61A Lecture 3

Announcements

Print and None

(Demo)

```
>>> None
>>> print(None)
None
>>> result = print(print(1), print(2))
1
2
None
None
>>> result
>>> print(None)
None
```

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

```
>>> def does_not_return_square(x):
...     x * x
...
>>> does_not_return_square(4)
>>> sixteen = does_not_return_square(4)
>>> sixteen + 4
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unsupported operand type(s) for +: 'NoneType' and 'int'
```

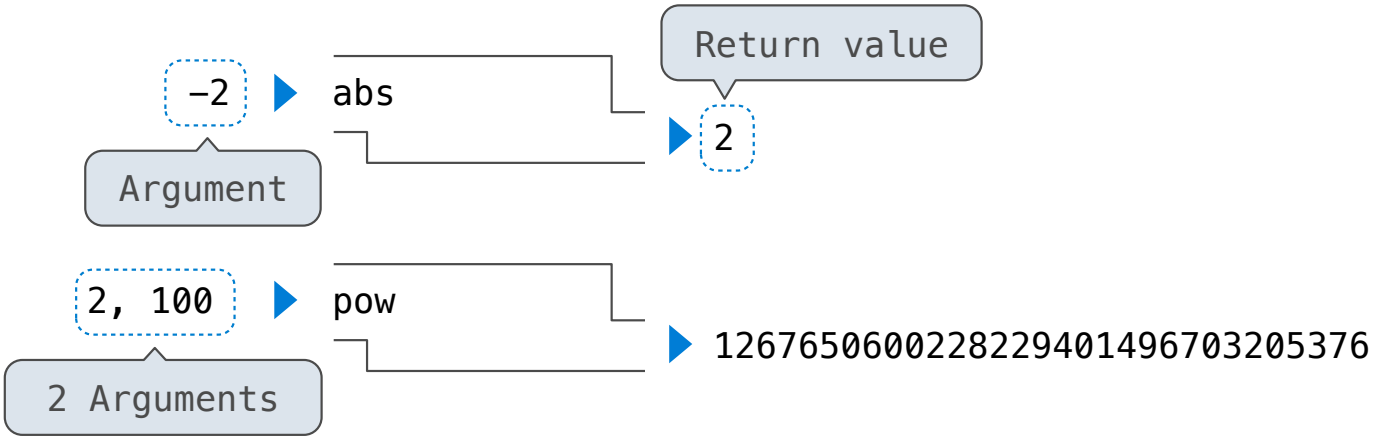
No **return**

None value is not displayed

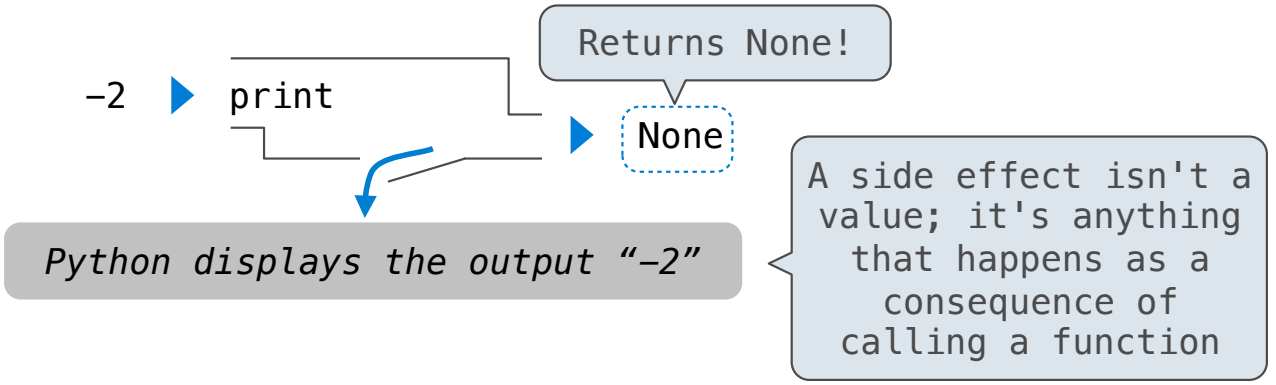
The name **sixteen** is now bound to the value **None**

Pure Functions & Non-Pure Functions

Pure Functions
just return values

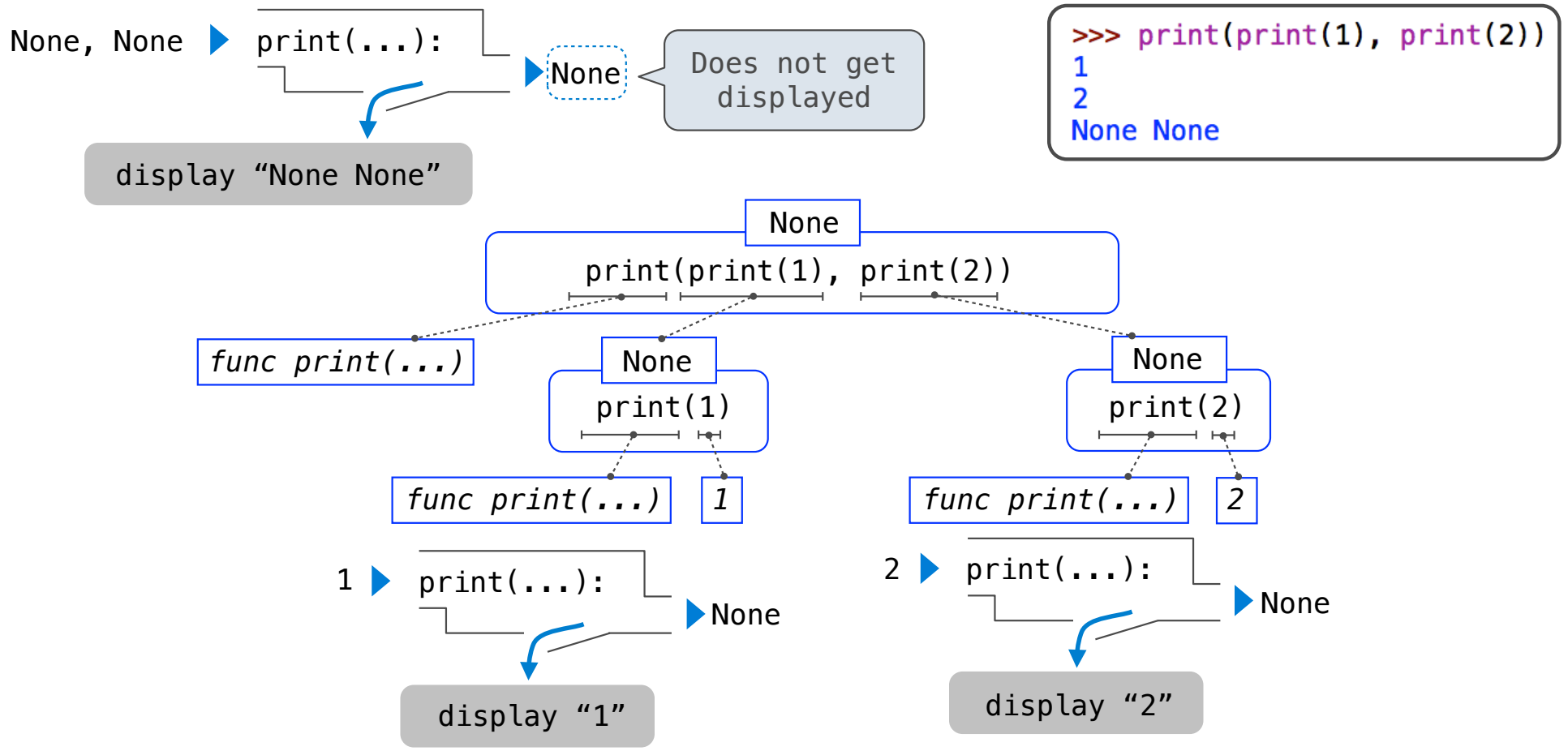


Non-Pure Functions
have side effects



(Demo)

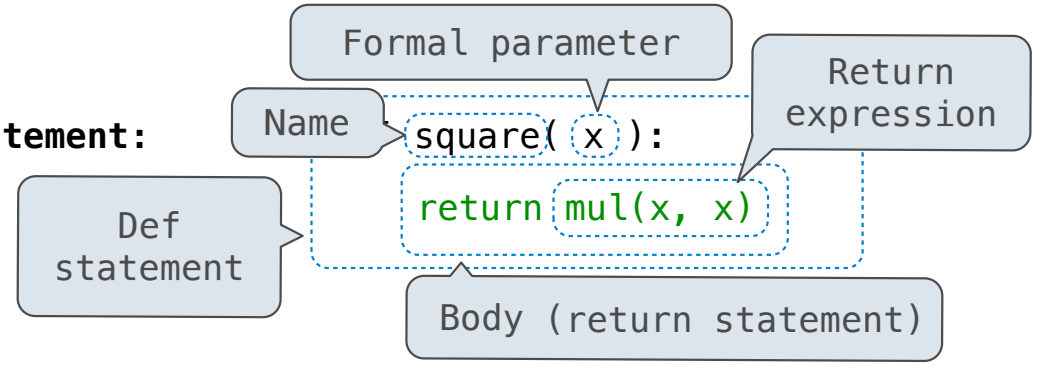
Nested Expressions with Print



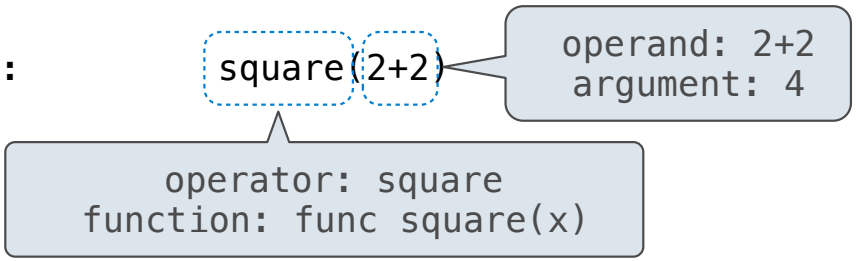
Multiple Environments

Life Cycle of a User-Defined Function

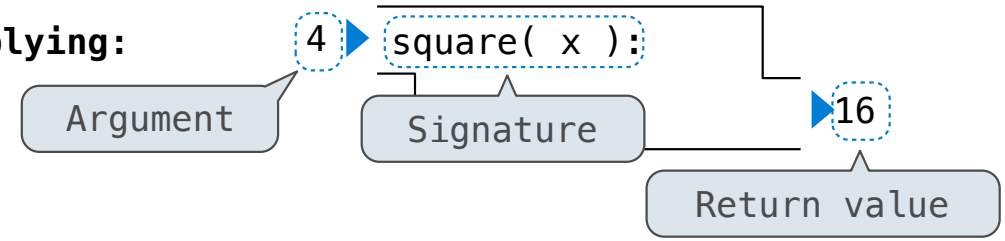
Def statement:



Call expression:



Calling/Applying:



What happens?

A new function is created!

Name bound to that function in the current frame

Operator & operands evaluated

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

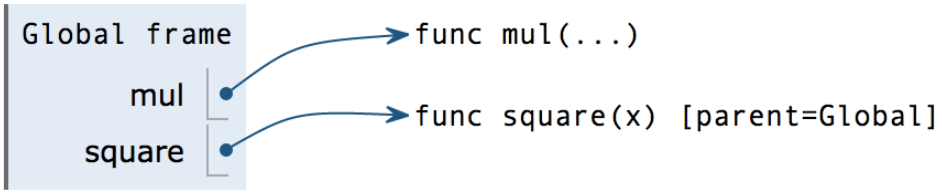
A new frame is created!

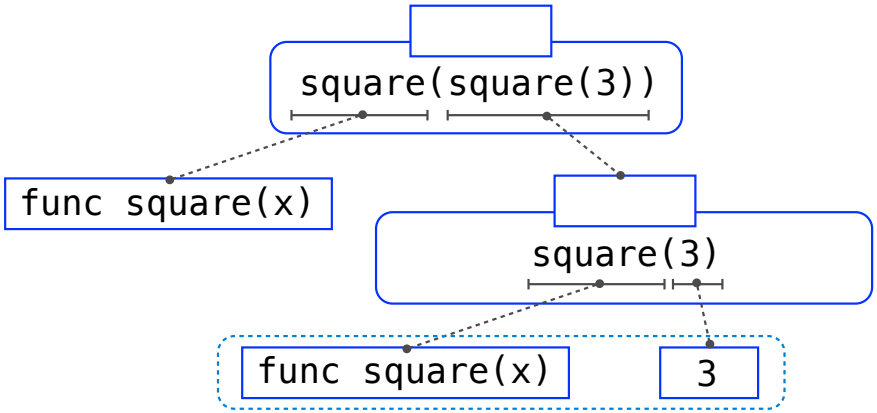
Parameters bound to arguments

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





Interactive Diagram

Multiple Environments in One Diagram!

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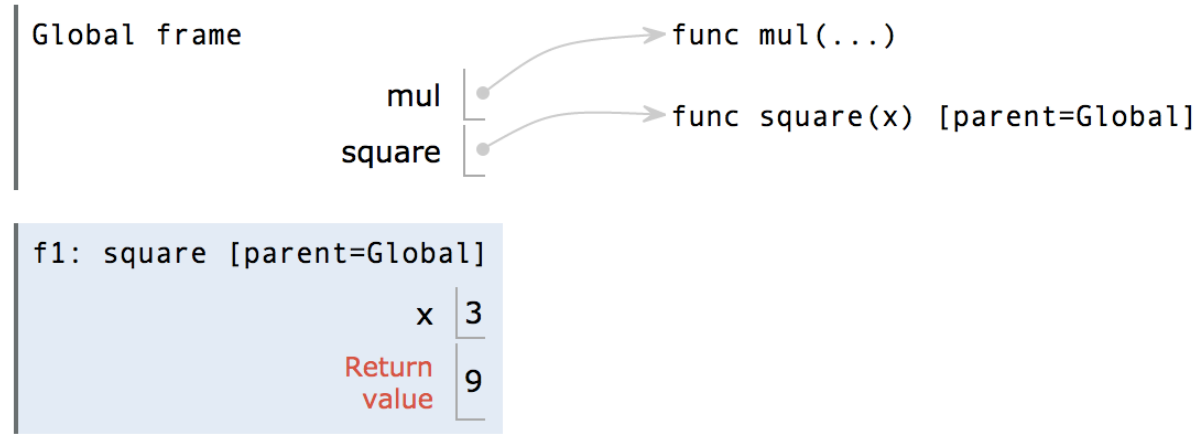
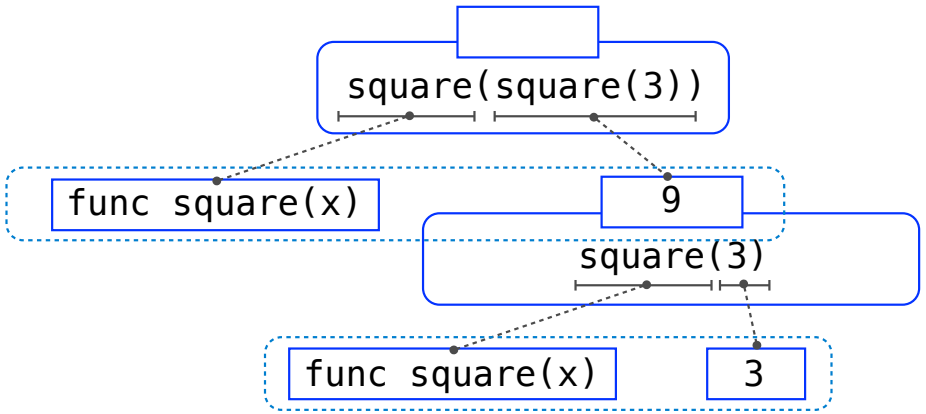
```





Interactive Diagram

Multiple Environments in One Diagram!

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1  from operator import mul
2  def square(x):
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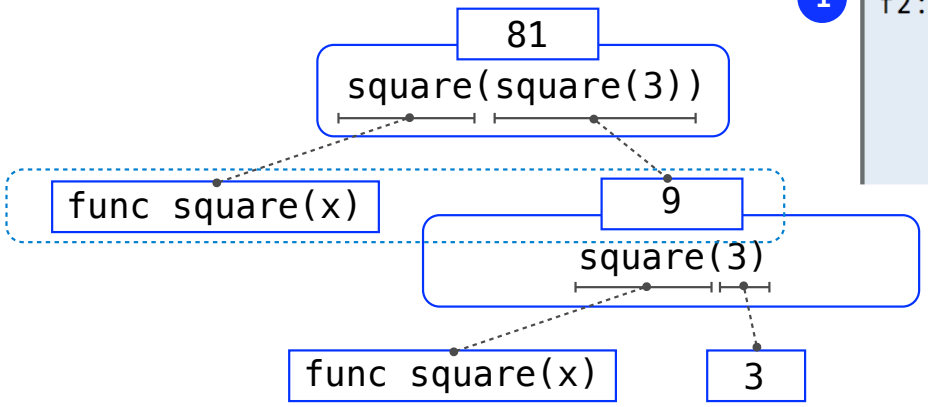
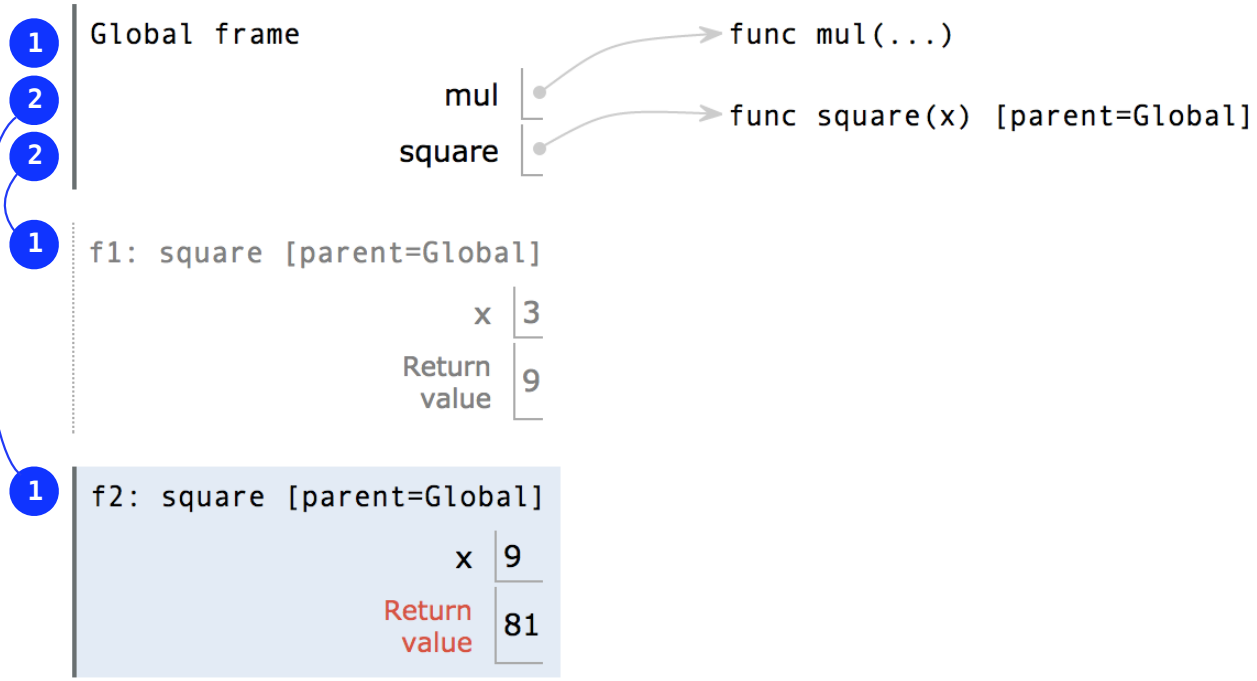


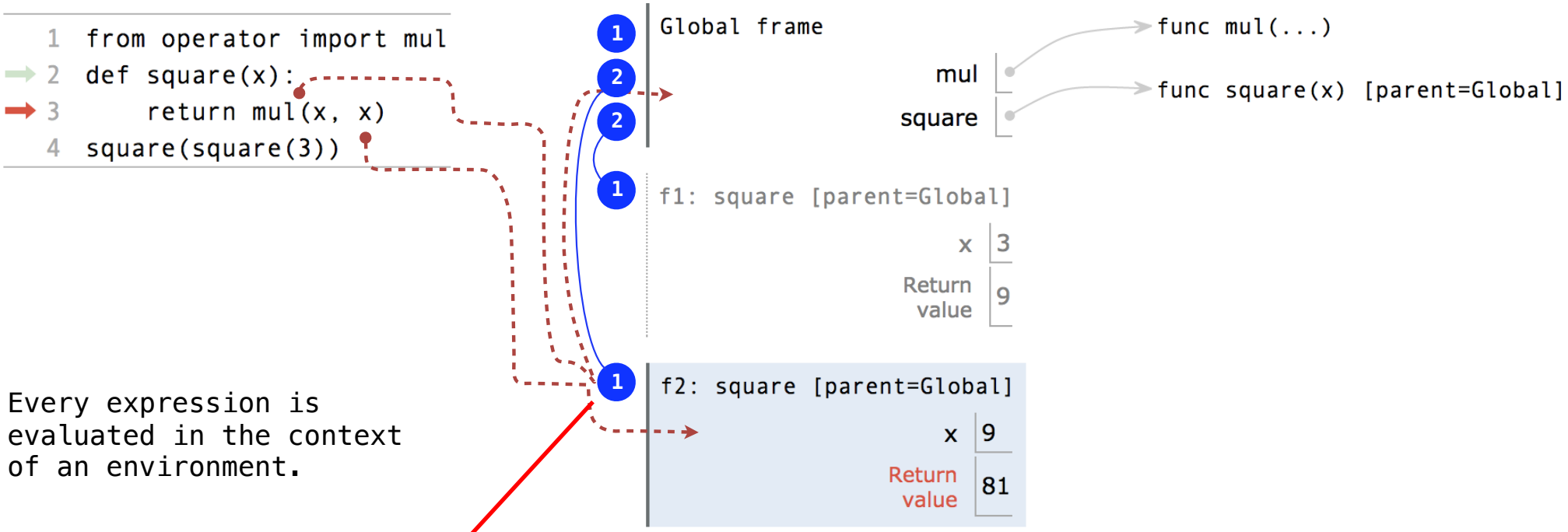


An environment is a sequence of frames.

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

Interactive Diagram

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.

An environment is a sequence of frames.

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

Interactive Diagram

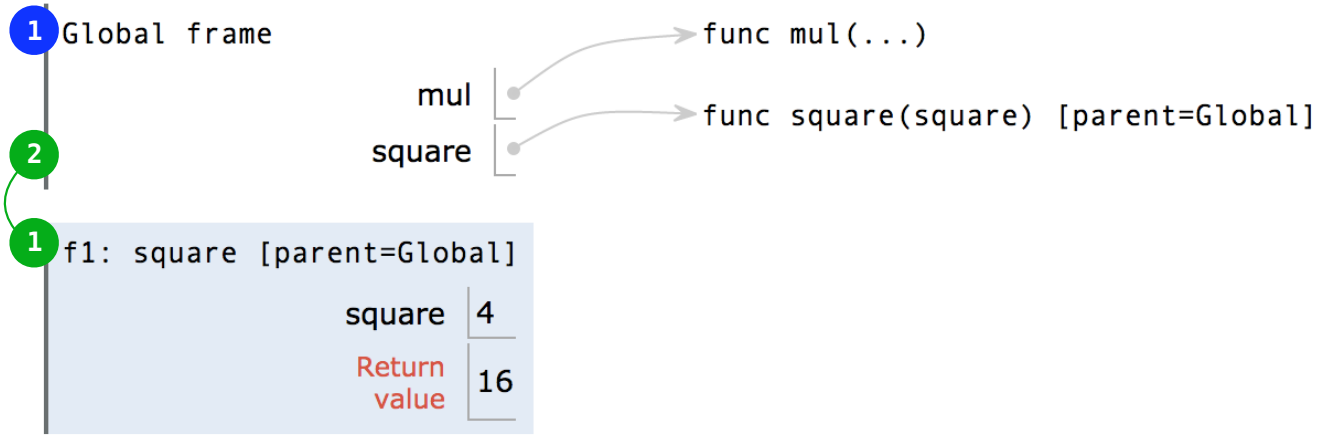
Names Have Different Meanings in Different Environments

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)
```

#1

#2



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

```
# Multiple return values
def divide_exact(n, d):
    return n // d, n % d
quotient, remainder = divide_exact(618, 10)
```

Miscellaneous Python Features

```
# Multiple return values
def divide_exact(n, d):
    return n // d, n % d
quotient, remainder = divide_exact(618, 10)
```

```
5 /  3  #truediv
5 // 3  #floordiv
5 % 3   #mod
```

Division

Multiple Return Values

Source Files

Doctests

Default Arguments

```
# Dostrings, doctests, & default arguments
def divide_exact(n, d=10):
    """Return the quotient and remainder of dividing N by D.  # Docstrings

    >>> quotient, remainder = divide_exact(618, 10)          # Doctests
    >>> quotient
    61
    >>> remainder
    8
    """
    return floordiv(n, d), mod(n, d)
```

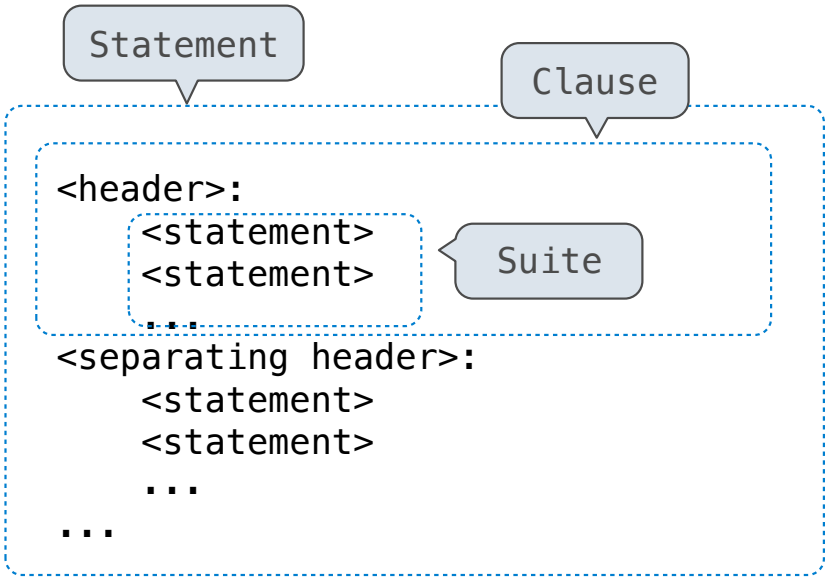
(Demo)

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>
    ...
...
```

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)

1 statement,
3 clauses,
3 headers,
3 suites

```
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:
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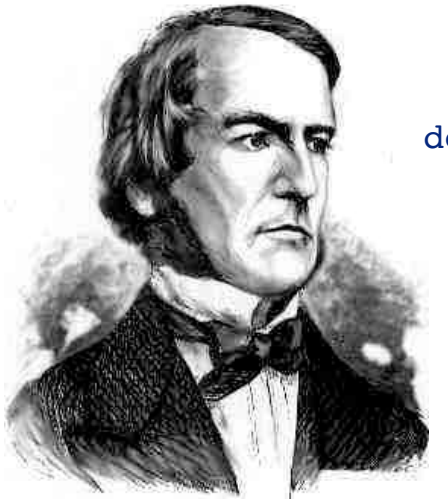
```

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)

Read Section 1.5.4!

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

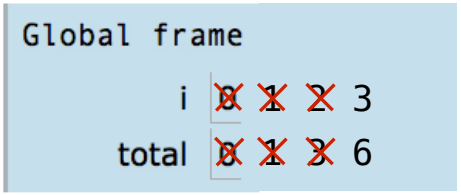
Iteration

While Statements

George Boole

(Demo)

```
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.