61A Lecture 3

Monday, January 26

Announcements

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- Project 1 due Thursday 2/5 @ 11:59pm
- Midterm 1 on Monday 2/9 @ 7pm

Multiple Environments

Life Cycle of a User-Defined Function

What happens?

Def statement:

Call expression:

Calling/Applying:

Life Cycle of a User-Defined Function

What happens?

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```
>>> def square( x ):
        return mul(x, x)
```

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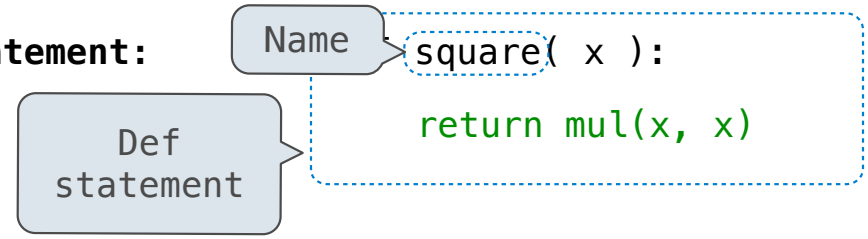

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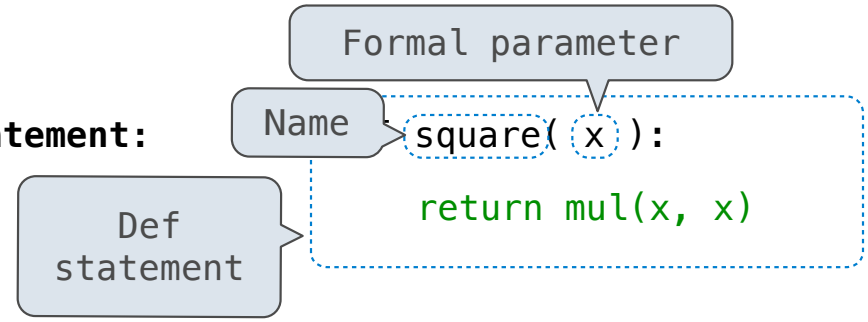

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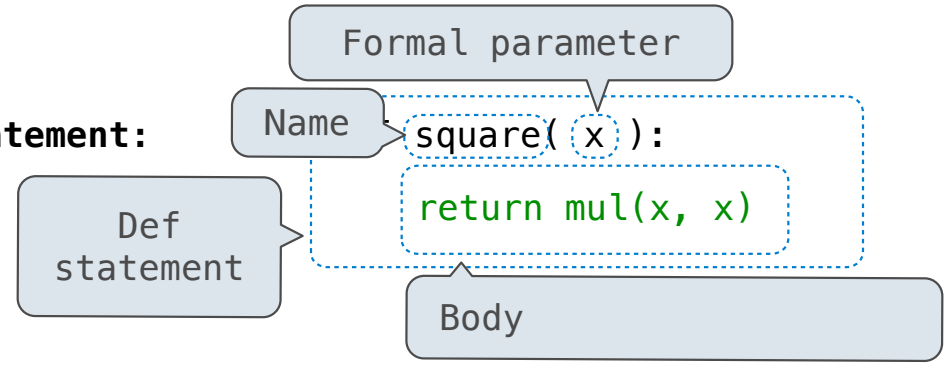

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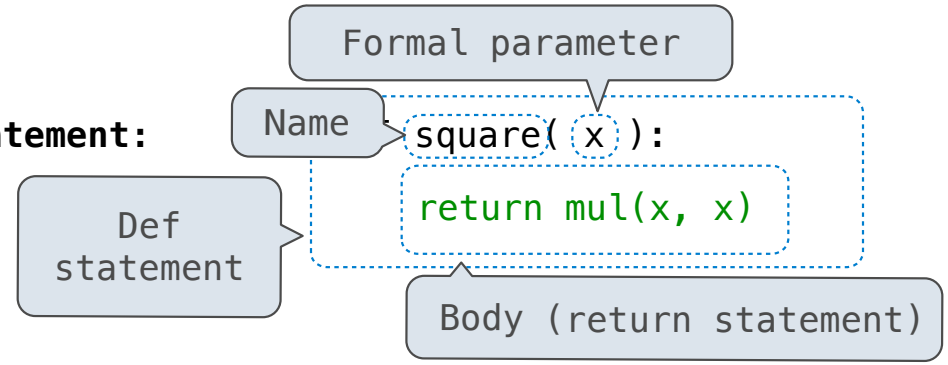

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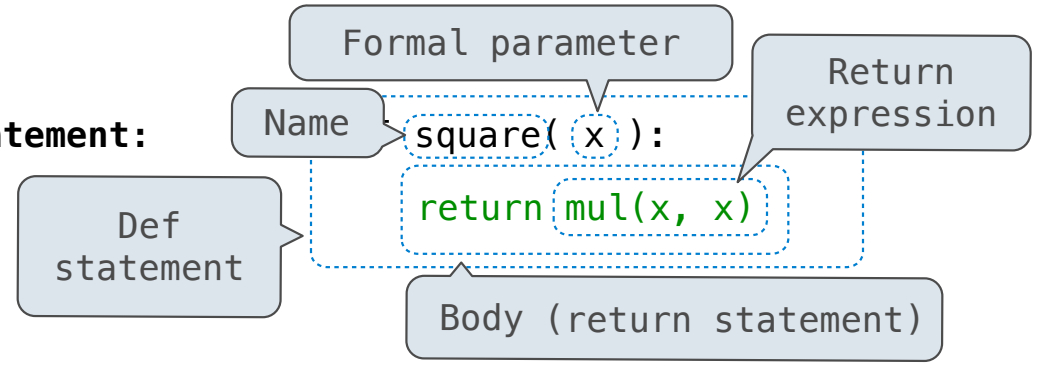

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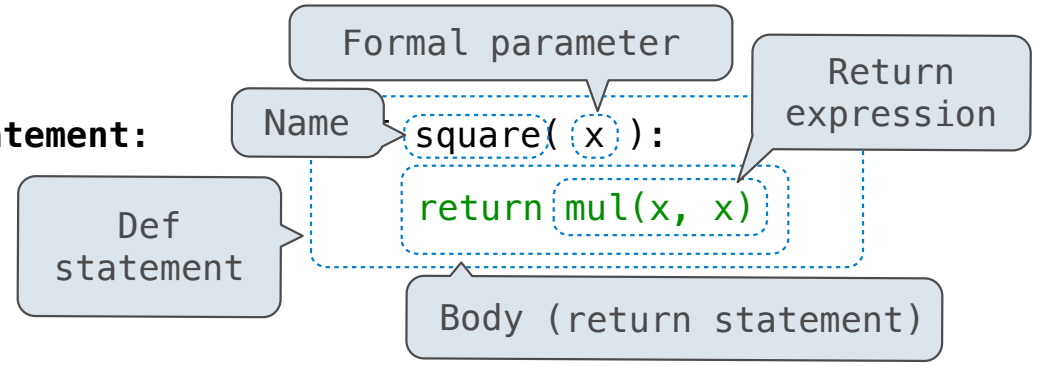

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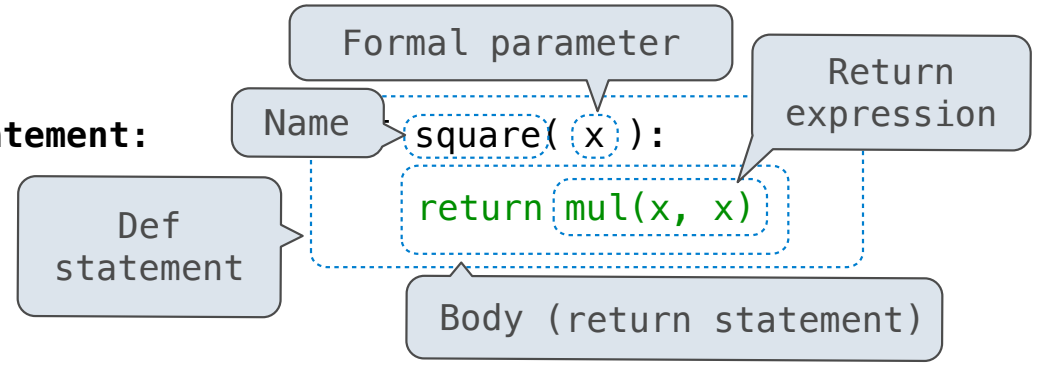

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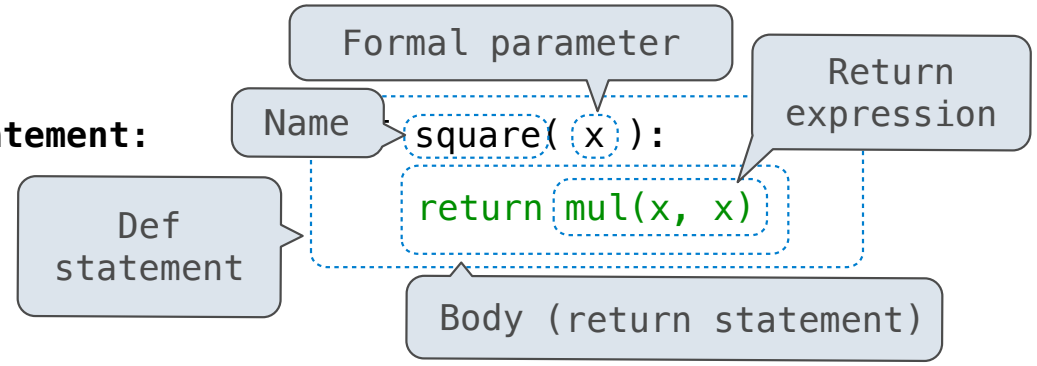

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Call expression: square(2+2)

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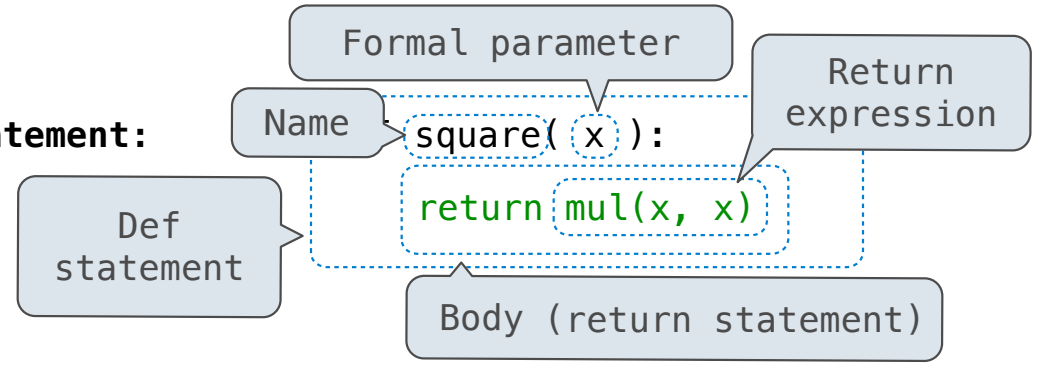

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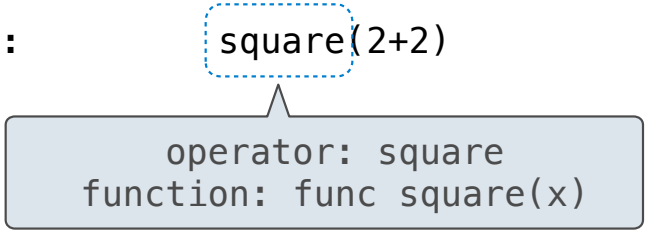

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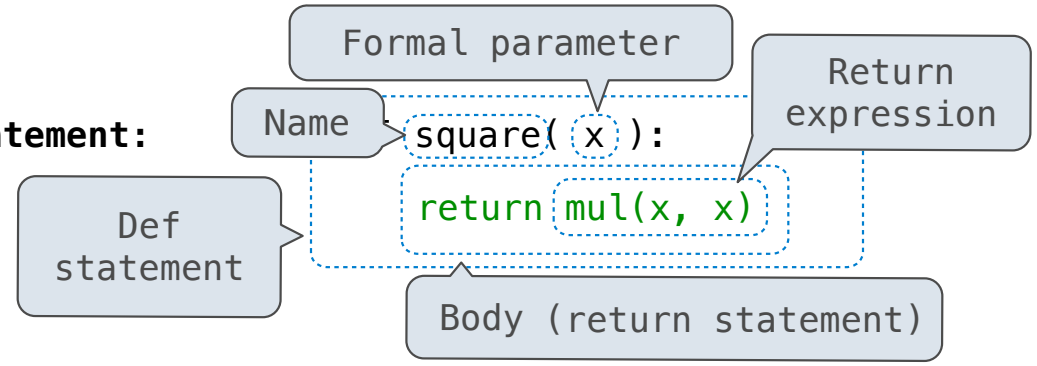

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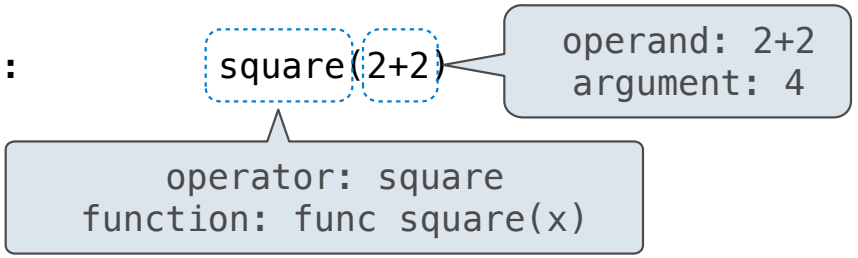

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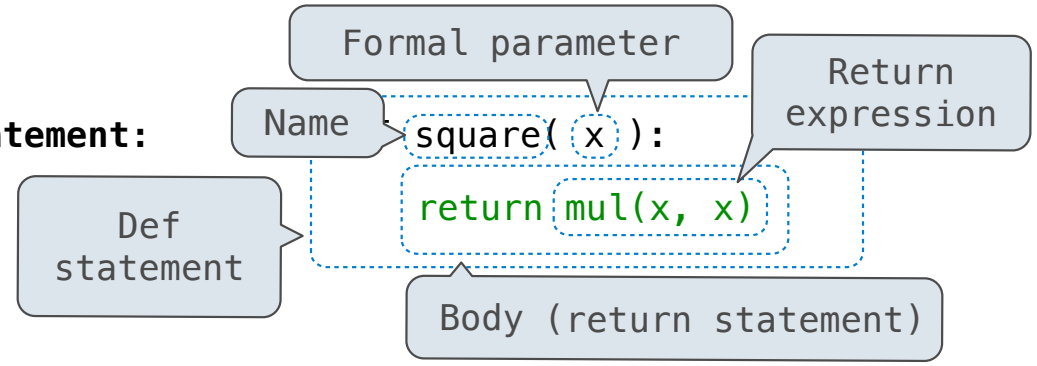

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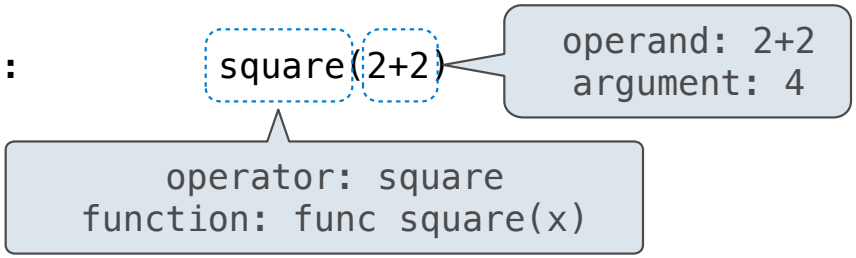

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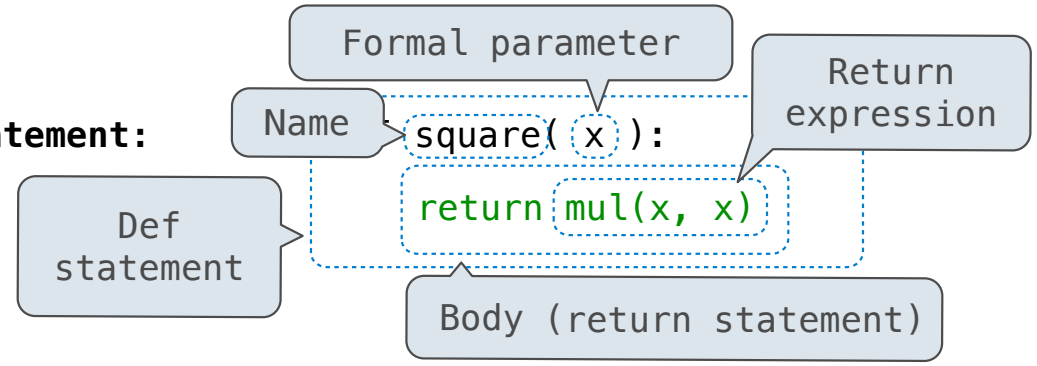

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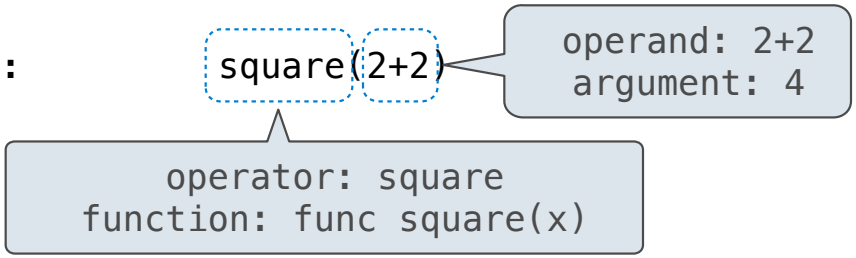

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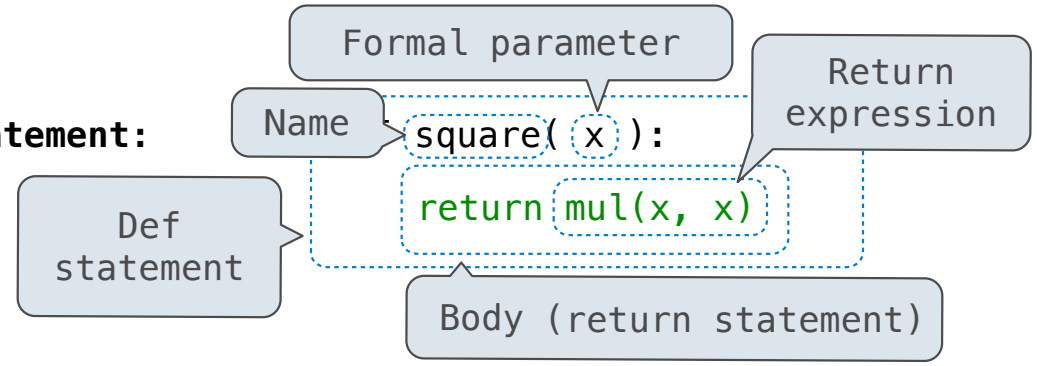

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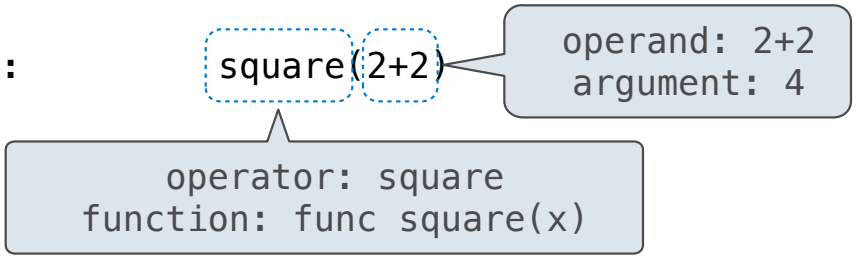

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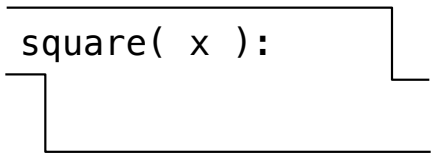

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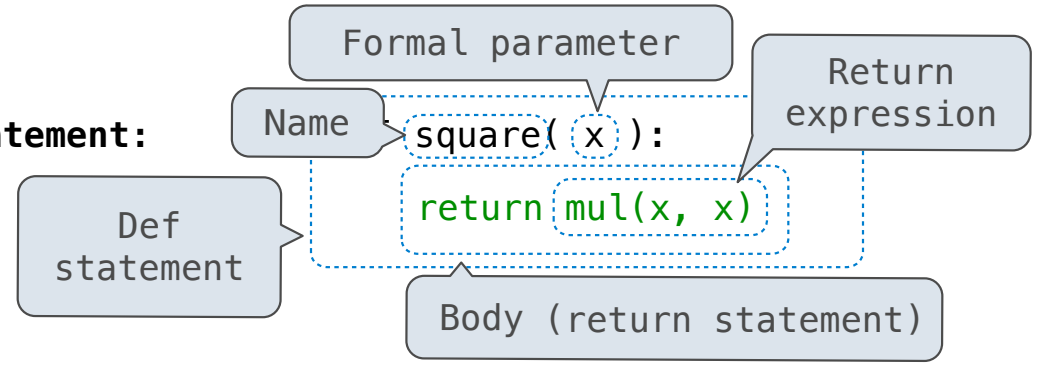

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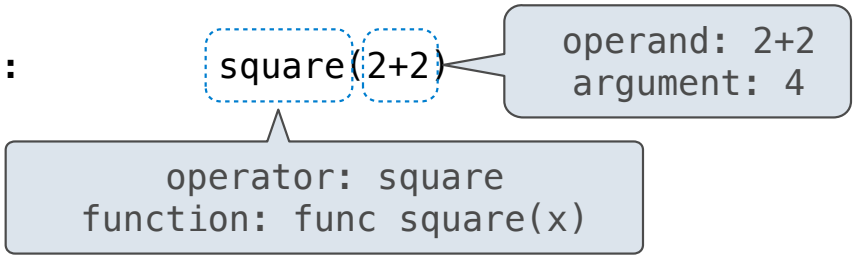

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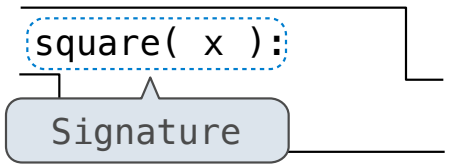

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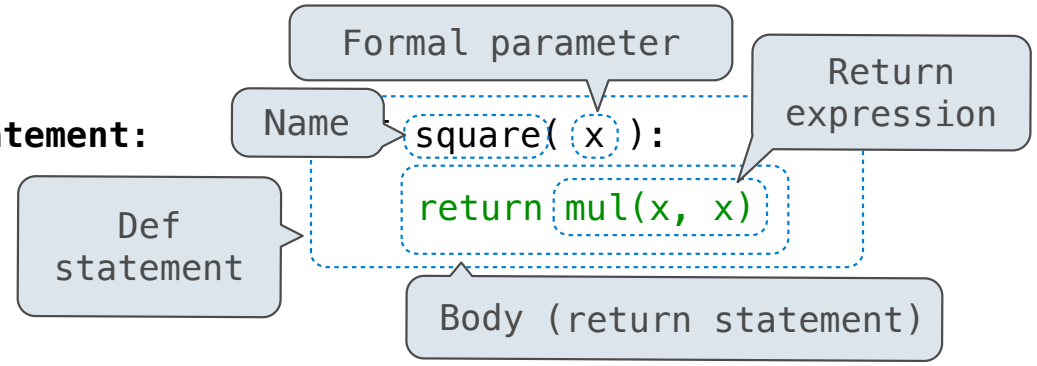

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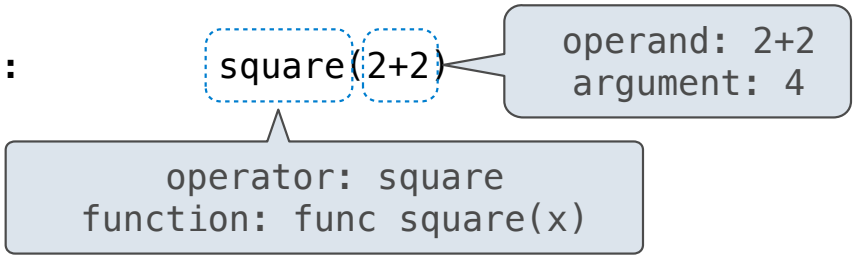

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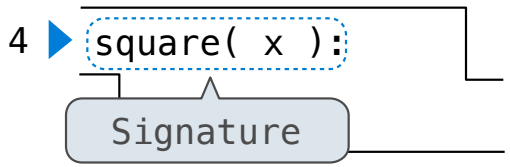

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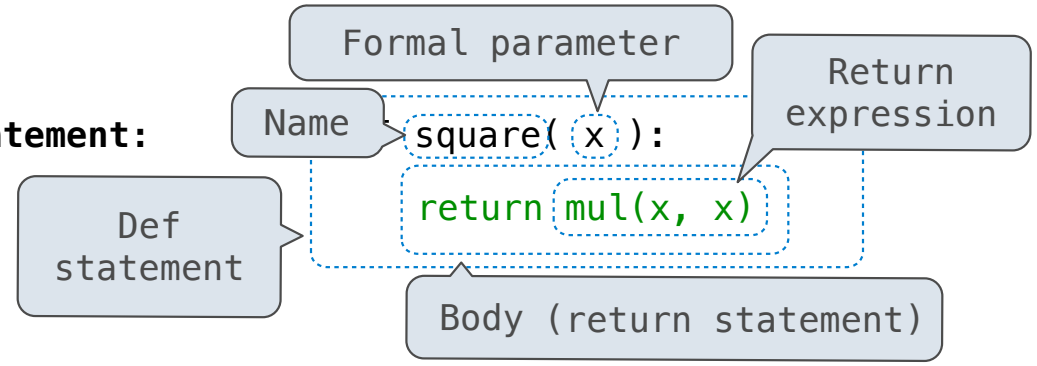

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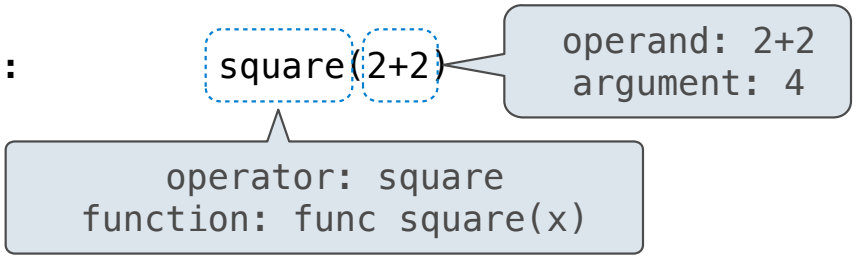

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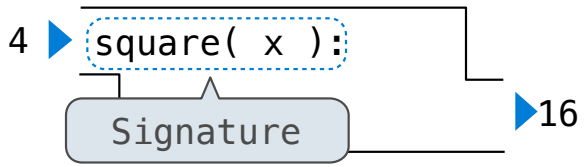

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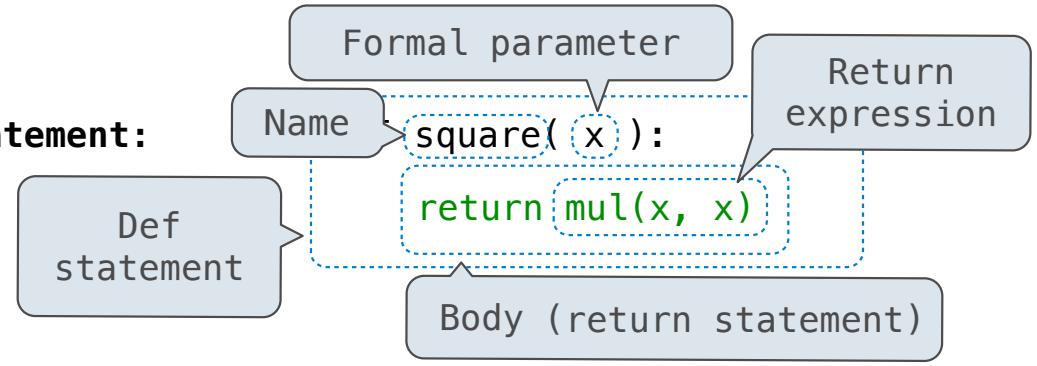

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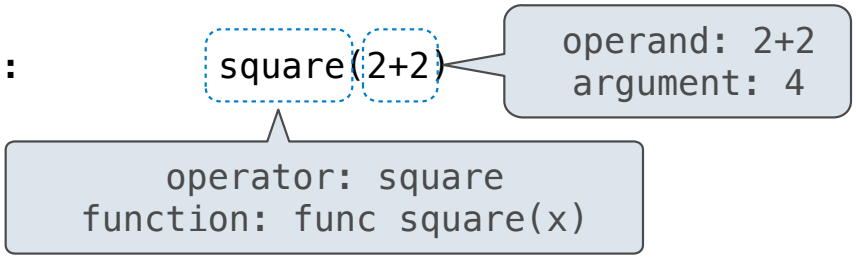

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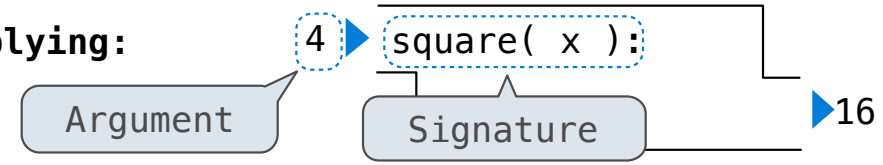

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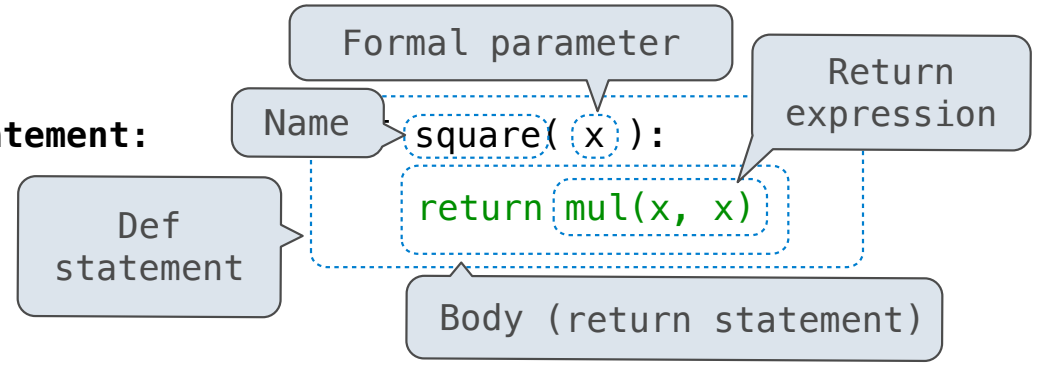

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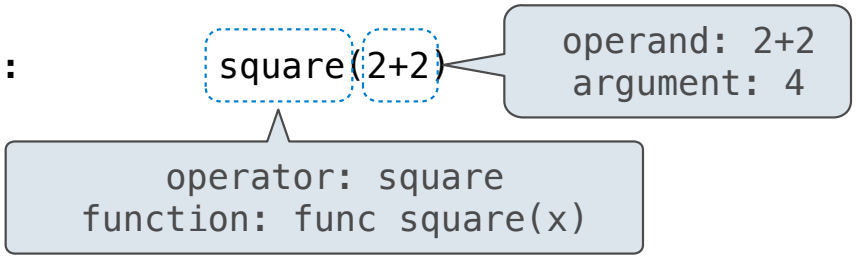

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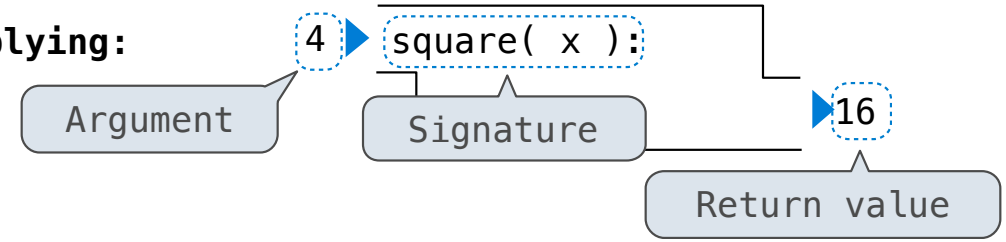

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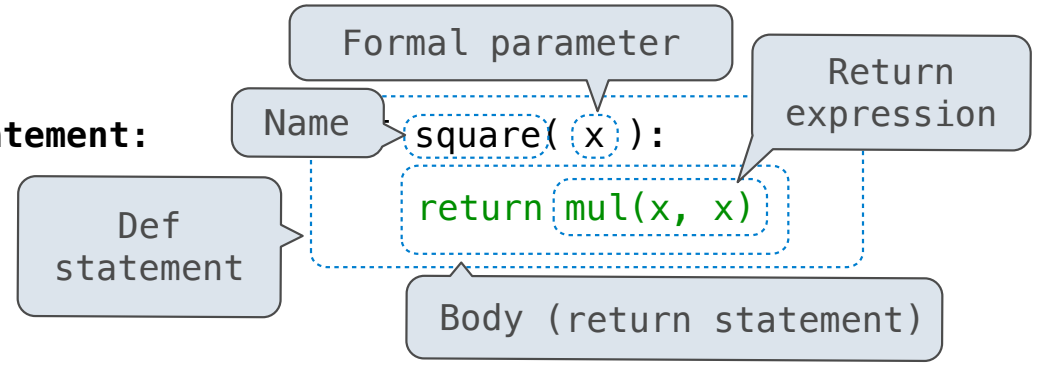

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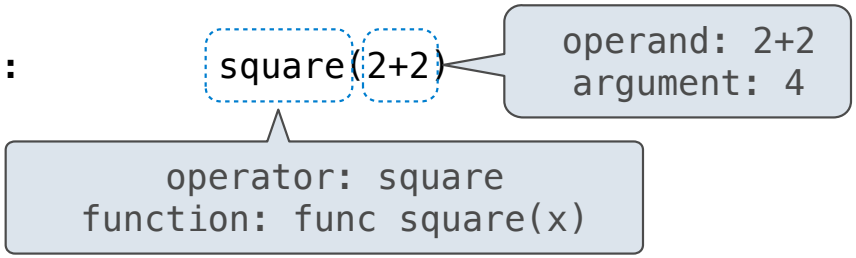

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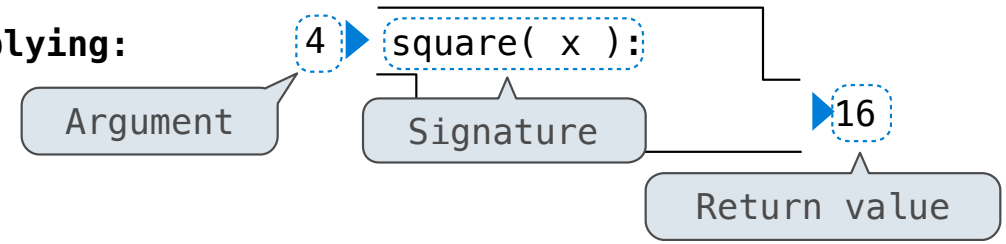

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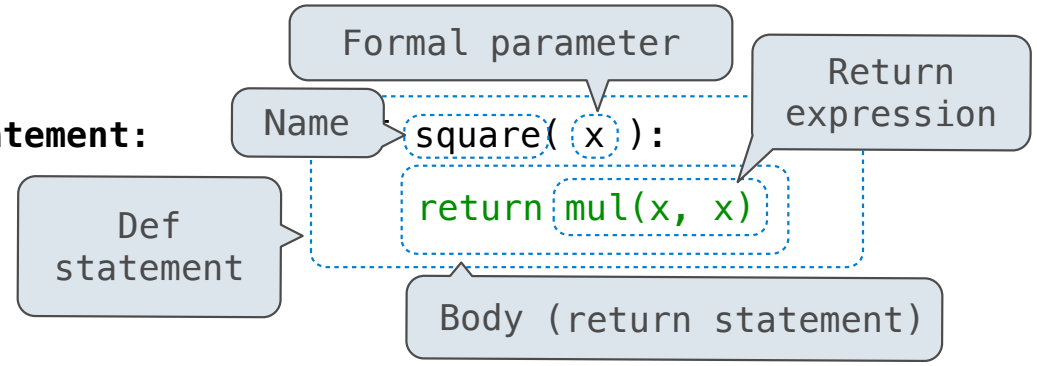

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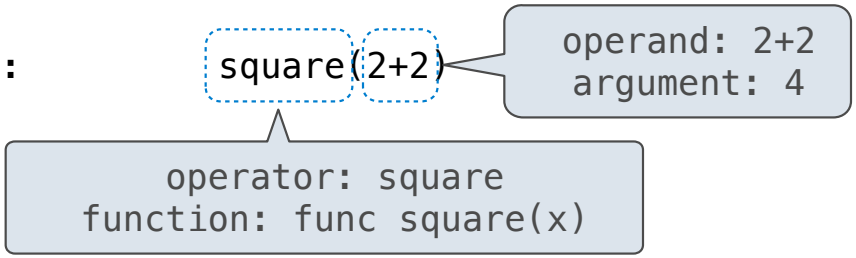

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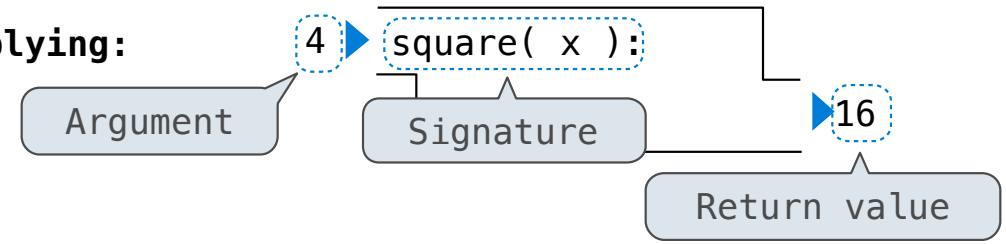

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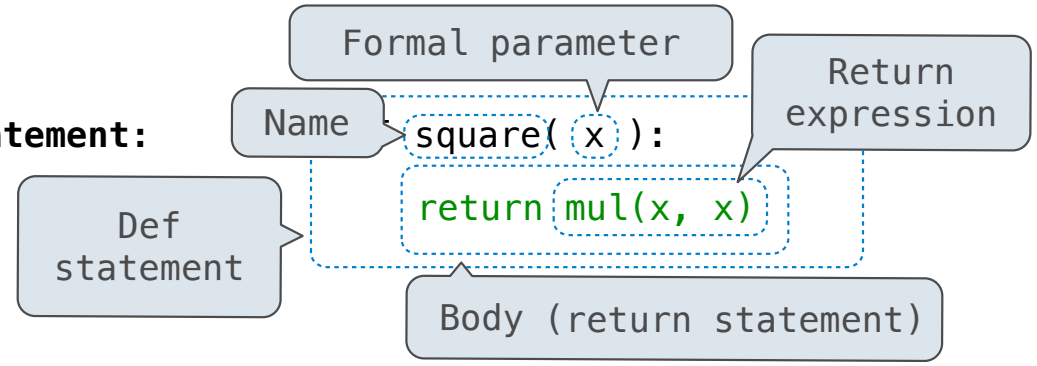

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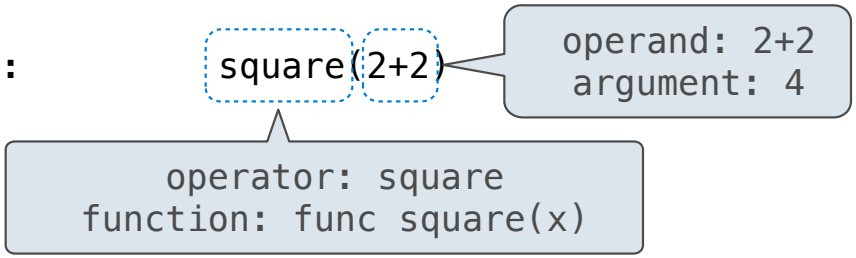

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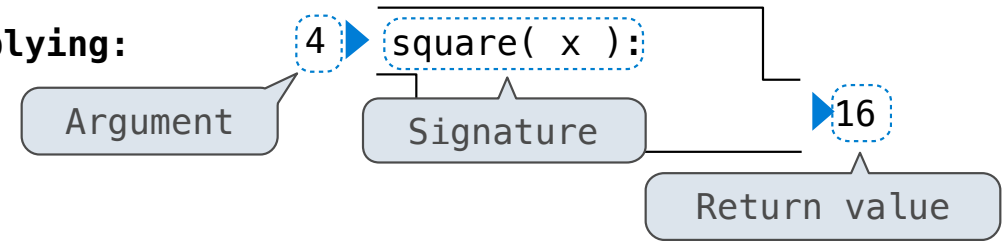

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Function (value of operator) called on arguments (values of operands)

A new frame is created!

Parameters bound to arguments

Body is executed in that new environment

Multiple Environments in One Diagram!

```
1 from operator import mul
2 def square(x):
3     return mul(x, x)
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Interactive Diagram

Multiple Environments in One Diagram!

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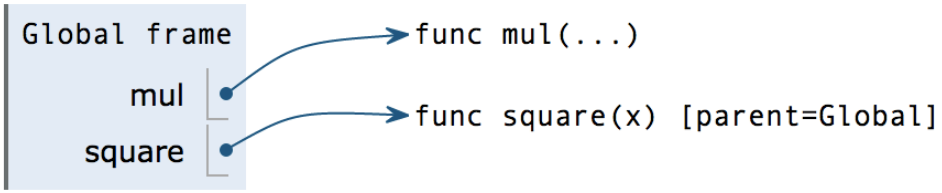

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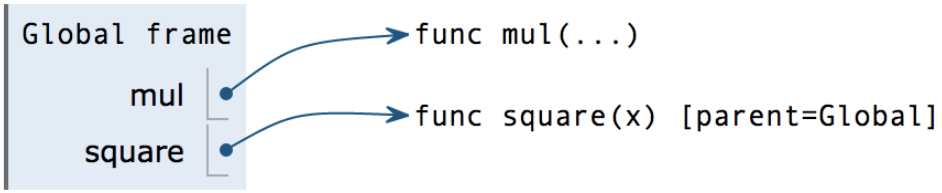


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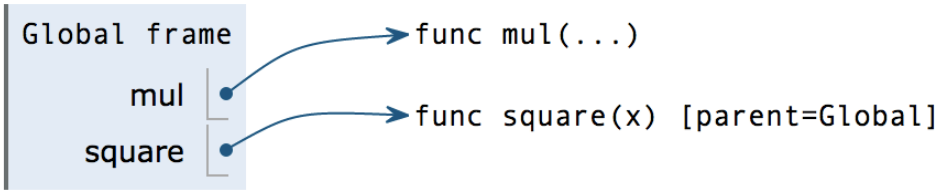

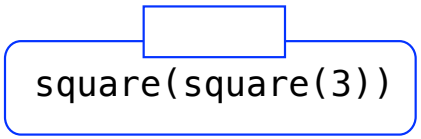

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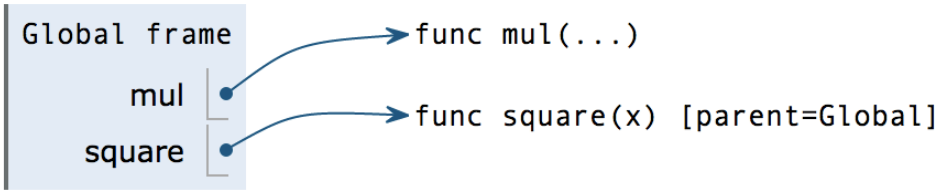

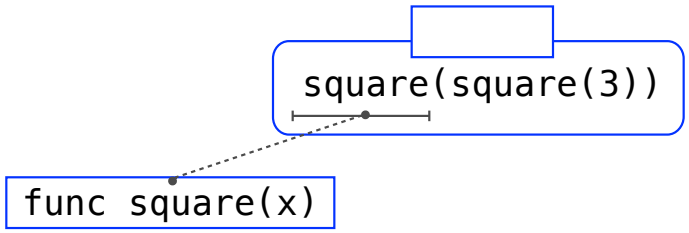

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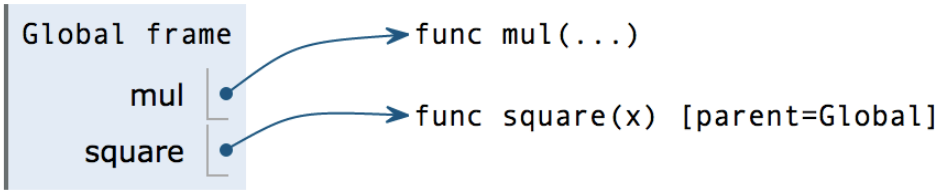

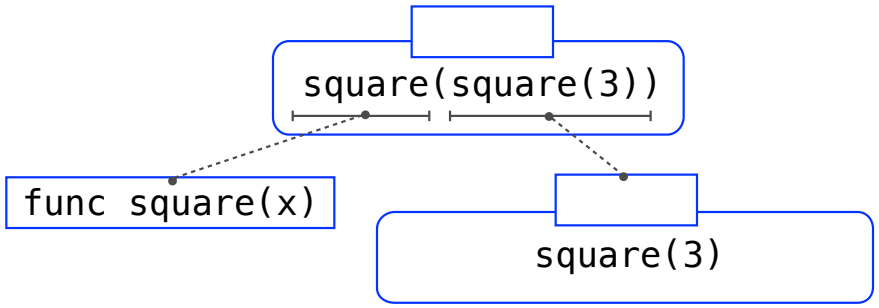

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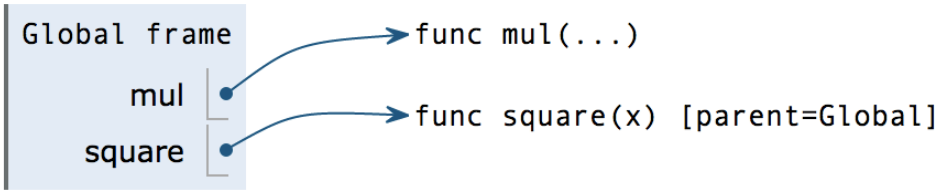

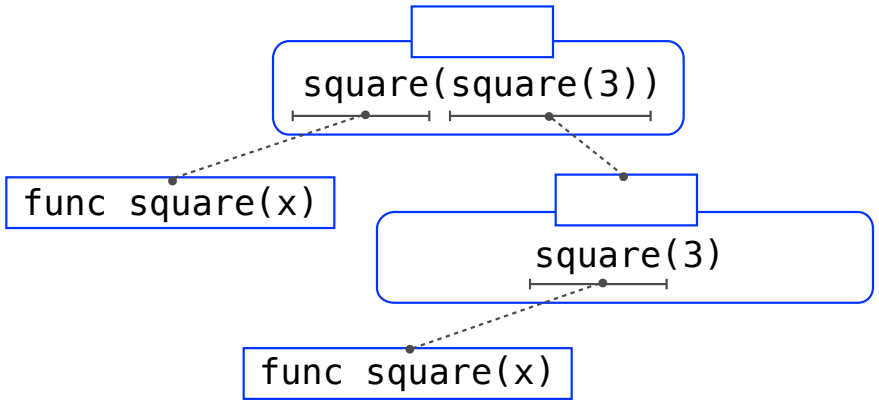

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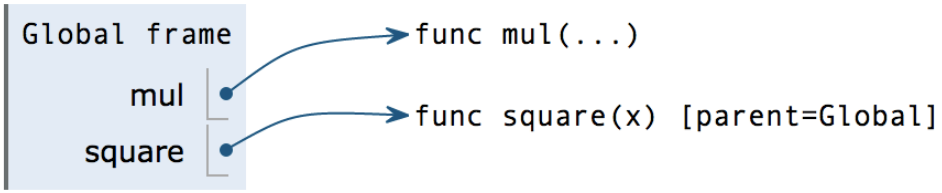

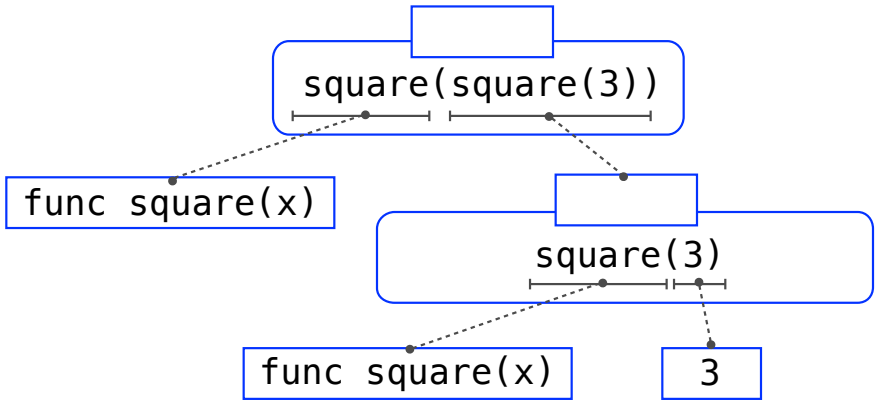

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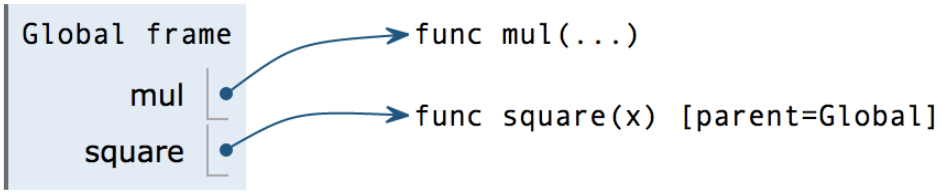

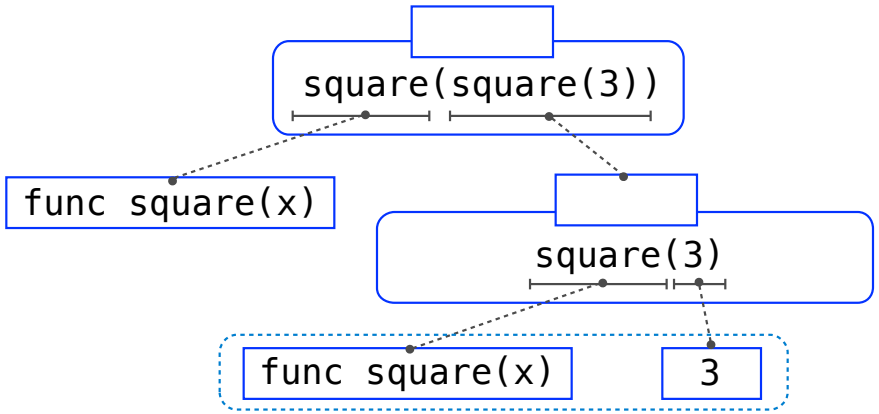

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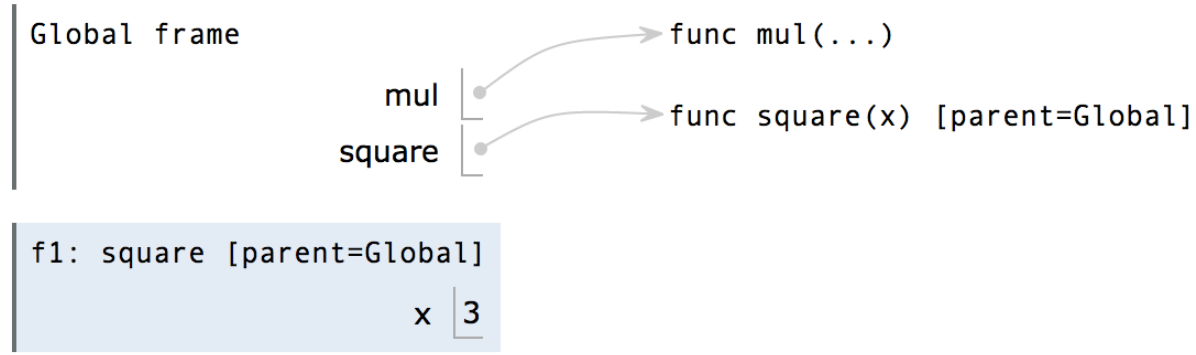

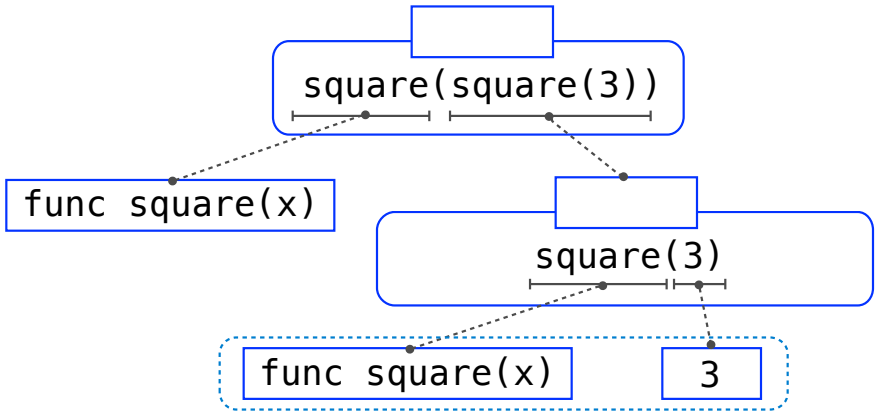

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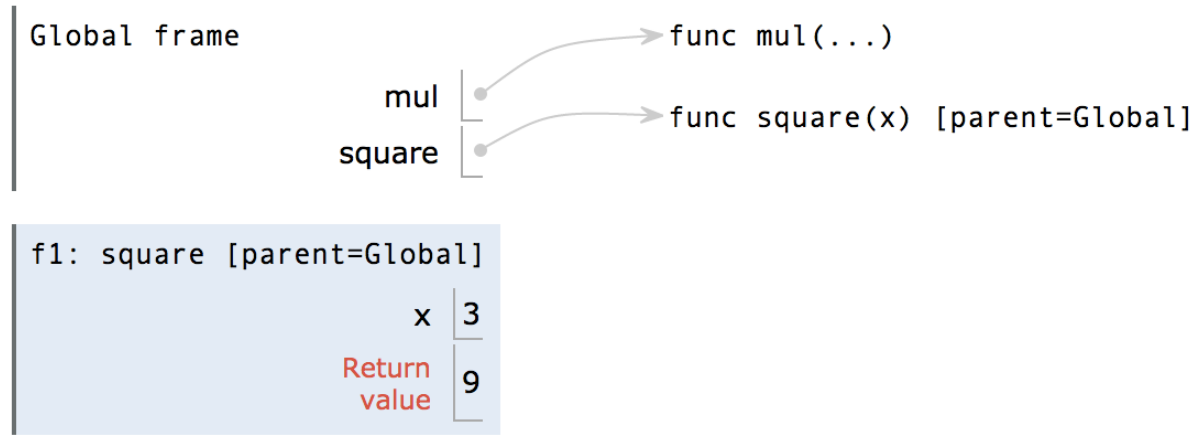

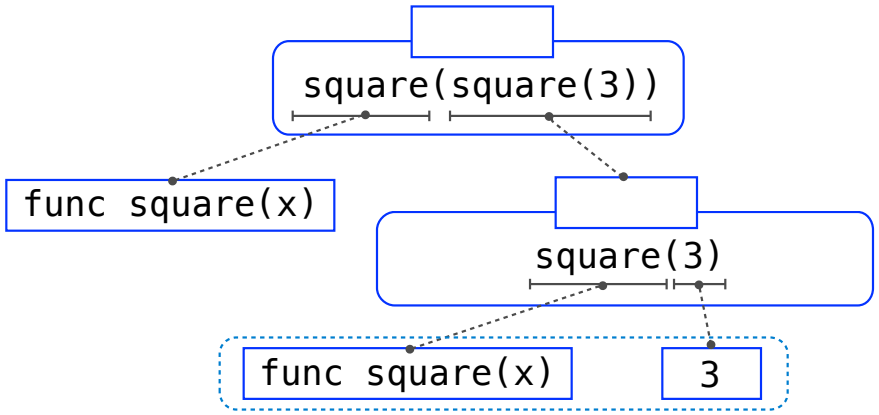

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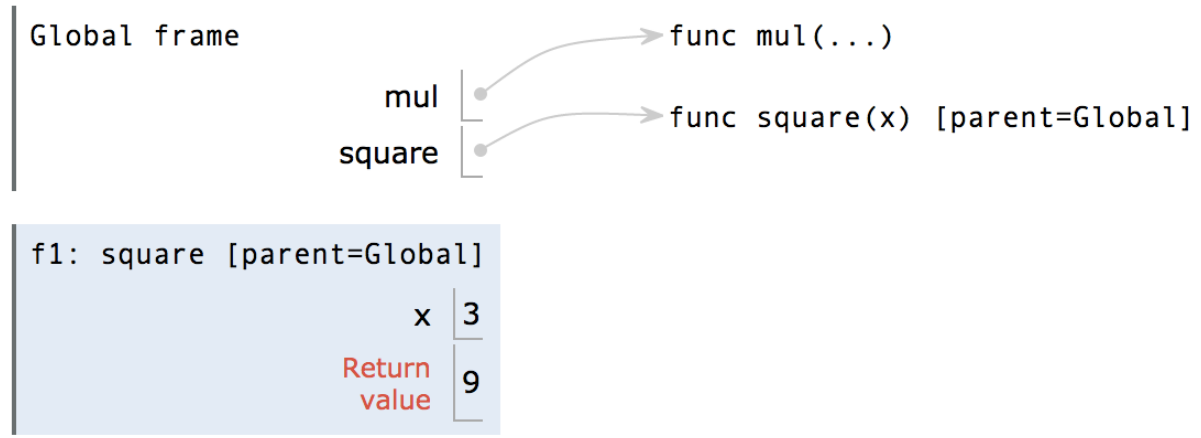

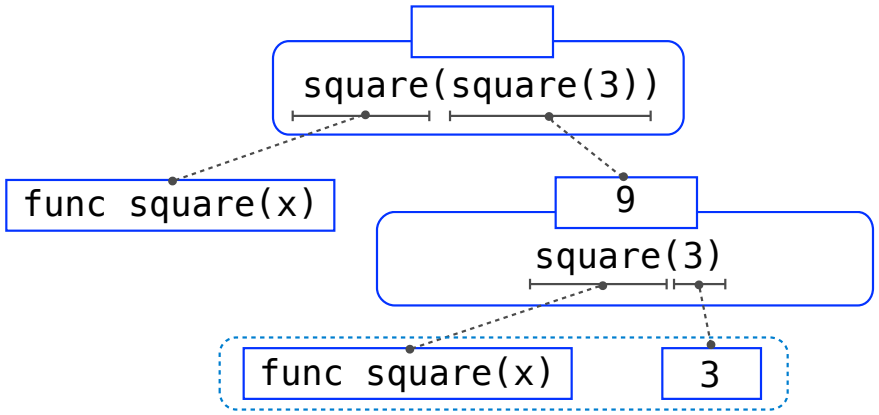

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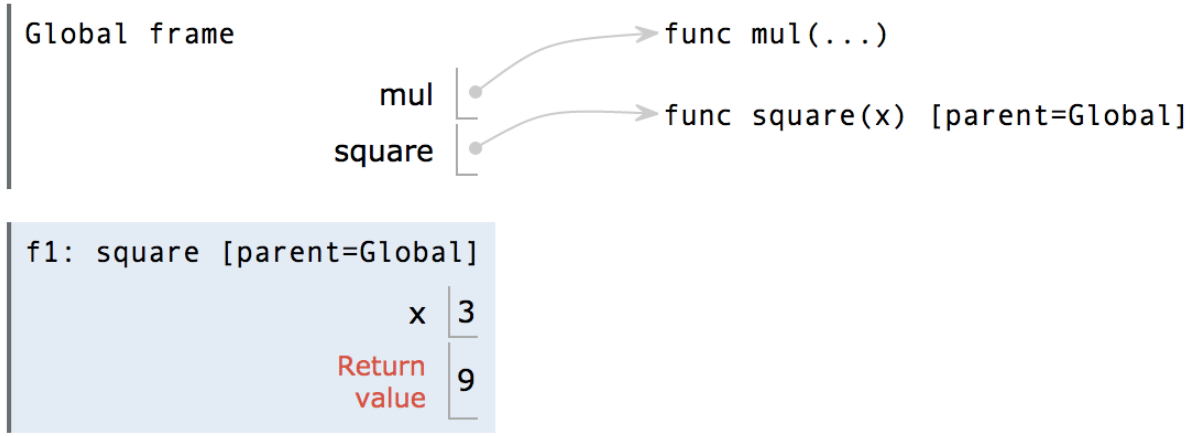

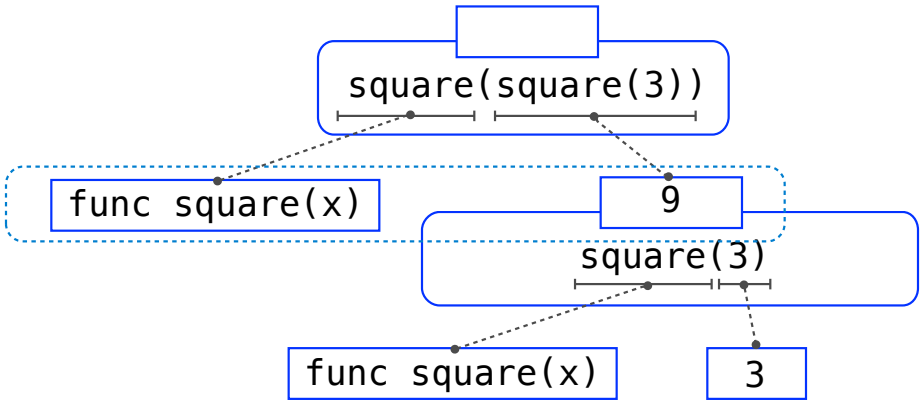

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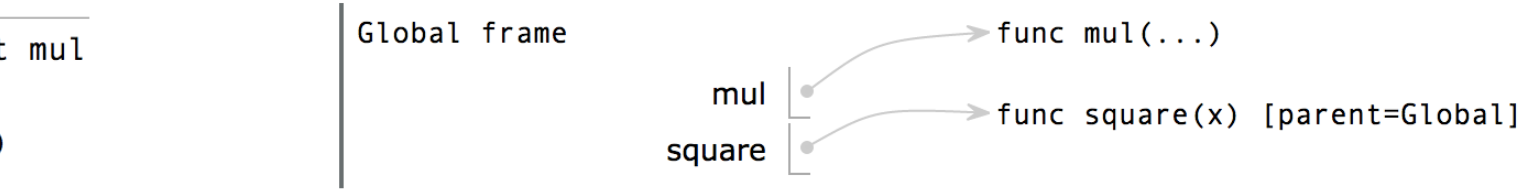

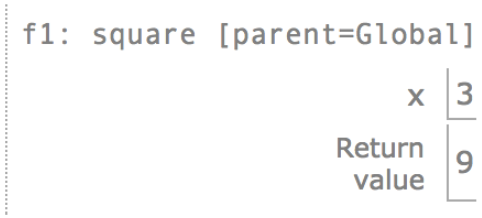

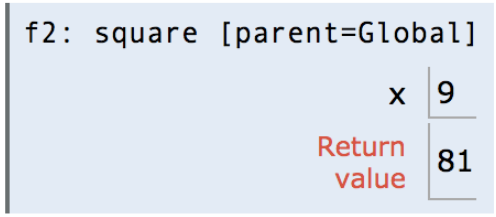

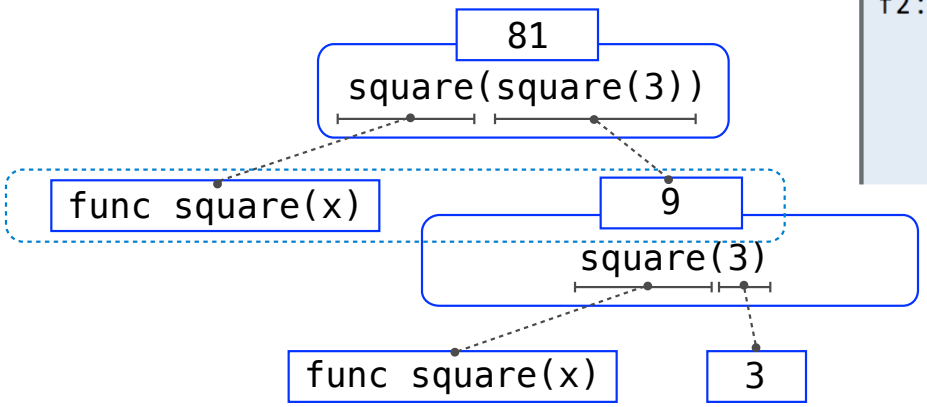

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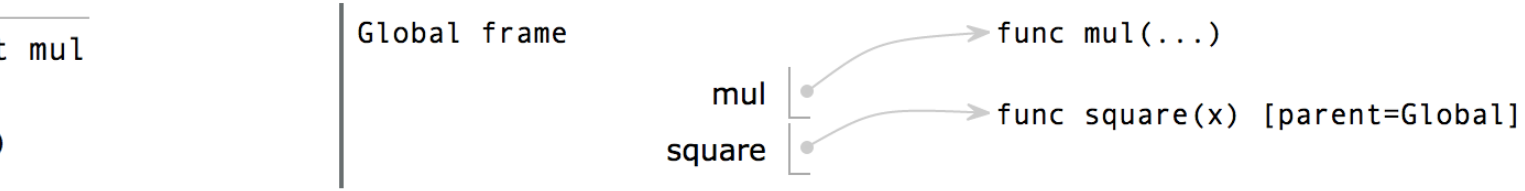

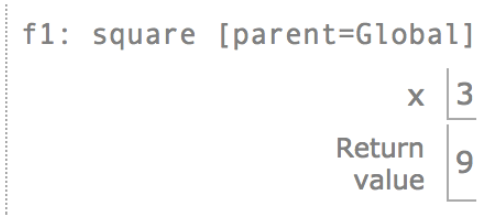

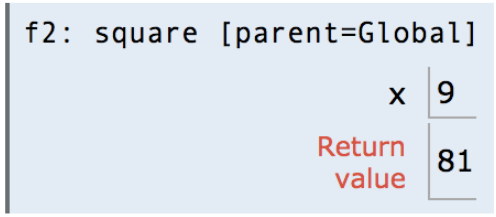

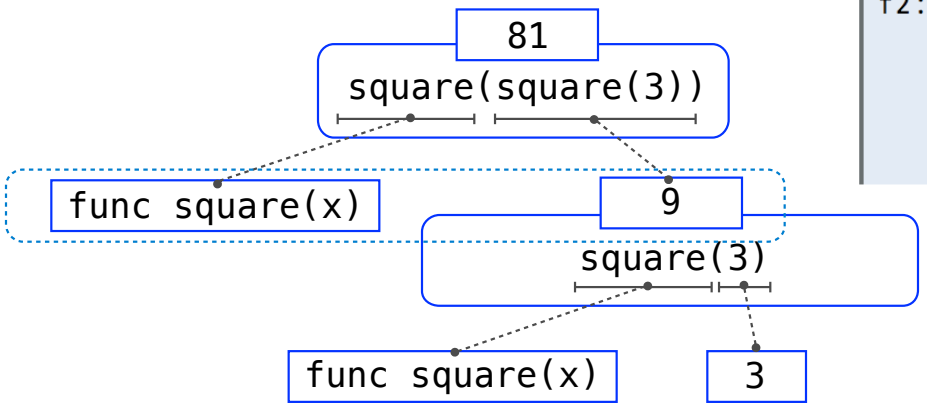

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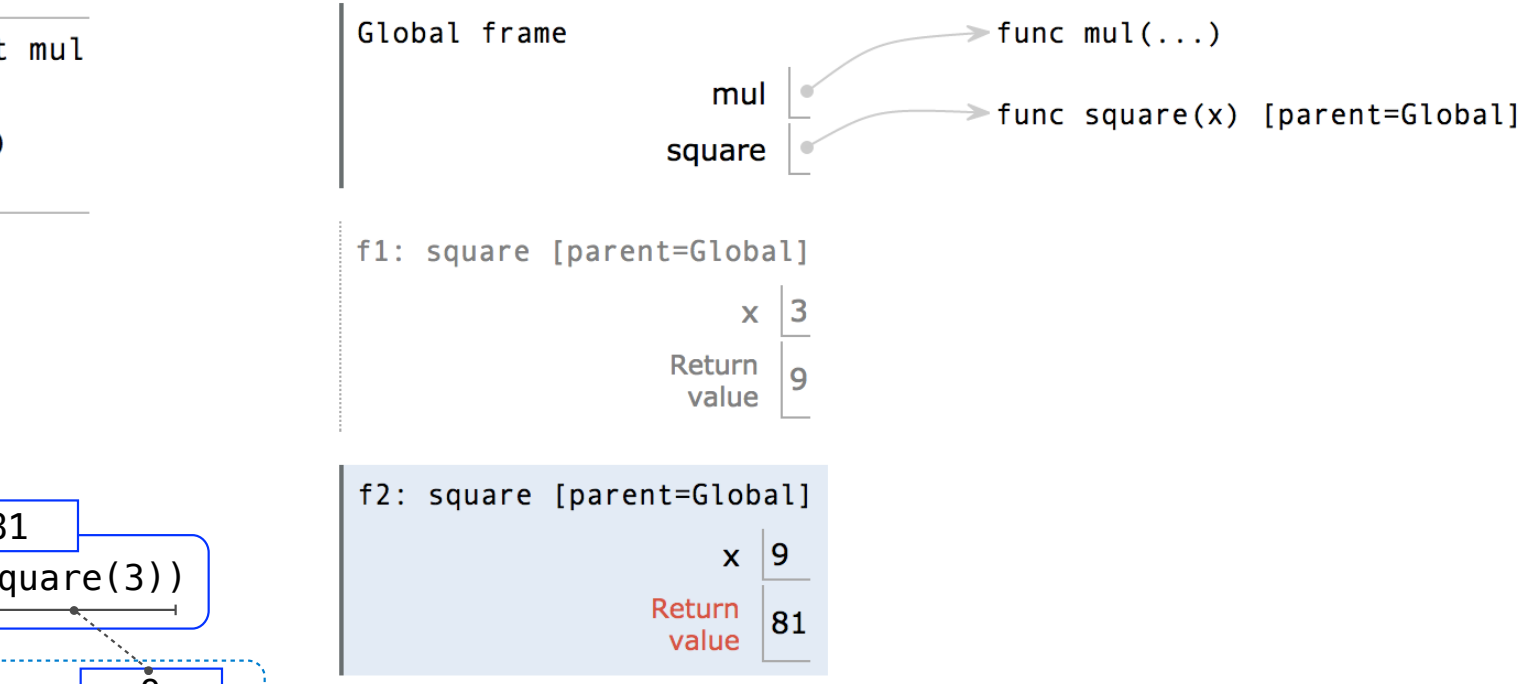

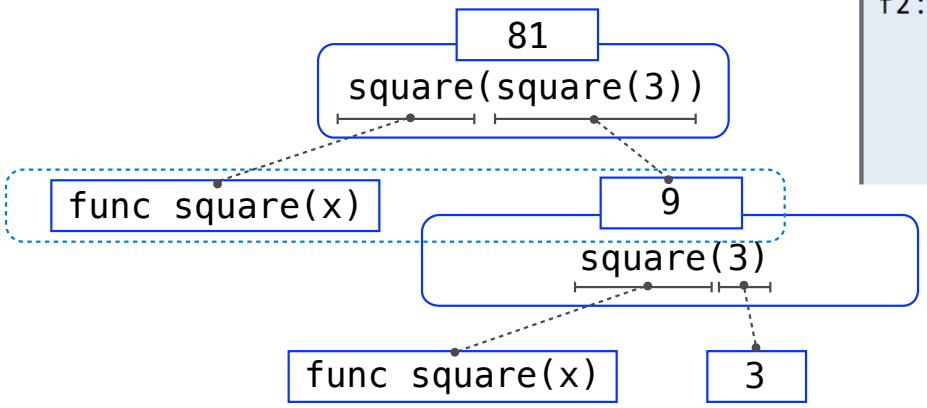

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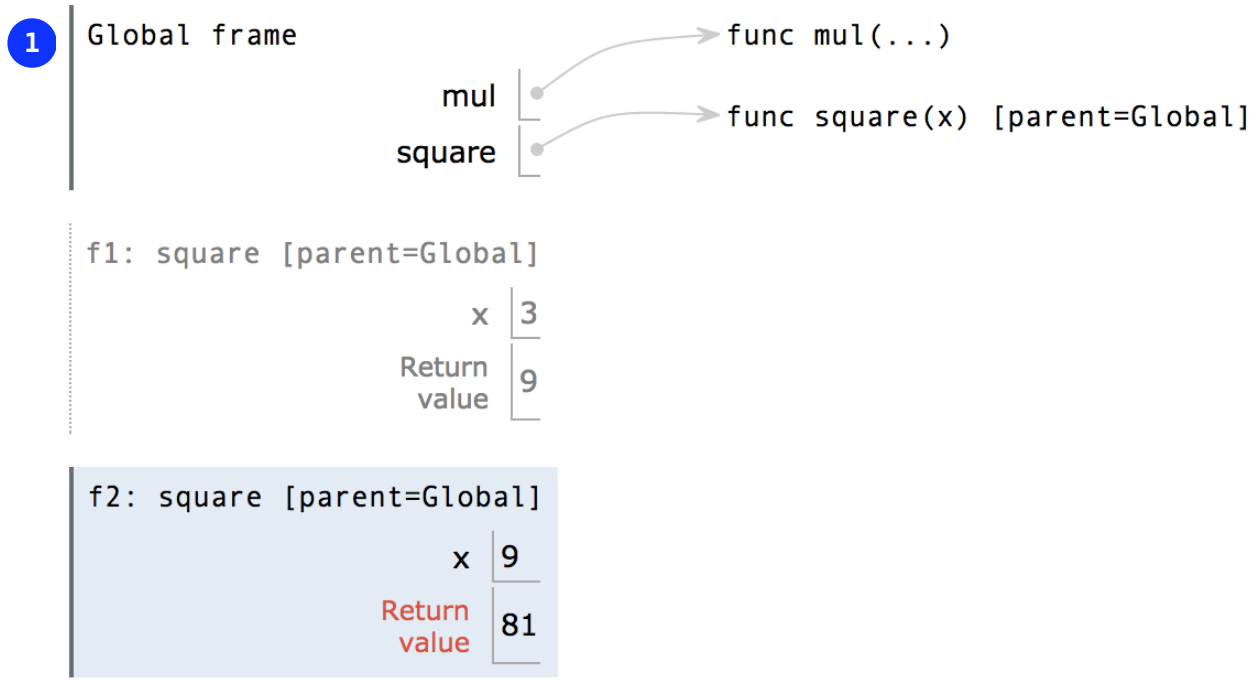

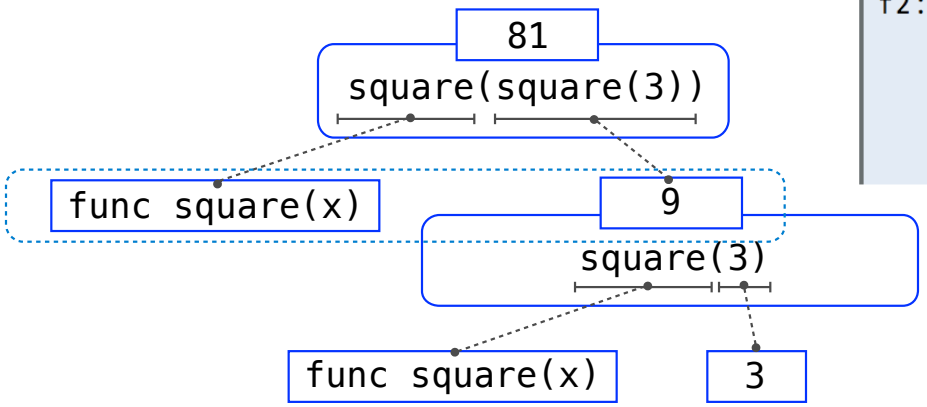

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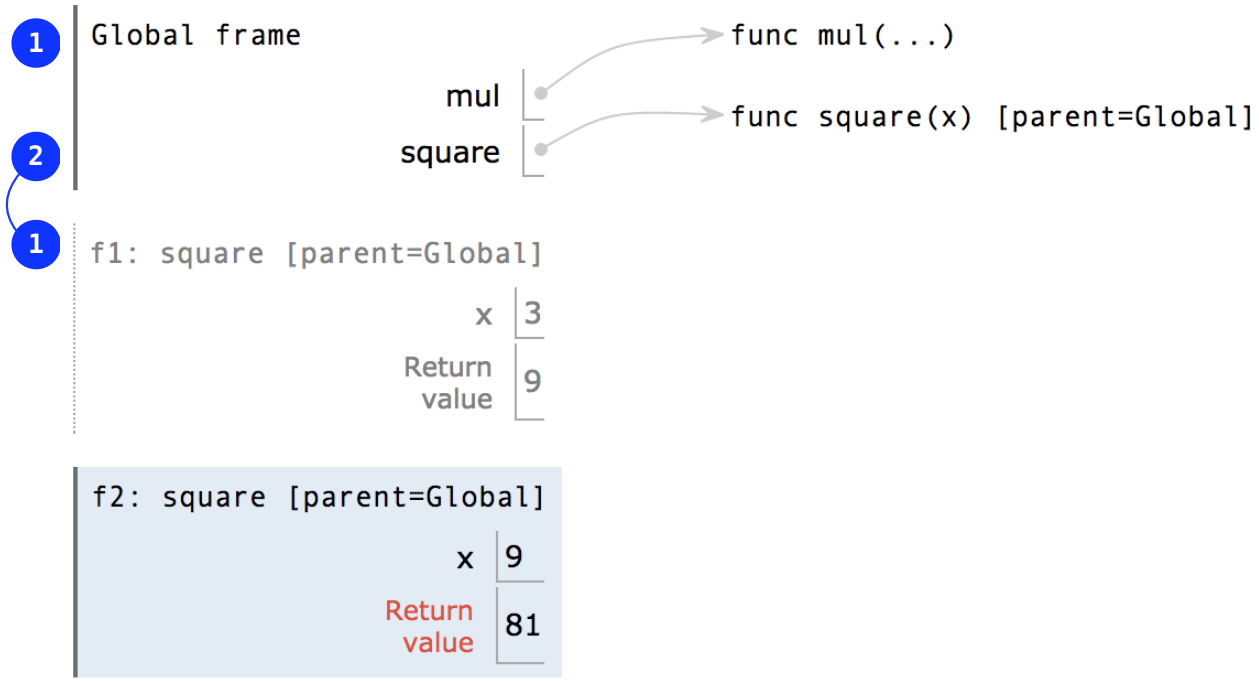

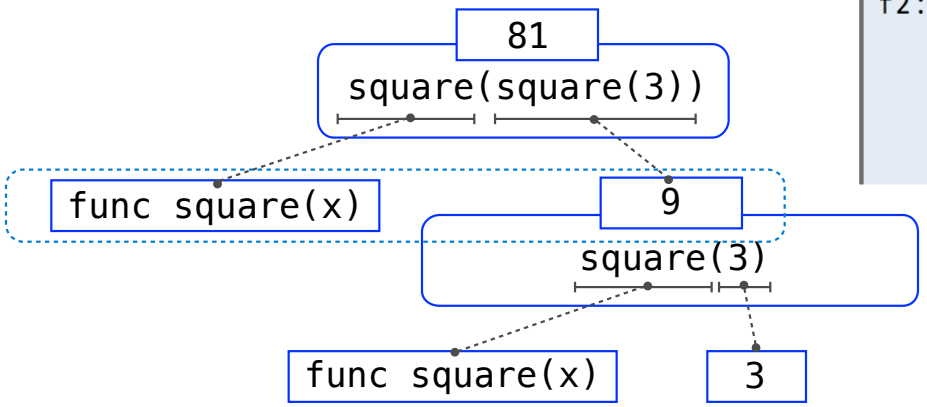

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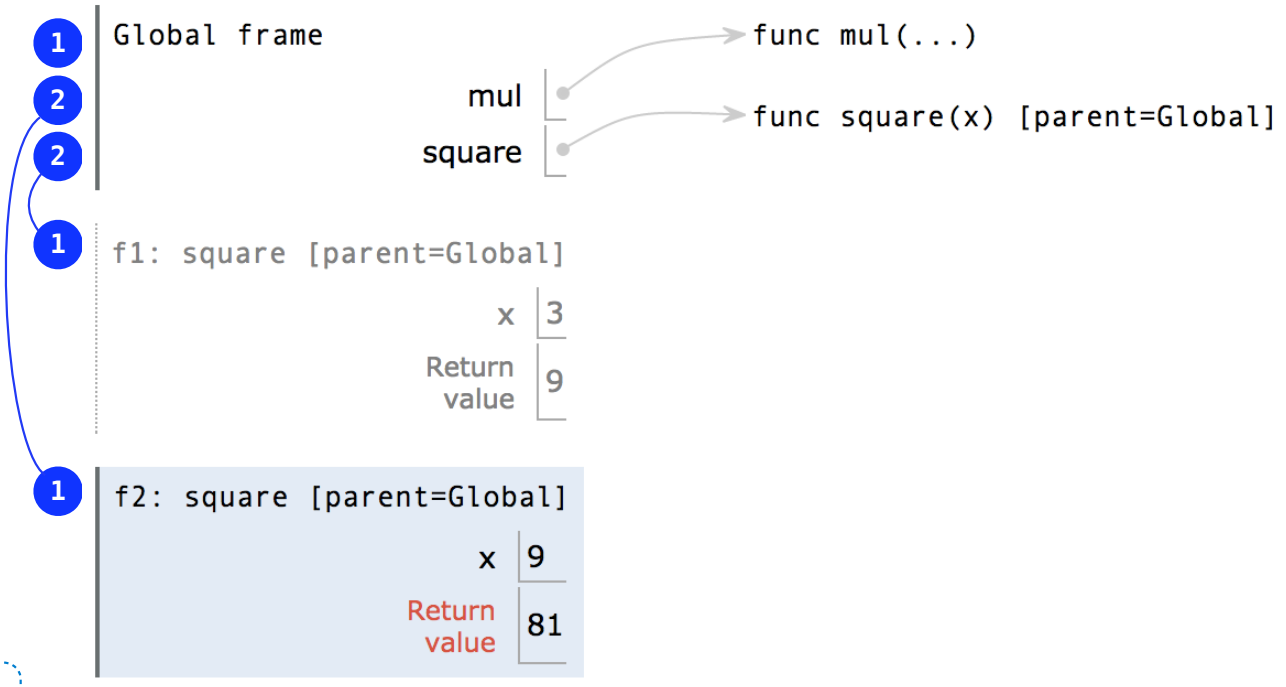

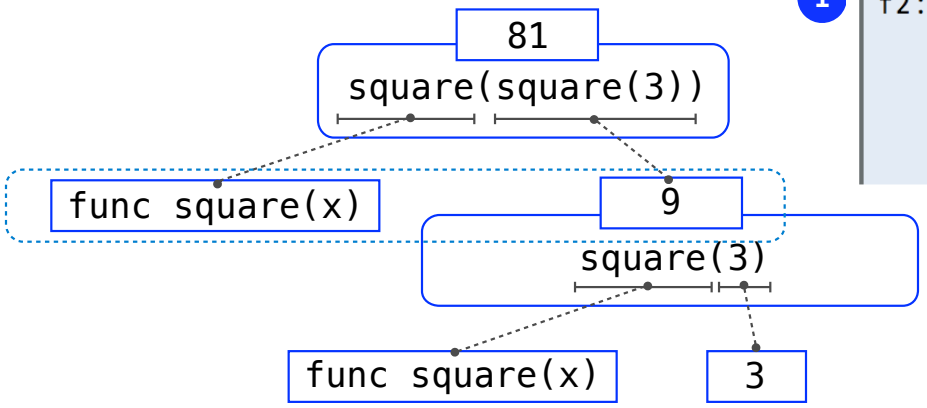

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Names Have No Meaning Without Environments

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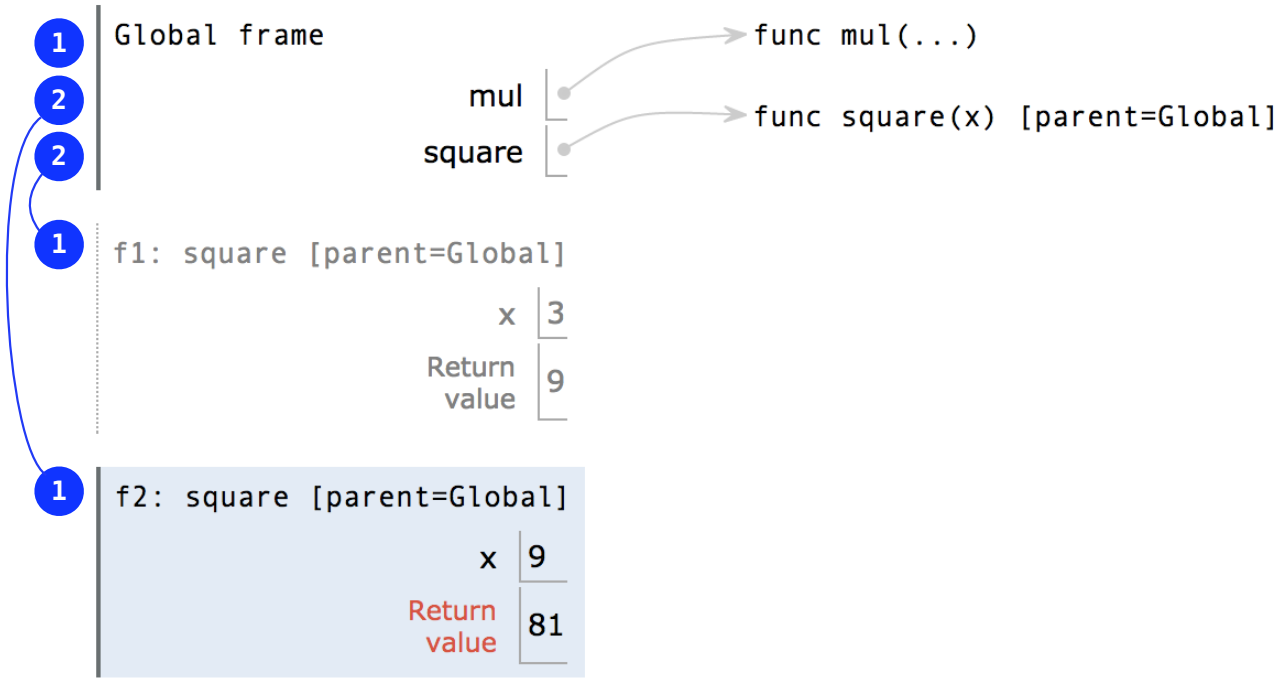

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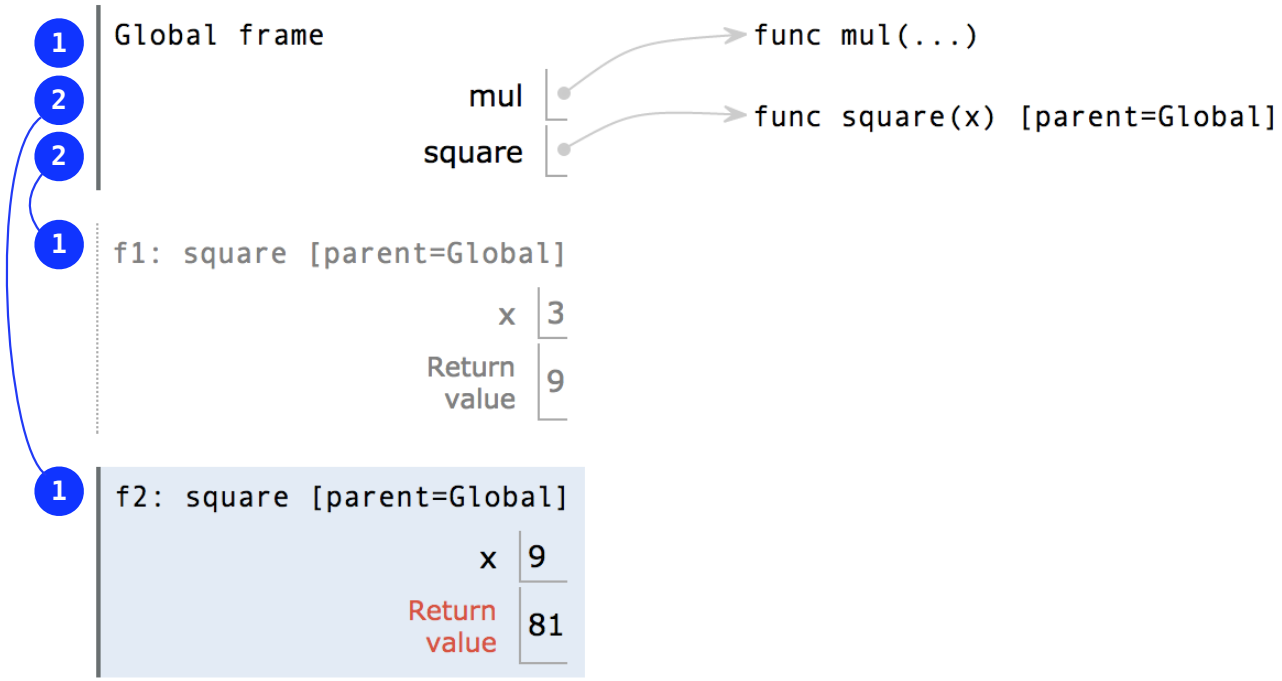

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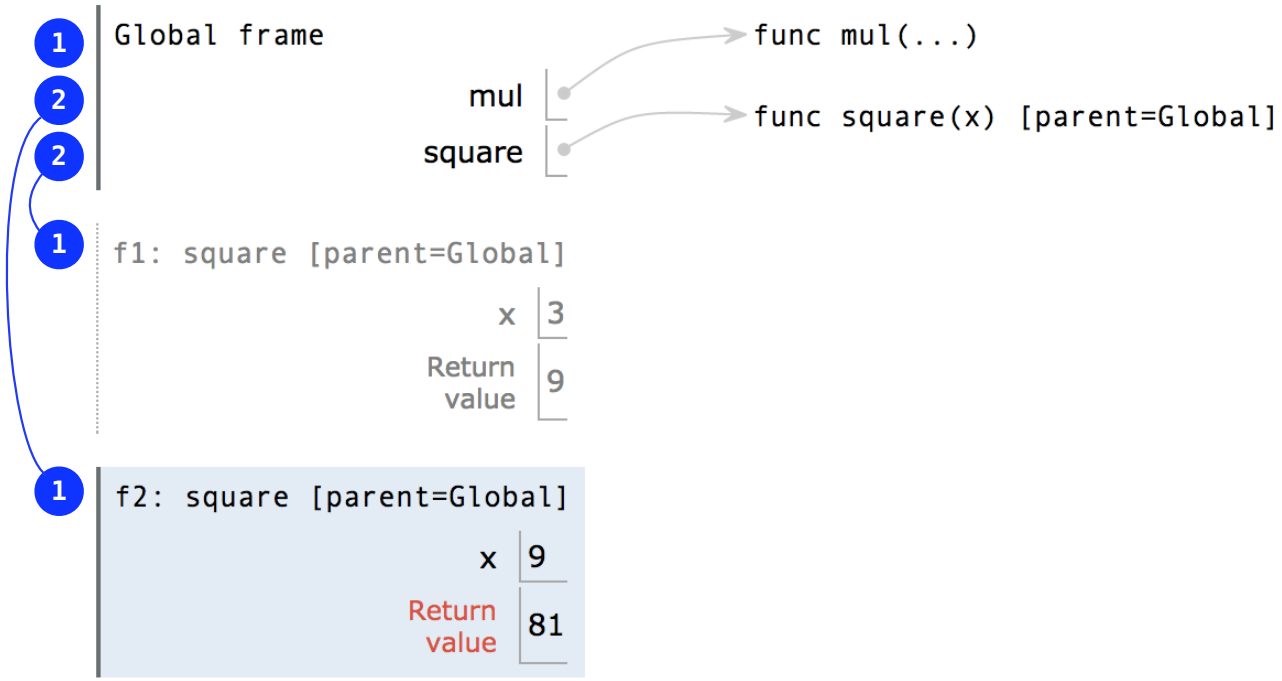

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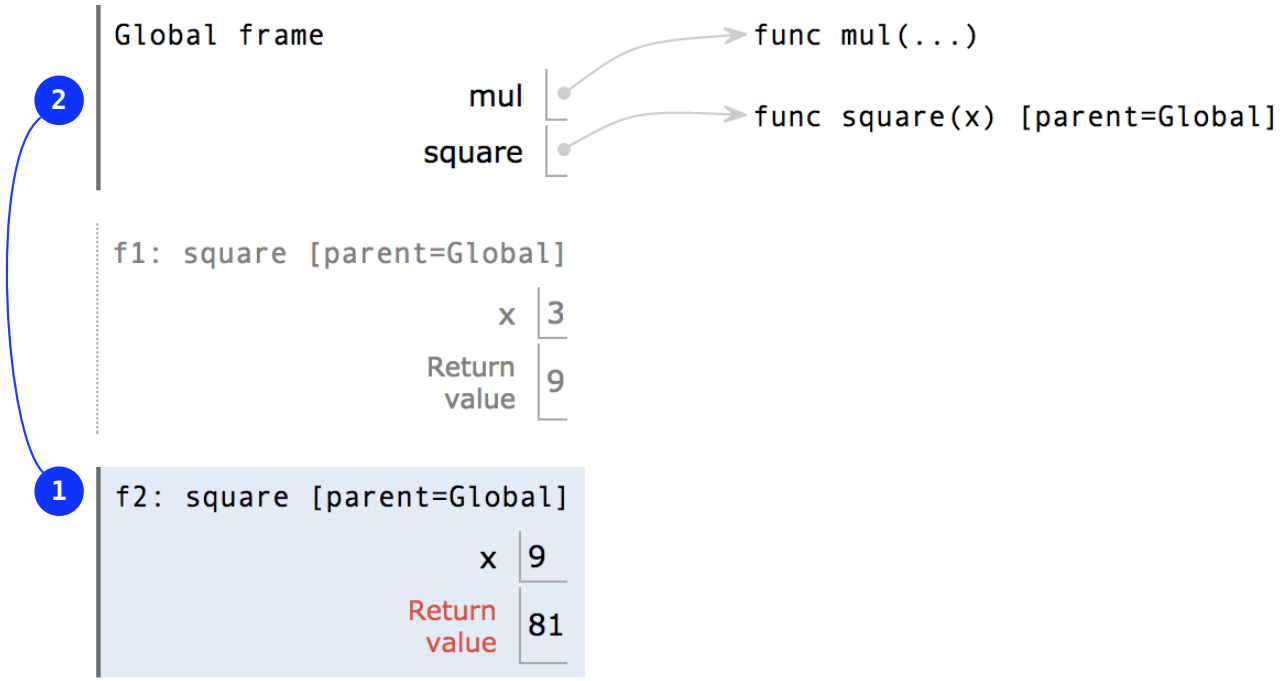

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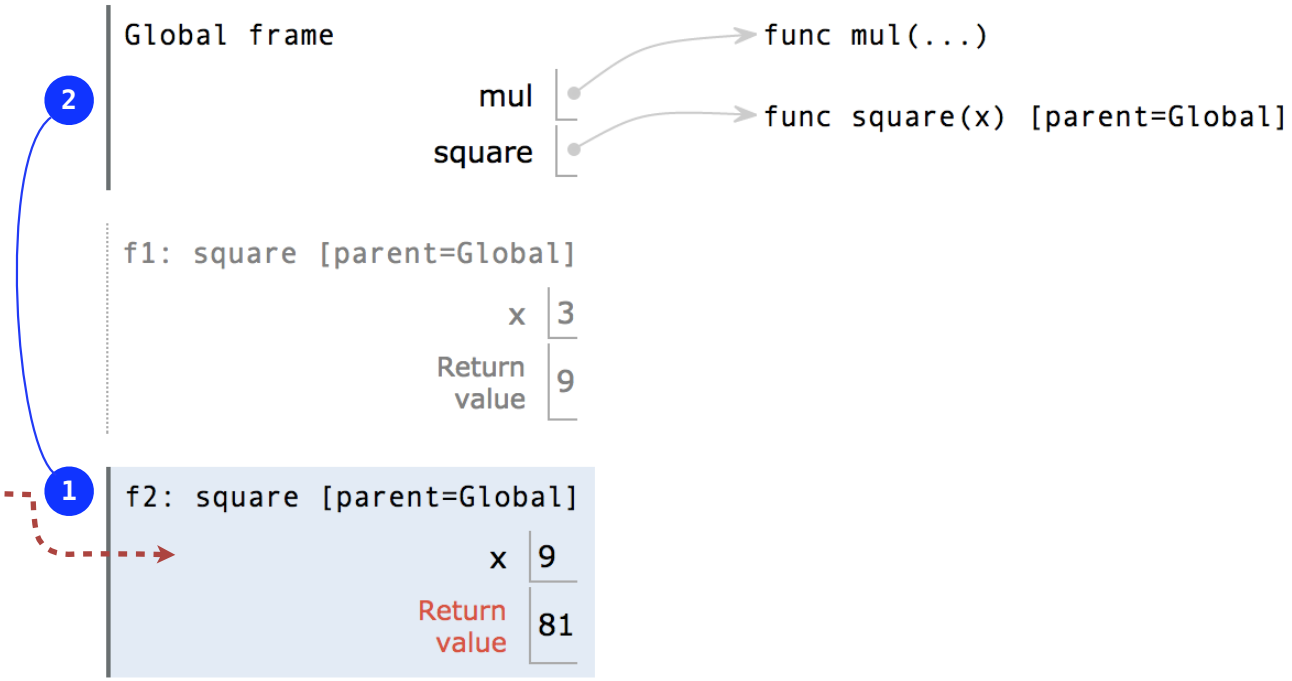

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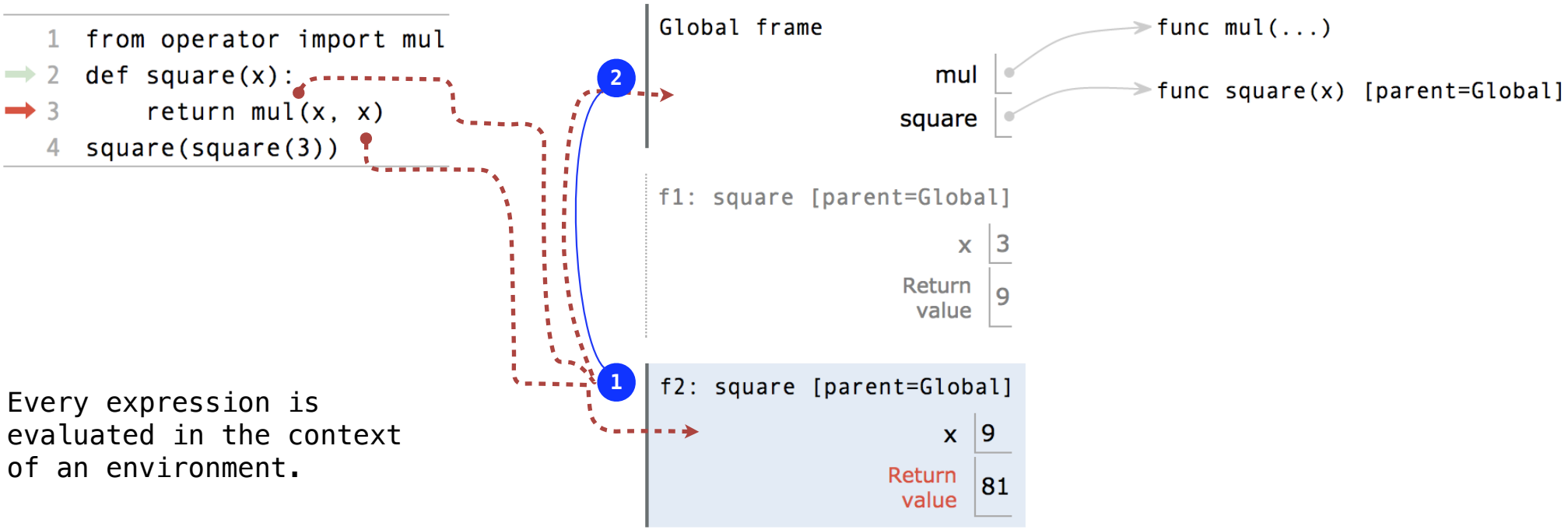

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Interactive Diagram

Names Have Different Meanings in Different Environments

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Interactive Diagram

Names Have Different Meanings in Different Environments

A call expression and the body of the function being called are evaluated in different environments

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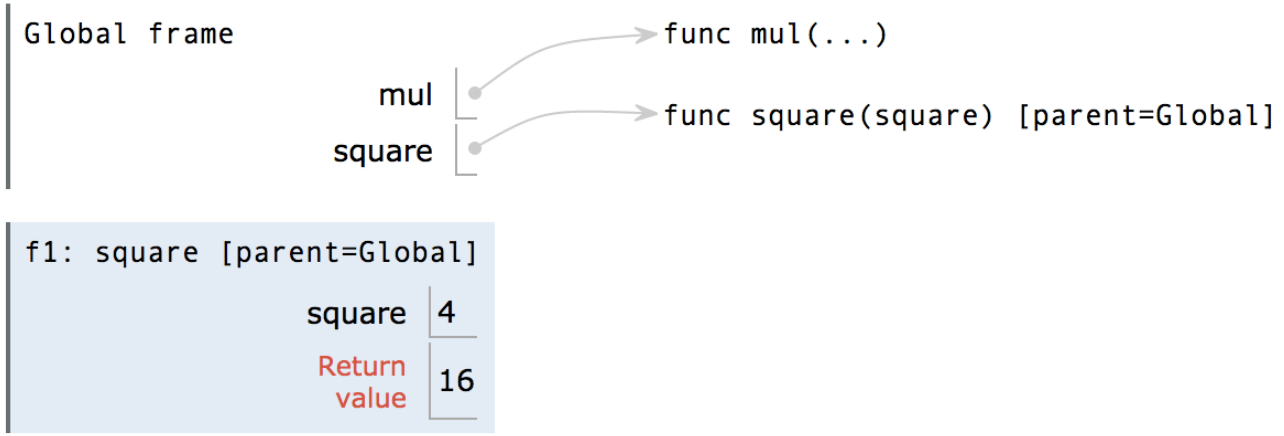

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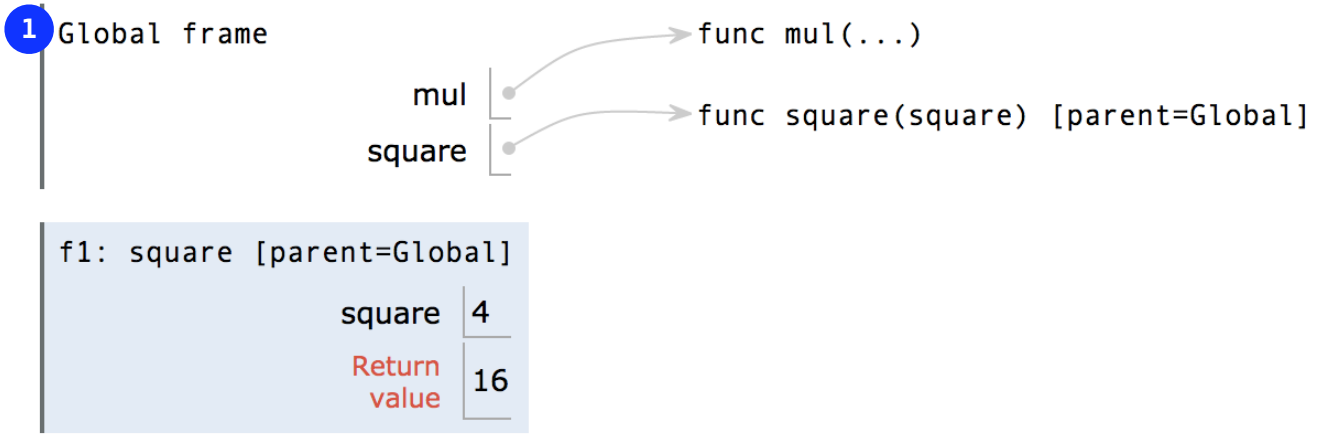


Every expression is evaluated in the context of an environment.

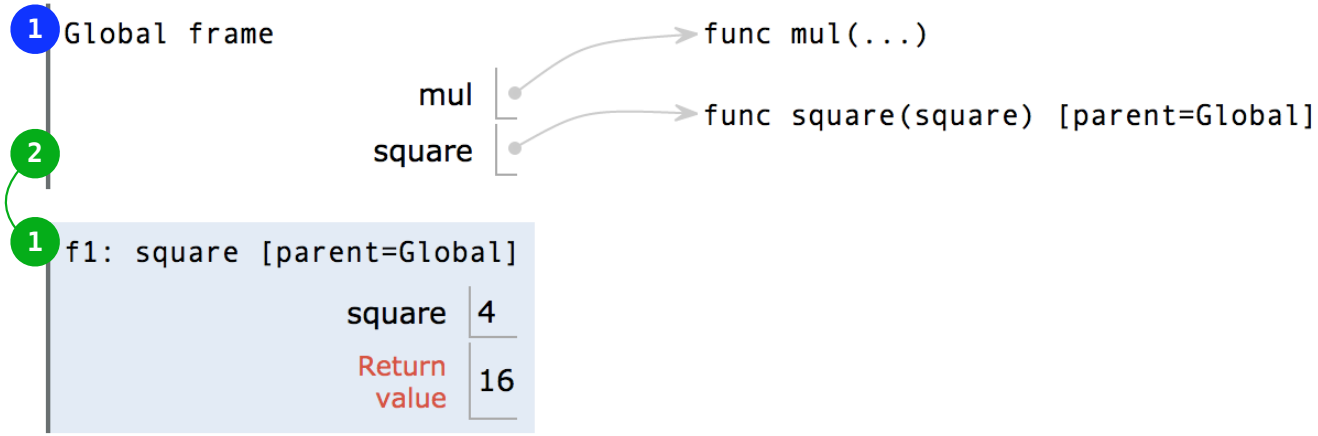
A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.

Interactive Diagram

Names Have Different Meanings in Different Environments

A call expression and the body of the function being called are evaluated in different environments

```
1 from operator import mul
2 def square(square):
3     return mul(square, square)
4 square(4)
```



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Interactive Diagram

Miscellaneous Python Features

Operators

Multiple Return Values

Docstrings

Doctests

Default Arguments

(Demo)

Conditional Statements

Statements

A ***statement*** is executed by the interpreter to perform an action

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A ***statement*** is executed by the interpreter to perform an action

Compound statements:

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Statements

A ***statement*** is executed by the interpreter to perform an action

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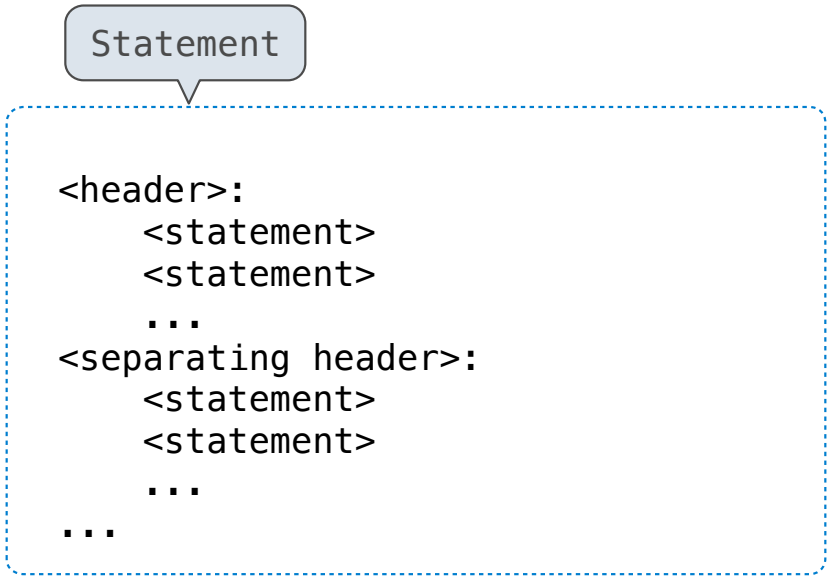

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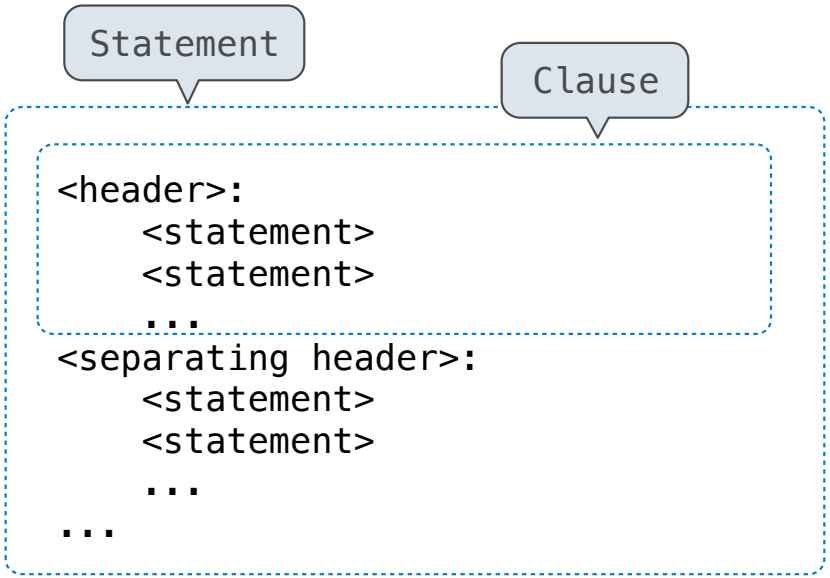

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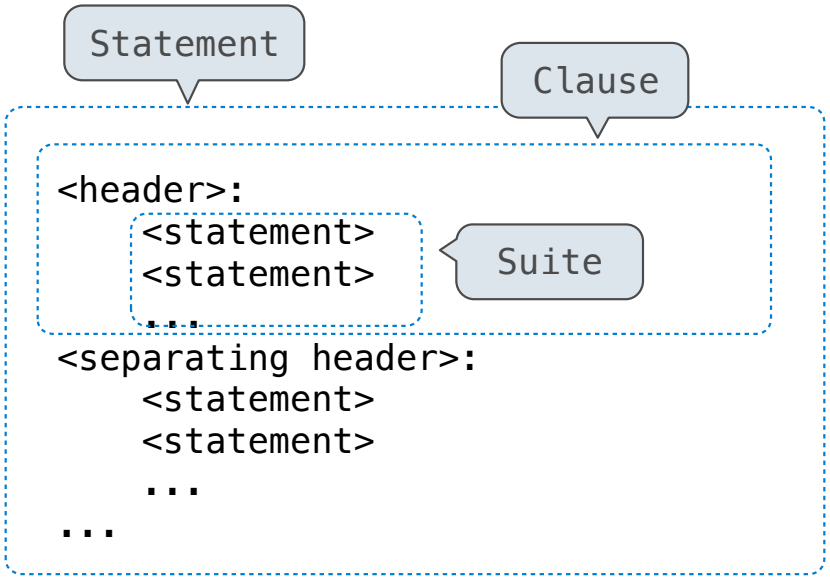

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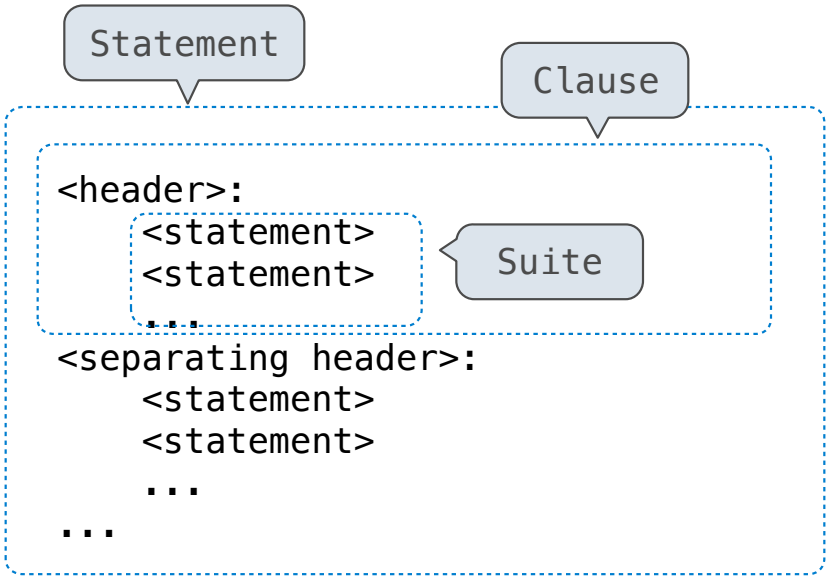

The first header determines a statement's type

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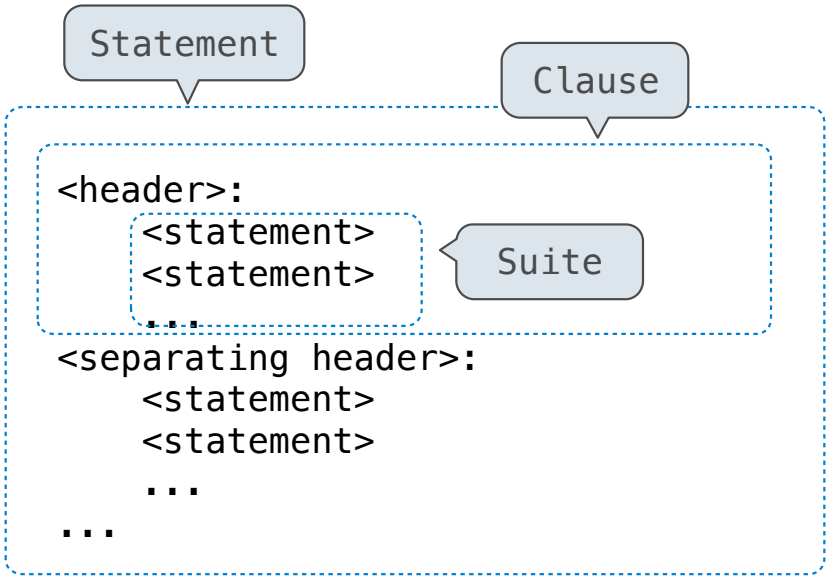

The first header determines a statement's type

The header of a clause "controls" the suite that follows

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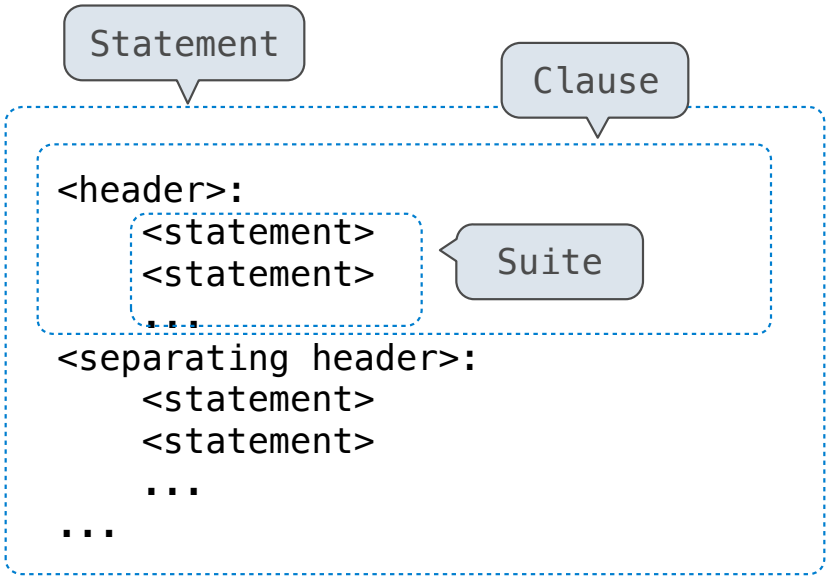

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The header of a clause "controls" the suite that follows

def statements are compound statements

Compound Statements

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    <statement>
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    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Compound Statements

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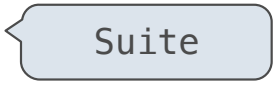

A suite is a sequence of statements

Compound Statements

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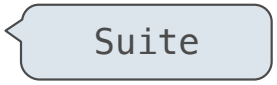
```



A suite is a sequence of statements

To “execute” a suite means to execute its sequence of statements, in order

Compound Statements

Compound statements:

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<separating header>:
    <statement>
    <statement>
    ...
...
```

Suite

A suite is a sequence of statements

To “execute” a suite means to execute its sequence of statements, in order

Execution Rule for a sequence of statements:

- Execute the first statement
- Unless directed otherwise, execute the rest

Conditional Statements

(Demo)

Conditional Statements

(Demo)

```
def absolute_value(x):
    """Return the absolute value of x."""
    if x < 0:
        return -x
    elif x == 0:
        return 0
    else:
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```

Conditional Statements

(Demo)

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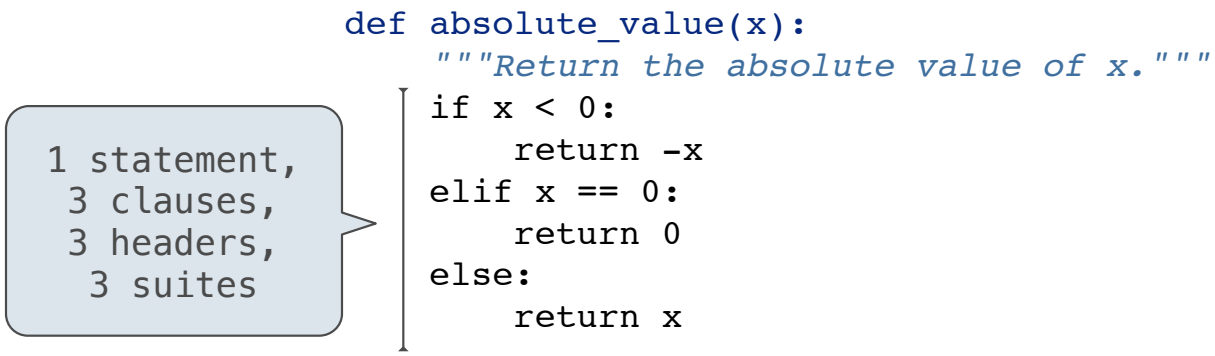
1 statement,
3 clauses,
3 headers,
3 suites

Conditional Statements

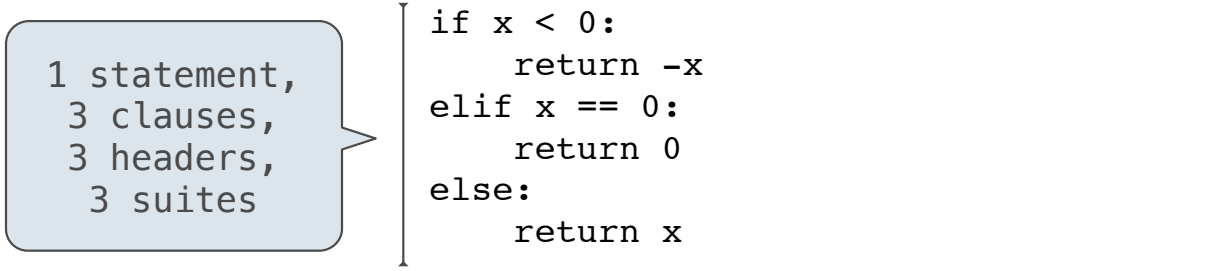
(Demo)



Execution Rule for Conditional Statements:

Conditional Statements

(Demo)

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Execution Rule for Conditional Statements:

Each clause is considered in order.

1. Evaluate the header's expression.

2. If it is a true value,
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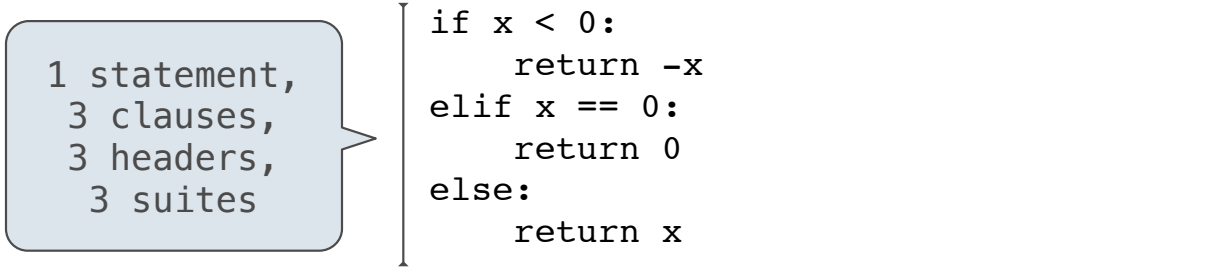
Conditional Statements

(Demo)

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Syntax Tips:

Conditional Statements

(Demo)

1 statement,
3 clauses,
3 headers,
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Execution Rule for Conditional Statements:

Each clause is considered in order.

1. Evaluate the header's expression.
2. If it is a true value,
   execute the suite & skip the remaining clauses.

Syntax Tips:

1. Always starts with "if" clause.
2. Zero or more "elif" clauses.
3. Zero or one "else" clause,
   always at the end.

Boolean Contexts

George Boole

```
def absolute_value(x):
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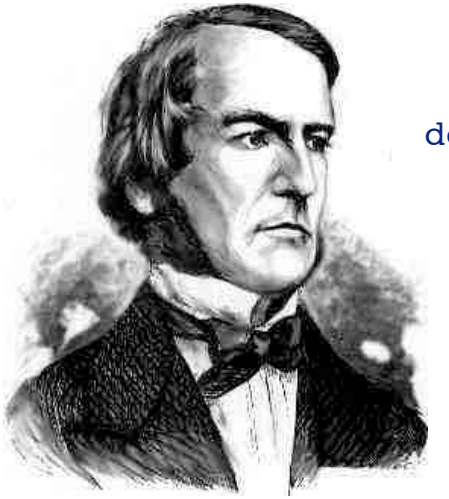

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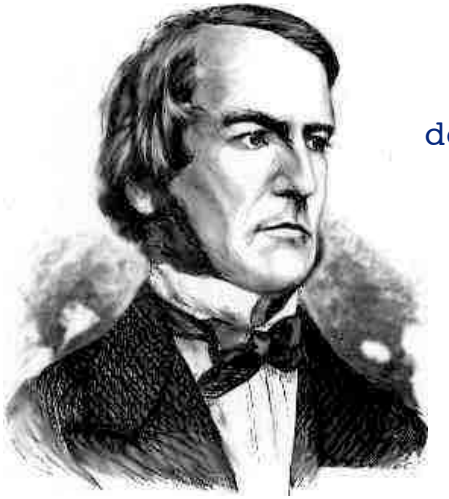

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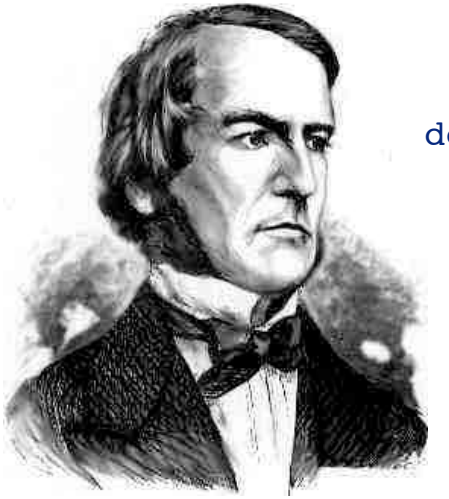

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False values in Python: False, 0, '', None

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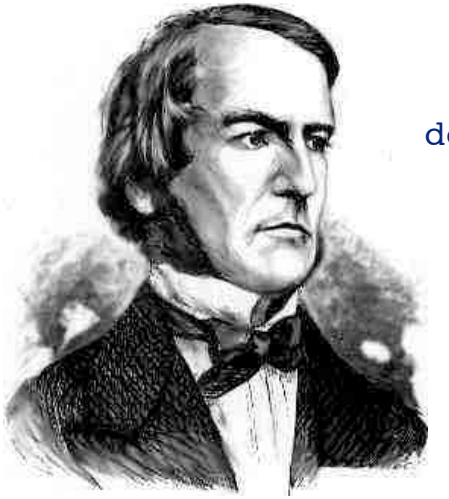

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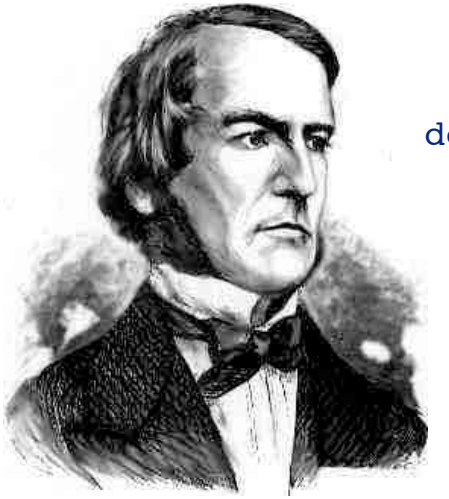

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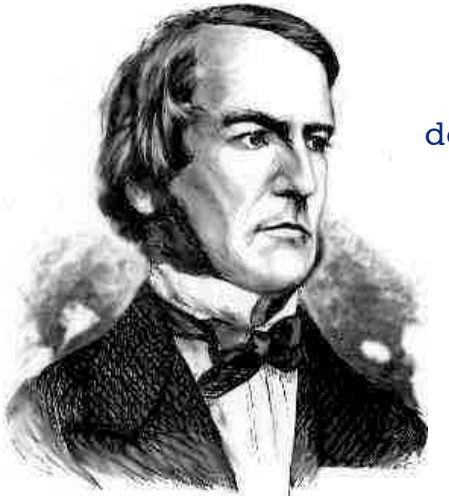

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Read Section 1.5.4!

Reading: http://composingprograms.com/pages/15-control.html#conditional-statements

Iteration

While Statements

(Demo)

While Statements

(Demo)

```
1  i, total = 0, 0
2  while i < 3:
3      i = i + 1
4      total = total + i
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While Statements

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While Statements

George Boole

(Demo)

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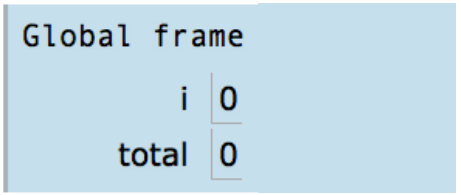

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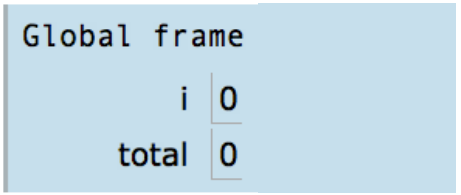

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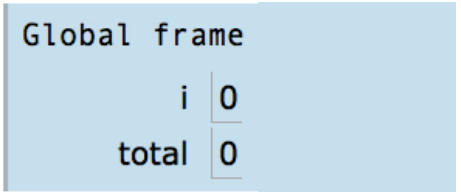

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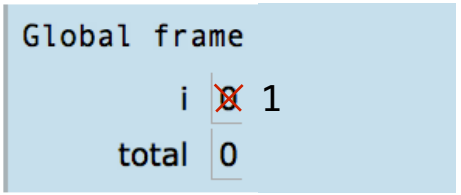

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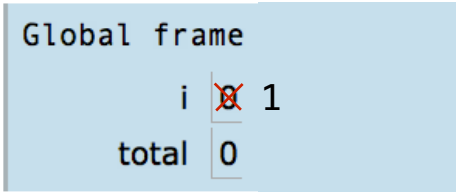

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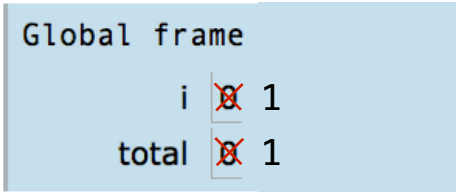

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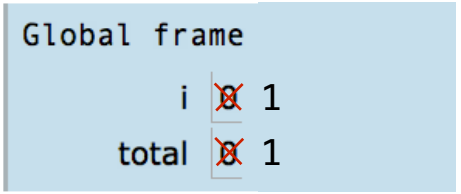

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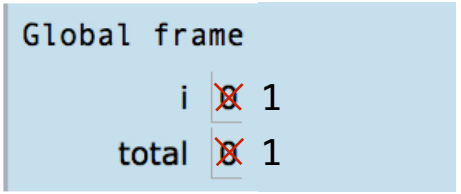

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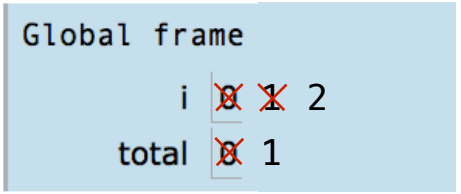

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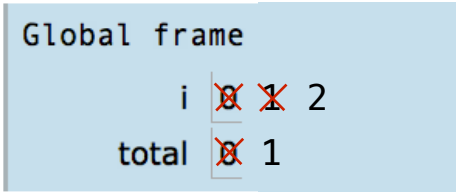

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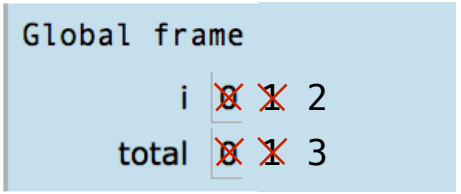

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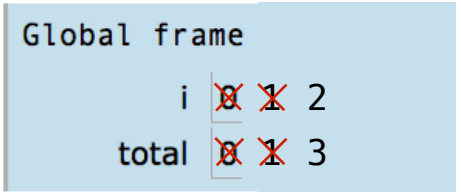

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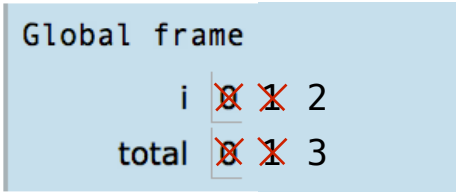

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While Statements

George Boole

(Demo)

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1  i, total = 0, 0
2  while i < 3:
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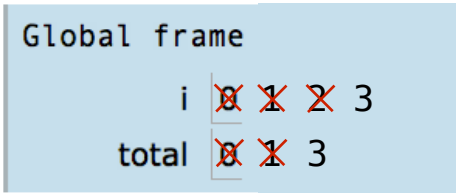

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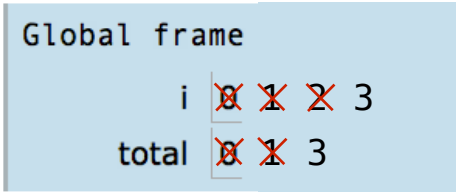

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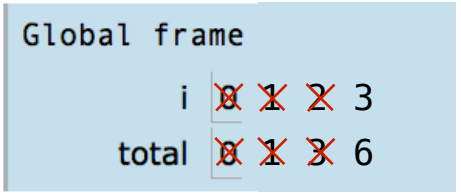

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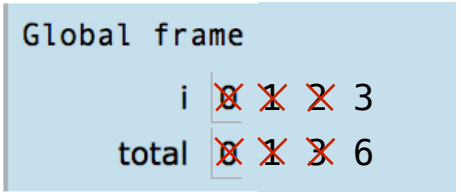

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