Function Examples

Announcements

Review

What Would Python Display?

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```
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(separated by spaces) when it is called.
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def square(x):
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```

This expression	Evaluates to	Interactive Output
5	5	

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```
from operator import add, mul
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This expression	Evaluates to	Interactive Output
5	5	5

What Would Python Display?

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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)`		

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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	

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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)
```

This expression	Evaluates to	Interactive Output
`5`	5	5
`print(5)`	None	5

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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
`print(print(5))`		

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This expression	Evaluates to	Interactive Output
`5`	`5`	`5`
`print(5)`	`None`	`5`
`print(print(5))`	`None`	

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`5`	`5`	`5`
`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`

print(print(5)) → None

```
def delay(arg):
    print('delayed')
    def g():
        return arg
    return g
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`5`	`5`	`5`
`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`

`None`

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def delay(arg):
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Names in nested def statements can refer to their enclosing scope

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

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

`print(print(5))` → `None`

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This expression	Evaluates to	Interactive Output
`5`	`5`	`5`
`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`
`delay(delay)()(6)()`		

`print(5)` → None

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`delay(delay)()(6)()`		`delayed` `delayed`

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		`delayed`
		`6`

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`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`

`delay(delay)()(6)()`	`6`	`delayed`
		`delayed`
		`6`

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This expression	Evaluates to	Interactive Output
`5`	`5`	`5`
`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`

`delay(delay)()(6)()`	`6`	`delayed`
		`delayed`
		`6`

`print(delay(print)()(4))`		

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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` `None`

`delay(delay)()(6)()`	`6`	`delayed`
		`delayed`
		`6`

`print(delay(print)()(4))`		`delayed`

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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` `None`

`delay(delay)()(6)()`	`6`	`delayed`
		`delayed`
		`6`

`print(delay(print)()(4))`		`delayed` `4`

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`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`

`delay(delay)()(6)()`	`6`	`delayed`
		`delayed`
		`6`

`print(delay(print)()(4))`		`delayed`
		`4`
		`None`

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`5`	`5`	`5`
`print(5)`	`None`	`5`
`print(print(5))`	`None`	`5` `None`

`delay(delay)()(6)()`	`6`	`delayed`
		`delayed`
		`6`

`print(delay(print)()(4))`	`None`	`delayed`
		`4`
		`None`

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This expression	Evaluates to	Interactive Output

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

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def pirate(arggg):
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    return plunder
```

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

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

```
def pirate(arggg):
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```

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

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def pirate(arggg):
    print('matey')
    def plunder(arggg):
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This expression	Evaluates to	Interactive Output
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This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`		Matey

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

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```

This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`		Matey
`pirate(3)`	*func square(x)*	

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This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`		Matey
func square(x)		

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```

This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`		Matey
`pirate(3)(square)`	*func square(x)*	
`pirate(3)(square)(4)`	*16*	

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This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`		Matey 17
`pirate(3)`	*func square(x)*	
`pirate(3)(square)(4)`	*16*	

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```

This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`	17	Matey 17

func square(x)

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This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)` *func square(x)* *16*	17	Matey 17
`pirate(pirate(pirate))(5)(7)`		

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This expression	Evaluates to	Interactive Output
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`add(pirate(3)(square)(4), 1)` *func square(x)* *16*	17	Matey 17
`pirate(pirate(pirate))(5)(7)` *Identity function*		Matey

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This expression	Evaluates to	Interactive Output
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`pirate(pirate(pirate))(5)(7)`		Matey Matey

func square(x)

16

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    def plunder(arggg):
        return arggg
    return plunder
```

This expression	Evaluates to	Interactive Output
`add(pirate(3)(square)(4), 1)`	17	Matey 17
`pirate(pirate(pirate))(5)(7)`		Matey Matey

func square(x)

16

Identity function

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

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mask = lambda horse: horse(2)

horse(mask)
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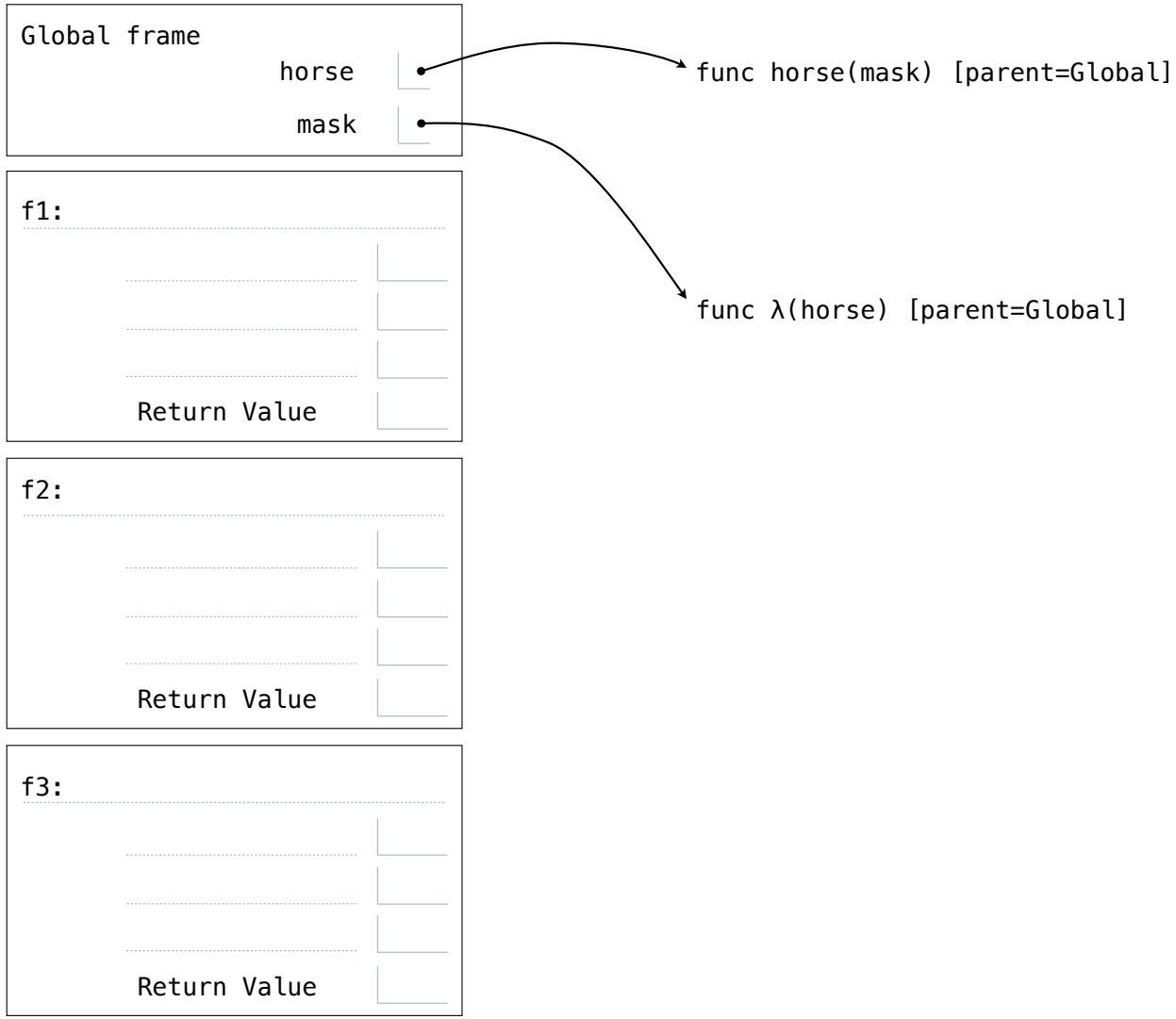

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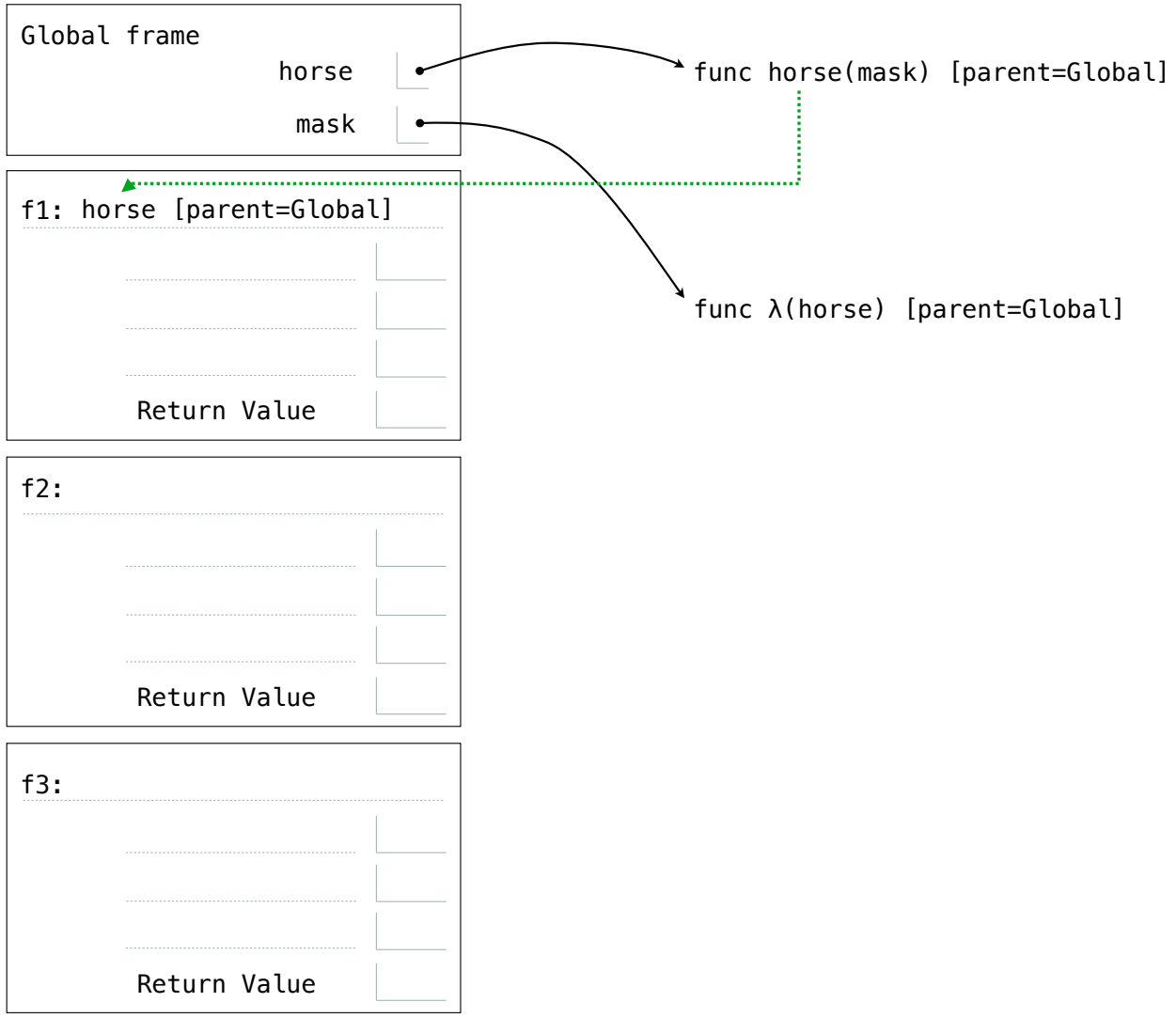

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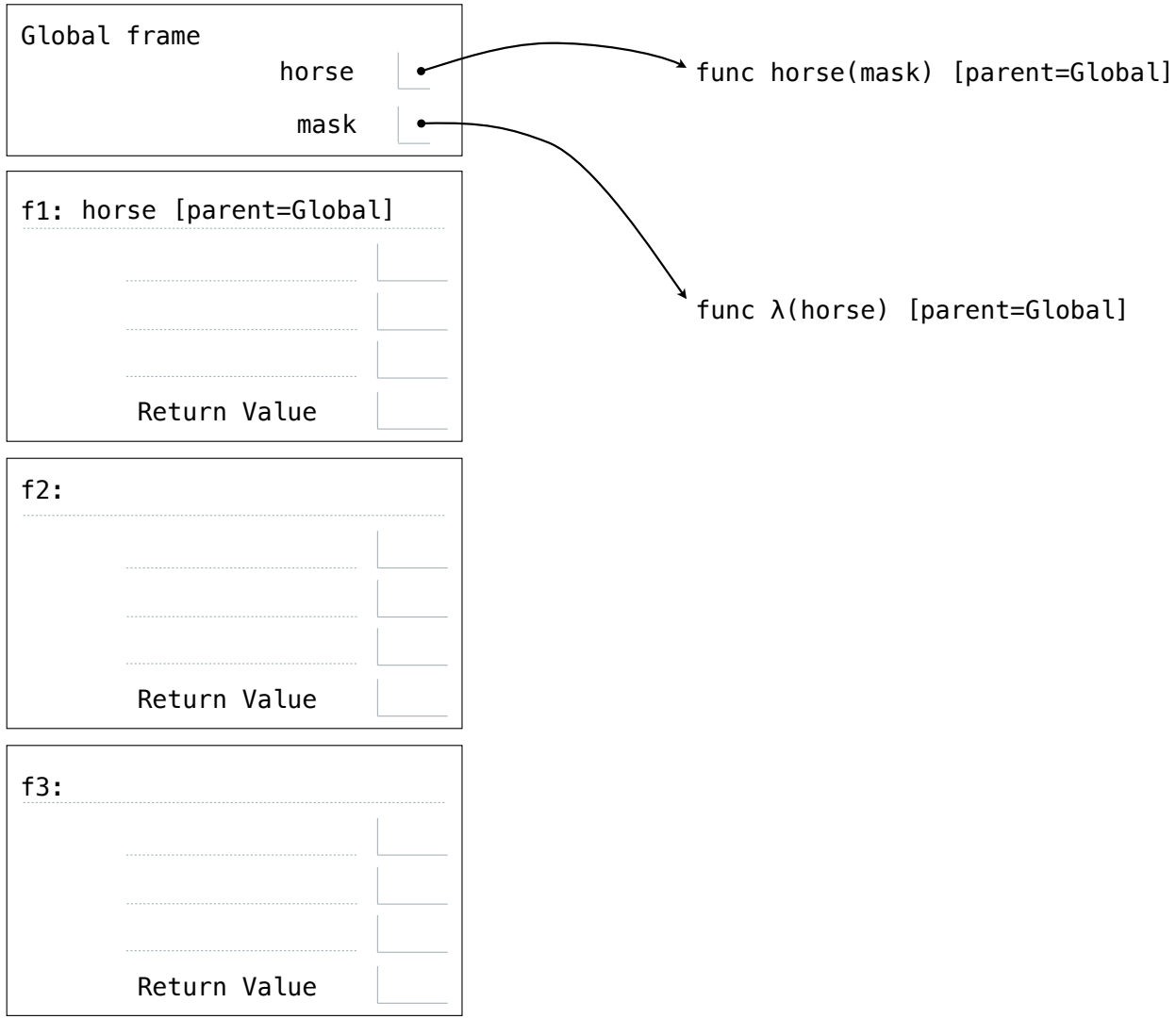

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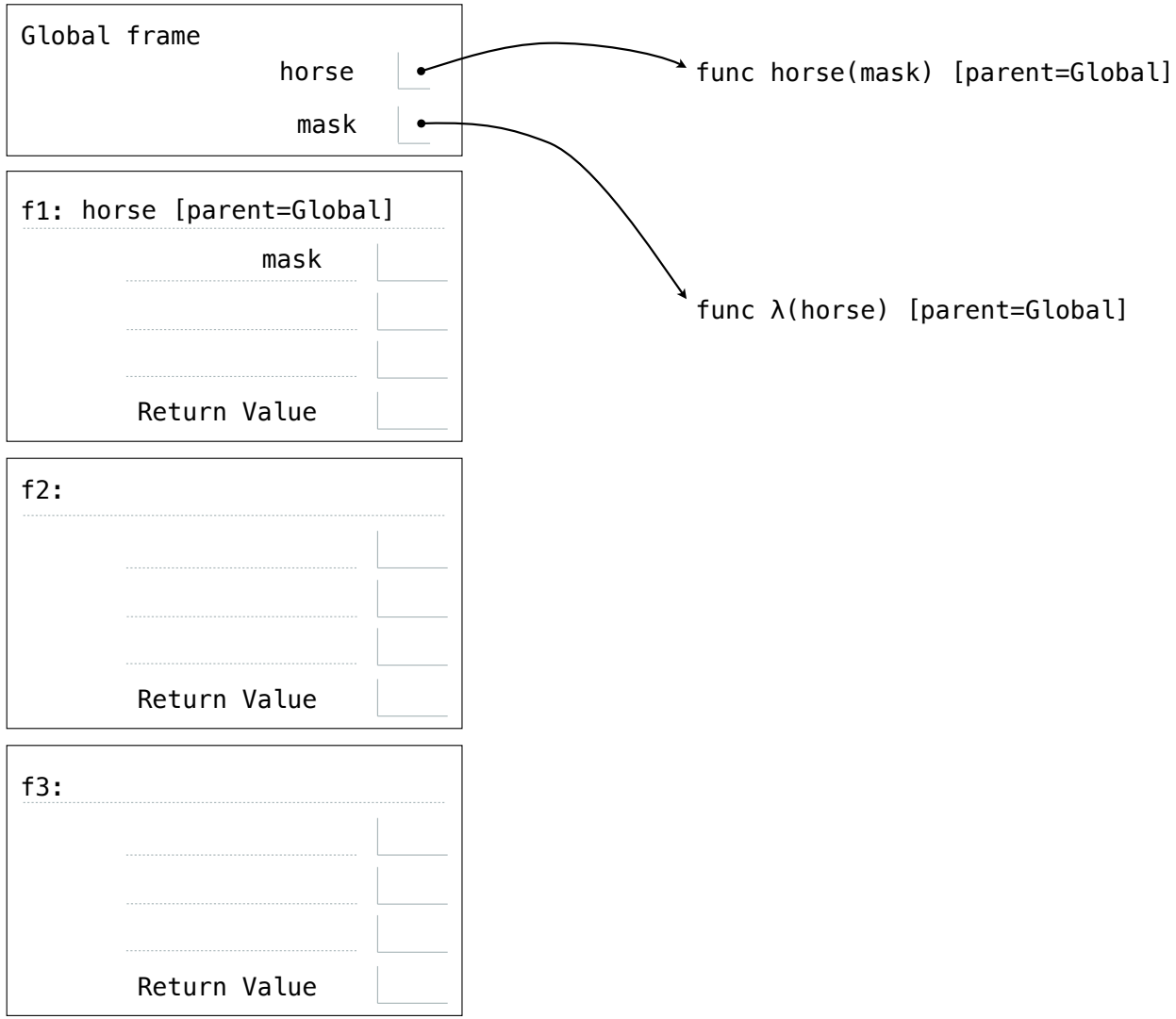

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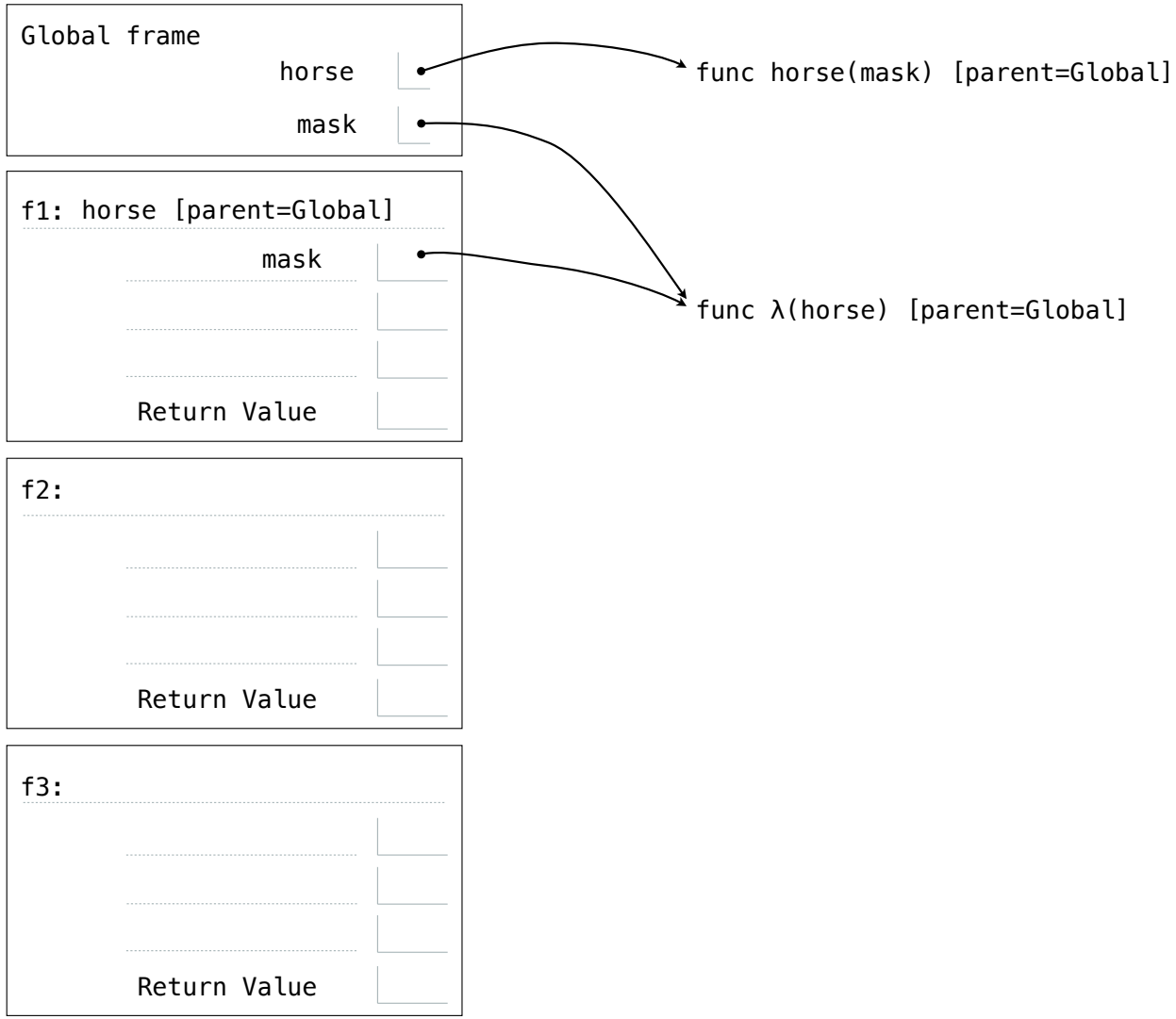

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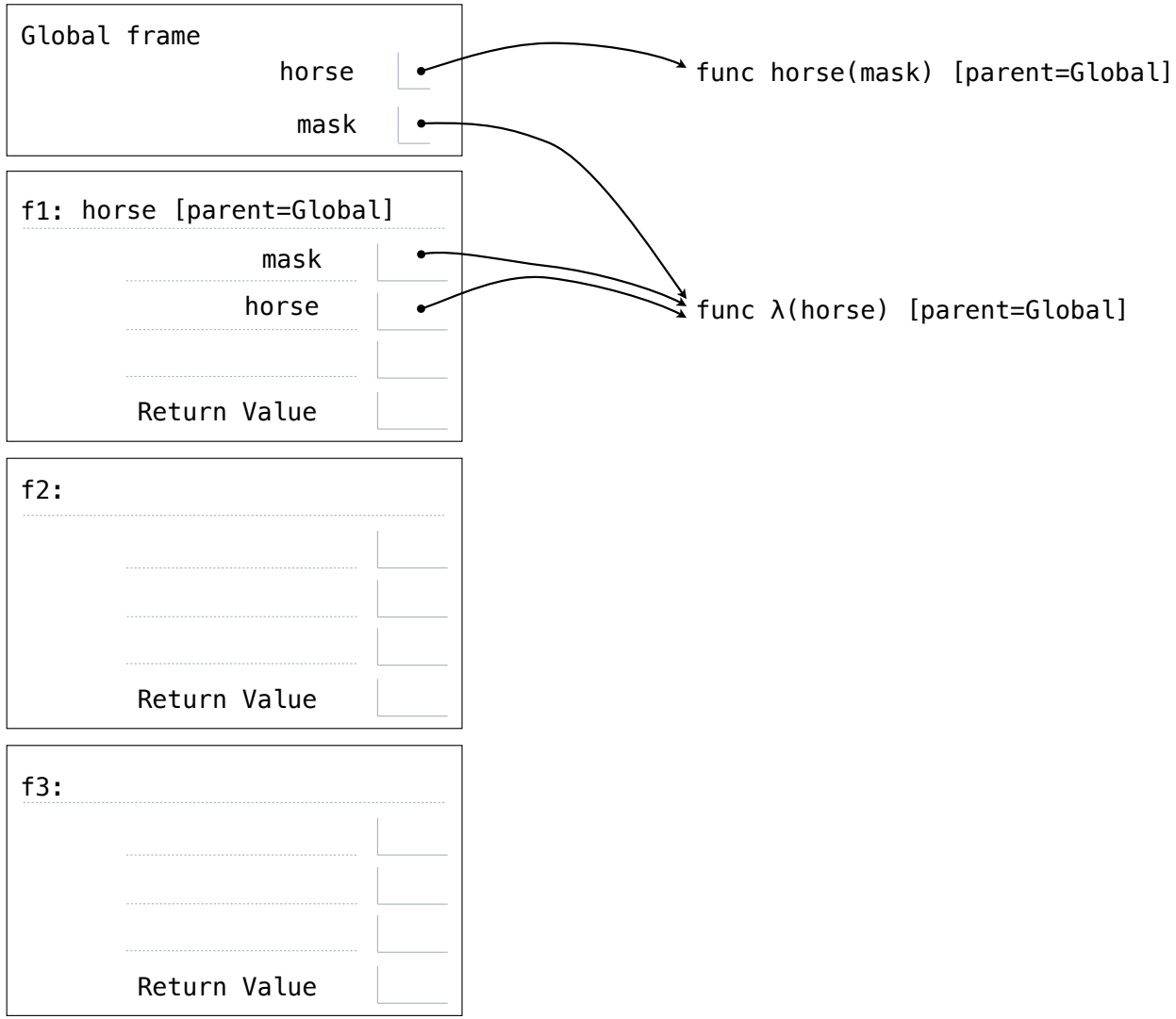

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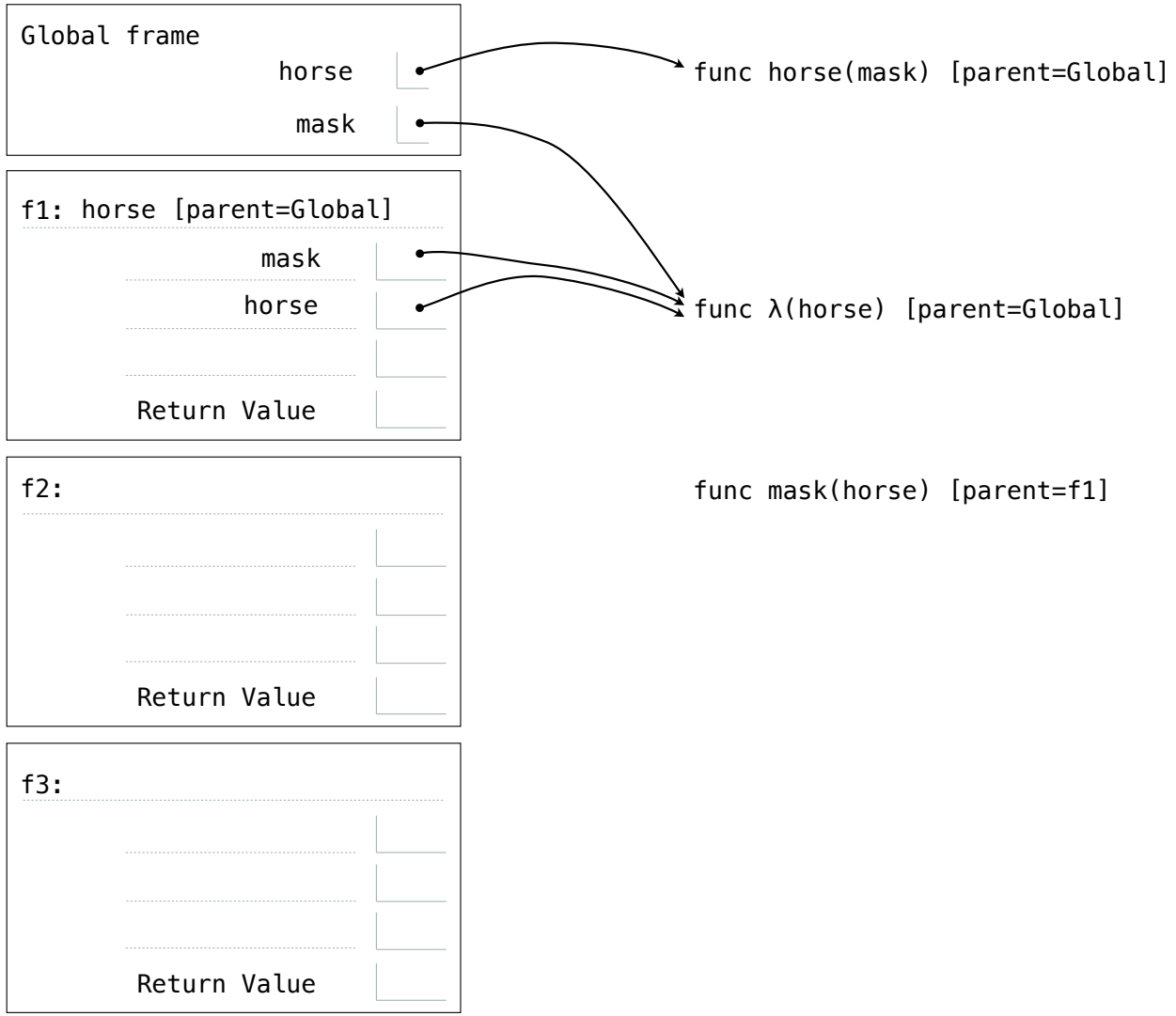

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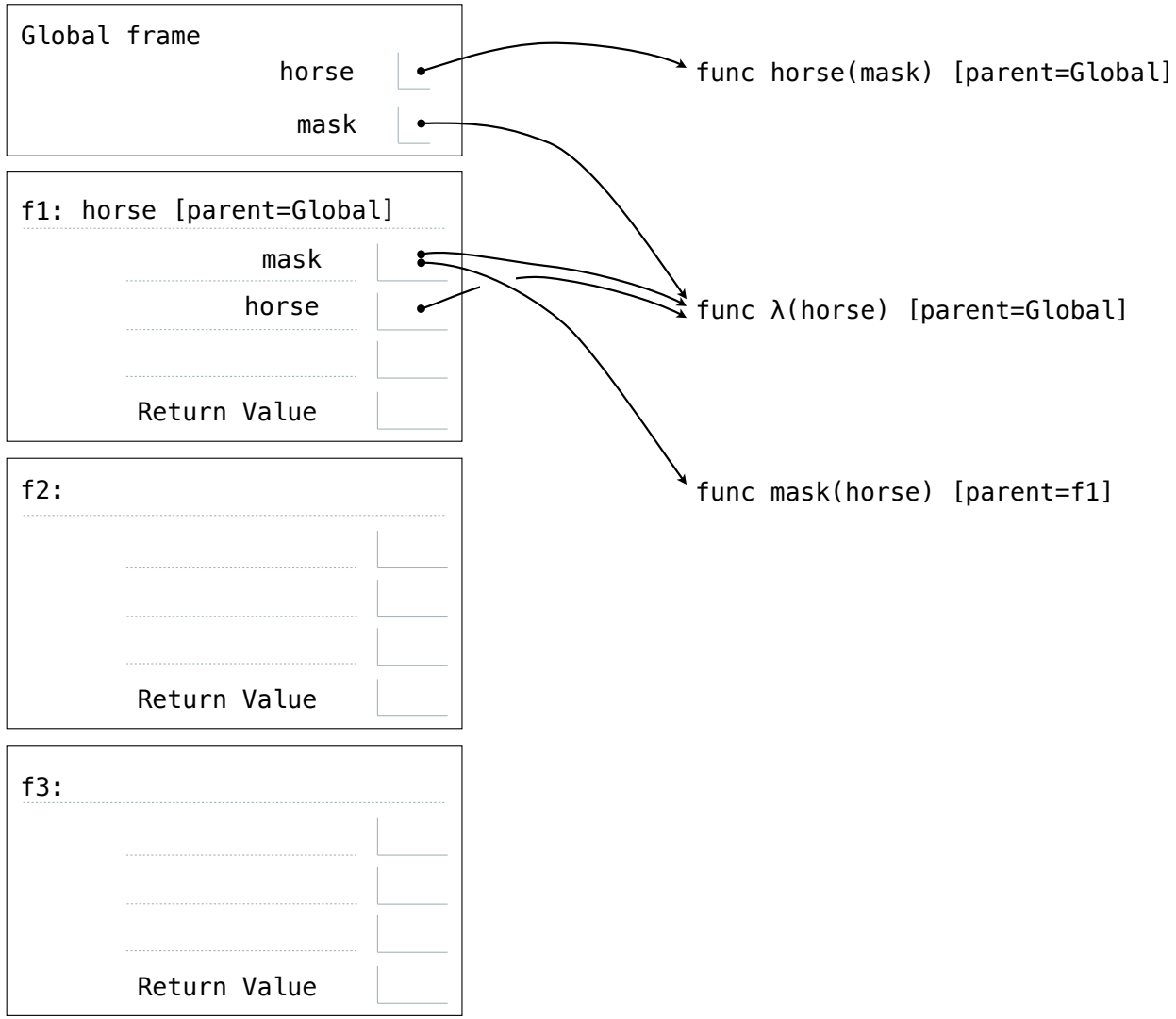

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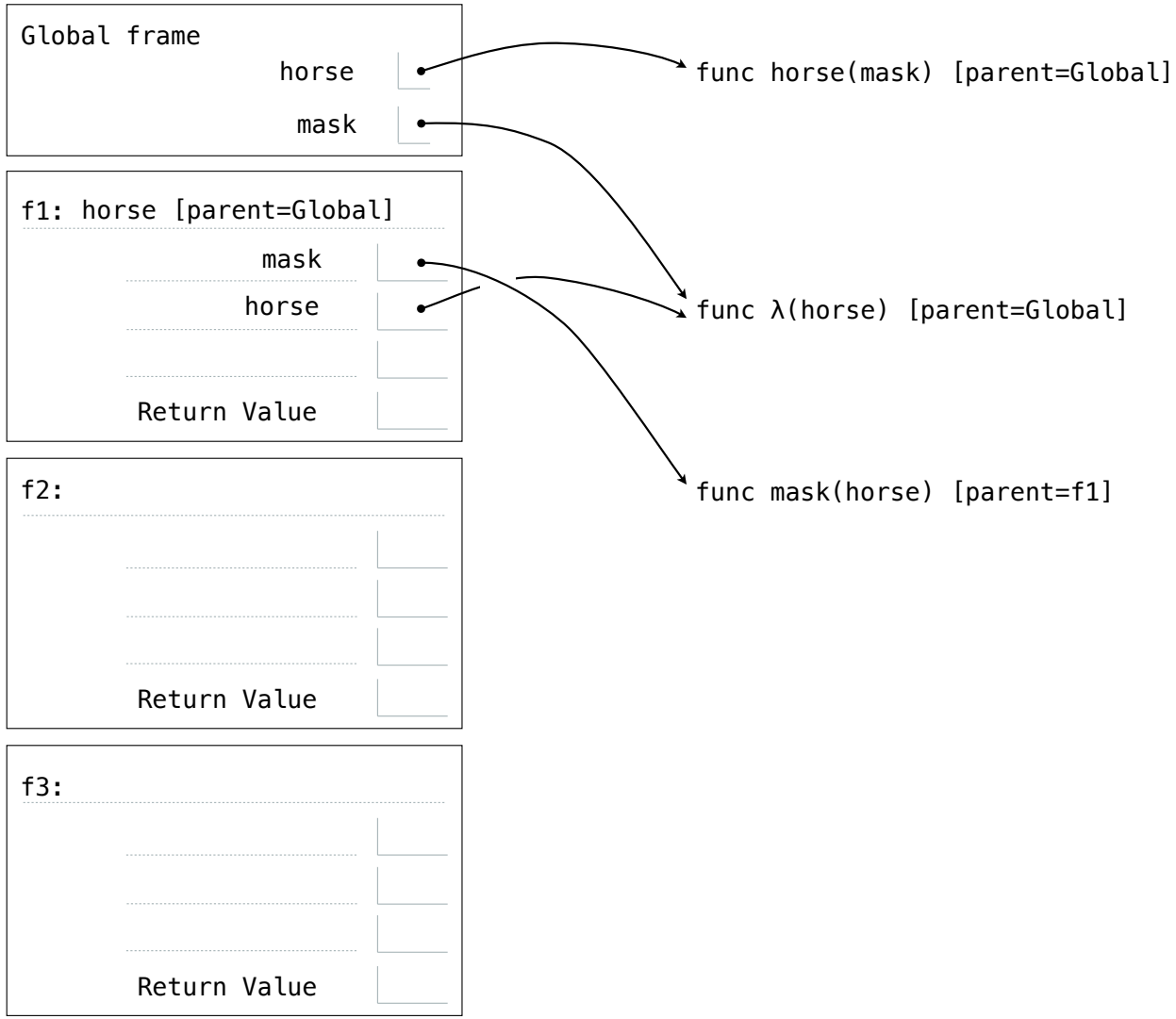

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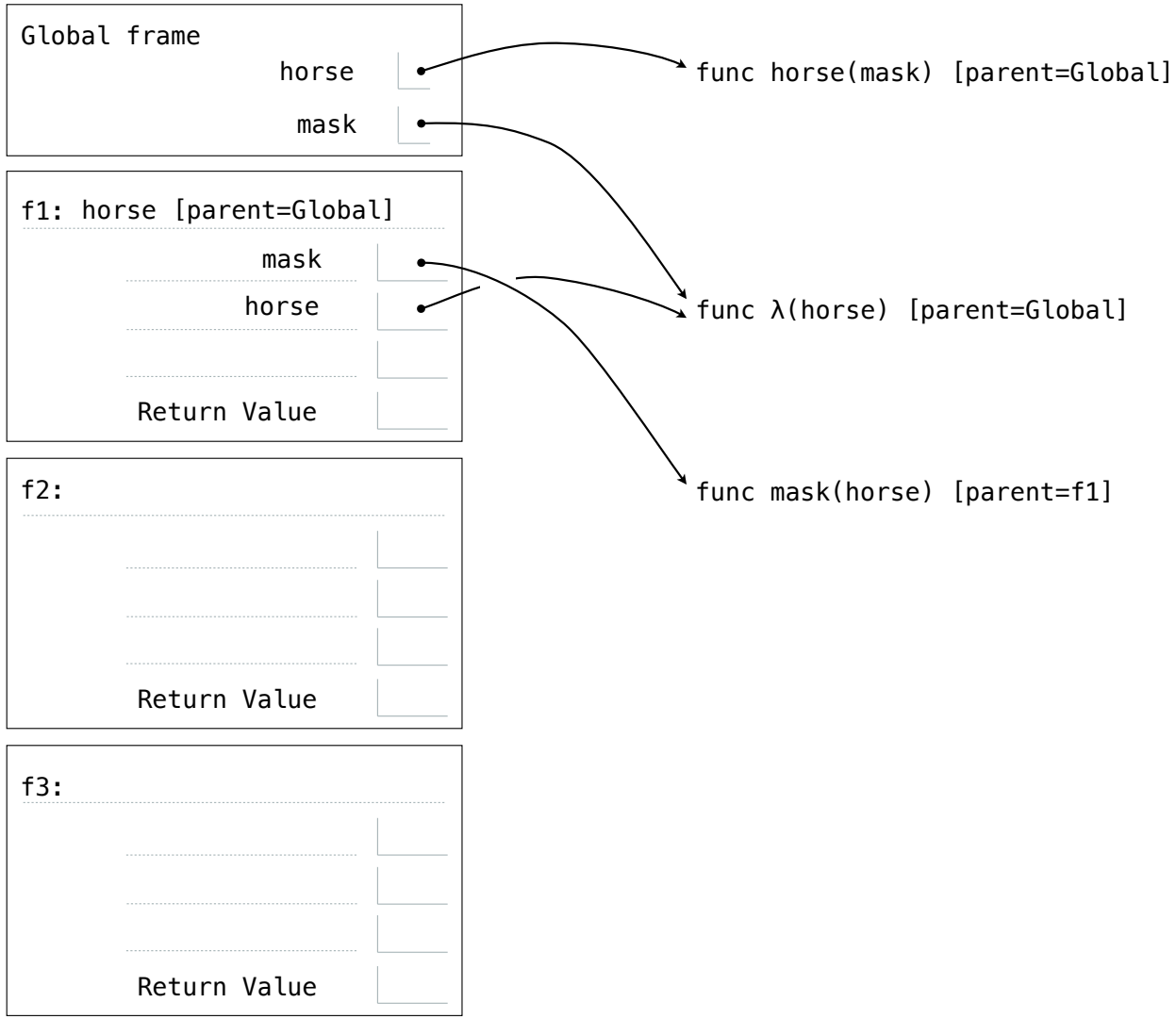

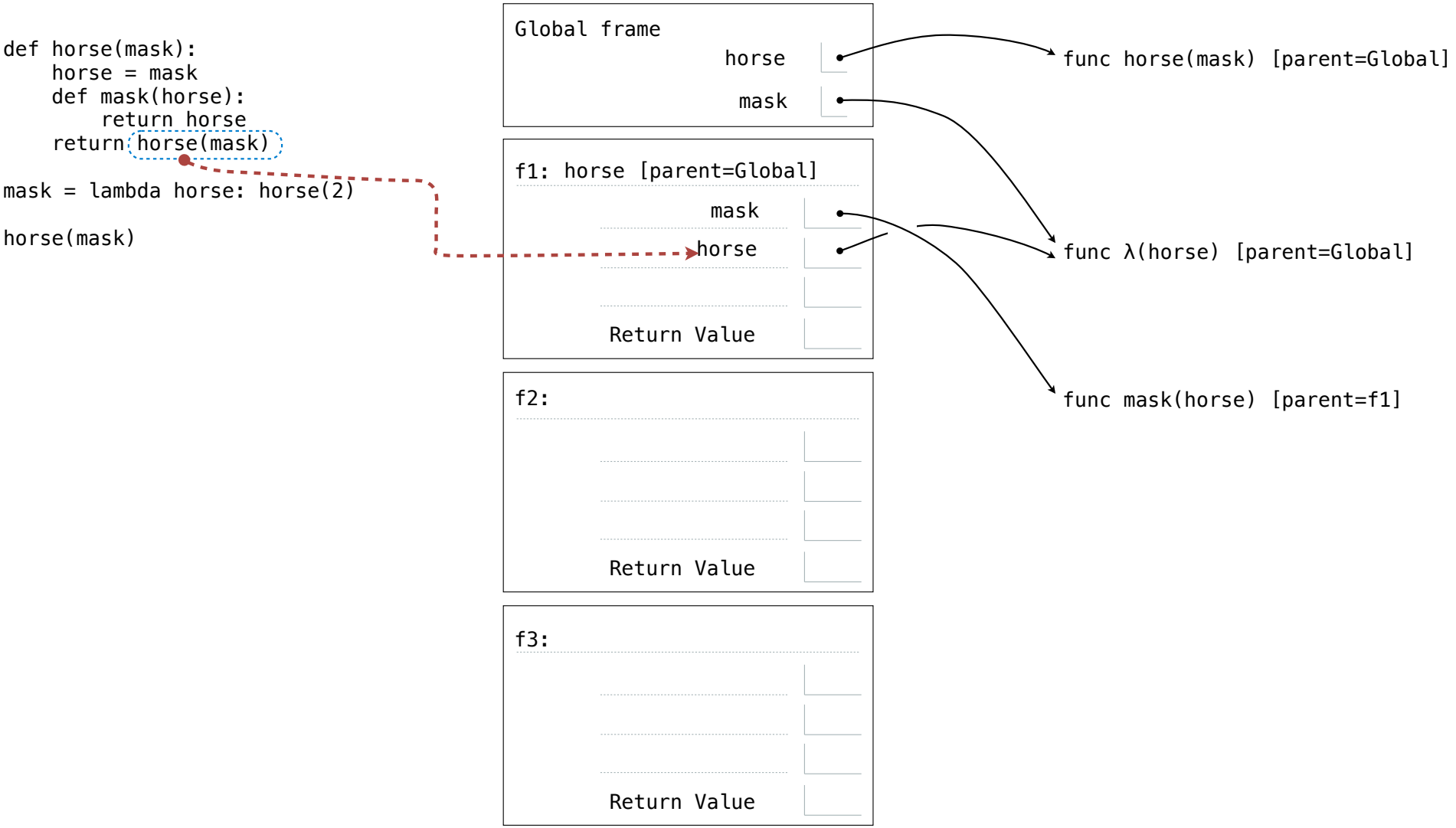
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Global frame
horse
mask
func horse(mask) [parent=Global]
f1: horse [parent=Global]
mask
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f2:
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f3:
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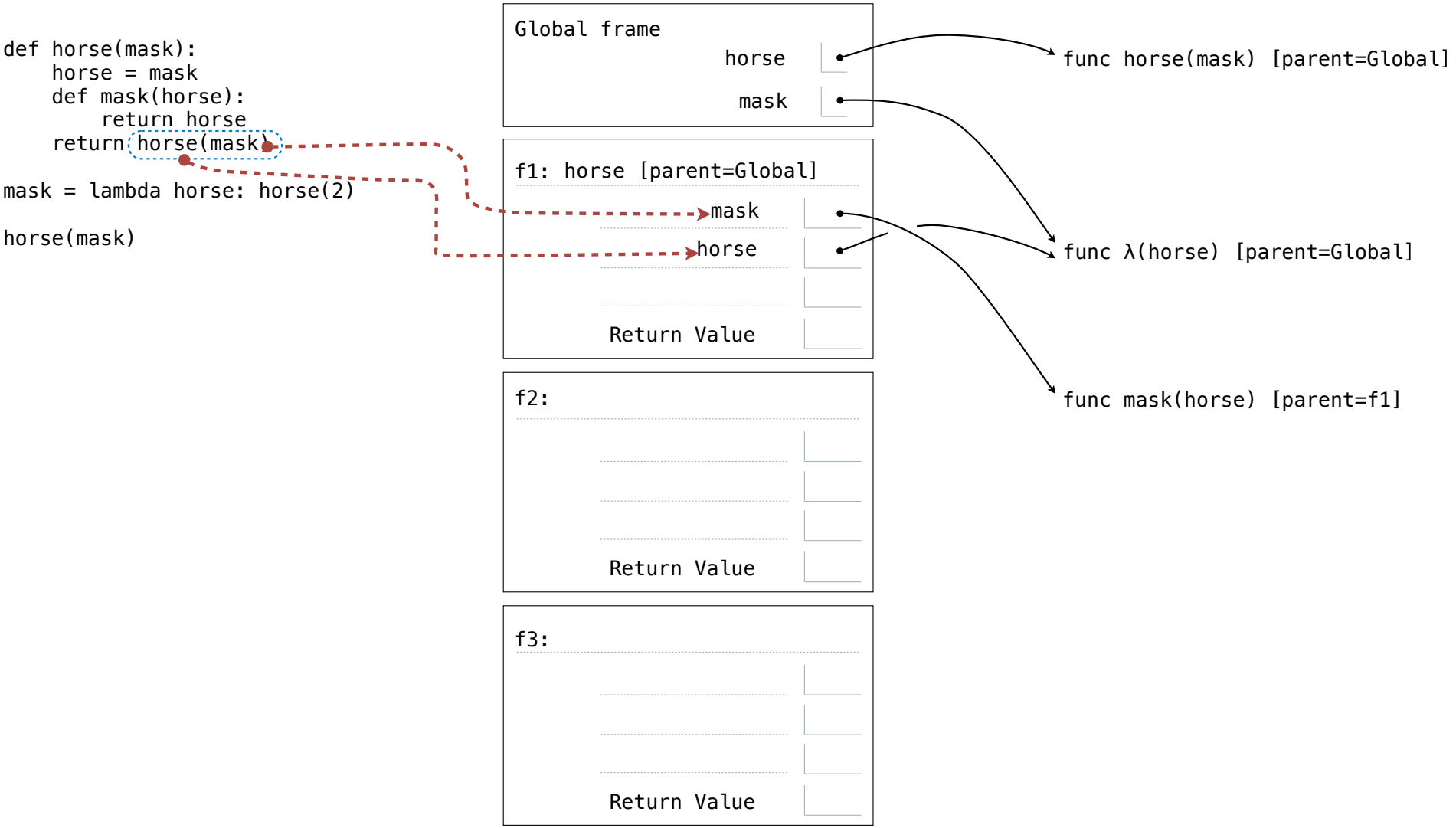
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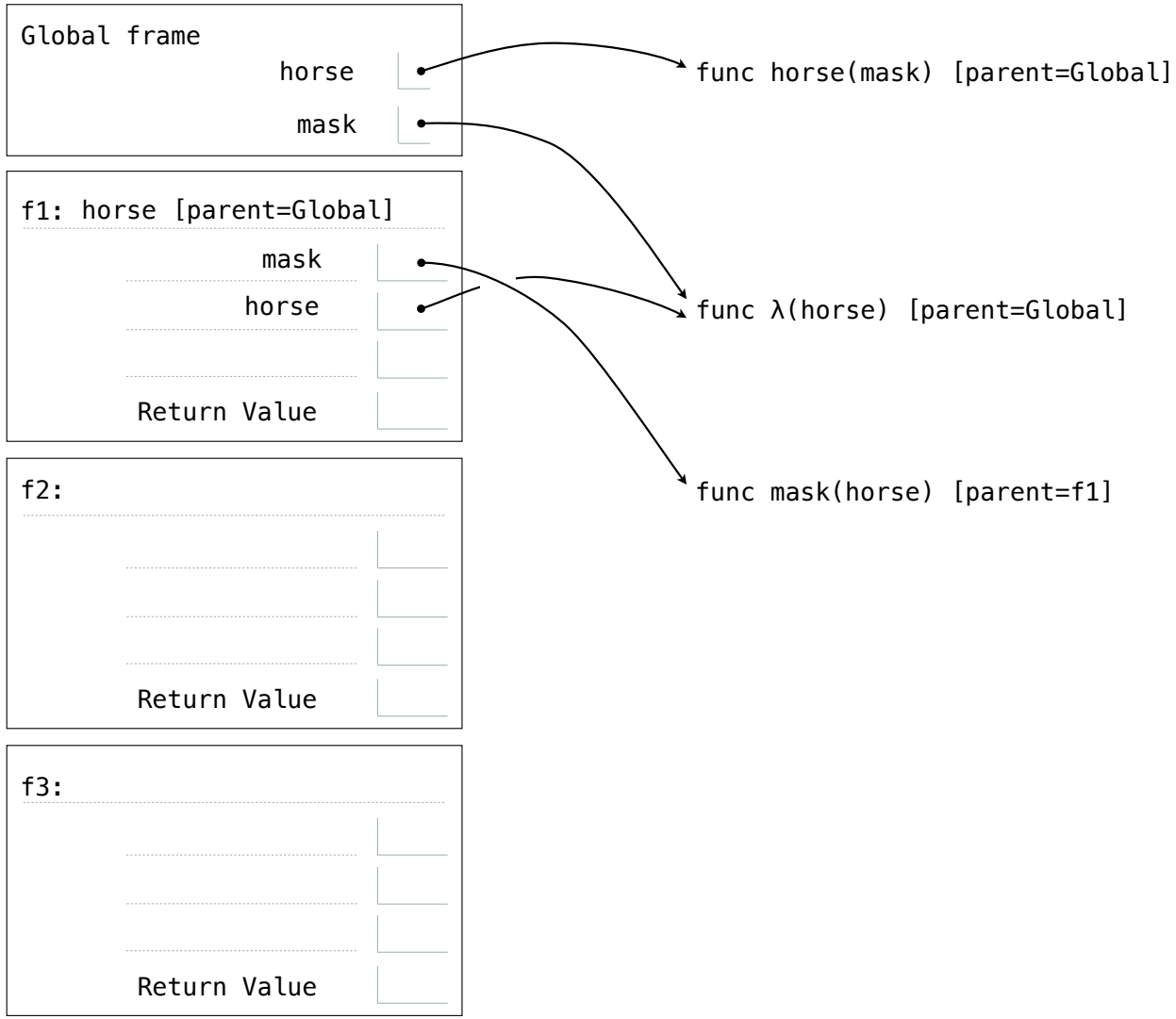

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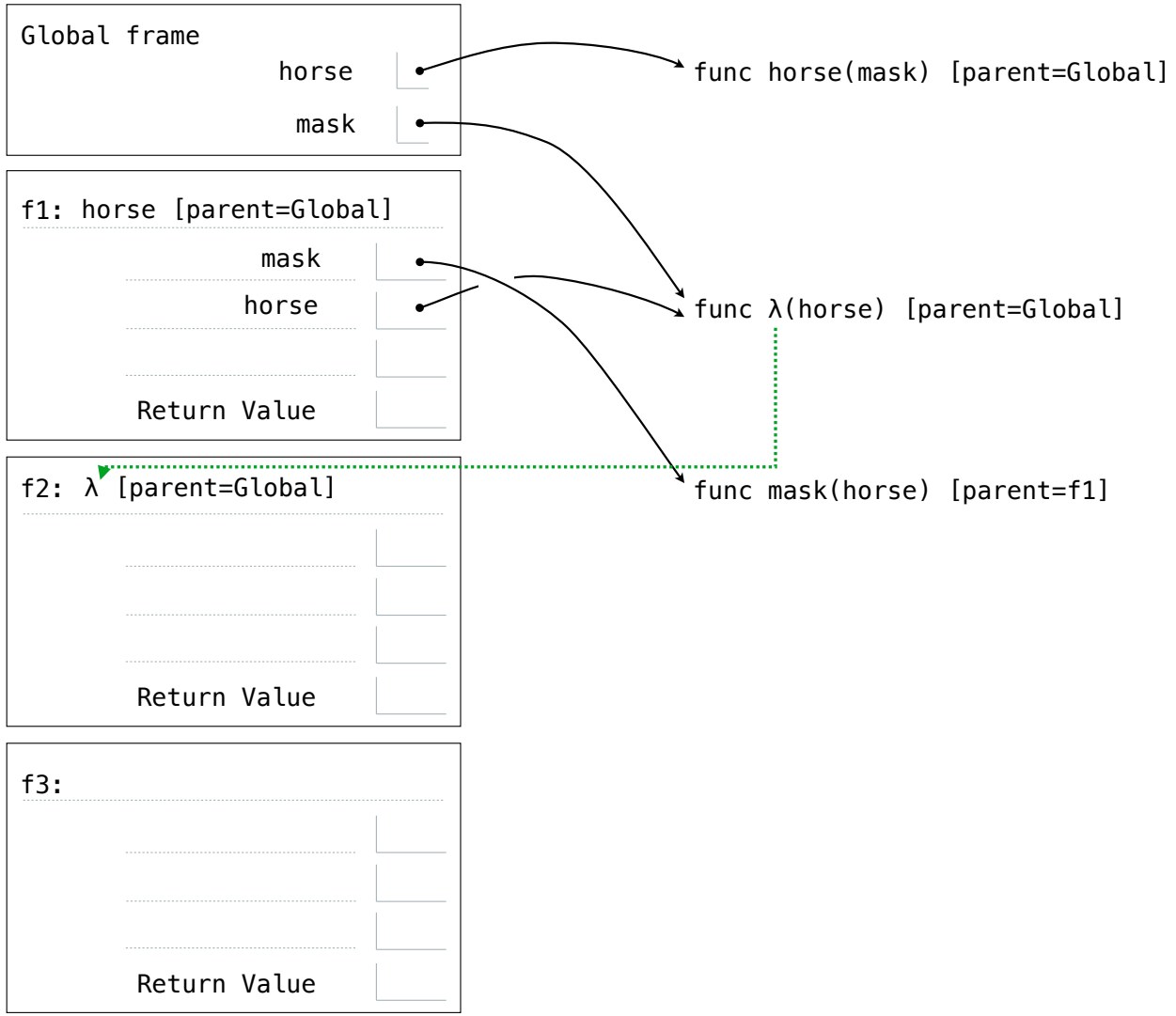

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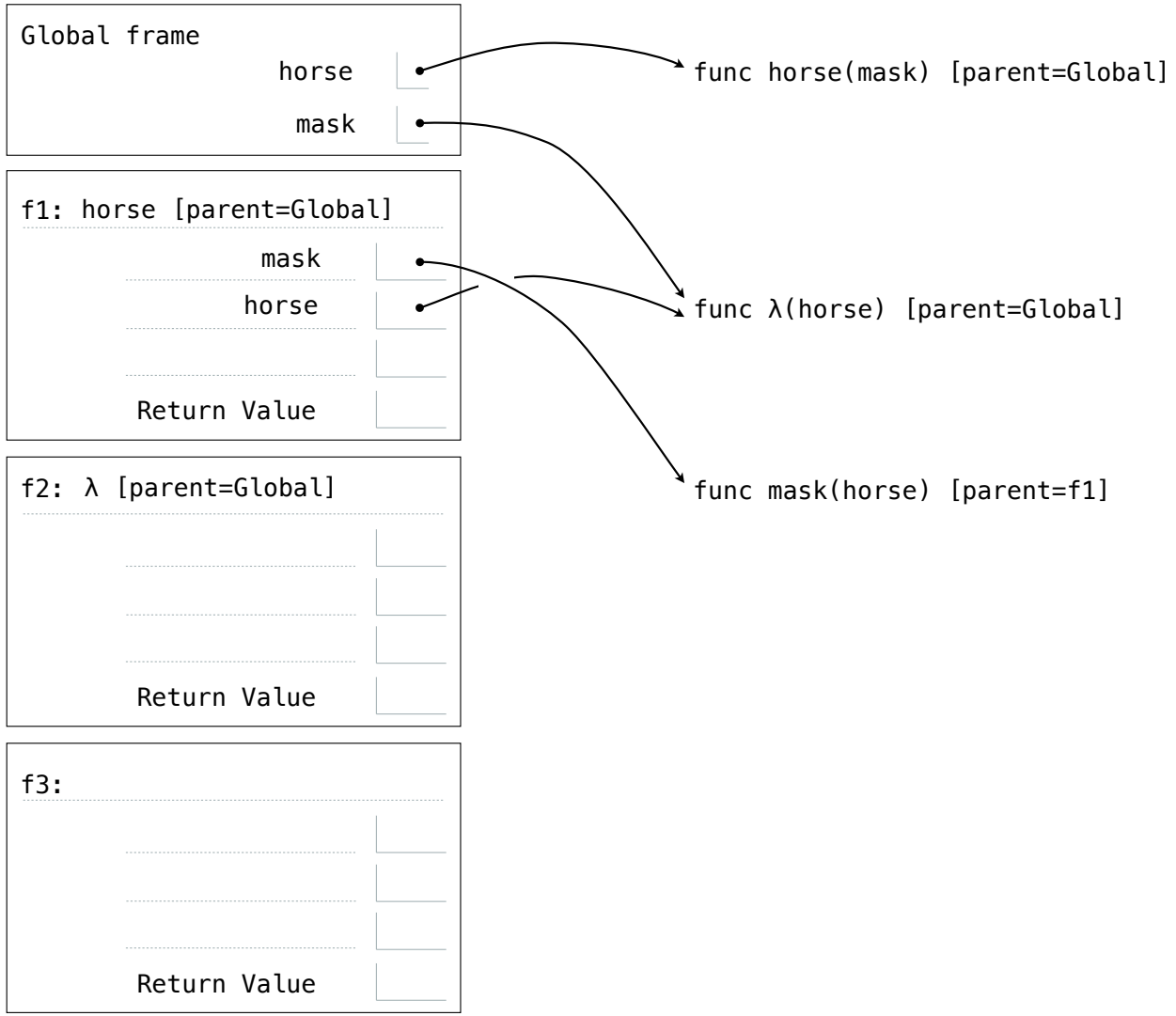

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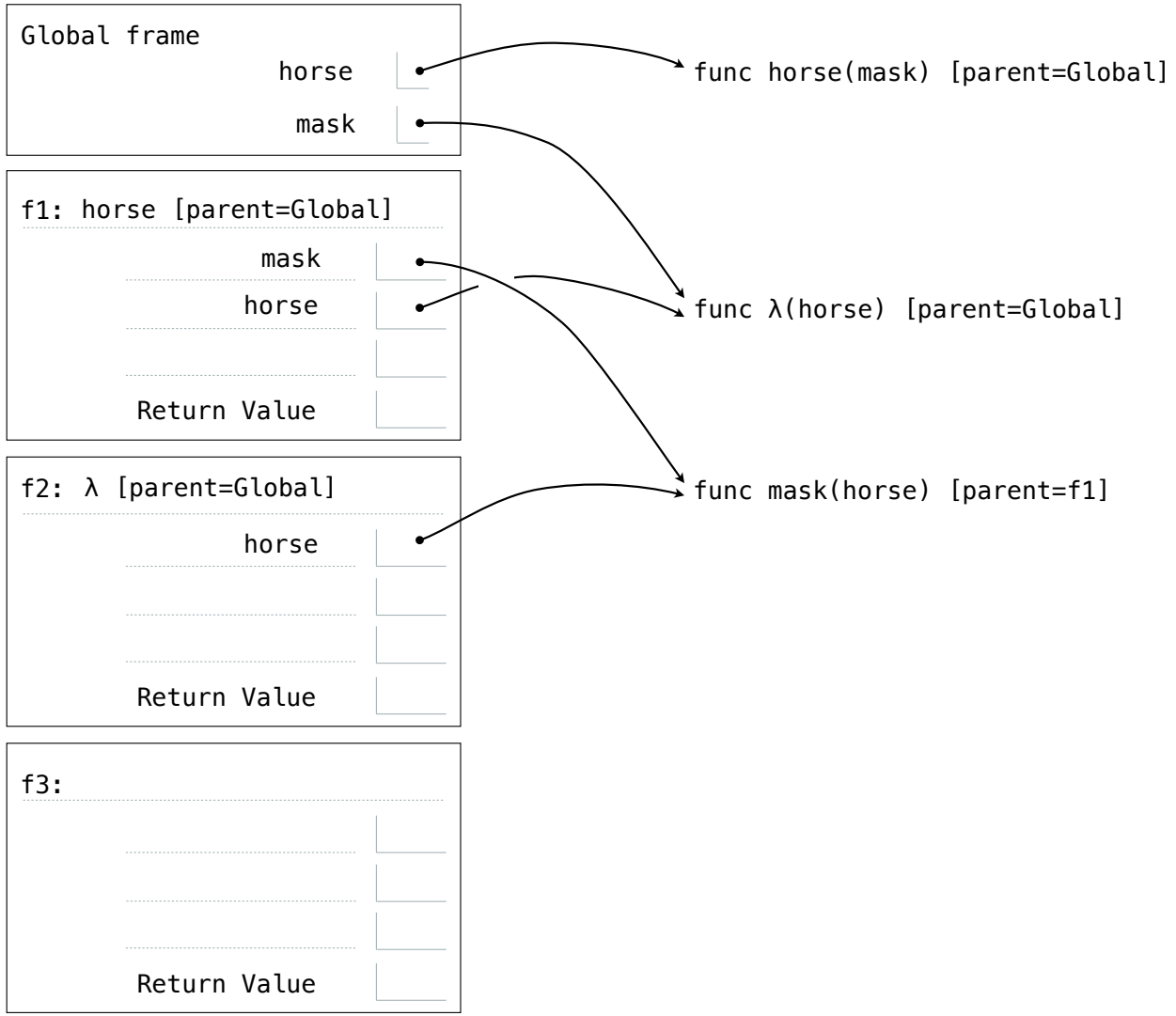

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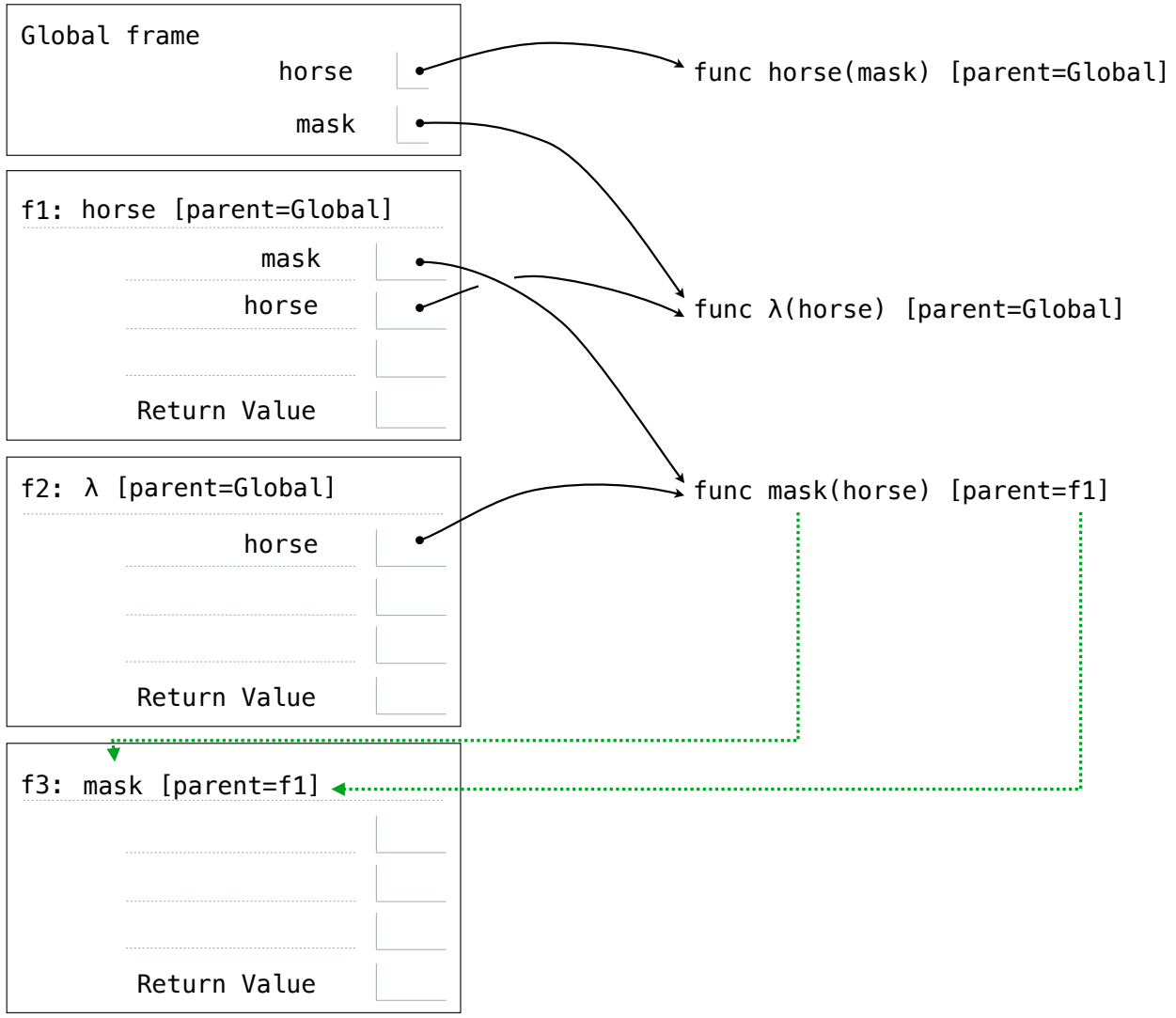

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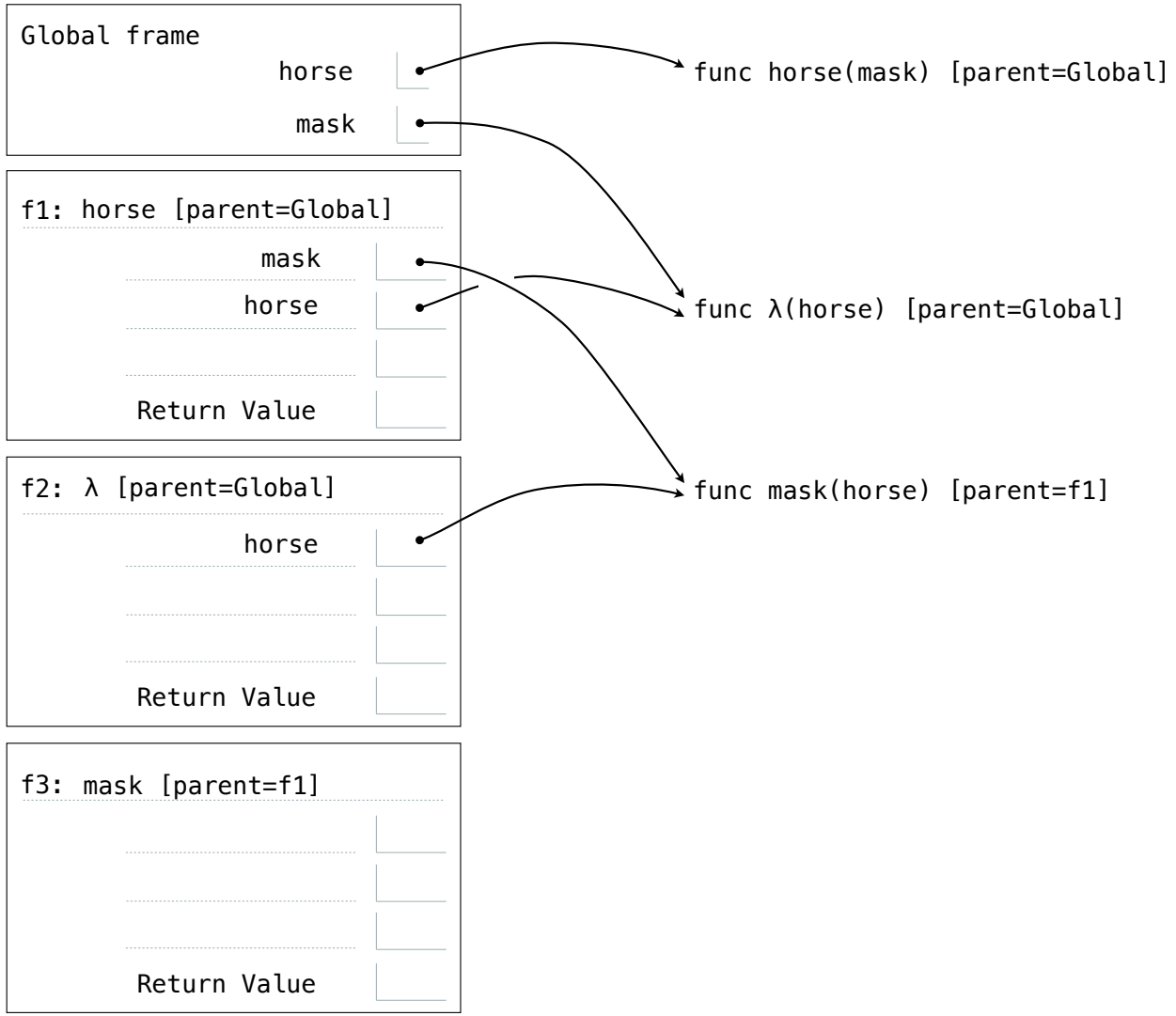

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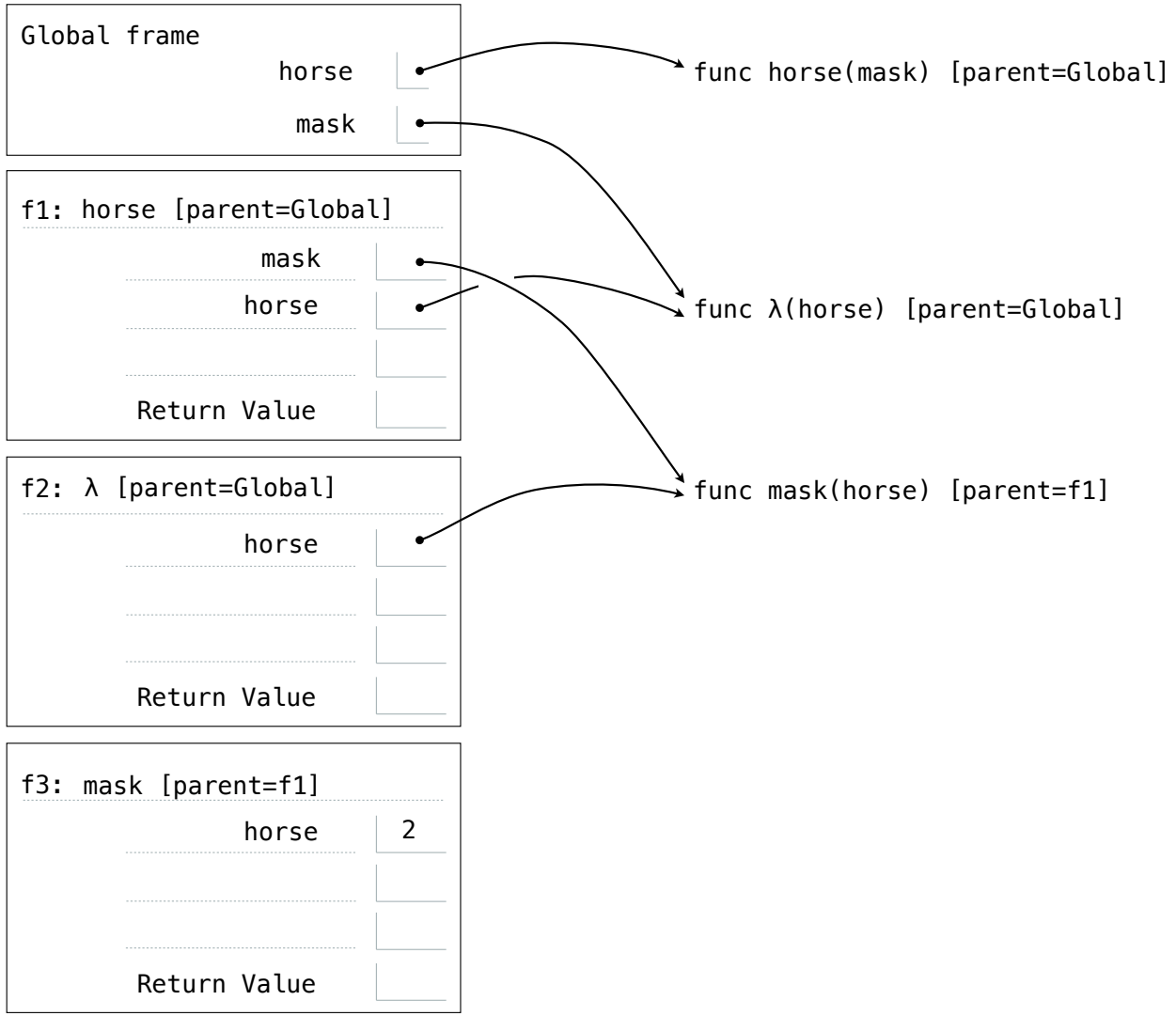

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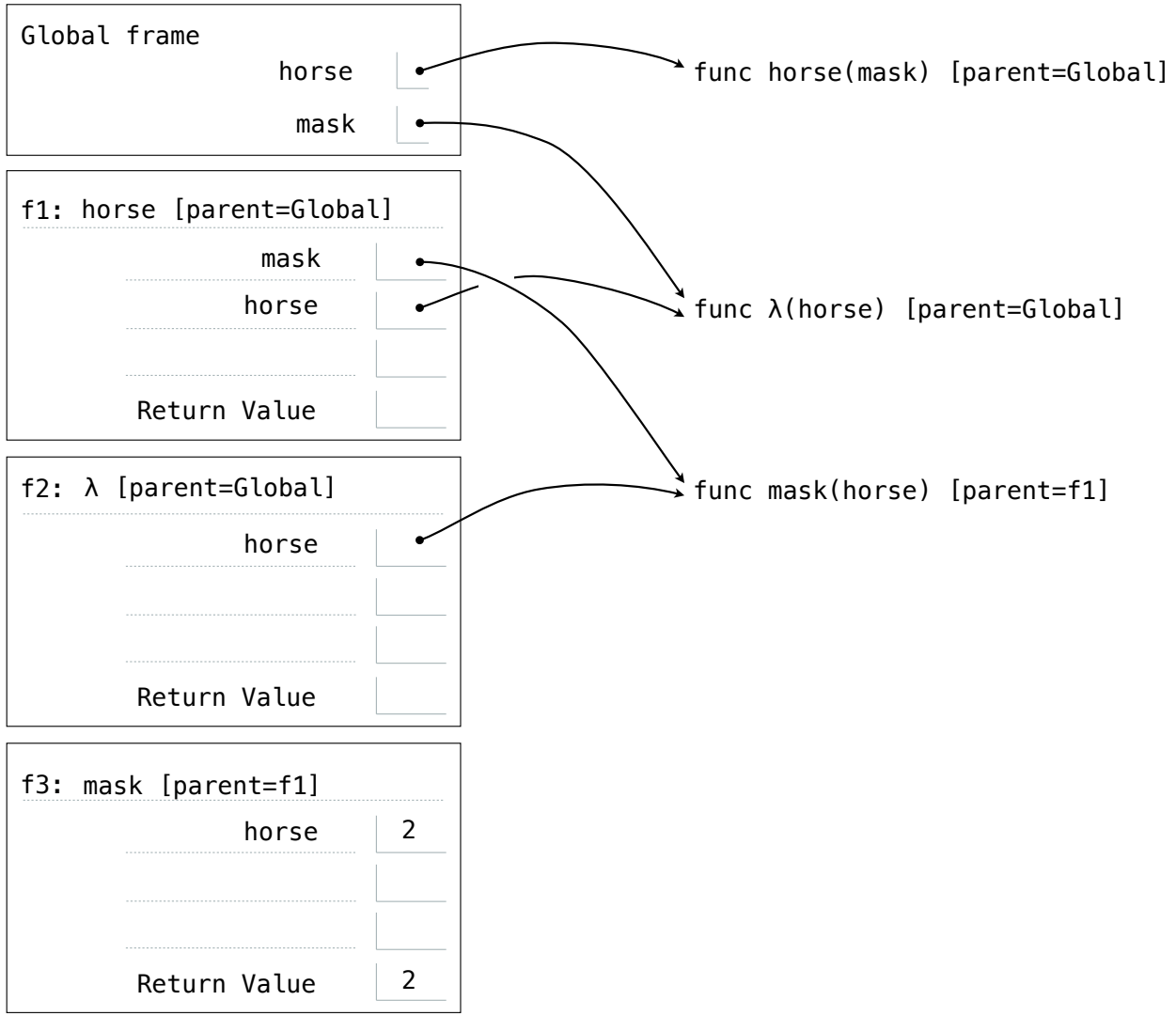

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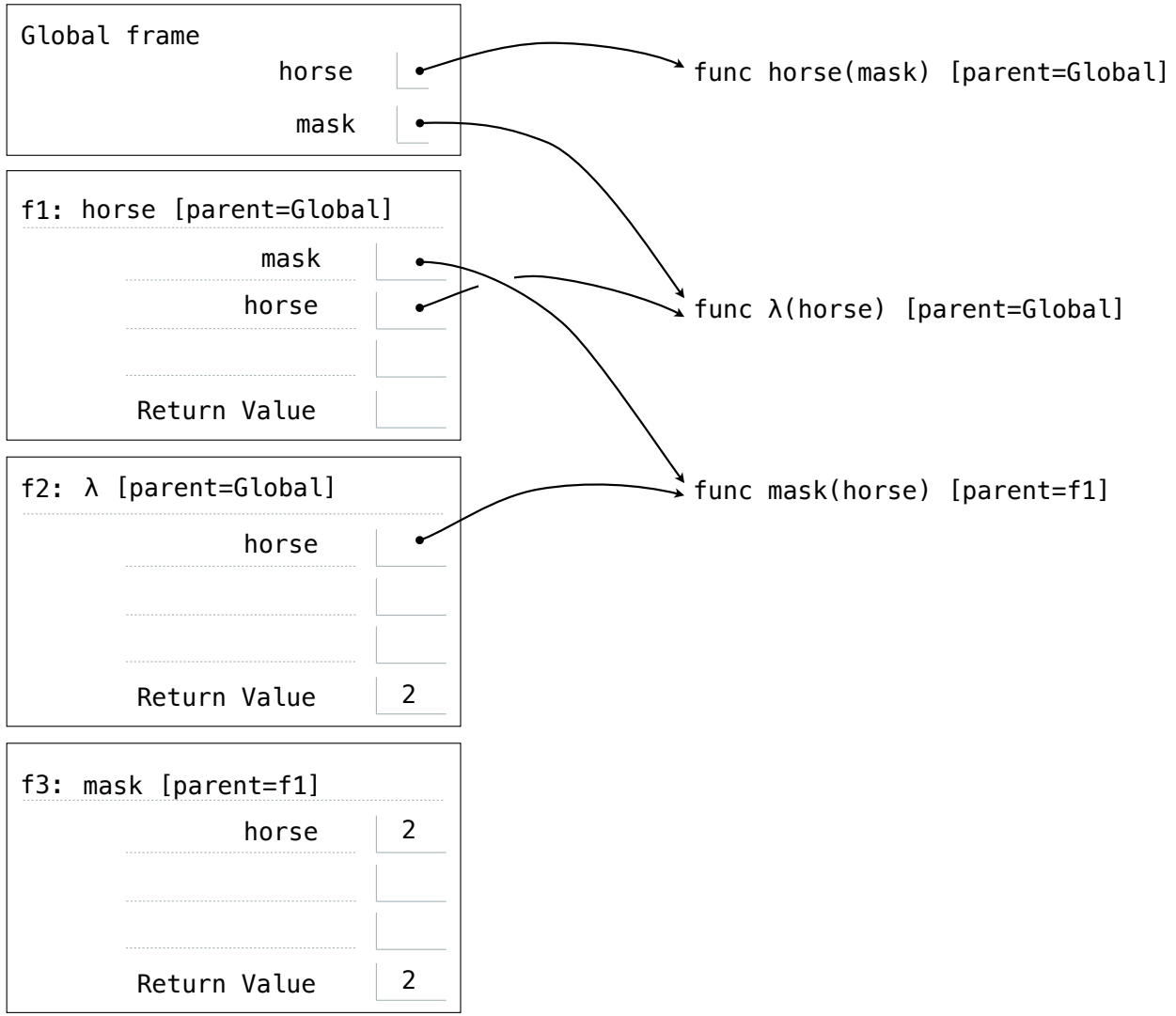

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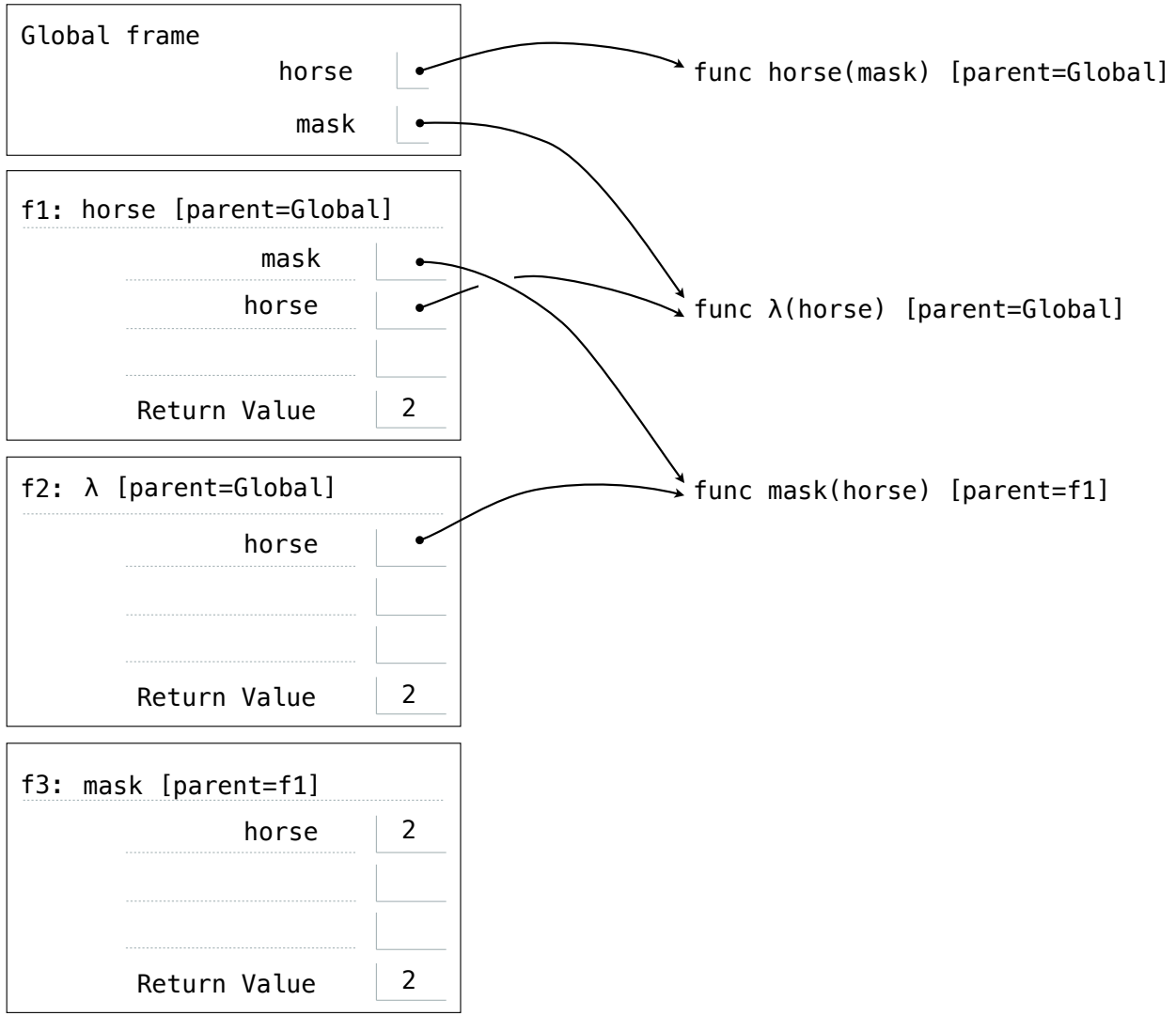

Implementing Functions

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 = ____________________________

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Verify the examples & pick a simple one

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OR
If the template is helpful, use it.

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Annotate names with values from your chosen example

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Write code to compute the result

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Write code to compute the result

Did you really return the right thing?

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231

3

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231

3

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231

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21

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231

3

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    >>> remove(231, 3)
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    4313
    """
    kept, digits = 0, 0
    while ____________n > 0____________:
        n, last = n // 10, n % 10
        if ____________last != digit____________:
            kept = ____________kept + last____________
        digits = ____________________
    return ____________kept____________
```

231

3

21

Read the description

Verify the examples & pick a simple one

Read the template

Implement without the template, then change your implementation to match the template.
OR
If the template is helpful, use it.

Annotate names with values from your chosen example

Write code to compute the result

Did you really return the right thing?

Check your solution with the other examples

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        if ____________________________:
            kept = ____________________
        digits = __________________
    return ____________________________
```

231

3

1

+ 20

21

n > 0

last != digit

~~10*~~kept + last*10

21

kept

Read the description

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            digits = ____________digits + 1____________
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```

231

3

21

```
  1
+ 20
----
 21
```

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            digits = ____________________________

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```

231

3

1

+ 20

21

n > 0

last != digit

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

digits + 1

21

kept

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        if ____________________________:

            kept = ____________________________

            digits = ____________________________

    return ____________________________
```

231

4

21

1

+ 20

21

n > 0

last != digit

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

digits + 1

kept

Read the description

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    """
    kept, digits = 0, 0

    while _____:
        n, last = n // 10, n % 10

        if _____:
            kept = _____

            digits = _____

    return _____
```

231

4

1

+ 20

21

n > 0

last != digit

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

231

digits + 1

kept

Read the description

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            digits = ____digits + 1____

    return ____________kept____________
```

231

4

1	1
+ 20	+ 30
	+ 200
21	231

231

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```

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    kept, digits = 0, 0
    while ____________n > 0____________:
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        if ____last != digit____:
            kept = ____kept/10 + last____
            digits = ____________________
    return ____kept____
```

231

3

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            kept = ____kept/10 + last____
            digits = ____________________
    return ____kept * 10____
```

231

3

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        if ____last != digit____:
            kept = ____kept/10 +  last____
            digits = ____digits + 1____
    return ____kept * 10 ** (digits-1)____
```

231

3

21

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    while ____________n > 0____________:
        n, last = n // 10, n % 10
        if ____________last != digit____________:
            kept = ____kept/10 +   last____
            digits = ____digits + 1____
    return ____round(kept * 10 ** (digits-1))____
```

231

3

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Did you really return the right thing?

Check your solution with the other examples

Decorators

Function Decorators

(Demo)

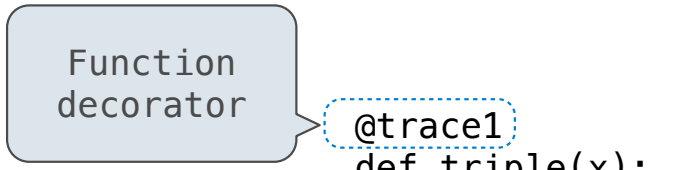
Function Decorators

(Demo)

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

Function Decorators

(Demo)

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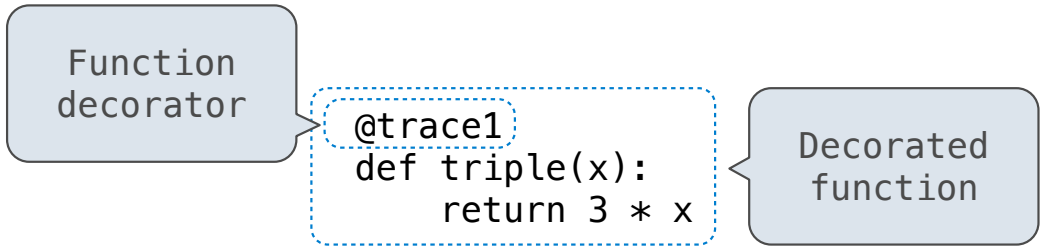
Function Decorators

(Demo)



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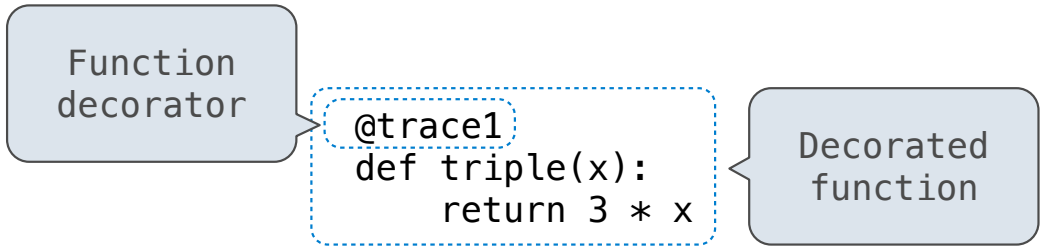
(Demo)



is identical to

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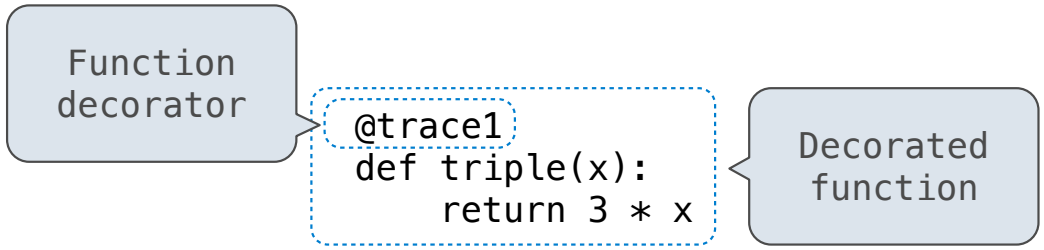
(Demo)



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):
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triple = trace1(triple)
```