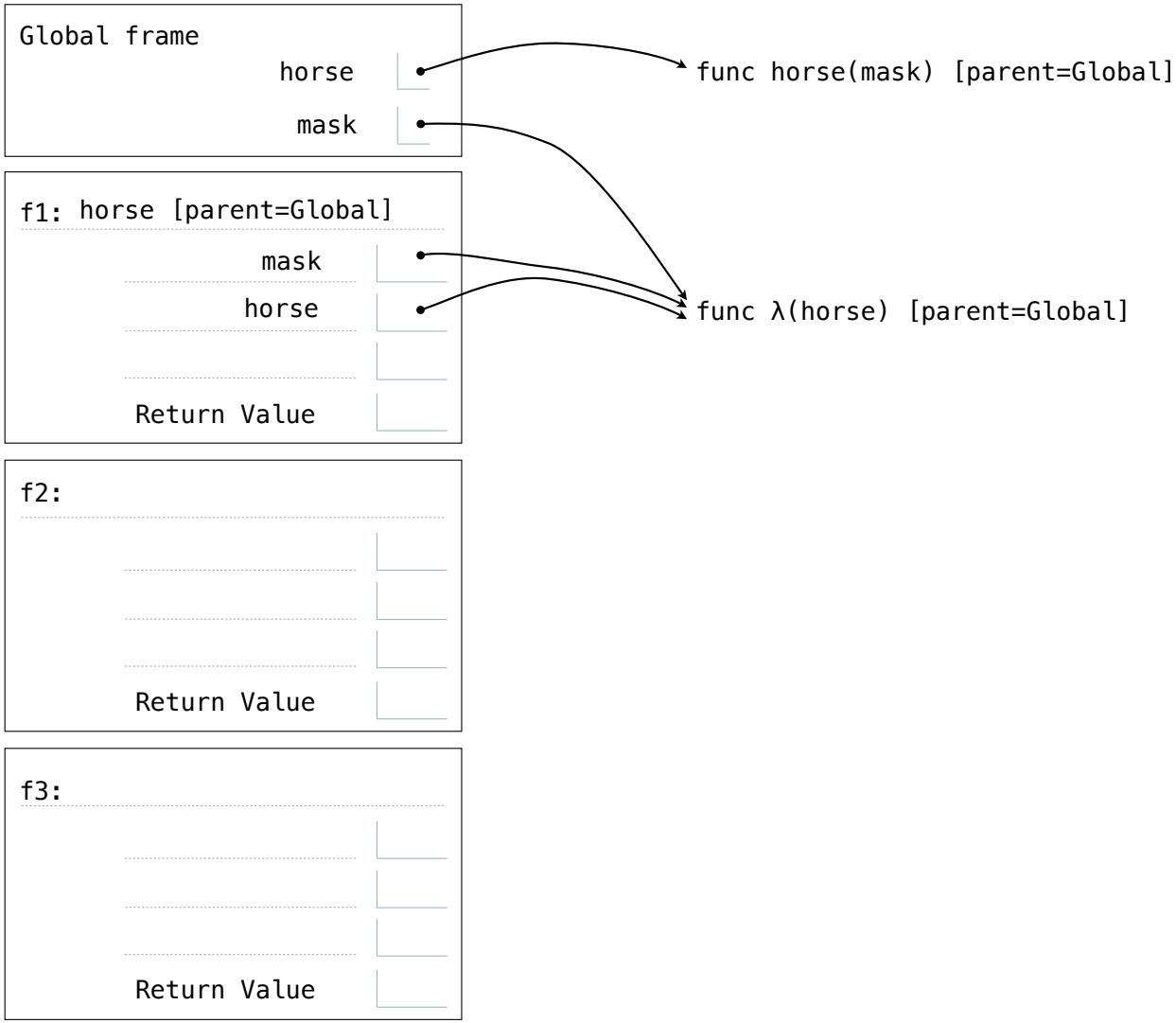

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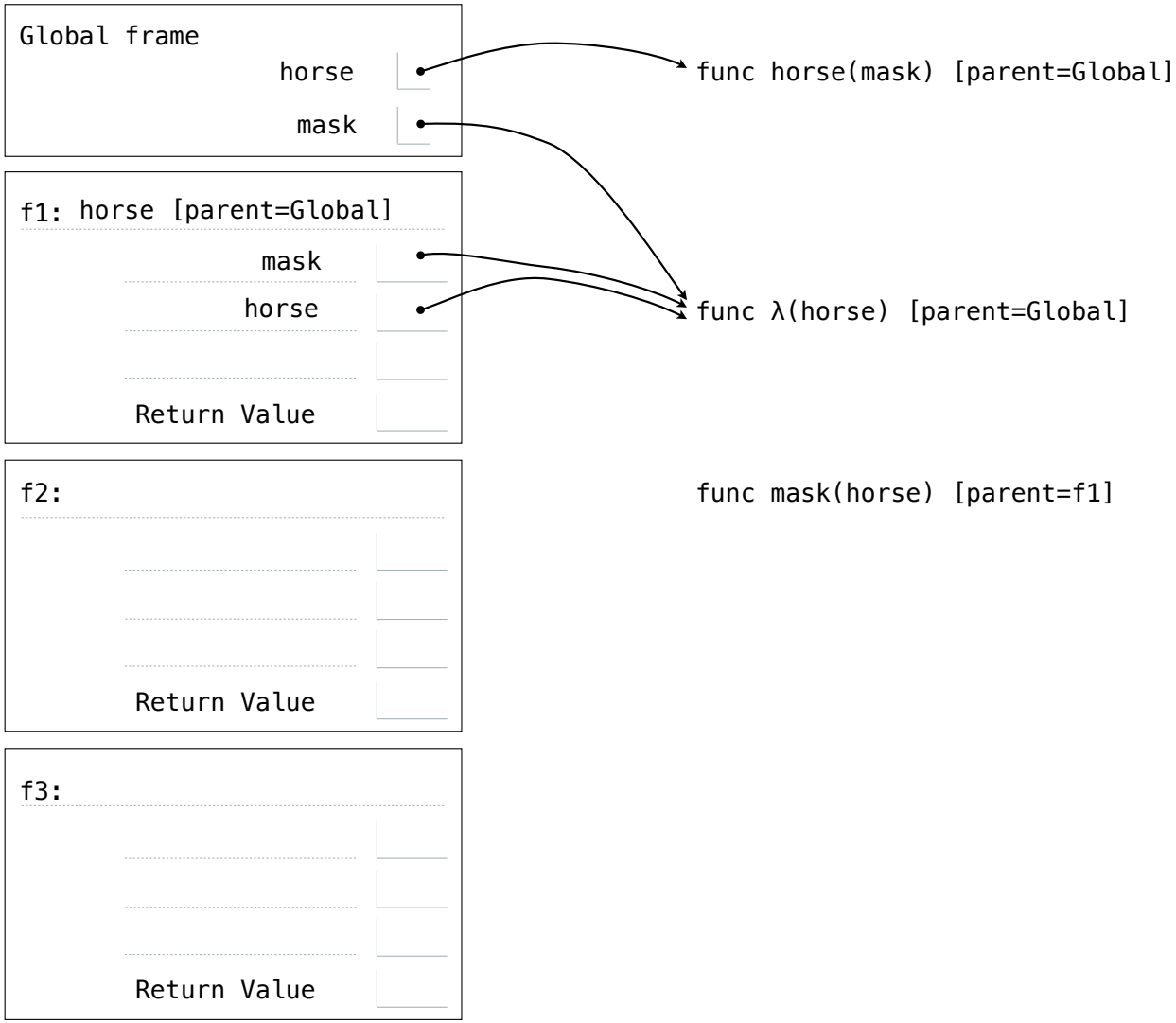

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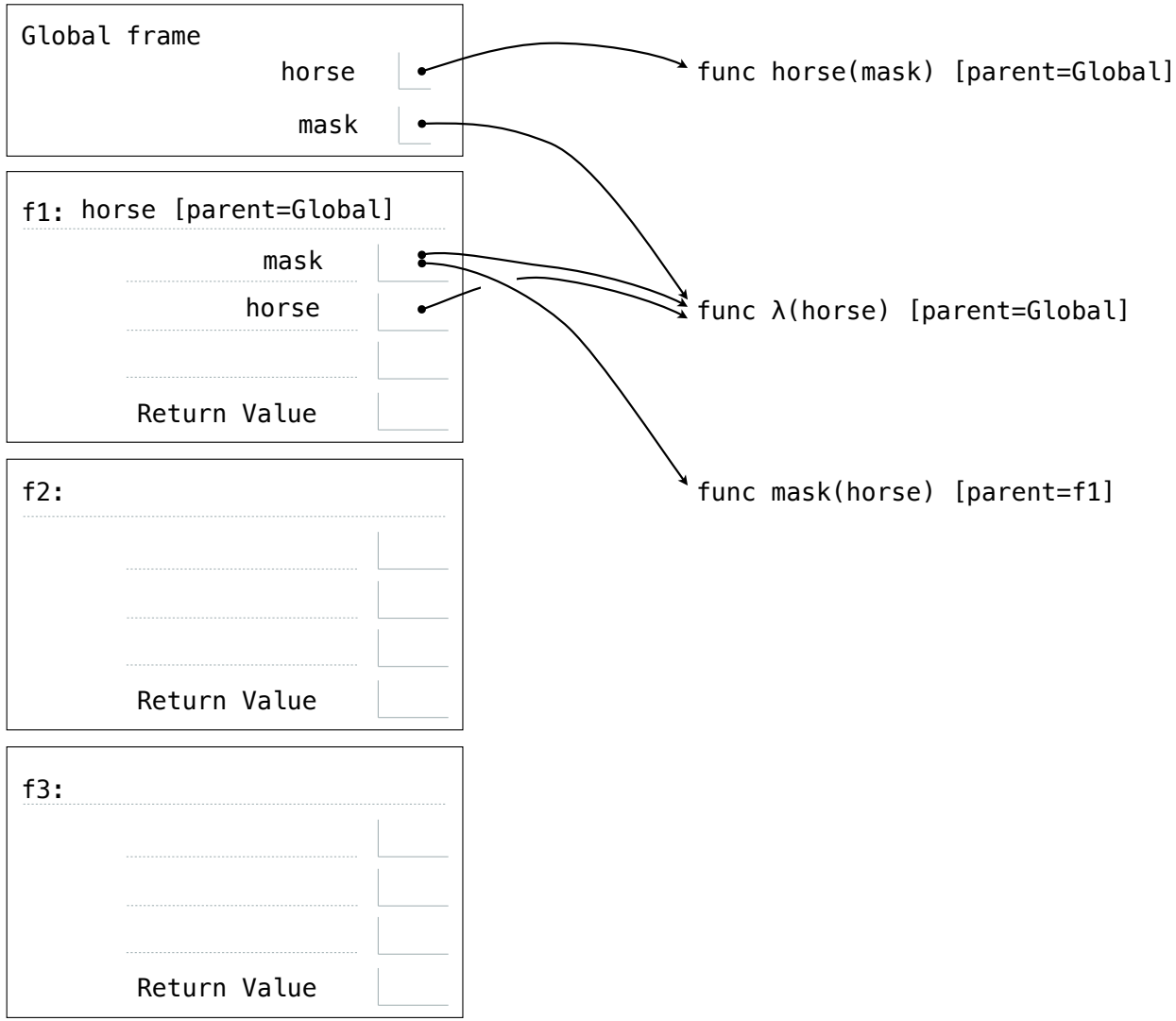

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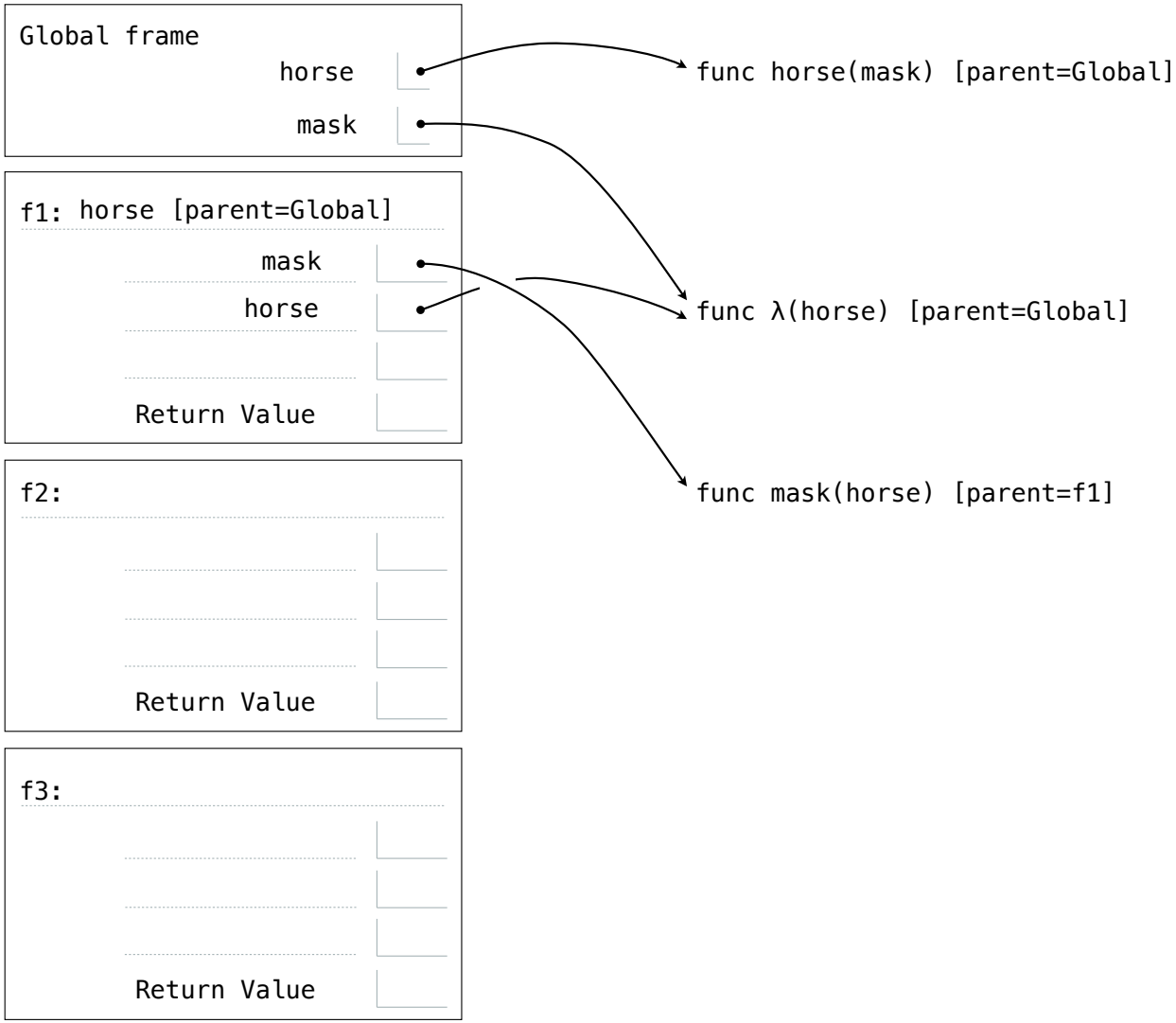

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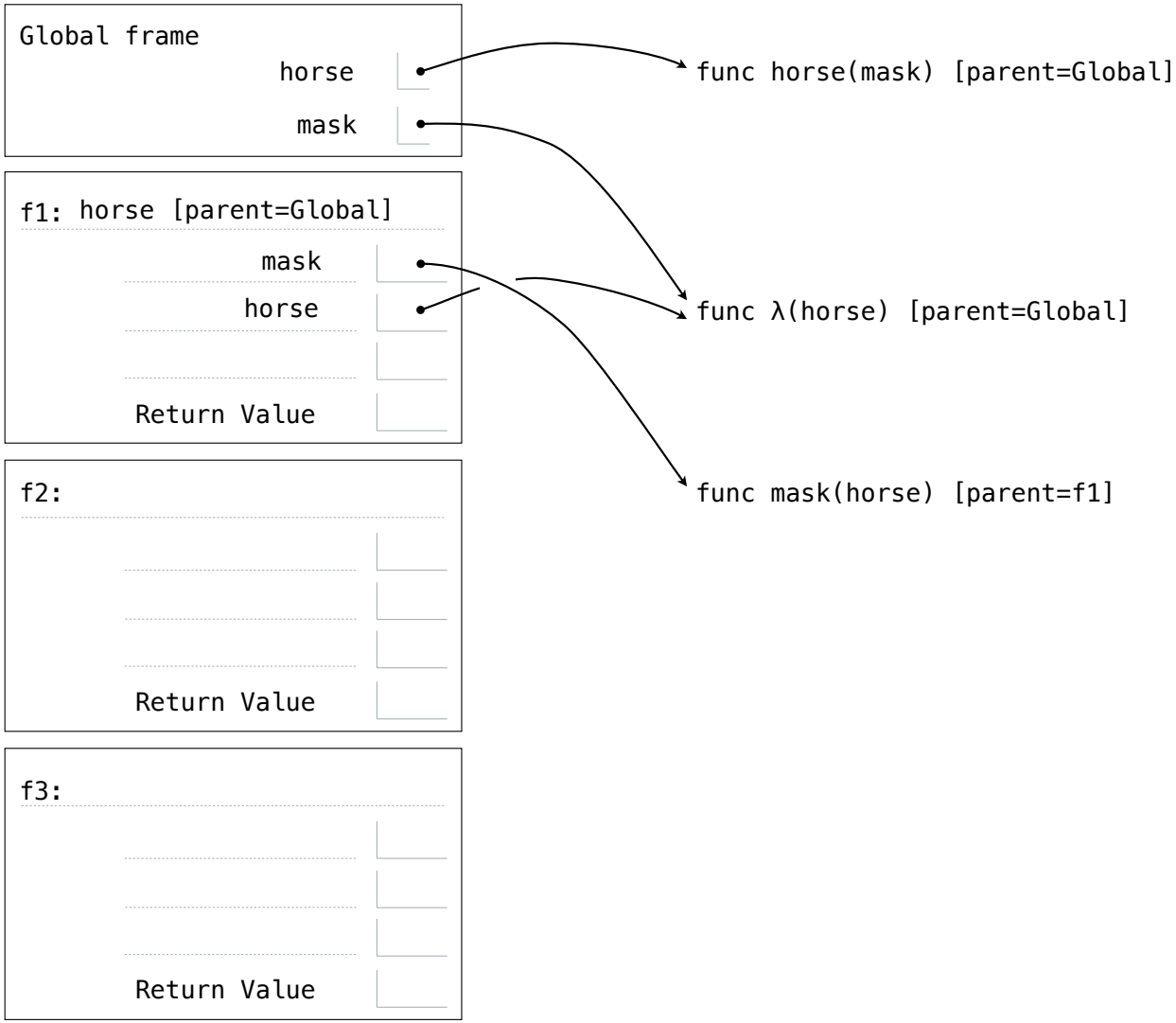

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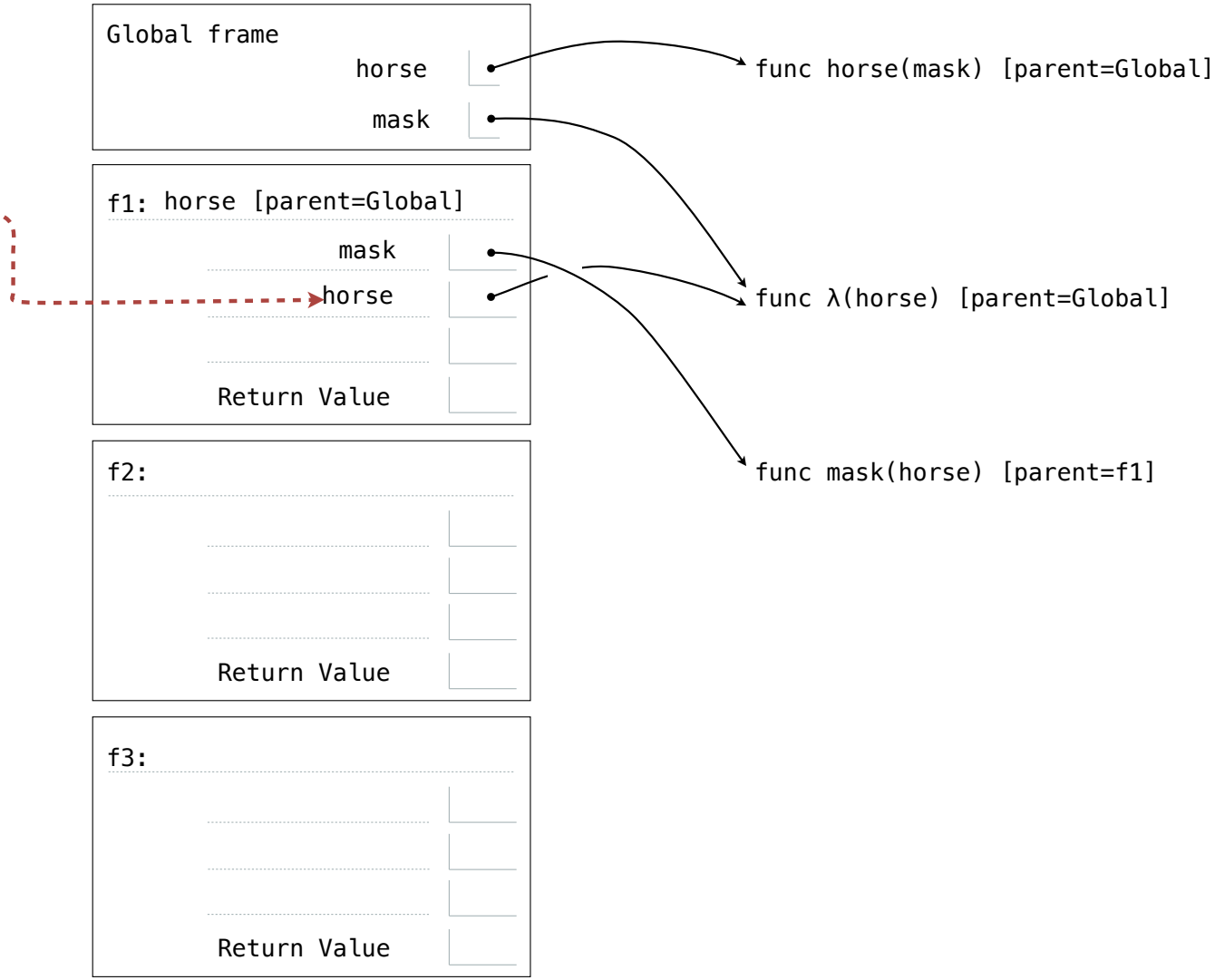

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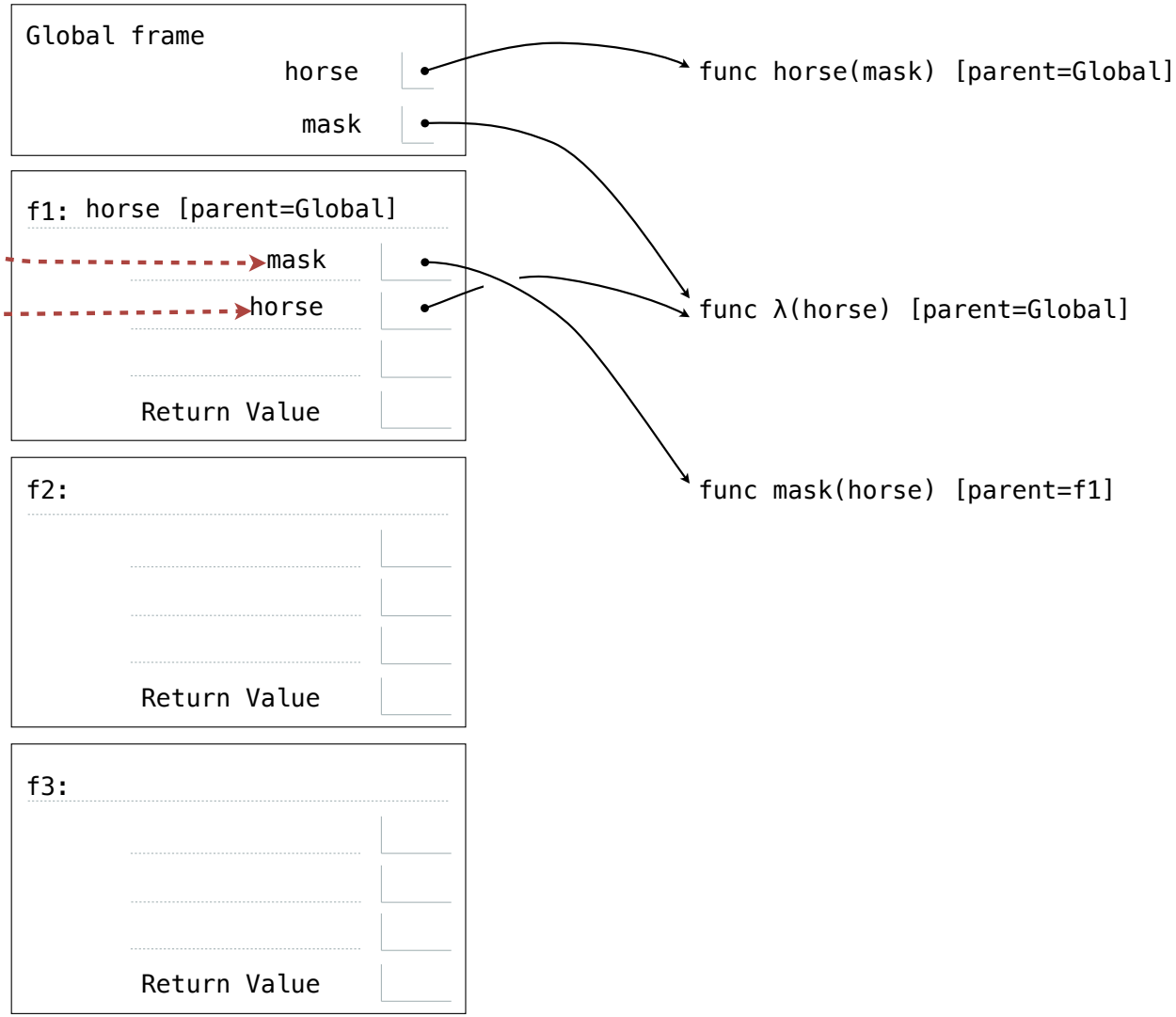

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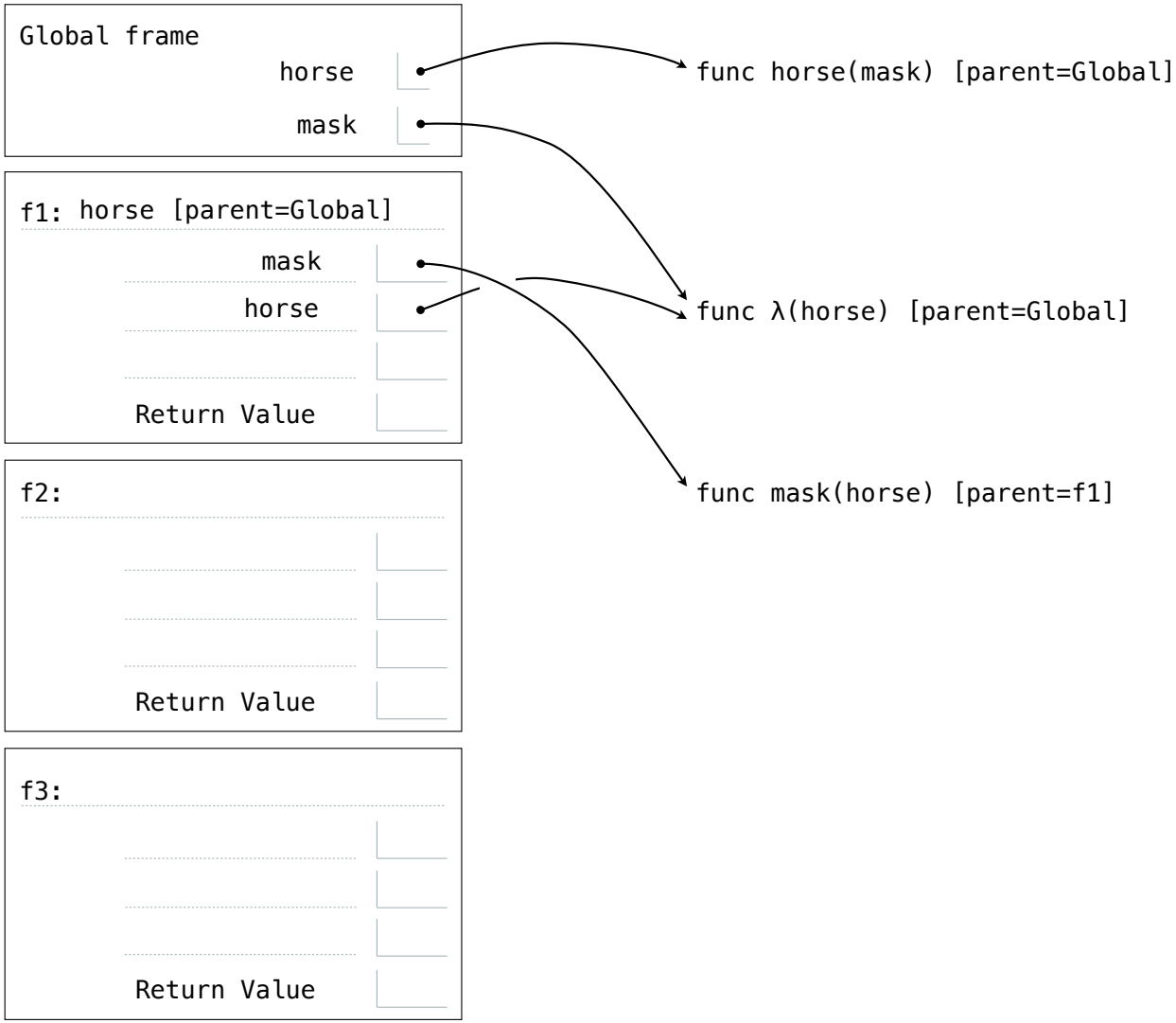

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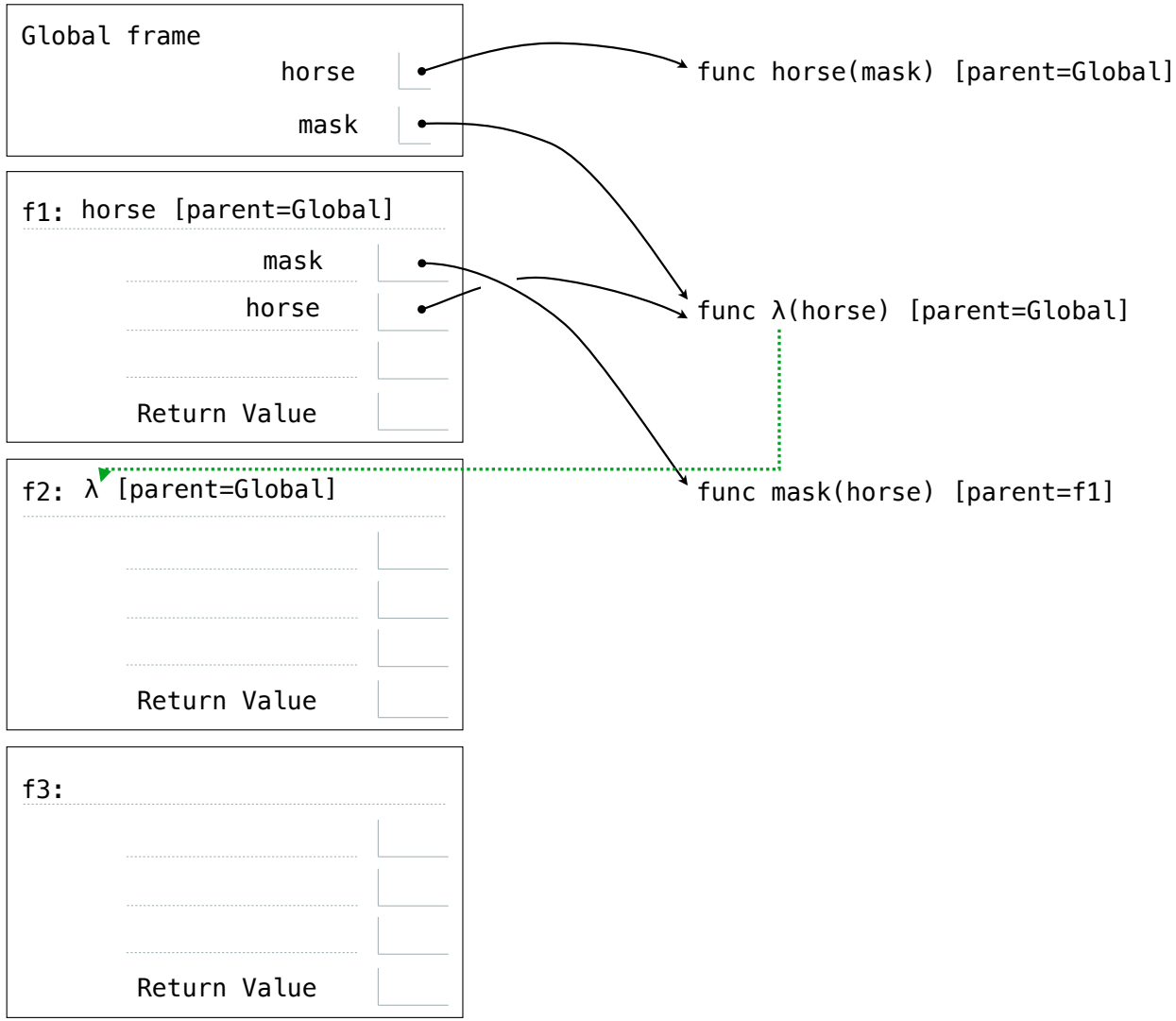

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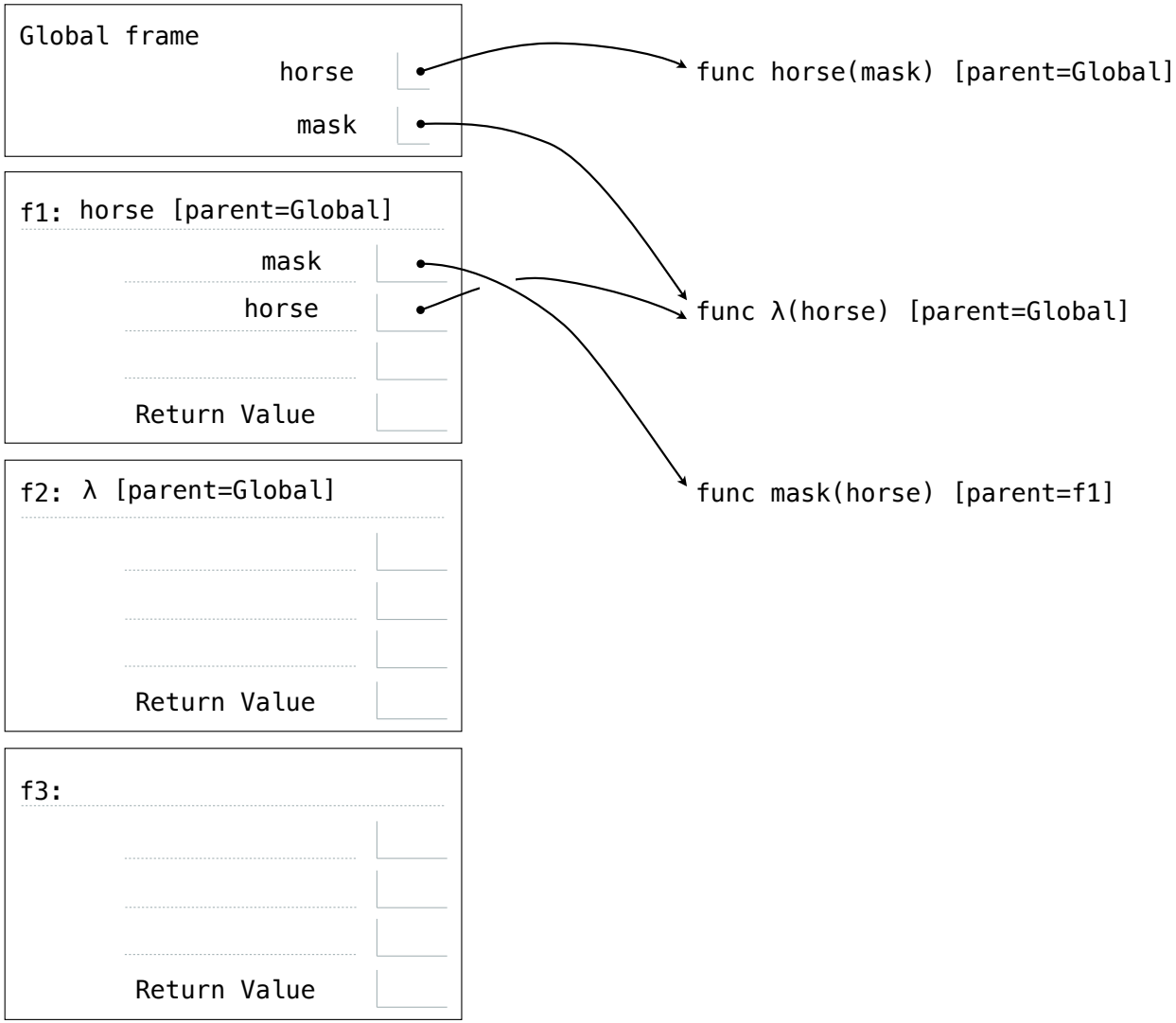

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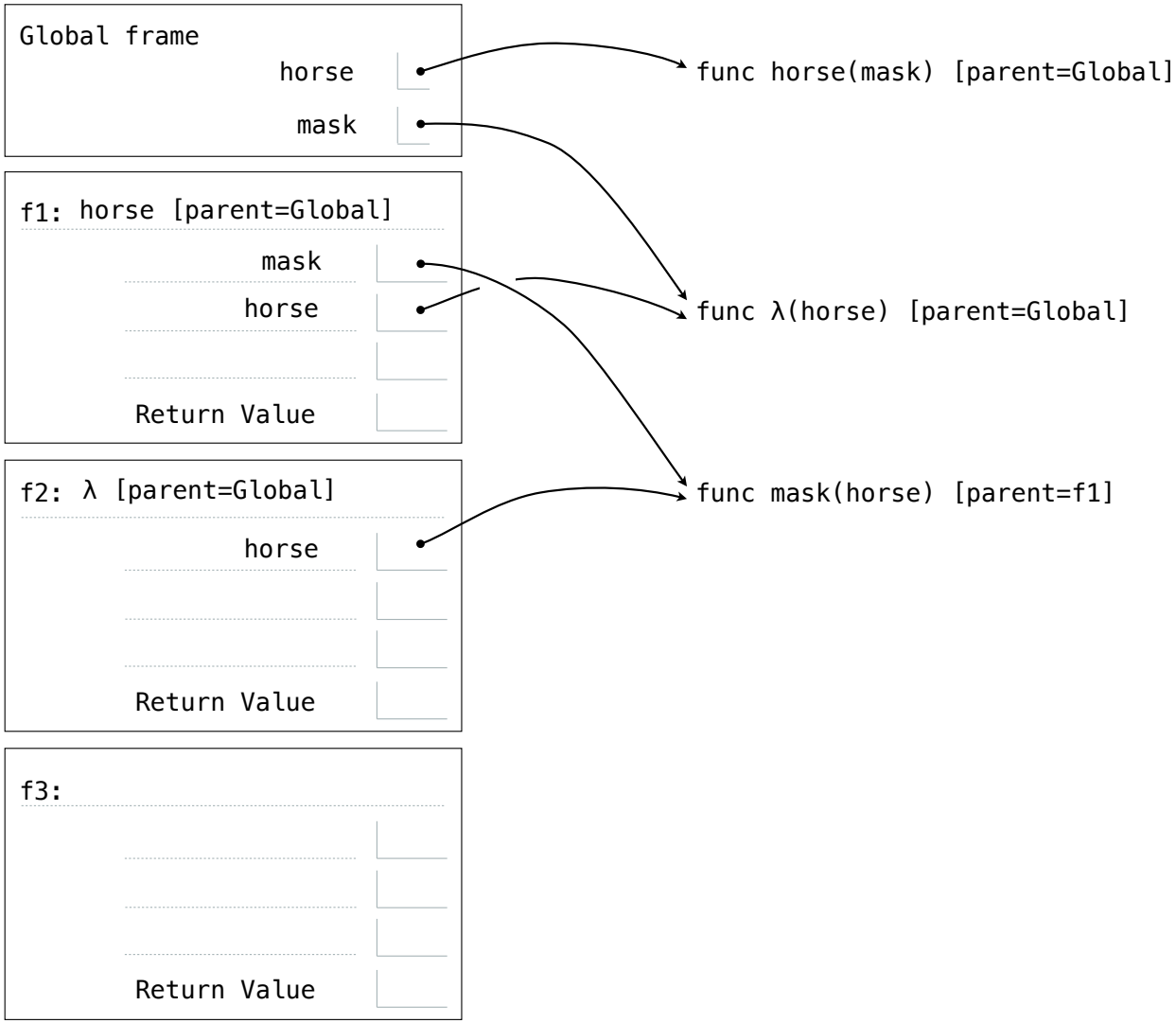

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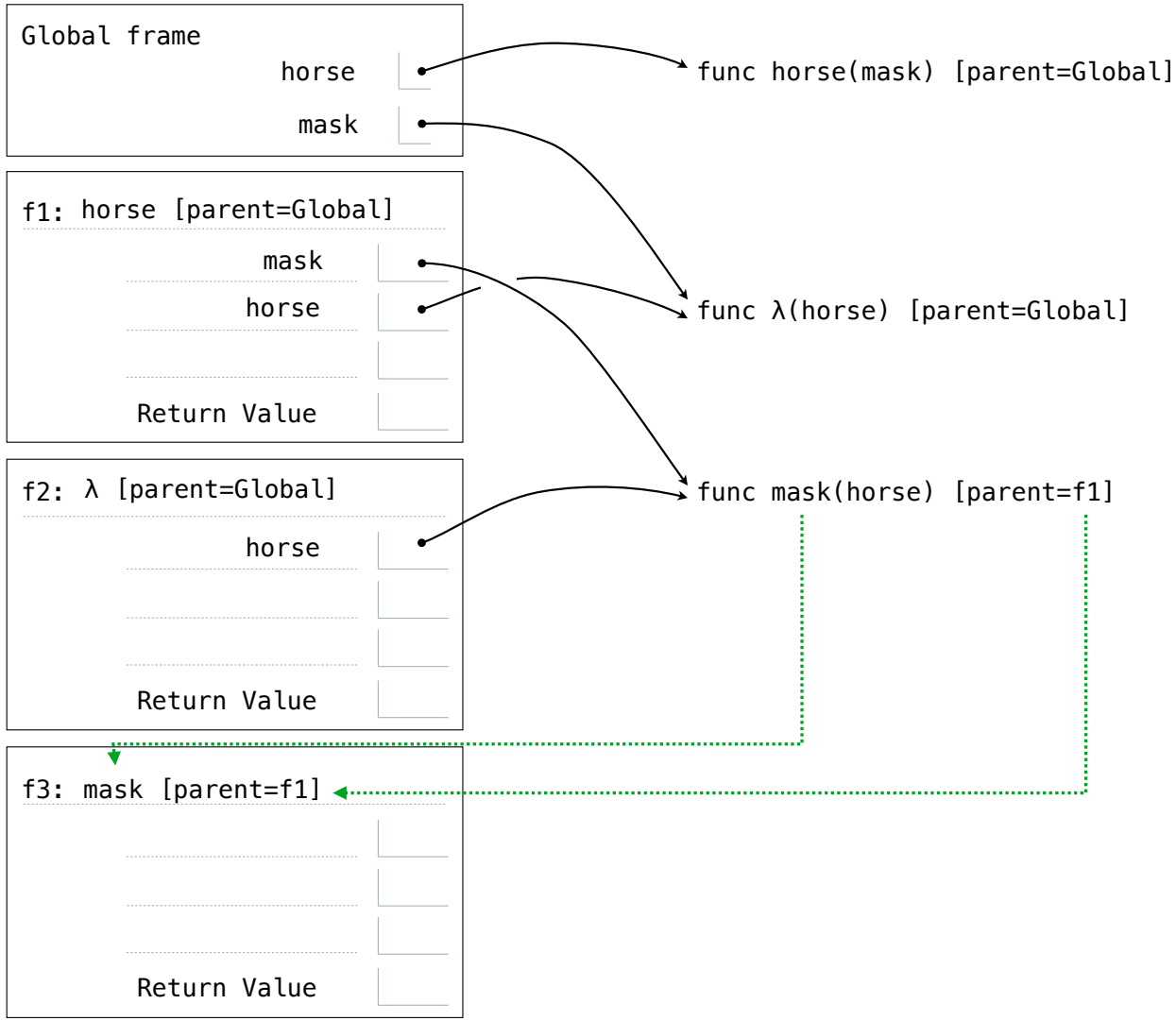

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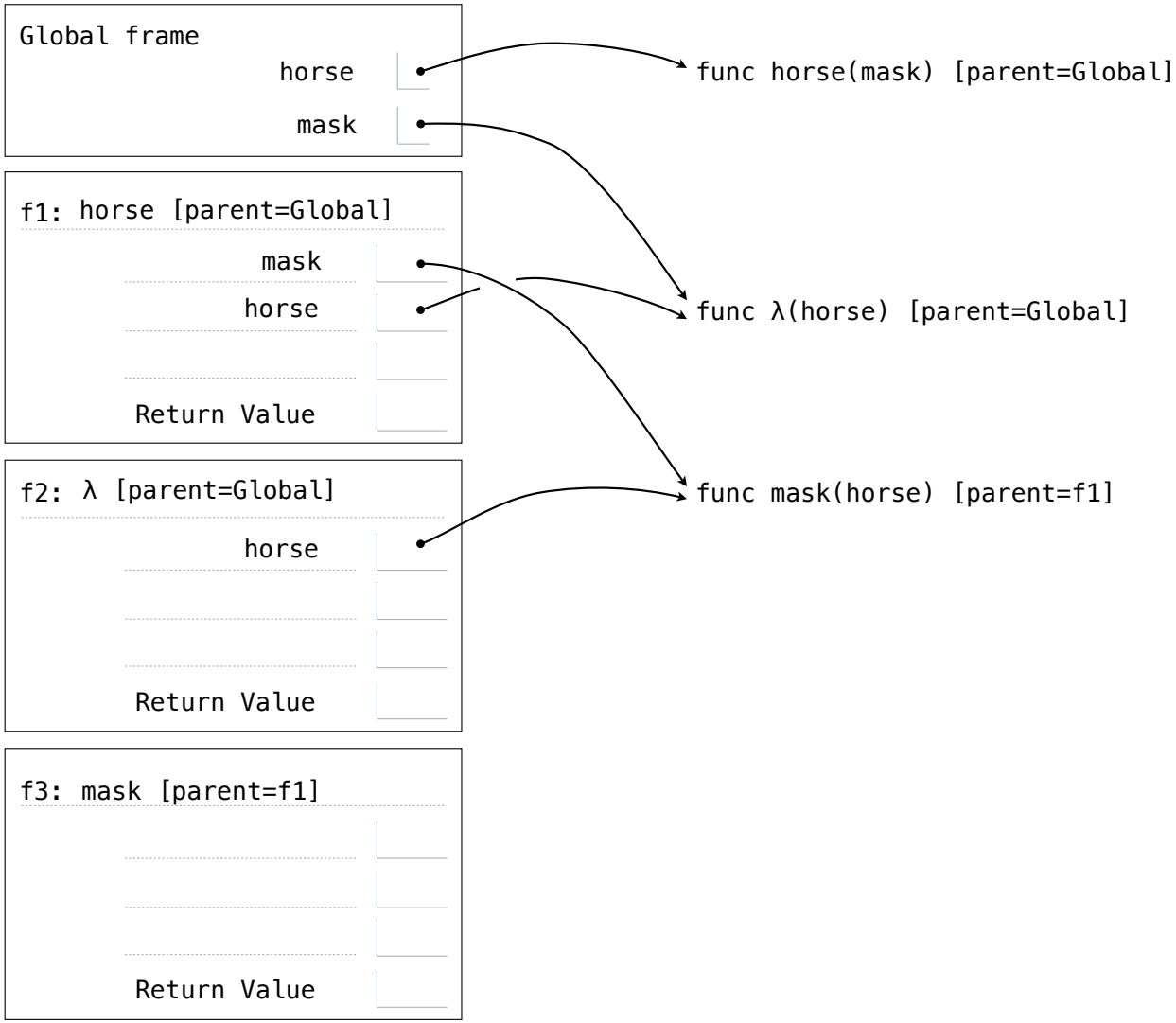

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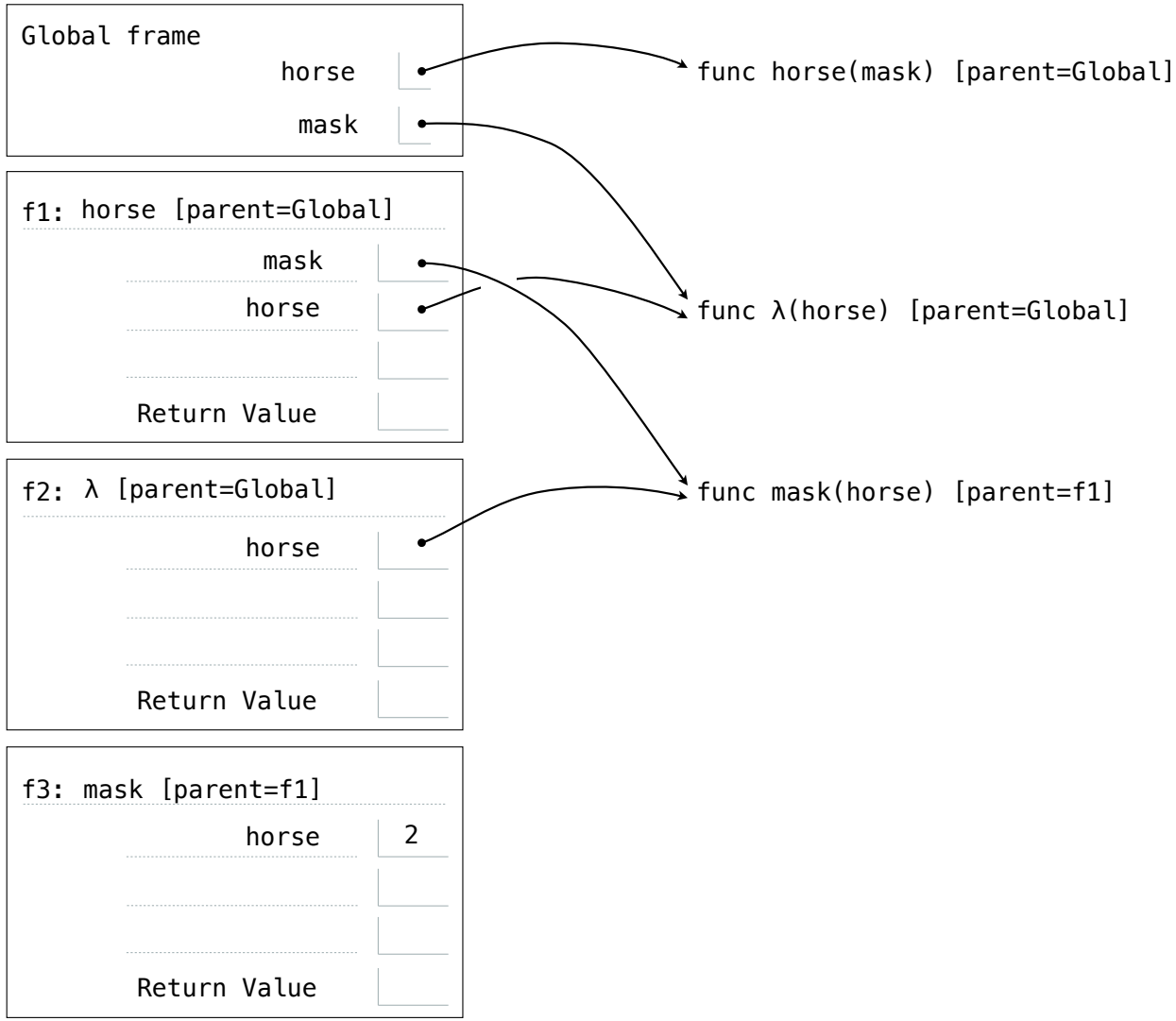

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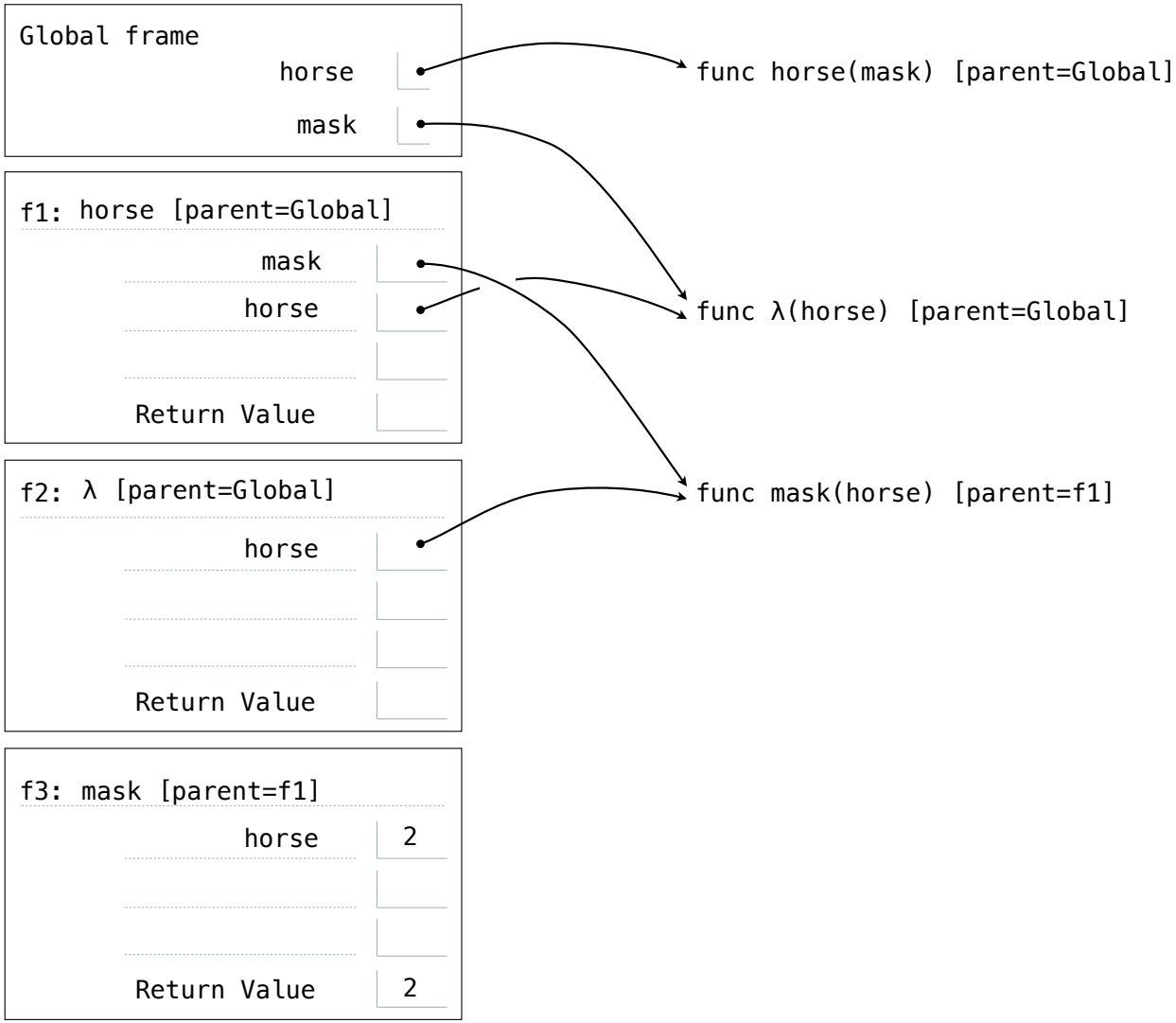

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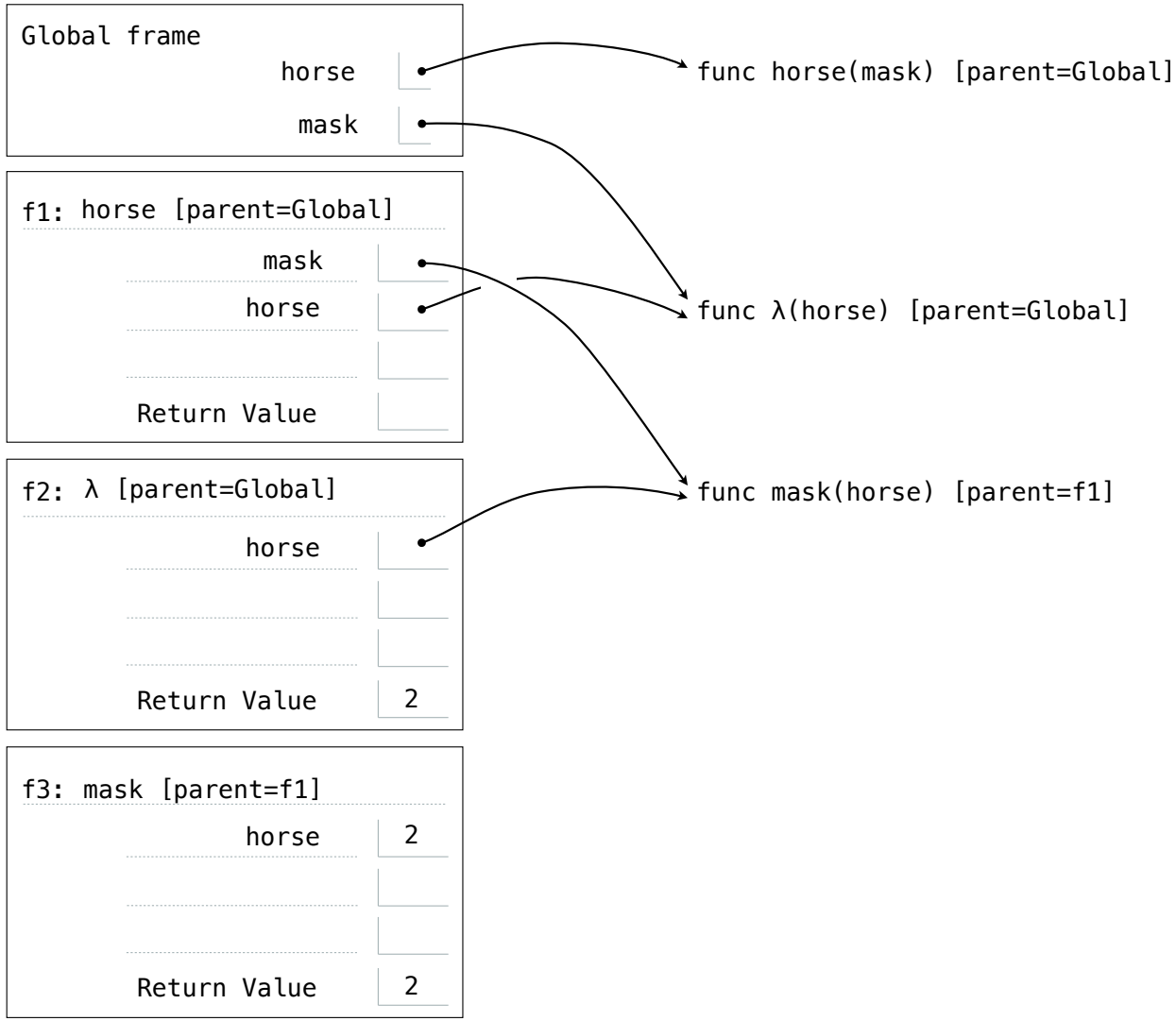

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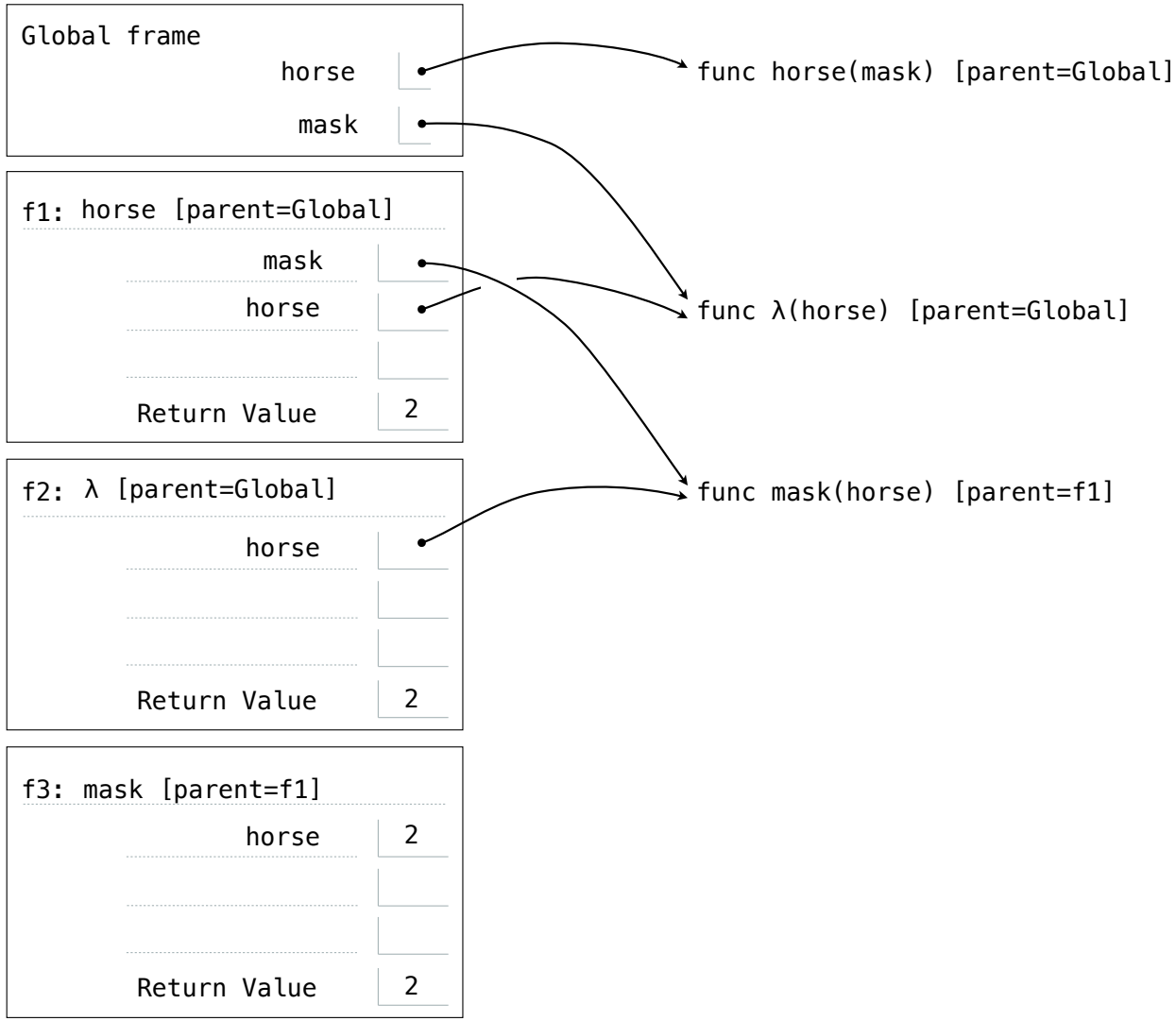

# Implementing Functions

## Implementing a Function

```
def remove(n, digit):
    """Return all digits of non-negative N
       that are not DIGIT, for some
       non-negative DIGIT less than 10.

    >>> remove(231, 3)
    21
    >>> remove(243132, 2)
    4313
    """
    kept, digits = 0, 0

    while ______________________________:

        n, last = n // 10, n % 10

        if ______________________________:

            kept = ______________________

            digits = ____________________

    return ______________________________
```

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            kept = ______________________

            digits = ____________________

    return ______________________________
```

Read the description

## Implementing a Function

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231

3

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    while ____n > 0____:

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            kept = ____kept + last____

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231

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        if ____________last != digit____________:

            kept = ____10*kept + last____

            digits = ____________________

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231

3

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231

4

21

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231

4

231

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            digits = ____digits + 1____

    return ____kept____
```

231

4

231

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231

4

231

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```

231

4

n > 0

last != digit

~~10*~~kept + last*10**digits

digits + 1

kept

231

```
   1
 + 30
 + 200
 ----
 231
```

Read the description

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231

3

21

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```

231

3

21

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```

231

3

21

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            digits = ____digits + 1____

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```

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3

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            digits = ____digits + 1____

    return ____round(kept * 10 ** (digits-1))____
```

231

3

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