

# [220 / 319] Creating Functions

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Readings:

Parts of Chapter 3 of Think Python,  
Chapter 5.5 to 5.8 of Python for Everybody  
Creating Fruitful Functions

# Learning Objectives

Explain the syntax of a function header:

- def, ( ), :, tabbing, return

Write a function with:

- correct header and indentation
- a return value (fruitful function) or without (void function)
- parameters that have default values

Write a function:

- knowing difference in outcomes of print and return statements

Determine result of function calls with 3 types of arguments:

- positional, keyword, and default

Trace function invocations, to determine control flow

**pre-installed** (e.g., math)

- sqrt()
- sin(), cos()
- pi, etc.

**built in**

- input()
- print()
- len()
- etc.

Where do *modules* come from?

**installed** (e.g., jupyter)

- pip install jupyter
- pip install ...

**custom**

- project (lab-p3)

*Anaconda did these installations for us*

### Main Code:

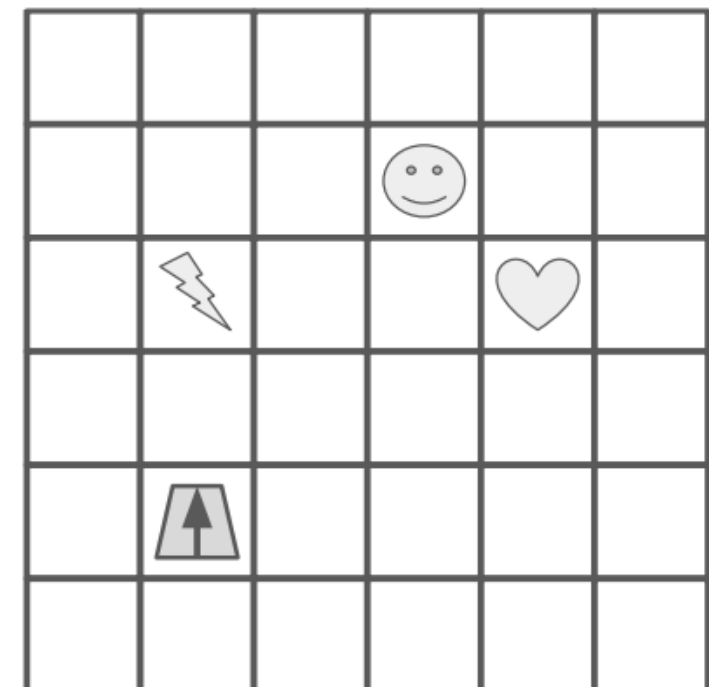
1. Put 2 in the “moves” box
2. Perform the steps under “Move Code”, then continue to step 3
3. Rotate the robot 90 degrees to the right (so arrow points to right)
4. Put 3 in the “moves” box
5. Perform the steps under “Move Code”, then continue to step 6
6. Whatever symbol the robot is sitting on, write that symbol in the “resut” box

### Move Code:

- A. If “moves” is 0, stop performing these steps in “Move Code”, and go back to where you last were in “Main Code” to complete more steps
- B. Move the robot forward one square, in the direction the arrow is pointing
- C. Decrease the value in “moves” by one
- D. Go back to step A

*how do we write functions  
like move code?*

**Functions are like “mini programs”,  
as in our robot worksheet problem**



# Types of functions

Sometimes functions **do** things

- Like “Move Code”
- May produce output with print
- May change variables

Sometimes functions **produce** values

- Similar to mathematical functions
- Many might say a function “**returns a value**”
- Downey calls these functions “**fruitful**” functions  
(we’ll use this, but don’t expect people to generally be aware of this terminology)

Sometimes functions do both!

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# Math to Python

**Math:**

$$f(x) = x^2$$

**Python:**

```
def f(x):  
    return x ** 2
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Function name is “f”



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It takes one parameter, "x"

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**Python:**

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```

1

In Python, start a function definition with “def” (short for definition), and use a colon (“:”) instead of an equal sign (“=”)

# Math to Python

**Math:**

$$f(x) = x^2$$

**Python:**

```
def f(x):  
    return x ** 2
```

2

In Python, put the “return” keyword before the expression associated with the function

# Math to Python

**Math:**  $f(x) = x^2$

**Python:**

```
def f(x):  
    return x ** 2
```

3

In Python, indent (tab space) before the statement(s)

# Math to Python

**Math:**  $g(r) = \pi r^2$

**Python:**

```
def g(r):  
    return 3.14 * r ** 2
```

4

Computing the area from the radius

# Math to Python

**Math:**  $g(r) = \pi r^2$

**Python:**

```
def get_area(radius):  
    return 3.14 * radius ** 2
```

5

In Python, it's common to have longer names for functions and arguments

# Math to Python

**Math:**  $g(r) = \pi r^2$

**Python:**

```
def get_area(diameter):  
    radius = diameter / 2  
    return 3.14 * radius ** 2
```

6

It's also common to have more than one line of code (all indented)

# ***Let's implement functions***

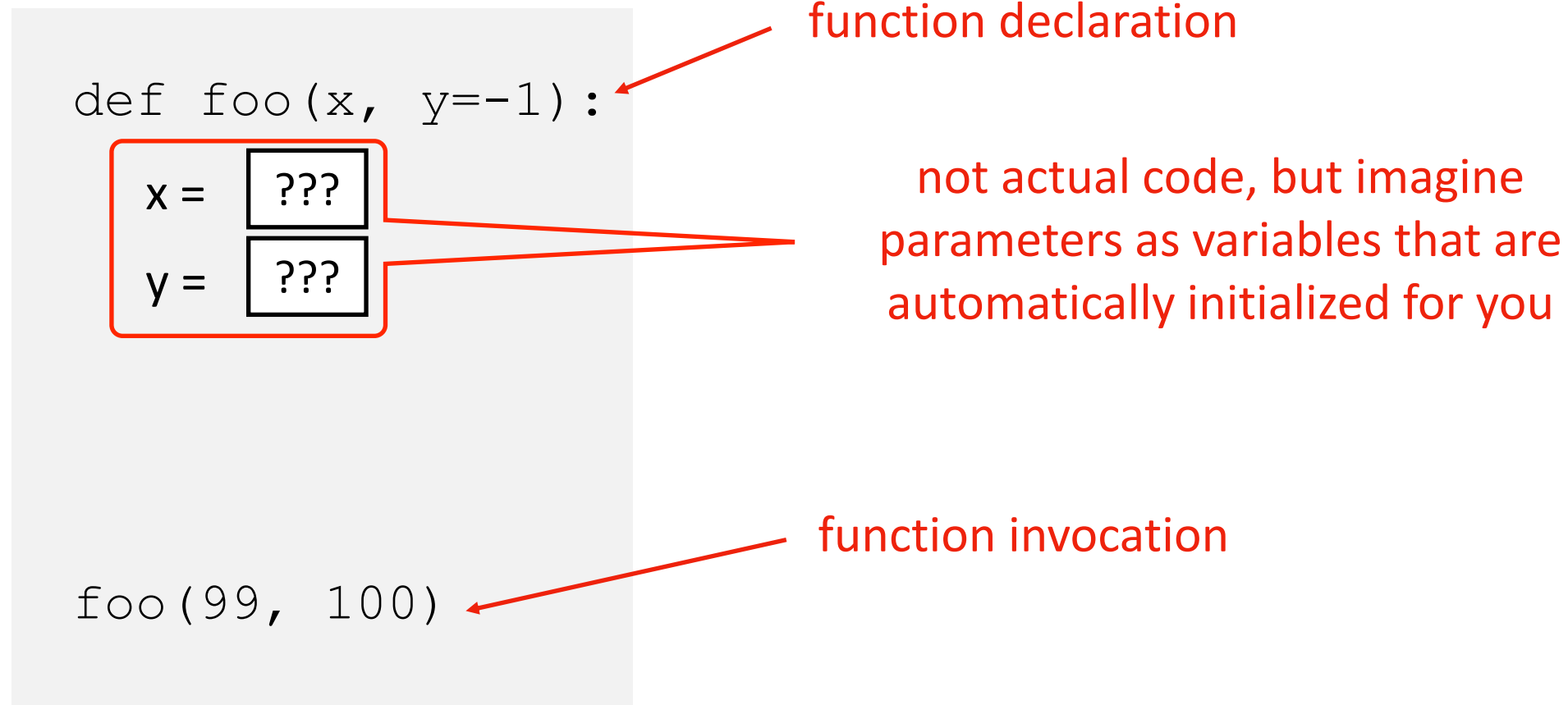
`cube(side)`

`is_between(lower, num, upper)`

*jupyter / PythonTutor demos ...*



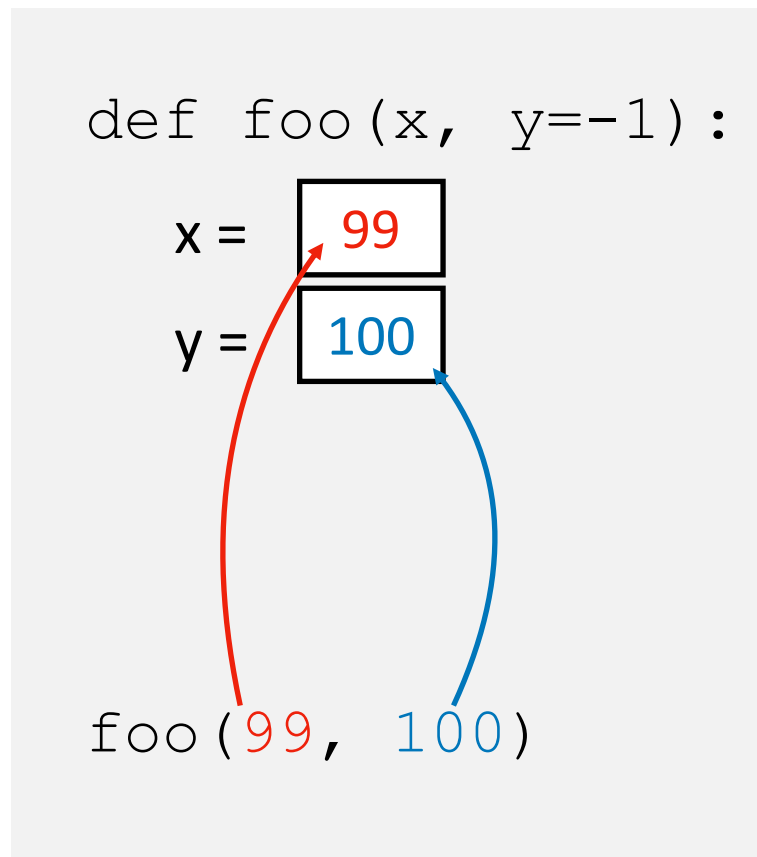
# Rules for filling parameters...



1

positional arguments

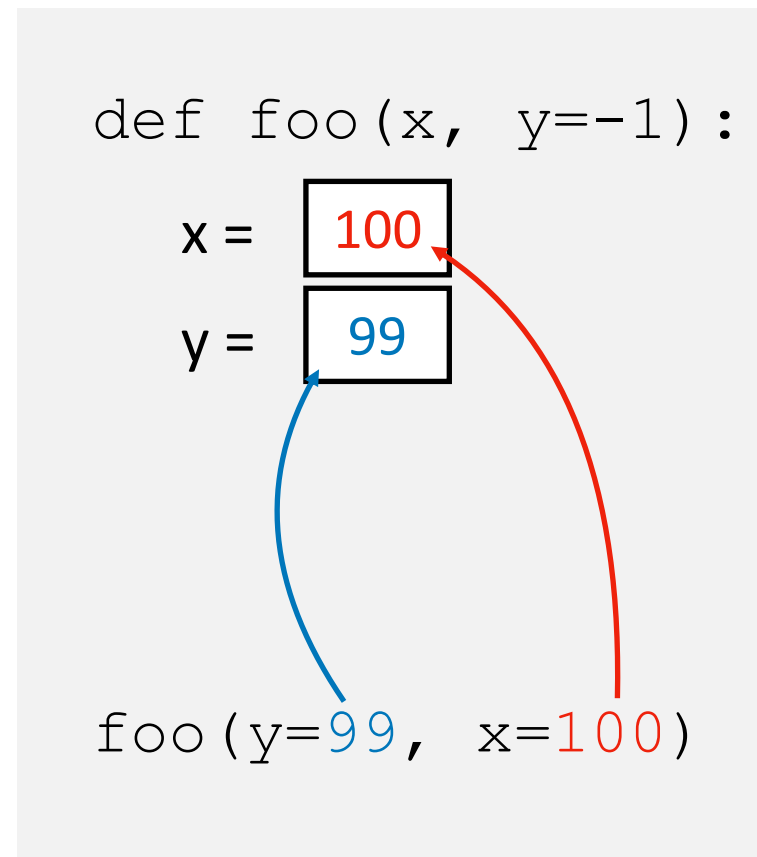
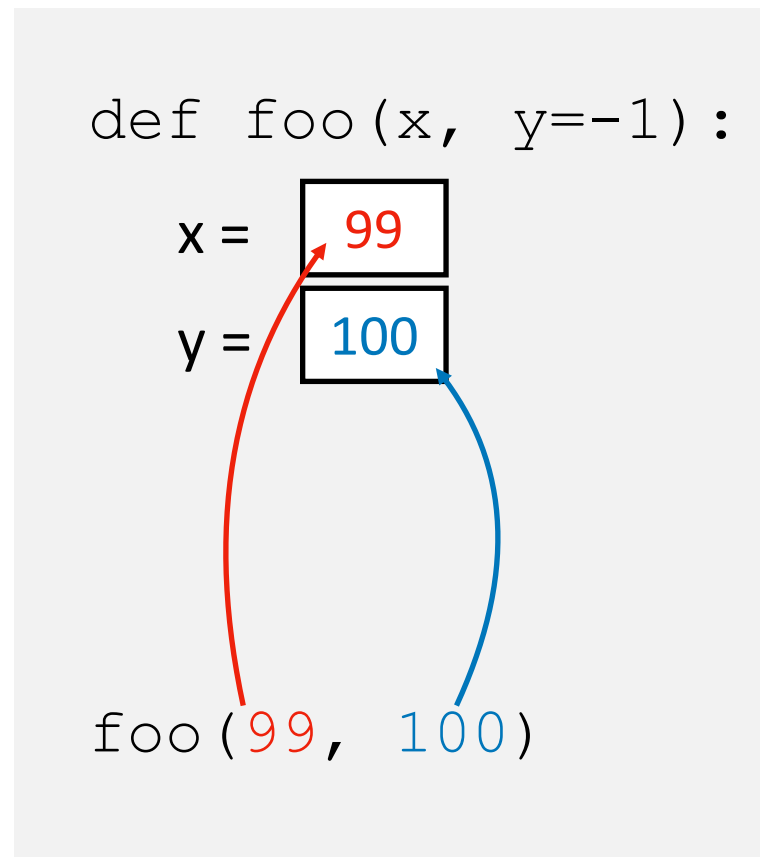
# Rules for filling parameters...



1

positional arguments

# Rules for filling parameters...



1

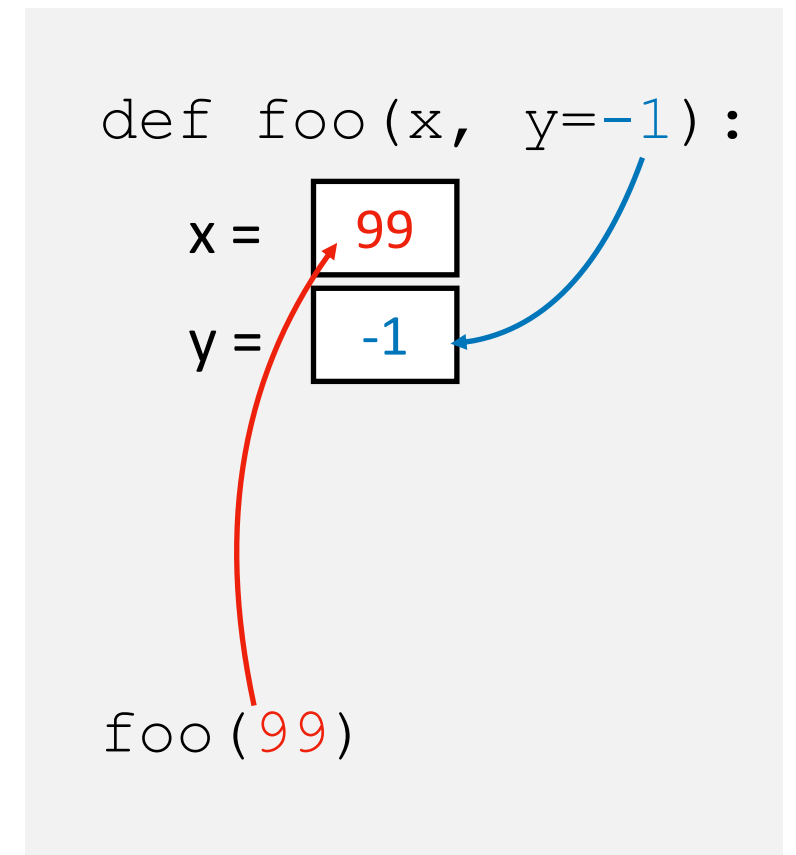
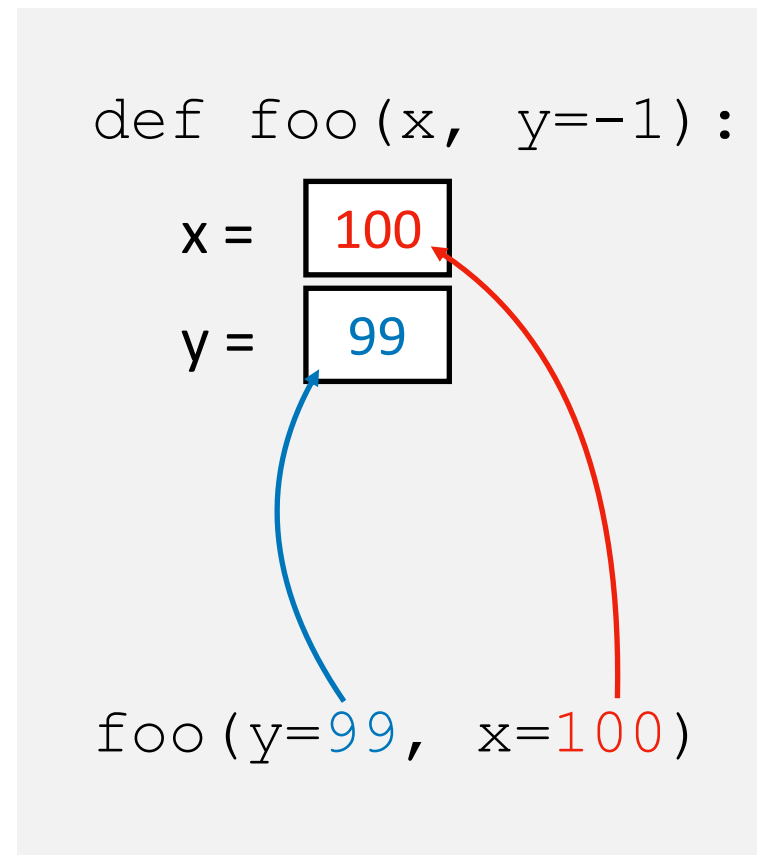
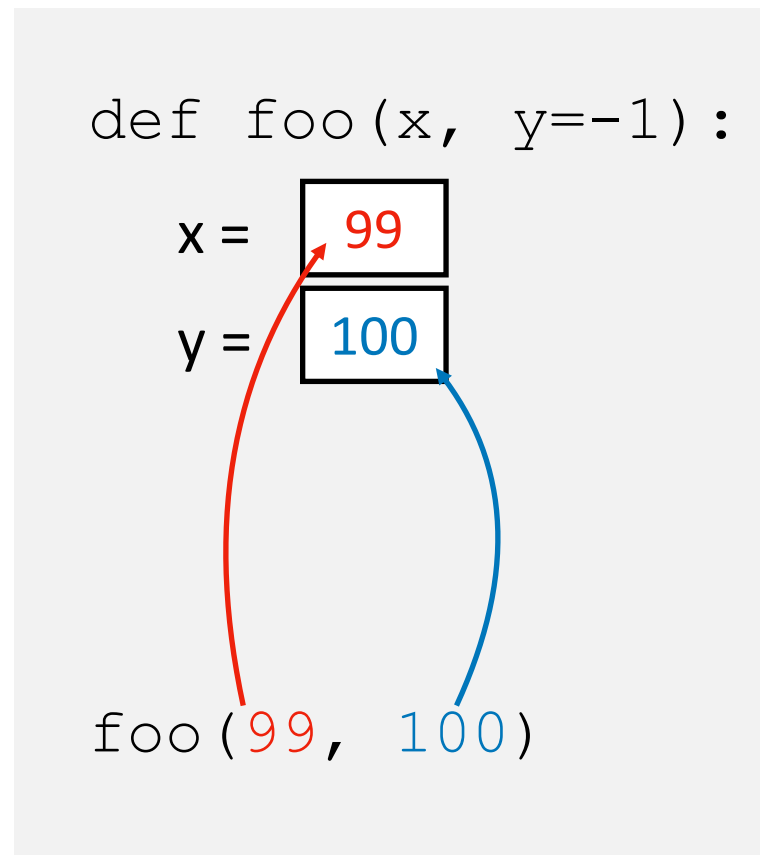
positional arguments

2

keyword arguments



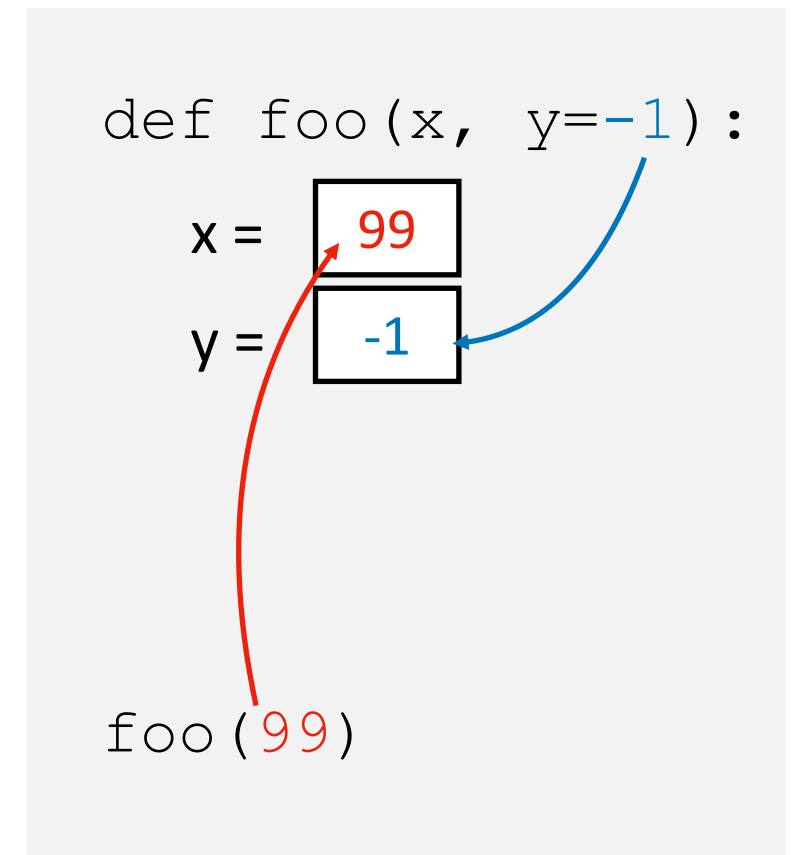
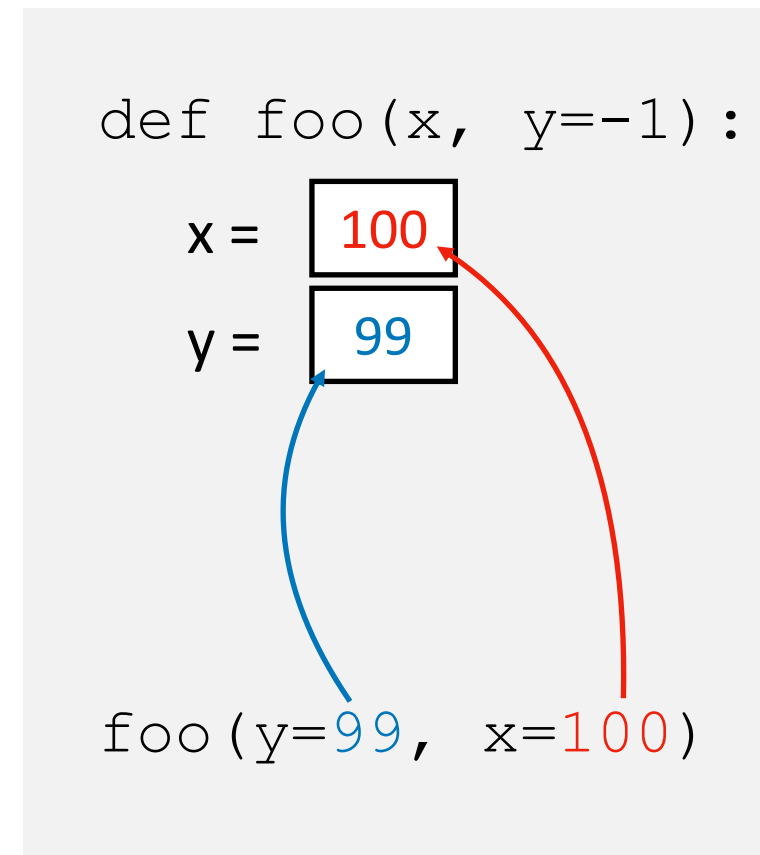
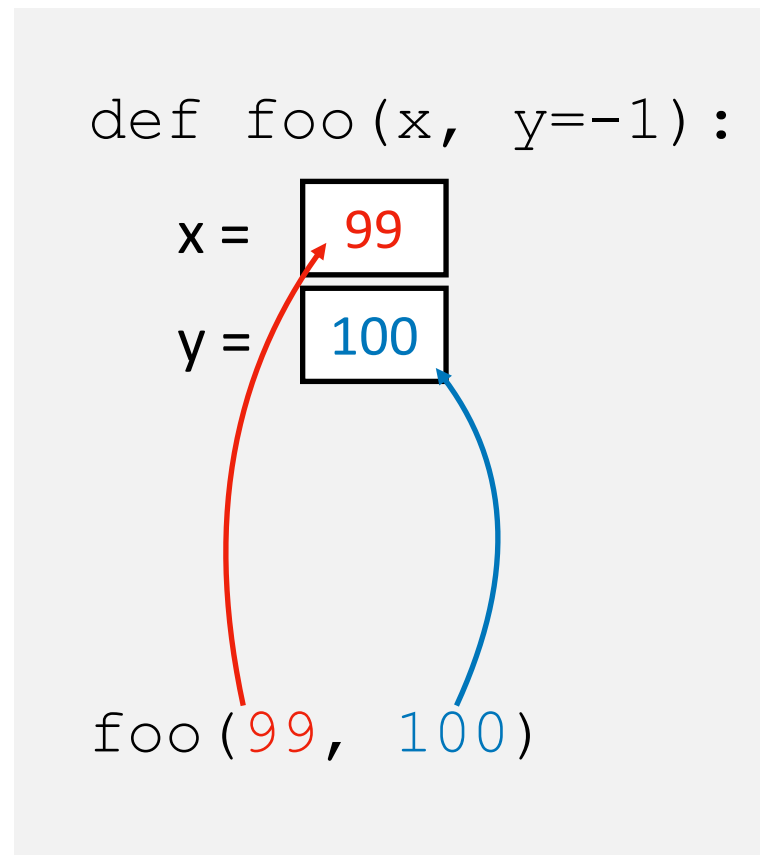
# Rules for filling parameters...



- 1 positional arguments
- 2 keyword arguments
- 3 default arguments

common pitfall: *confusing keyword arguments and default arguments*

# Rules for filling parameters...



- 1 positional arguments
- 2 keyword arguments
- 3 default arguments

*worksheet practice...*

# ***Generating grid for game like Battleship***

Grid:

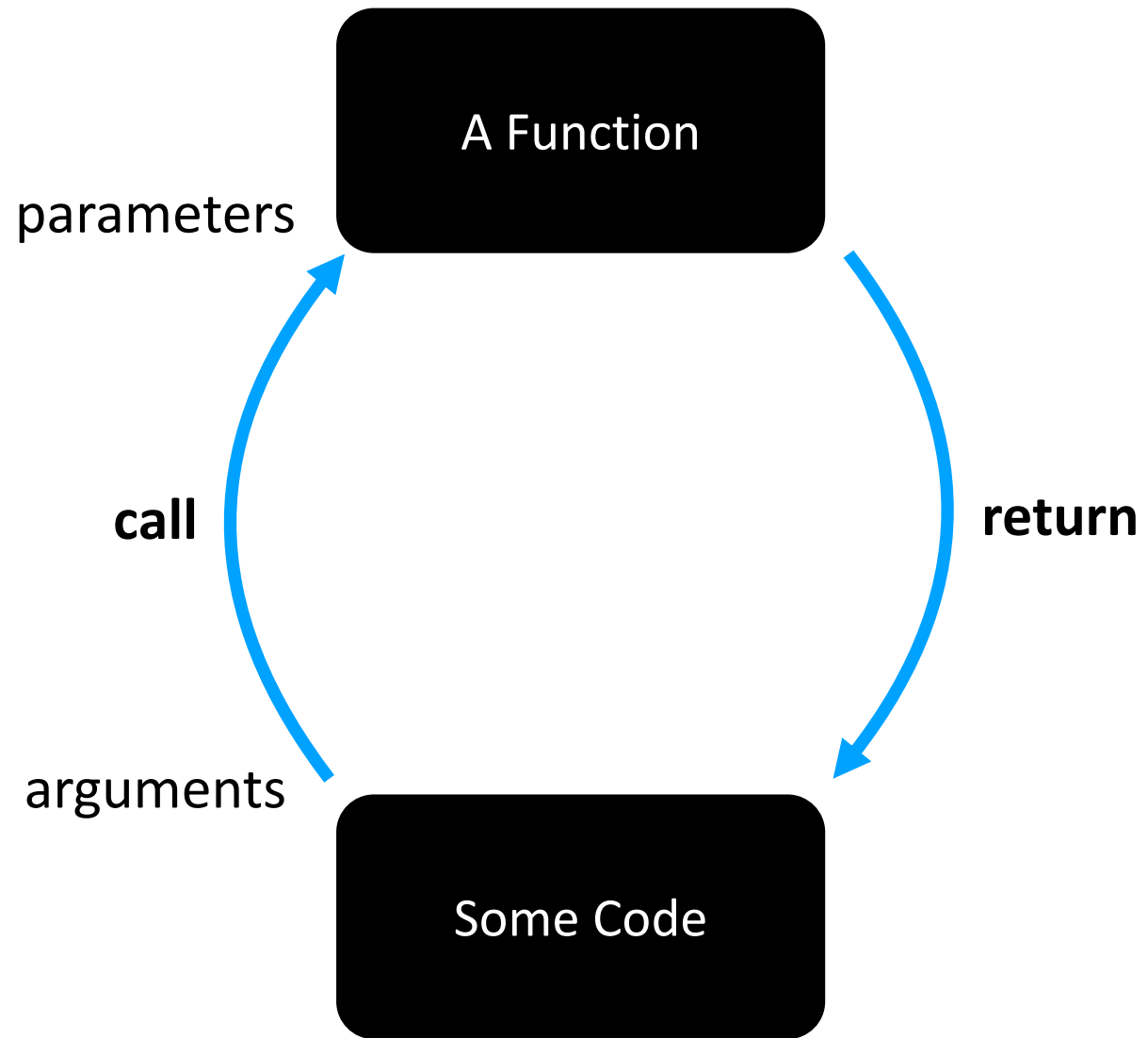
```
#####  
#####  
#####  
#####  
#####  
#####  
#####  
#####  
#####
```

10 x 8 grid

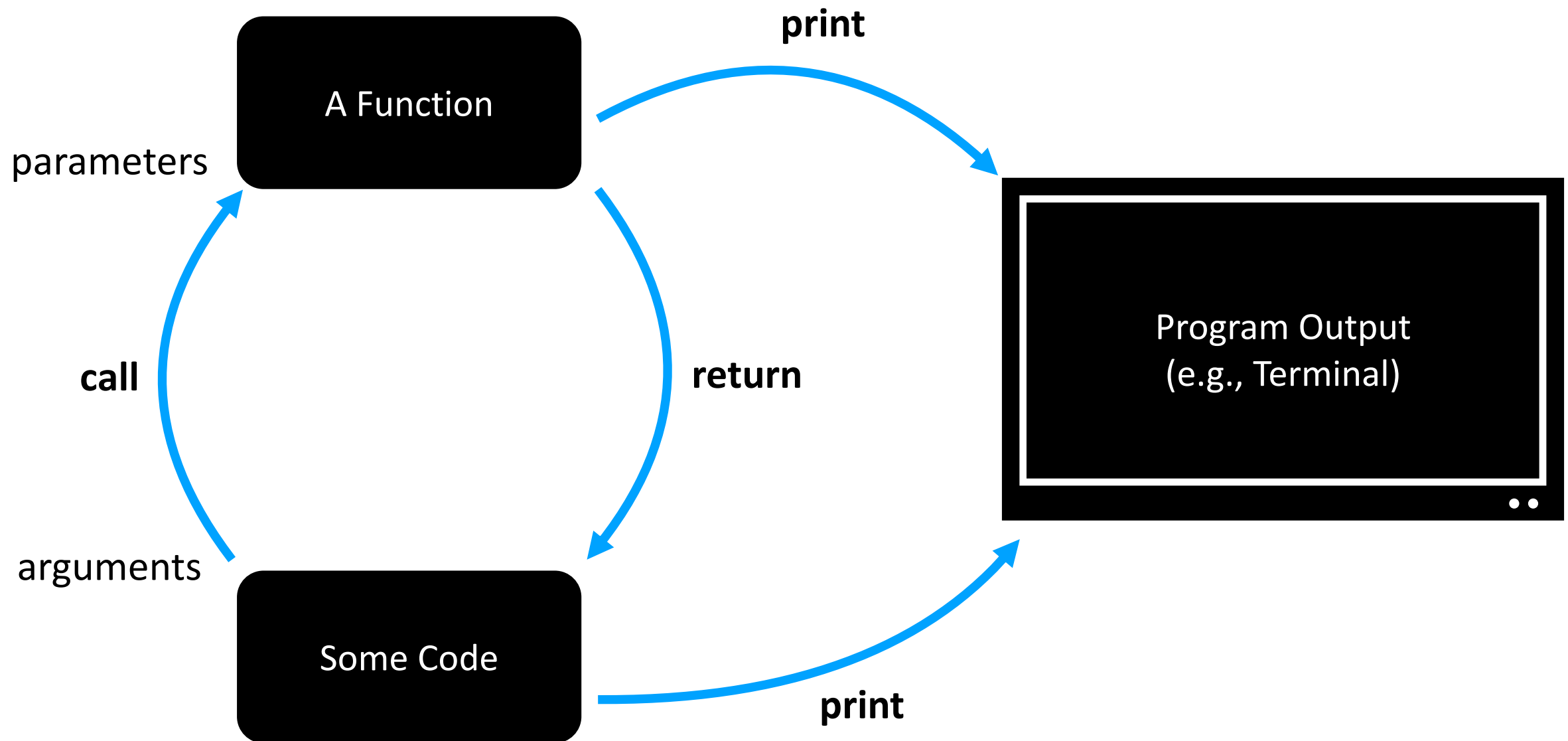
```
get_grid(width, height, symb = '#', title = 'Grid:')
```

*PythonTutor demo...*

# Print vs. Return



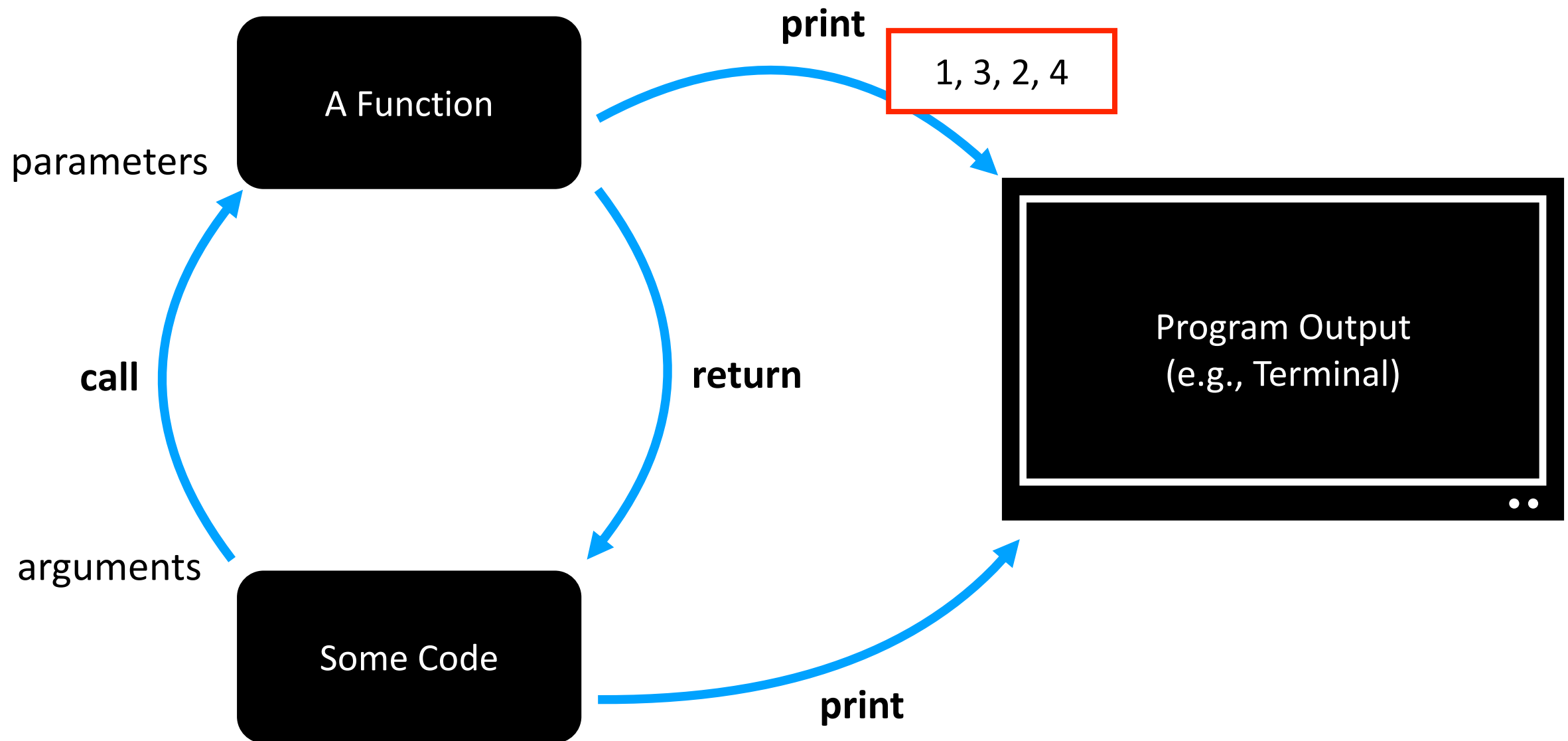
# Print vs. Return



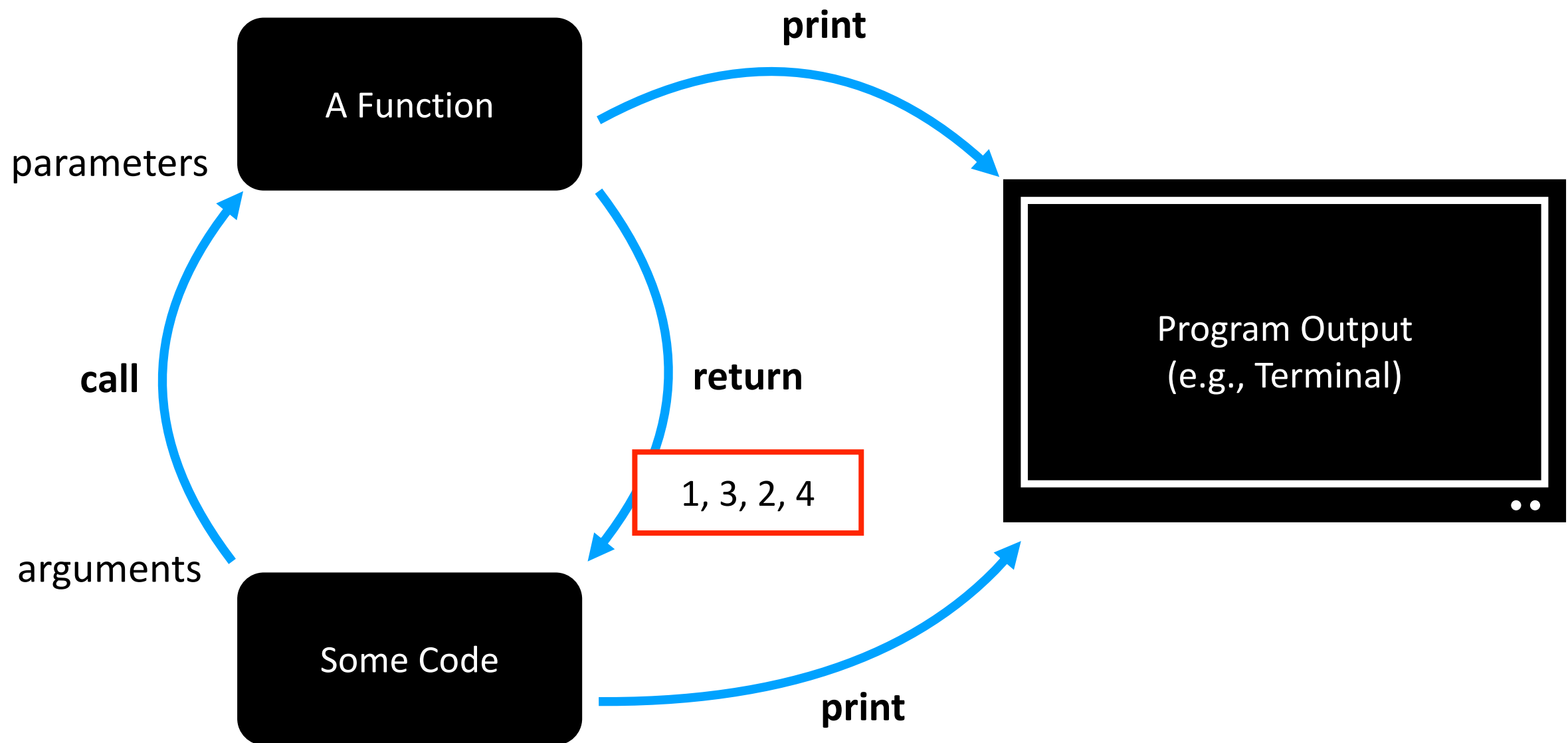
we could call print from multiple places



# Print vs. Return

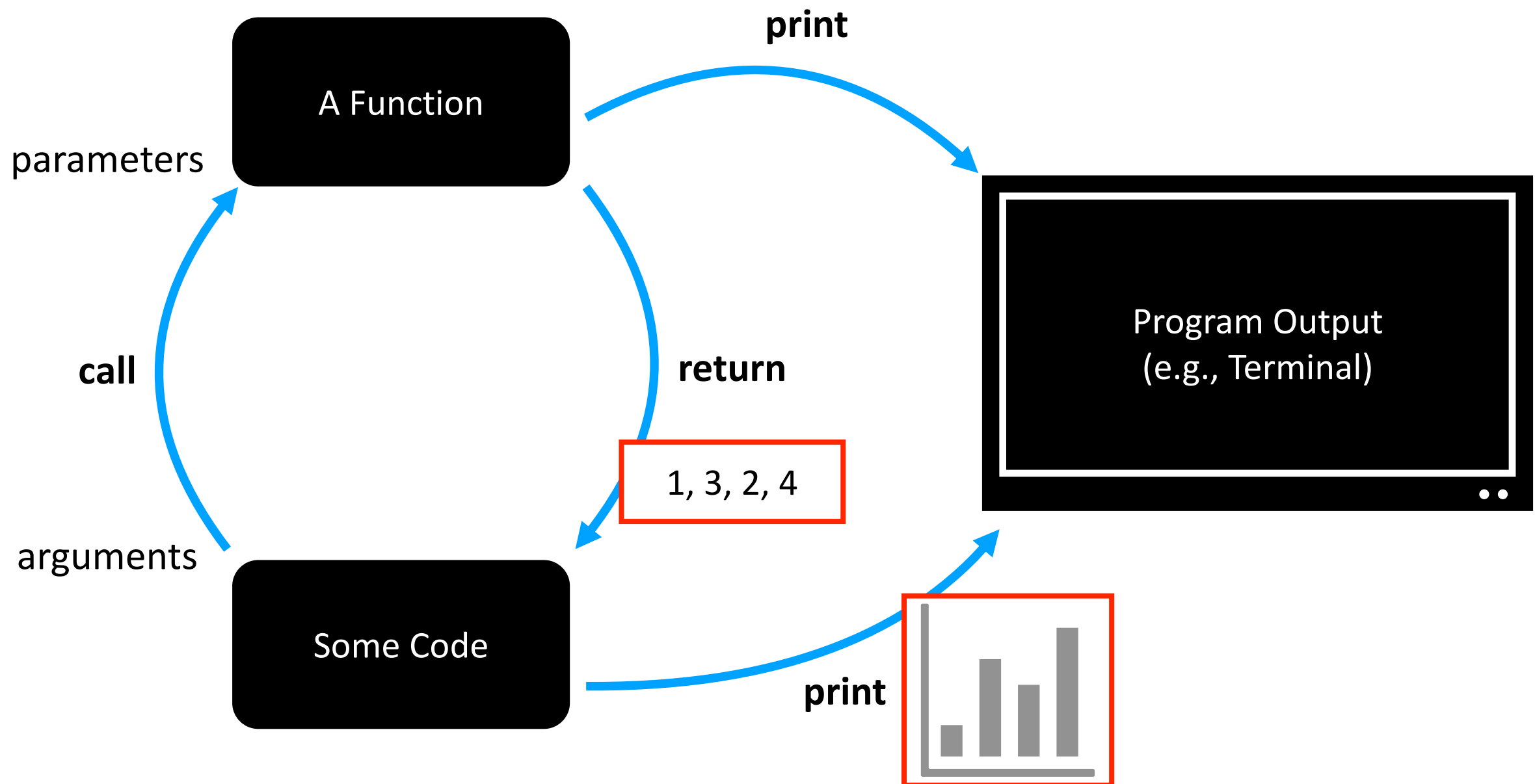


# Print vs. Return



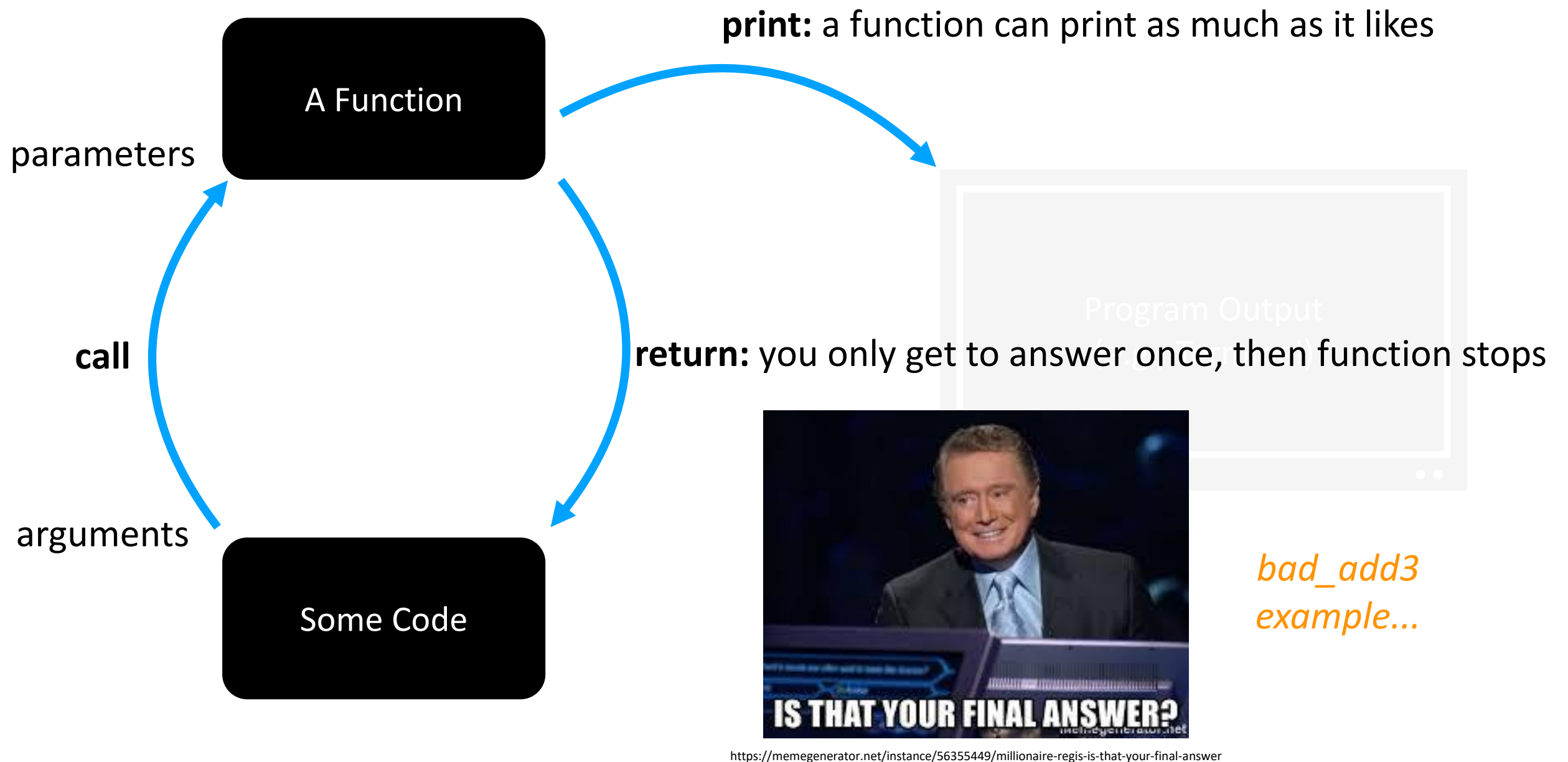
**returning**, instead of **printing**, gives callers different options for how to use the result

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# Interactive Examples with PythonTutor

*Course website schedule page entry for “Creating Functions”*

```
def func_c():  
    print("C")
```

```
def func_b():  
    print("B1")  
    func_c()  
    print("B2")
```

```
def func_a():  
    print("A1")  
    func_b()  
    print("A2")
```

```
func_a()
```

*Let's trace this example*

# Challenge: Approximation Program

**input:** a number from user

**output:** is it approximately equal to an important number? (pi or zero)

```
please enter a number: 3.14  
close to zero?      False  
close to pi?        True
```

```
please enter a number: 0.000001  
close to zero?      True  
close to pi?        False
```

```
please enter a number: 3  
close to zero?      False  
close to pi?        False
```

**what is error between 4 and 8?**

- 100%
- 50%

$\text{abs}(8 - 4)$

---

$\text{max}(\text{abs}(4), \text{abs}(8))$