

[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:

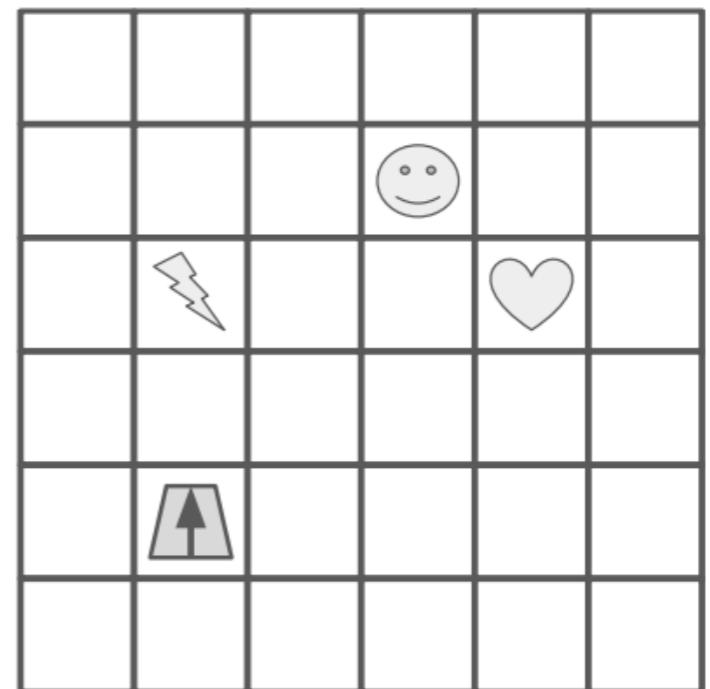
1. Put 2 in the “moves” box
2. Perform the steps under “Move Code”, then continue to step 3
3. Rotate the robot 90 degrees to the right (so arrow points to right)
4. Put 3 in the “moves” box
5. Perform the steps under “Move Code”, then continue to step 6
6. Whatever symbol the robot is sitting on, write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

Types of functions

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Sometimes functions do both!

Math to Python

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

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

Math to Python

Math:

$$\boxed{f}(x) = x^2$$

Python:

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

Function name is “f”

Math to Python

Math:

$$f(\boxed{x}) = x^2$$

Python:

```
def f (\boxed{x}):
    return x ** 2
```

It takes one parameter, “x”

Math to Python

Math:

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

Python:

```
def f(x):
```

```
    return x ** 2
```

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:

$$f(x) = \boxed{x^2}$$

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)

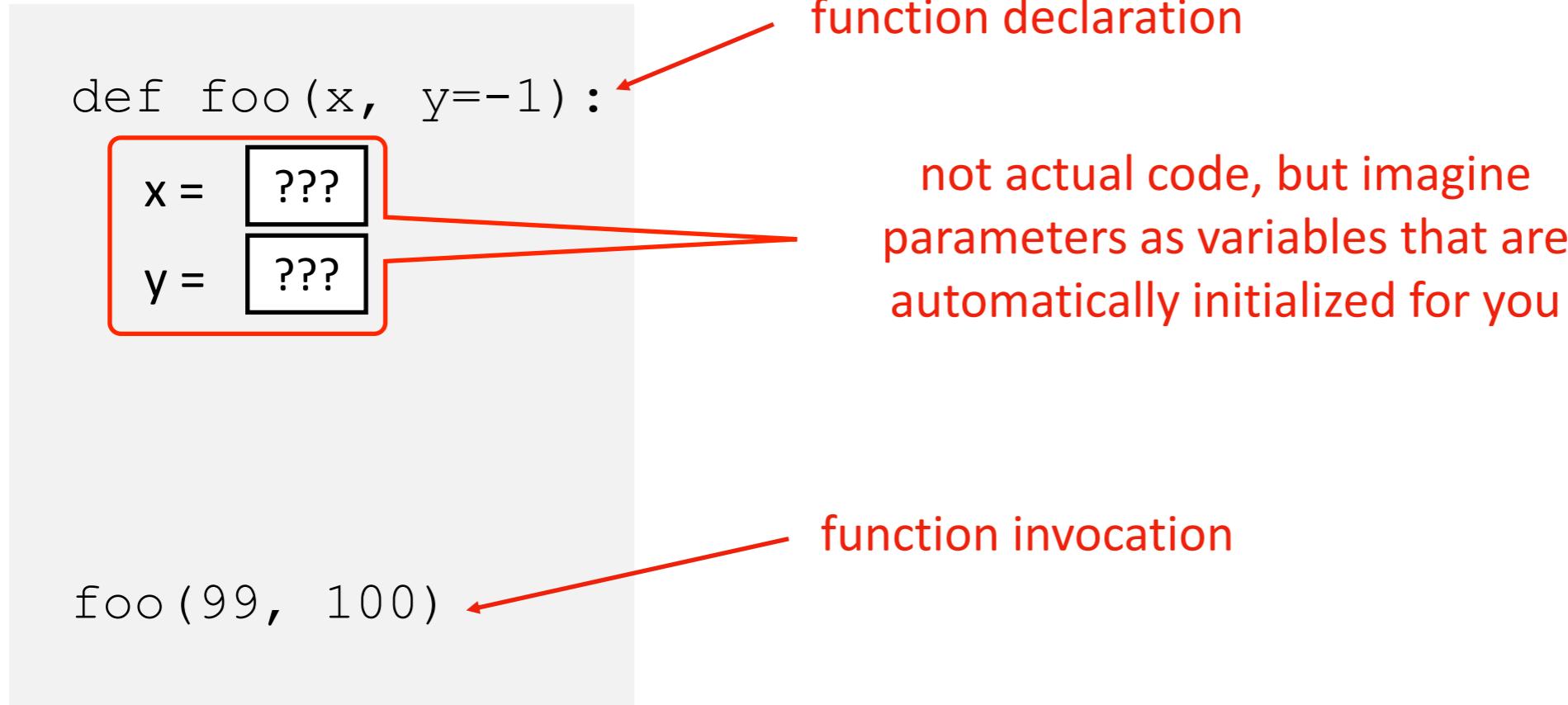
Let's implement functions

`cube(side)`

`is_between(lower, num, upper)`

jupyter / PythonTutor demos ...

Rules for filling parameters...



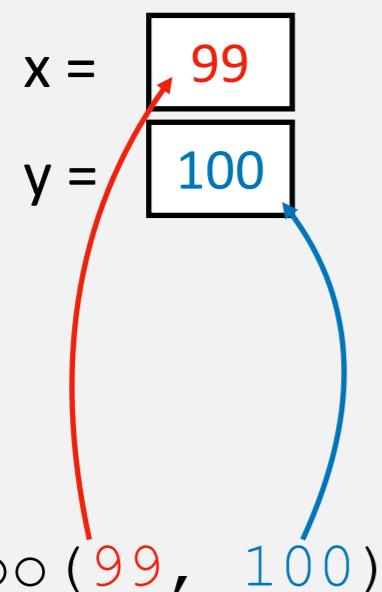
1

positional arguments

Rules for filling parameters...

```
def foo(x, y=-1):
```

```
    x = 99  
    y = 100  
  
foo(99, 100)
```



1

positional arguments

Rules for filling parameters...

```
def foo(x, y=-1):  
    x = 99  
    y = 100  
  
foo(99, 100)
```

```
def foo(x, y=-1):  
    x = 100  
    y = 99  
  
foo(y=99, x=100)
```

1

positional arguments

2

keyword arguments



Rules for filling parameters...

```
def foo(x, y=-1):  
    x = 99  
    y = 100  
  
foo(99, 100)
```

```
def foo(x, y=-1):  
    x = 100  
    y = 99  
  
foo(y=99, x=100)
```

```
def foo(x, y=-1):  
    x = 99  
    y = -1  
  
foo(99)
```

1

positional arguments

2

keyword arguments

3

default arguments

common pitfall: *confusing keyword arguments and default arguments*

Rules for filling parameters...

```
def foo(x, y=-1):  
    x = 99  
    y = 100  
  
foo(99, 100)
```

```
def foo(x, y=-1):  
    x = 100  
    y = 99  
  
foo(y=99, x=100)
```

```
def foo(x, y=-1):  
    x = 99  
    y = -1  
  
foo(99)
```

1

positional arguments

2

keyword arguments

3

default arguments

worksheet practice...

Generating grid for game like Battleship

Grid:

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

#####
#####

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

#####
#####

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

#####
#####

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

#####
#####

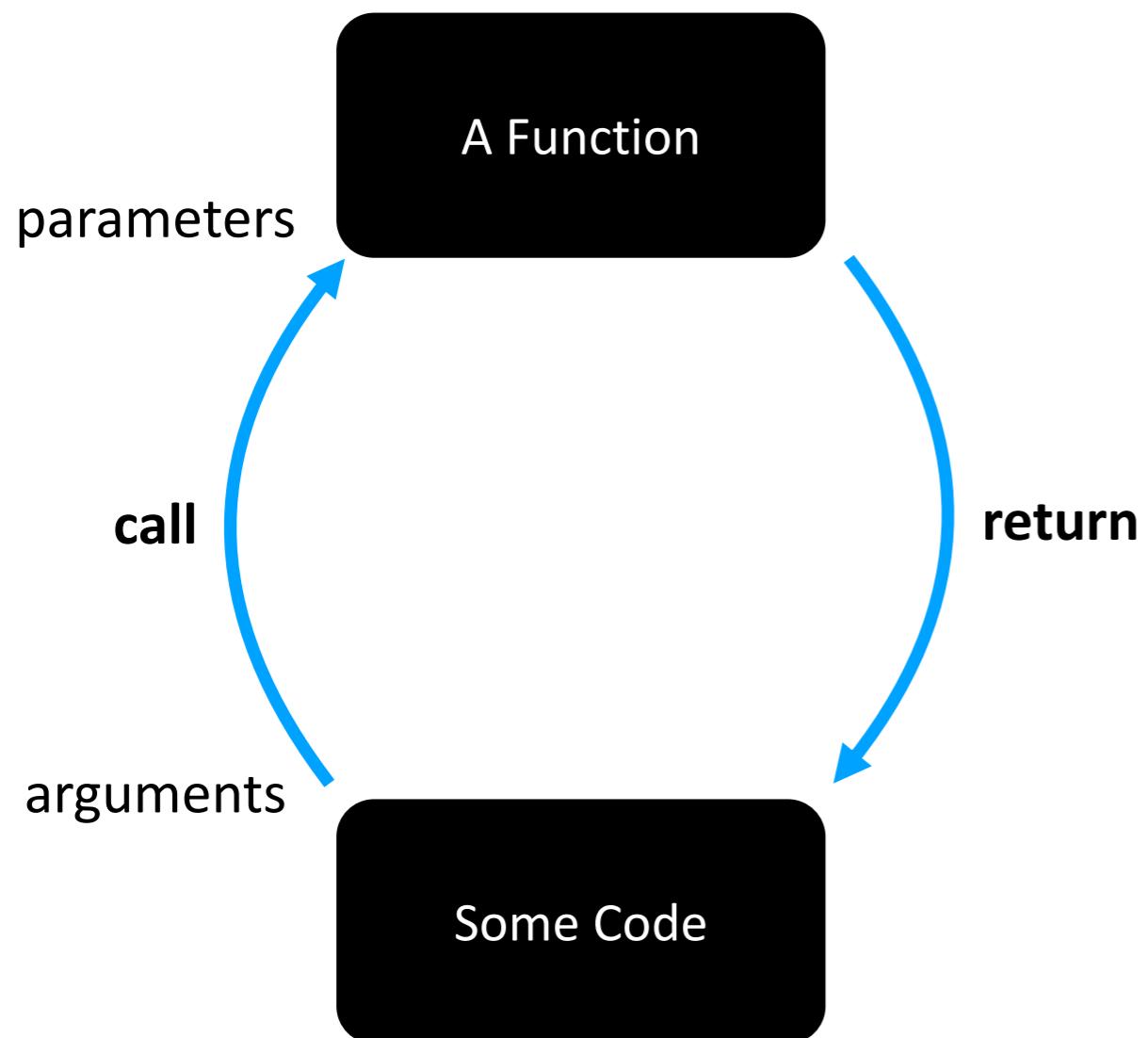
```
#####
#####
```

10 x 8 grid

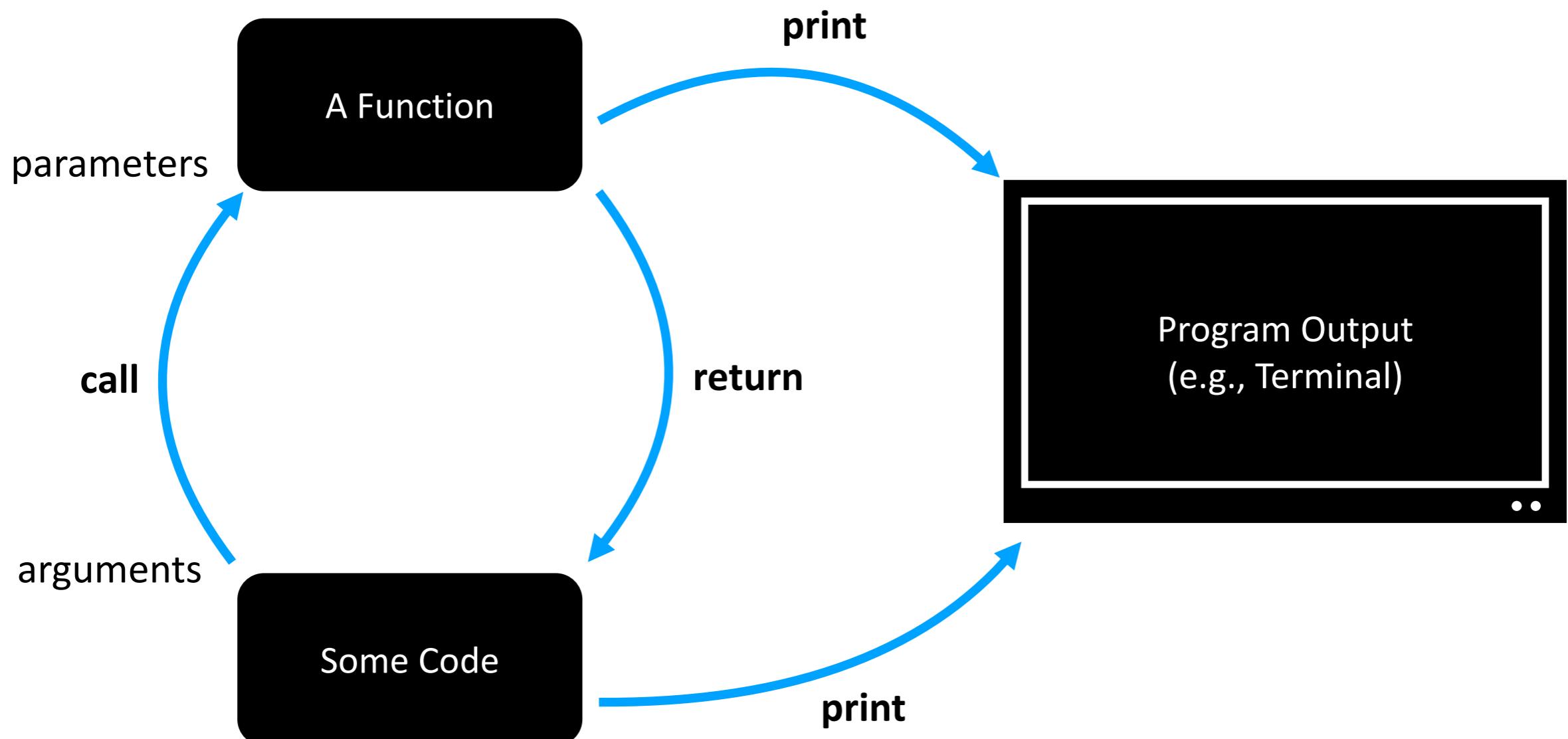
```
get_grid(width, height, symb = '#', title = 'Grid:')
```

PythonTutor demo...

Print vs. Return

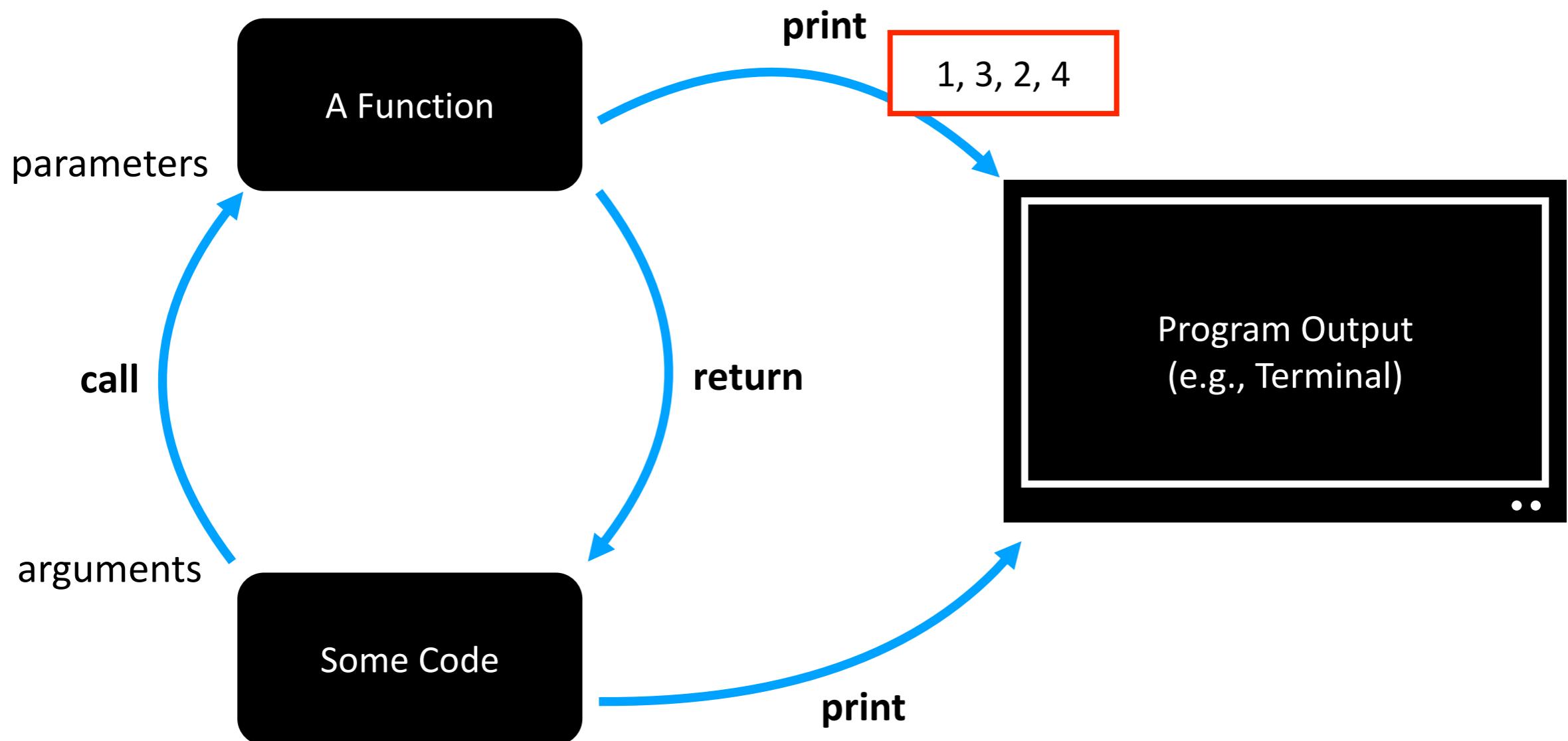


Print vs. Return

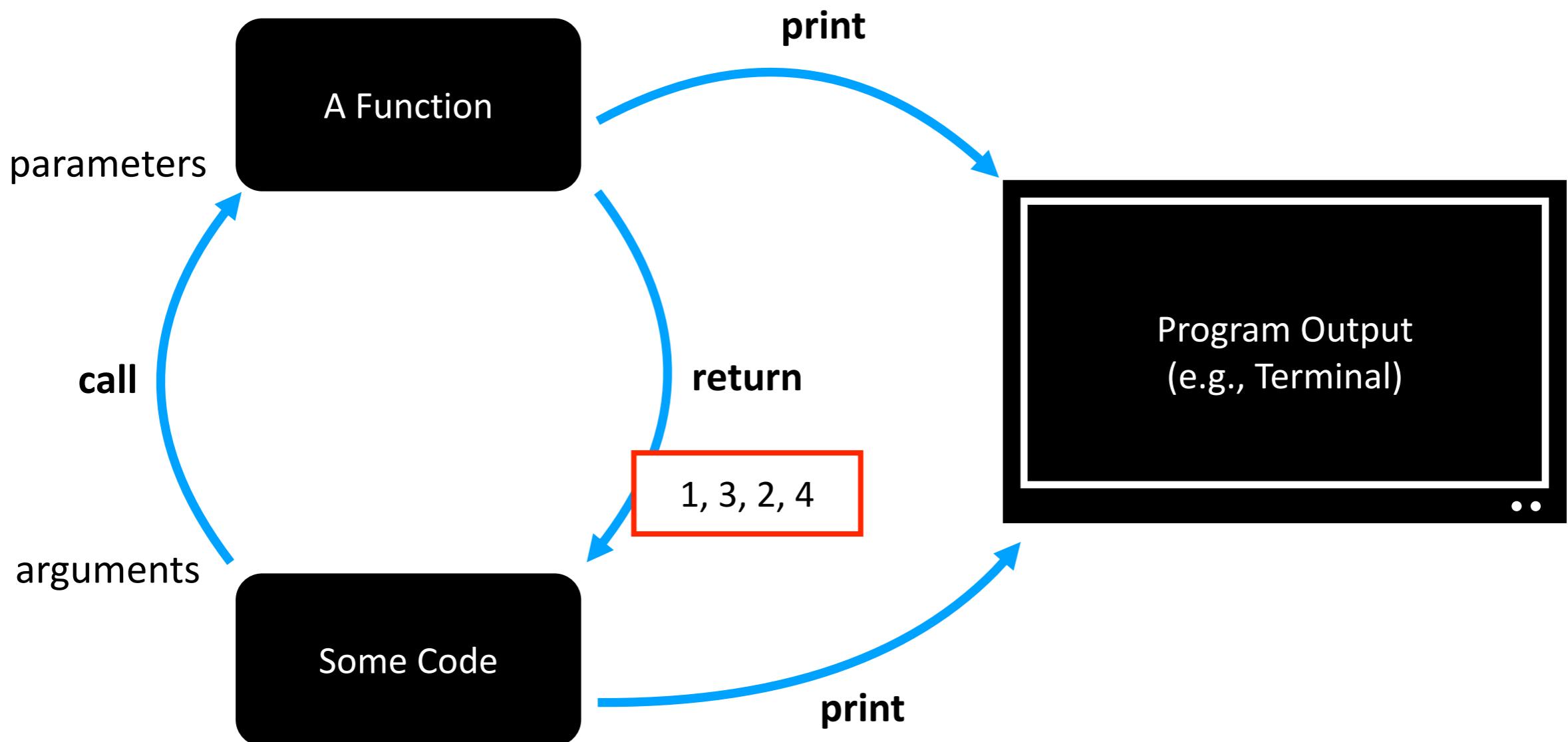


we could call print from multiple places

Print vs. Return

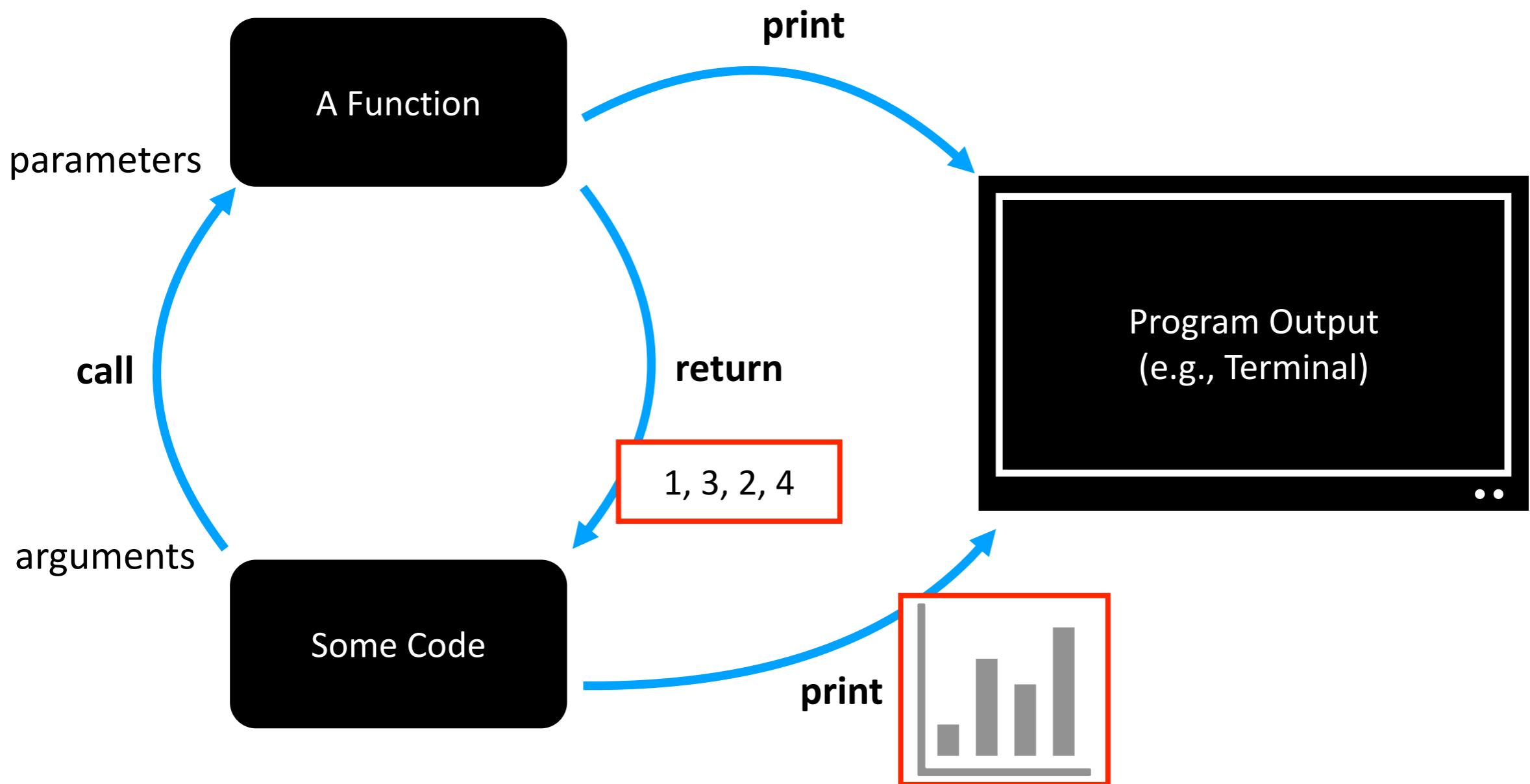


Print vs. Return



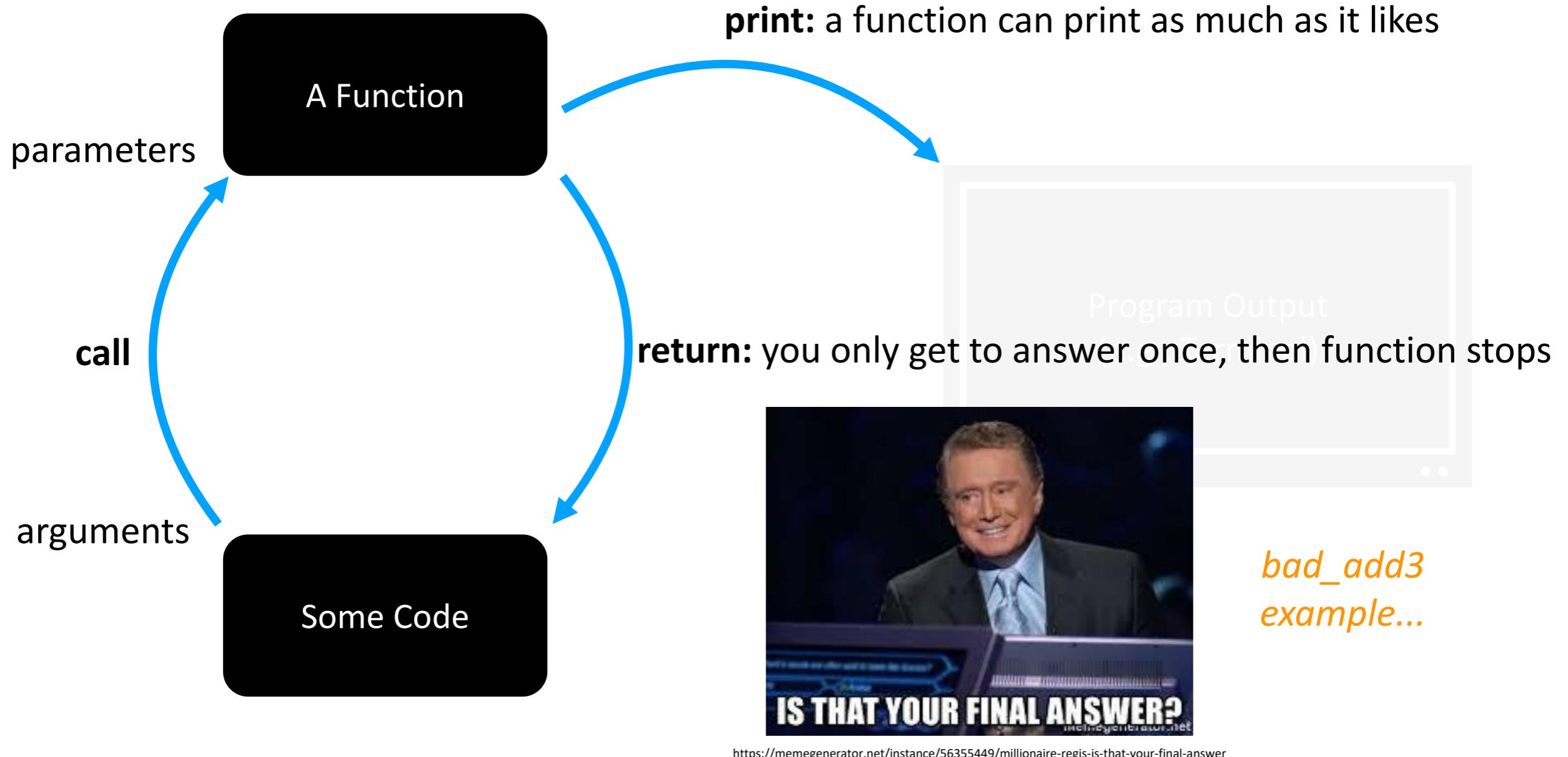
returning, instead of **printing**, gives callers different options for how to use the result

Print vs. Return



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

Print vs. Return



*bad_add3
example...*

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

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")
```

Let's trace this example

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

```
func_a()
```