SICP

God's Programming Book

Lecture-03 Control

Control

Slides Adapted from cs61a of UC Berkeley

Print and None

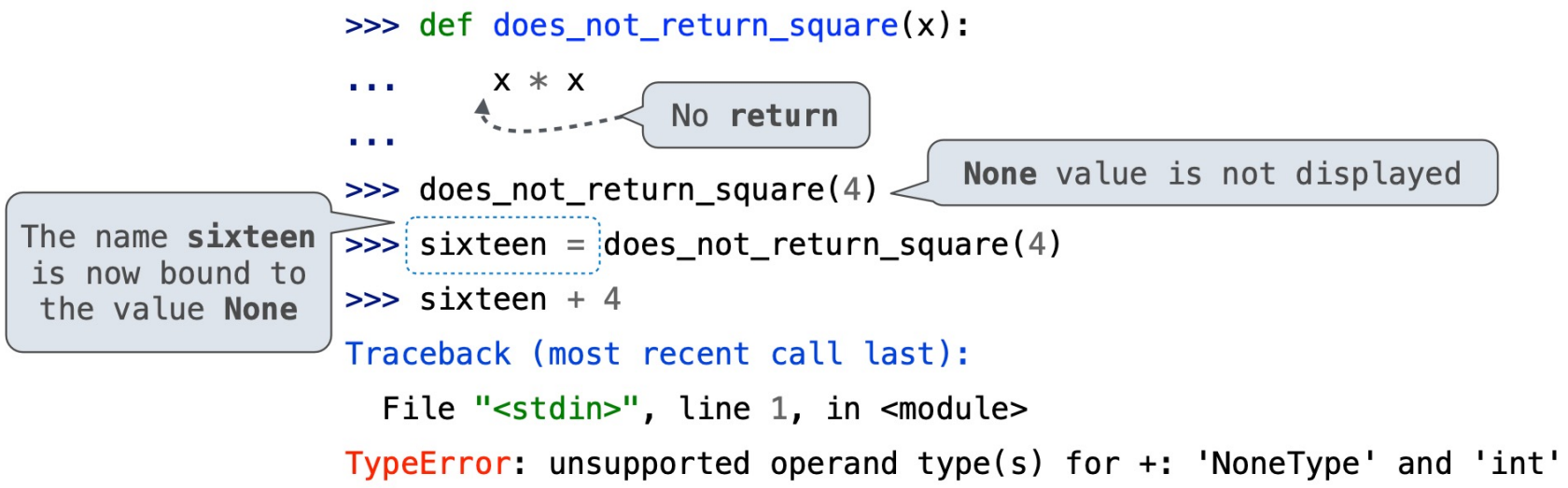
(Demo)

None Indicates that Nothing is Returned

The special value **None** represents nothing in Python

A function that does not explicitly return a value will return **None**

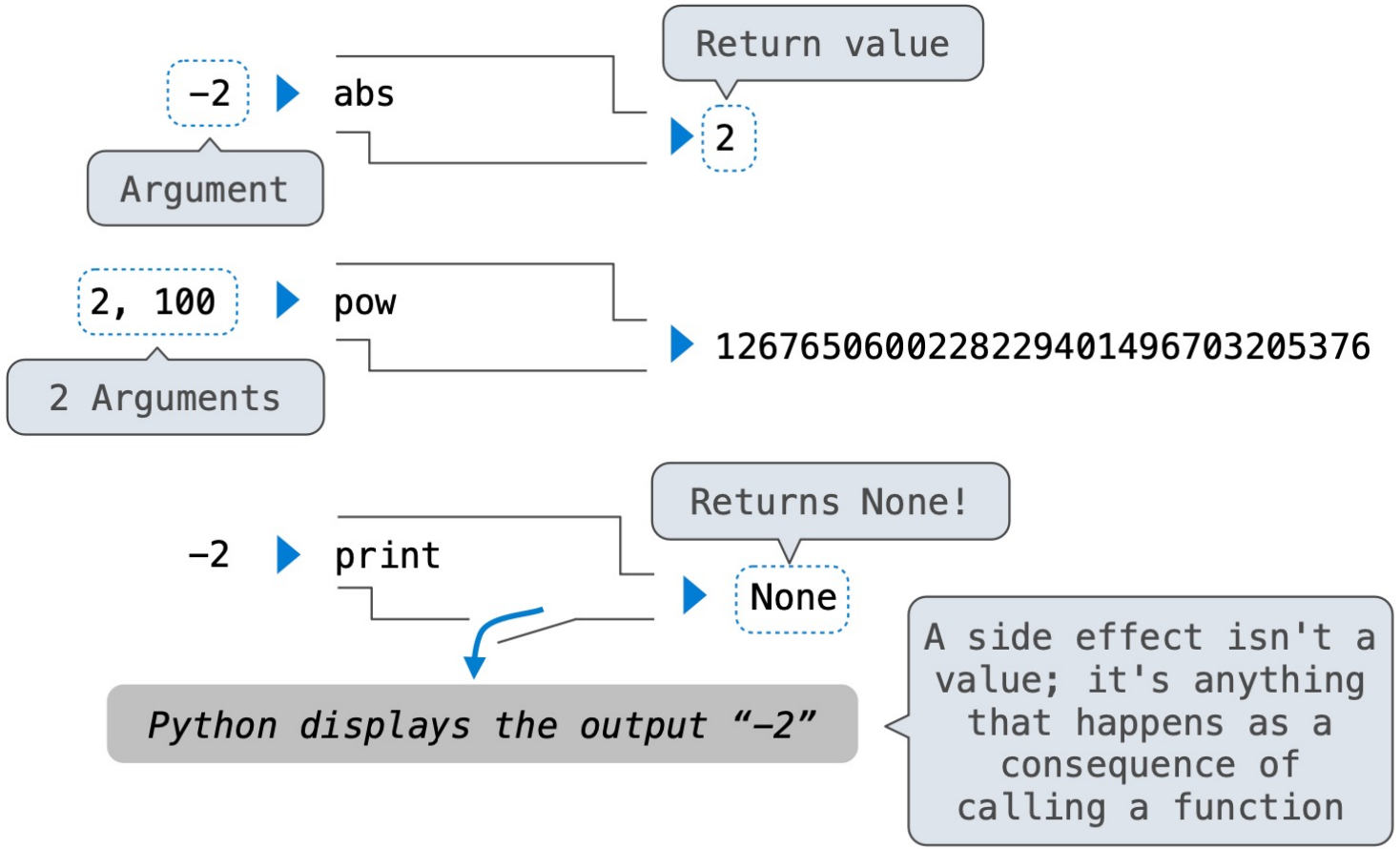
Careful: **None** is not displayed by the interpreter as the value of an expression



Pure Functions & Non-Pure Functions

Pure Functions

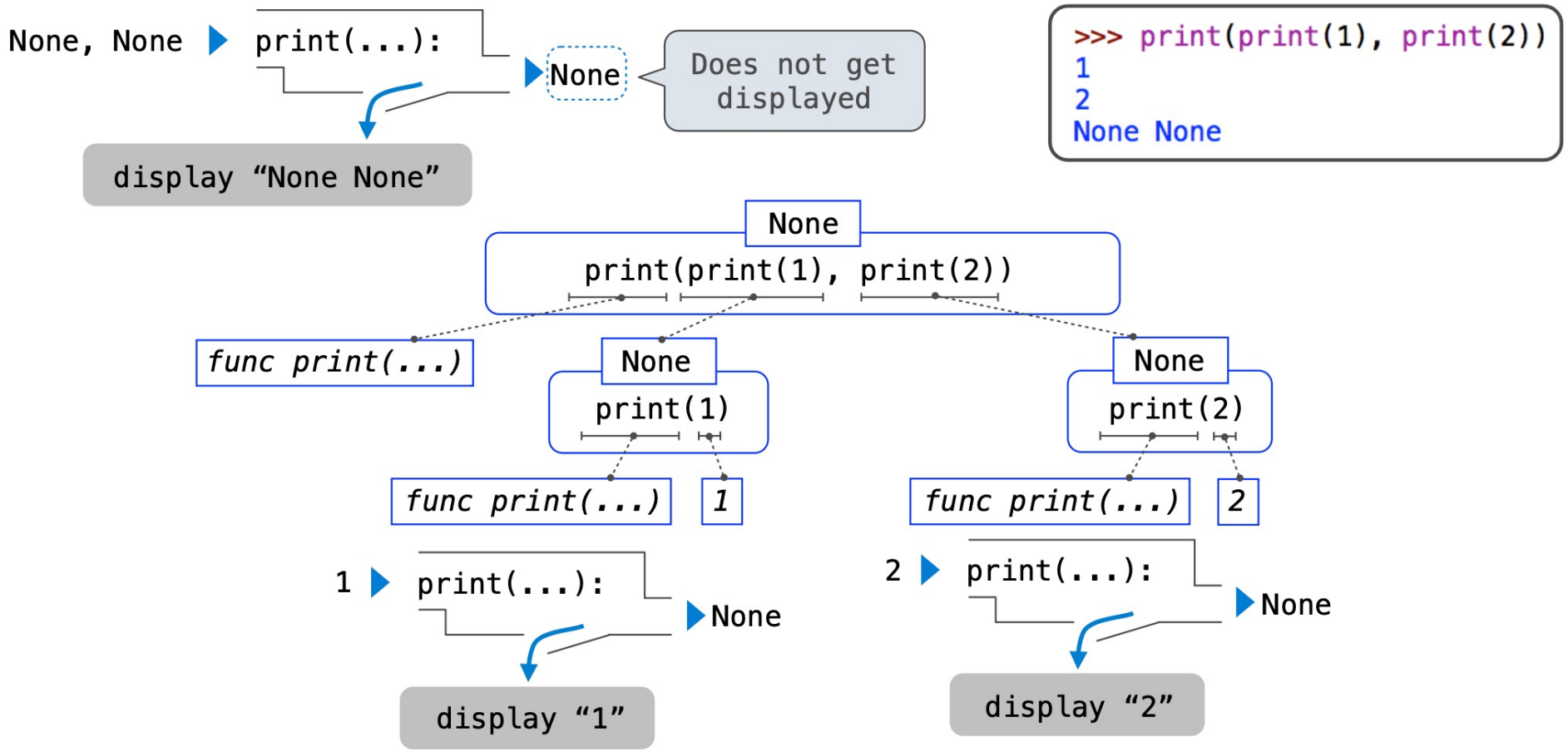
just return values



Non-Pure Functions

have side effects

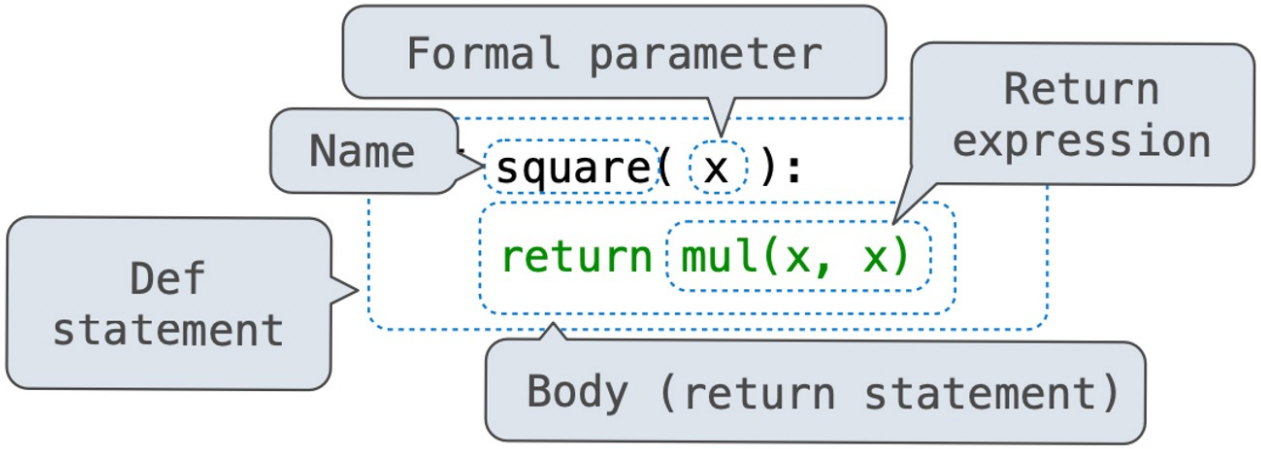
Nested Expressions with Print



Multiple Environments

Life Cycle of a User-Defined Function

Def statement:



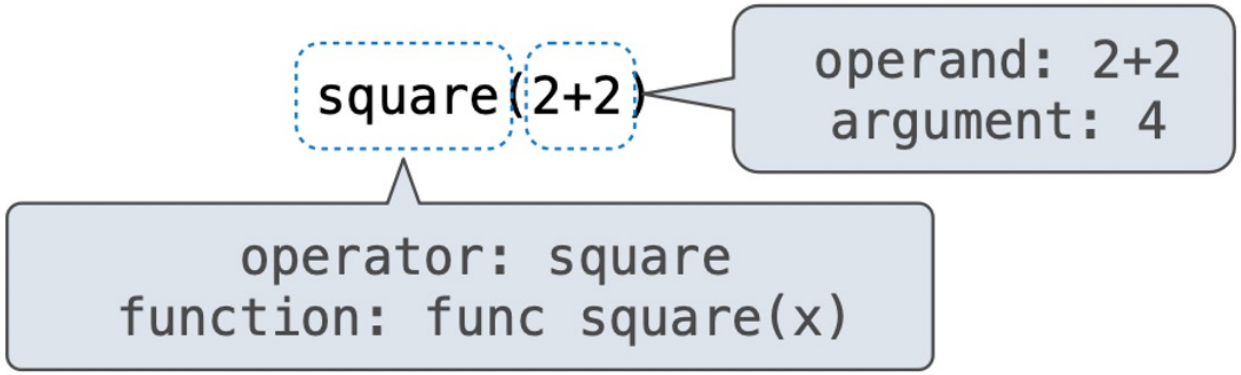
What happens?

A new function is created!

Name bound to that function in the current frame

Life Cycle of a User-Defined Function

Call Expression:



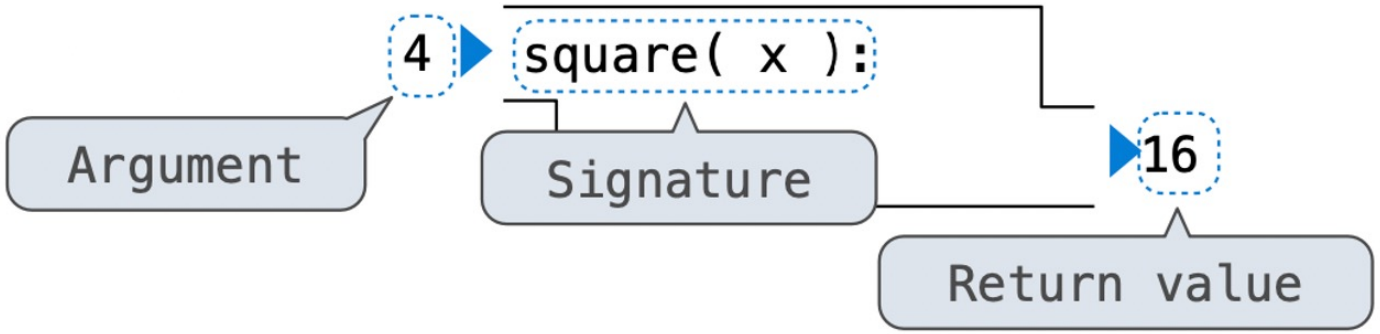
What happens?

Operator & operands evaluated

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

Life Cycle of a User-Defined Function

Calling/Applying:



What happens?

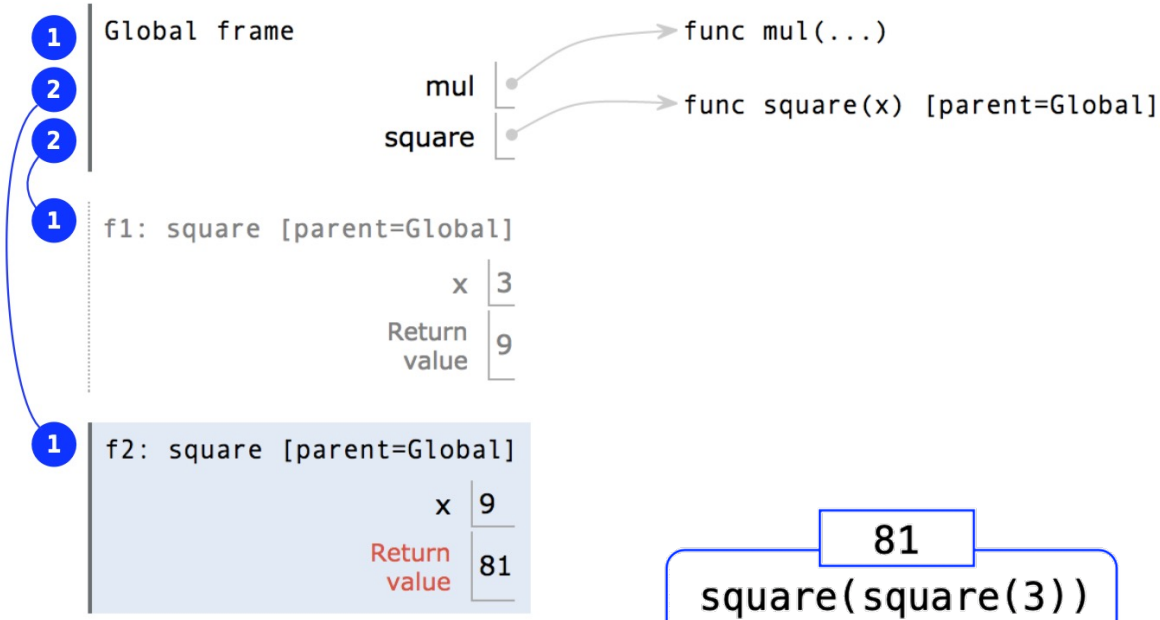
A new frame is created!

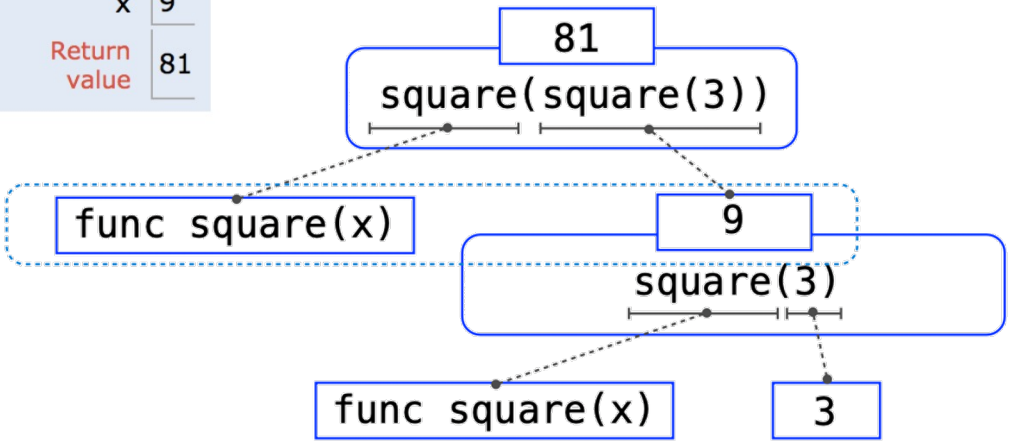
Parameters bound to arguments

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)
4  square(square(3))
```

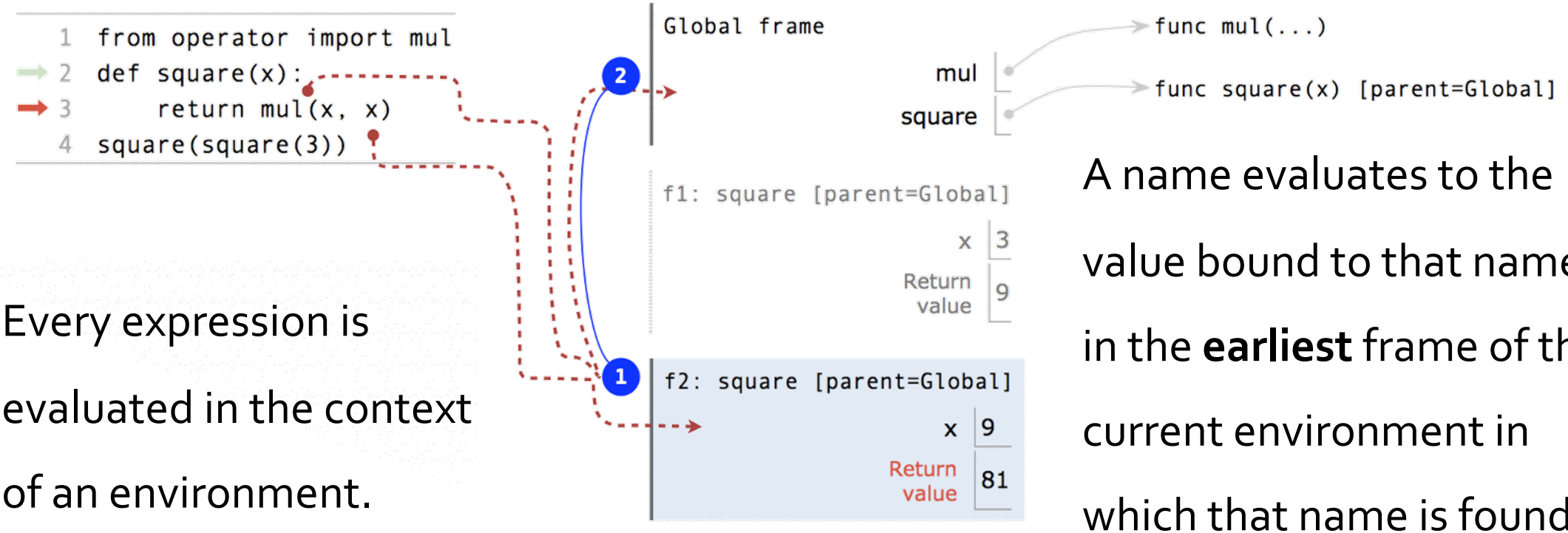




An environment is a sequence of frames.

- The global frame alone
- A local, then the global frame

Names Have No Meaning Without Environments

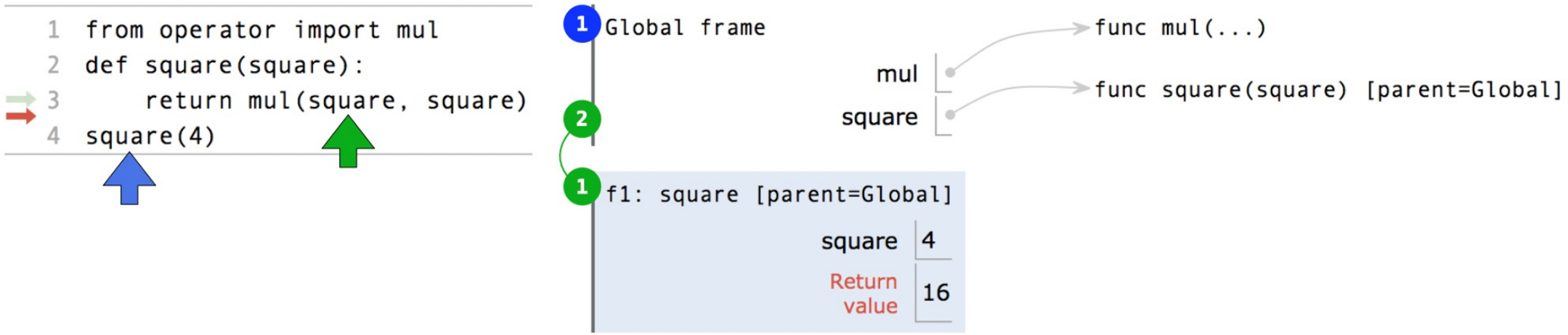


Every expression is evaluated in the context of an environment.

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

Names Have Different Meanings in Different Environments

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



Miscellaneous Python Features

Miscellaneous Python Features

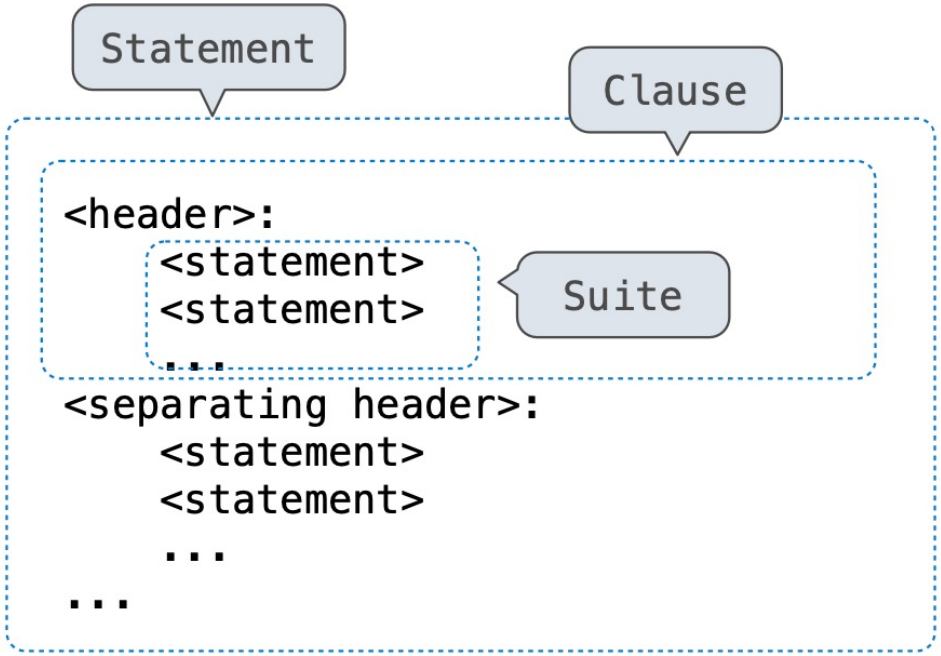
- Division
- Multiple Return Values
- Source Files
- Doctests
- Default Arguments

Conditional Statements

Statements

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

Compound statements:



- The first header determines a statement's type
- The header of a clause "controls" the suite that follows
- def statements are compound statements

Compound Statements

Compound statements:

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

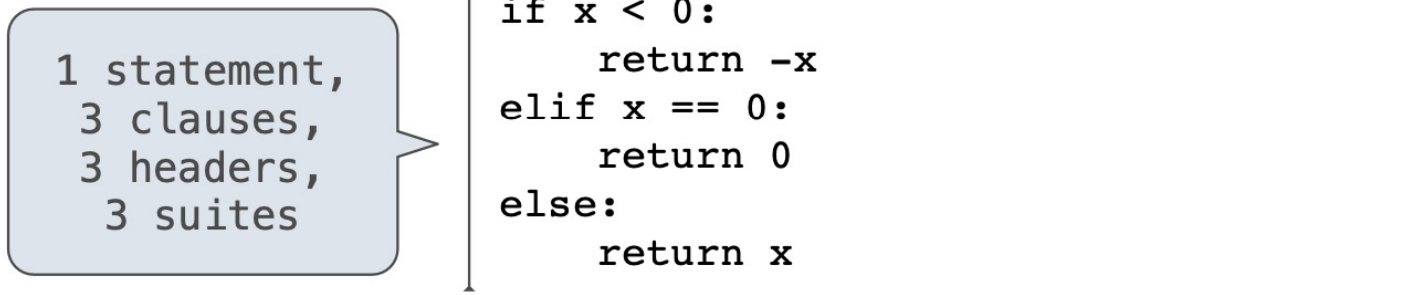
Suite

- 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




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

Execution Rule for Conditional Statements:

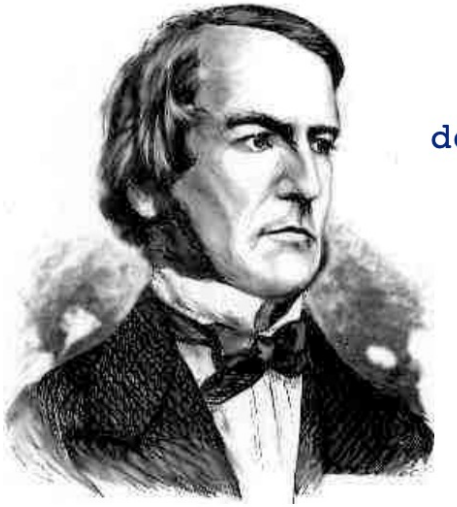
Each clause is considered in order.

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

Two boolean contexts

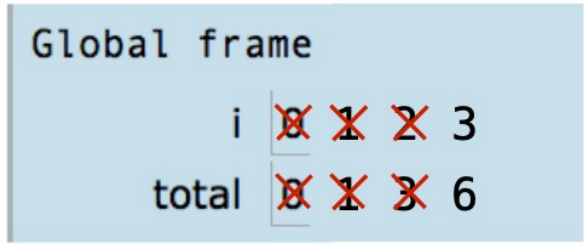
- False values in Python: False, 0, '', None (more to come)
- True values in Python: Anything else (True)

Iteration

While Statements

George Boole

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



Execution Rule for While Statements:

1. Evaluate the header's expression.
2. If it is a true value, execute the (whole) suite, then return to step 1.

Example: Prime Factorization

Prime Factorization

Each positive integer n has a set of prime factors: primes whose product is n

…
8 =2*2*2 9 =3*3
10 = 2 * 5
11 = 11
12 = 2 * 2 * 3

…

One approach: Find the smallest prime factor of n, then divide by it

$$858 = 2*429 = 2*3*143 = 2*3*11*13$$

Thanks for Listening