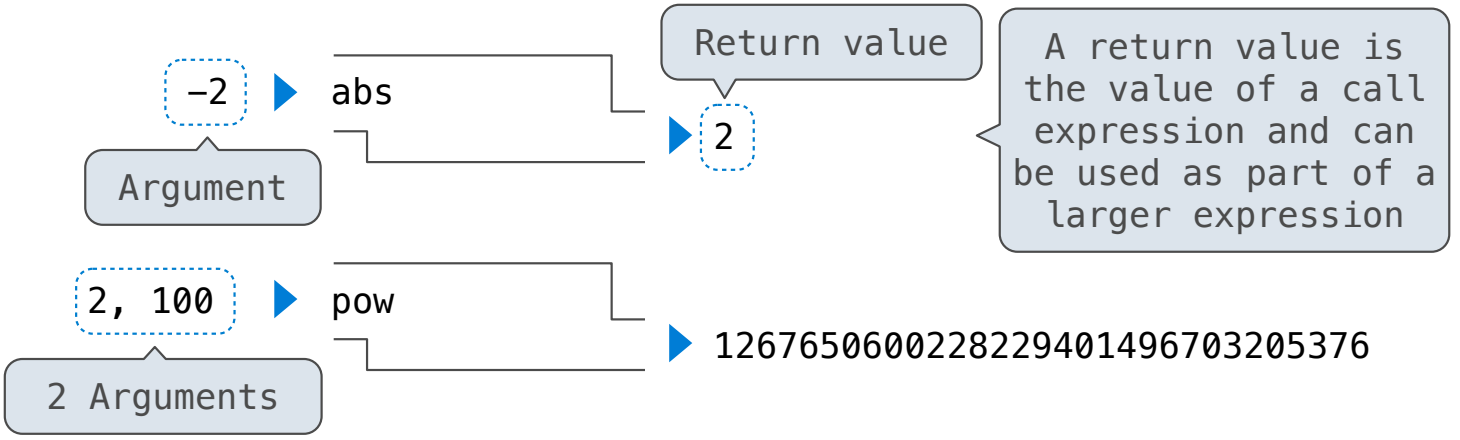
Control

Announcements

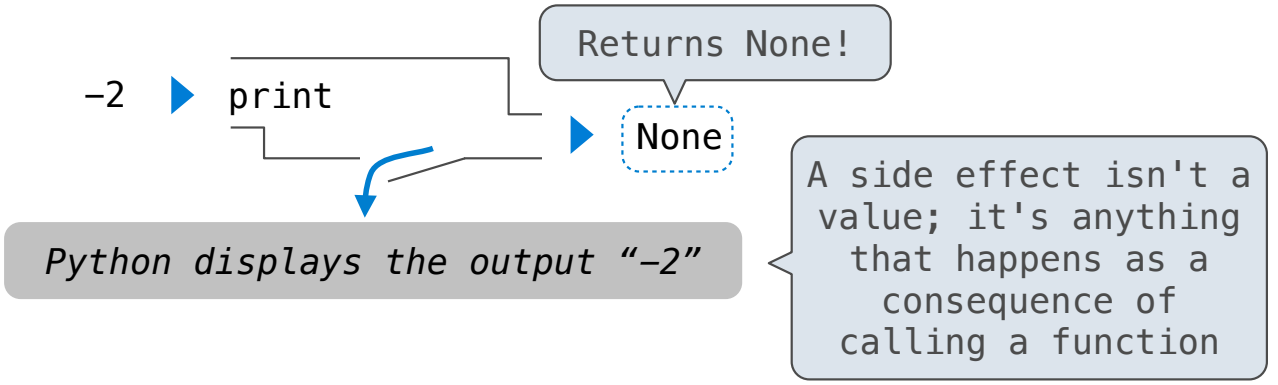
Print and None

Pure Functions & Non-Pure Functions

Pure Functions
just return values



Non-Pure Functions
have side effects



Example: Print Then Return

Implement a function h(x) that first prints, then returns, the value of f(x).

```
def h(x):
    return print(f(x))
```

(A)

```
def h(x):
    print(f(x))
    return f(x)
```

(B)

```
def h(x):
    y = f(x)
    print(y)
    return y
```

(C)

What's a function f for which implementations (B) and (C) would have different behavior?

```
>>> h(2)
...
```

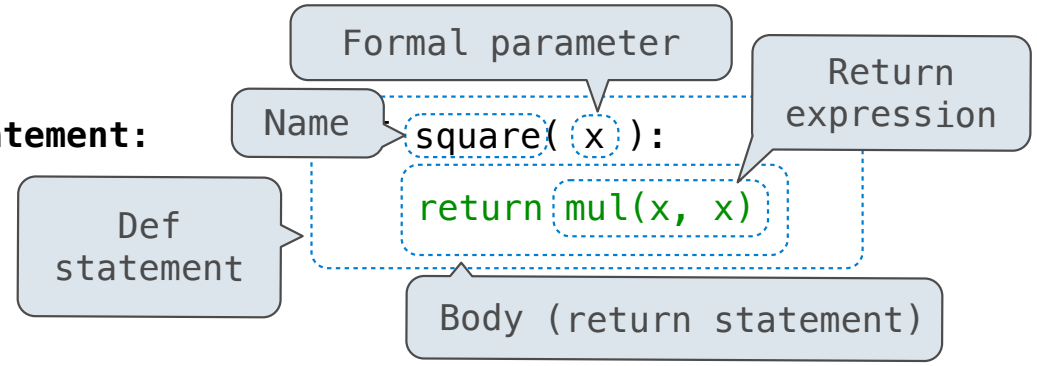
```
>>> h(2)
...
```

(Demo)

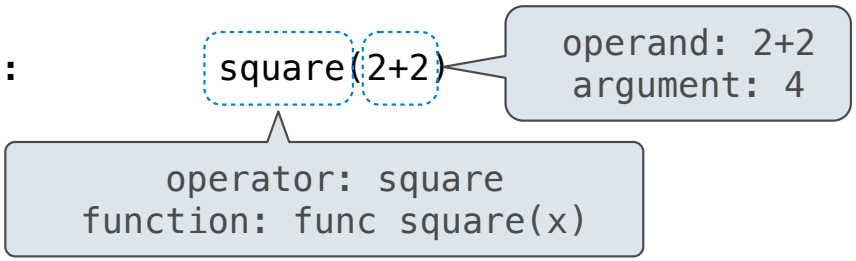
Multiple Environments

Life Cycle of a User-Defined Function

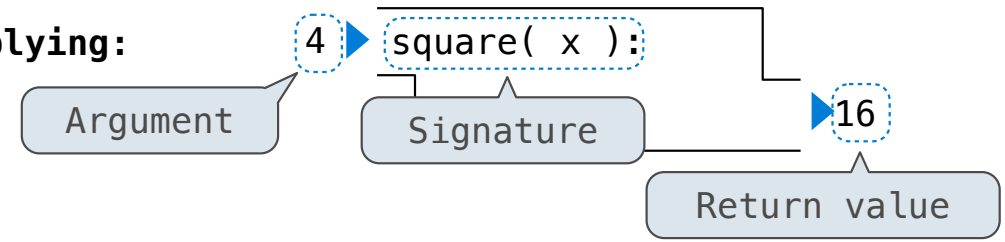
Def statement:



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

https://pythontutor.com/cp/composingprograms.html#code=def%20f%28x%29%3A%0A%20%20%20%20return%20square%28x%20%2B%20square%28y%20%2B%201%29%29%0A%20%20%20%20%0Adef%20square%28z%29%3A%0A%20%20%20%20y%20%3D%20z%20*%20z%0A%20%20%20%20return%20y%0A%20%20%20%20%0Ax,%20y,%20z%20%3D%201,%202,%203%0Aprint%28f%28z%29%29&cumulative=true&curInstr=0&mode=display&origin=composingprograms.js&py=3&rawInputLstJSON=%5B%5D

Control

What is Control?

Thus far, when we call a user-defined function, we execute the body of the function top down until we've reached the end of a function or we've hit a return statement. However, many of the programs we write will not necessarily run in this order.

What are some examples of certain functions we may write that may **stop early** or run **out of order?**

Conditional Statements

Conditional statements (often called "If" Statements) contain statements that may or may not be evaluated.

		x=10	x=1	x=-1

`if x > 2:`
`  print('big')`
`if x > 0:`
`  print('positive')`
	Two separate (unrelated) conditional statements	big
		positive
			positive	

`if x > 2:`
`  print('big')`
`elif x > 0:`
`  print('less big')`
	One statement with two clauses: if and elif
	Only one body can ever be executed
		big	less big	

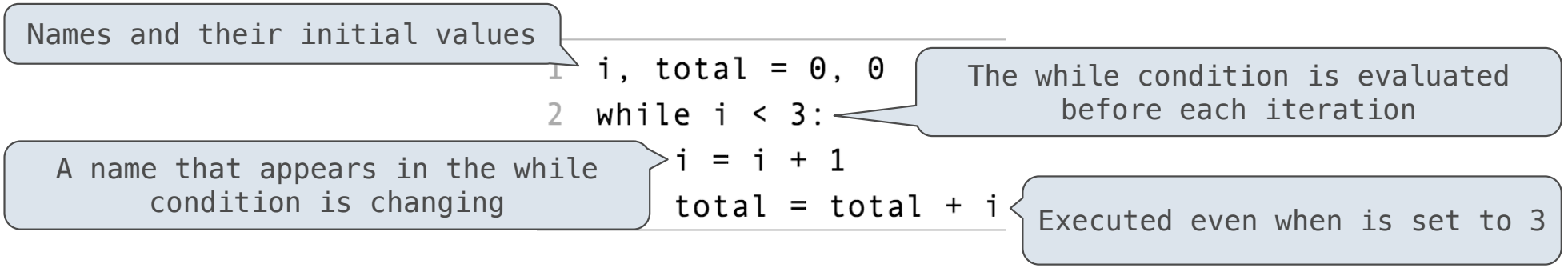
`if x > 2:`
`  print('big')`
`elif x > 0:`
`  print('less big')`
`else:`
`  print('not pos')`
	One statement with three clauses: if, elif, else
	Only one body can ever be executed
		big	less big	not pos

While Statements

While statements contain statements that are repeated as long as some condition is true.

Important considerations:

- How many separate names are needed and what do they mean?
- The while condition **must eventually become a false value** for the statement to end (unless there is a return statement inside the while body).
- Once the while condition is evaluated, the entire body is executed.



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
...
```

How can we determine whether a number is divisible by another?

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

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

(Demo)