[301] Creating Functions

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Learning Objectives Today

Function syntax:

- basics, return, tabbing

Input/output:

- parameters
- three types of arguments
- print vs. return

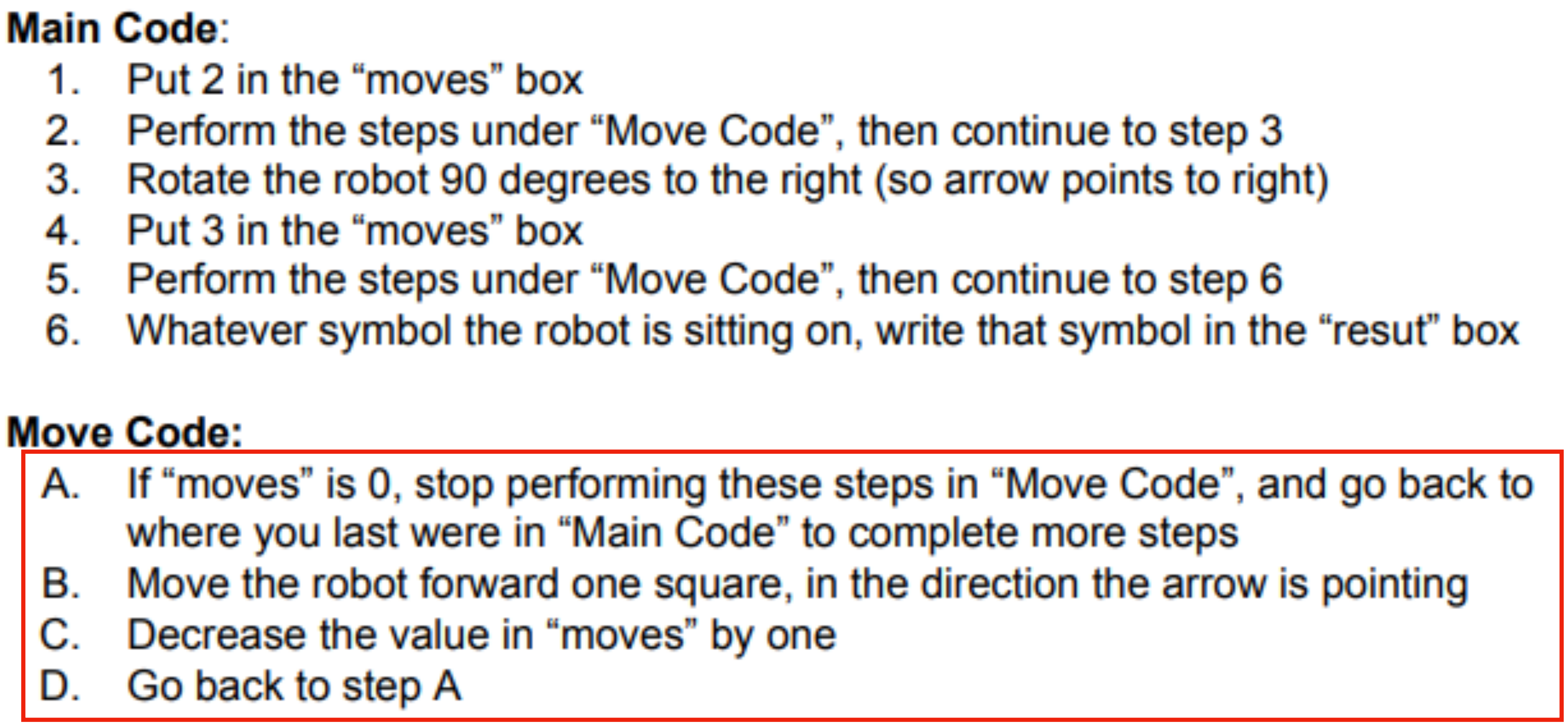
Tracing:

- What happens when?
- PythonTutor

Please continue reading
Chapter 3 of Think Python

Also read 301 bonus:
"Creating Fruitful Functions"

link on schedule



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

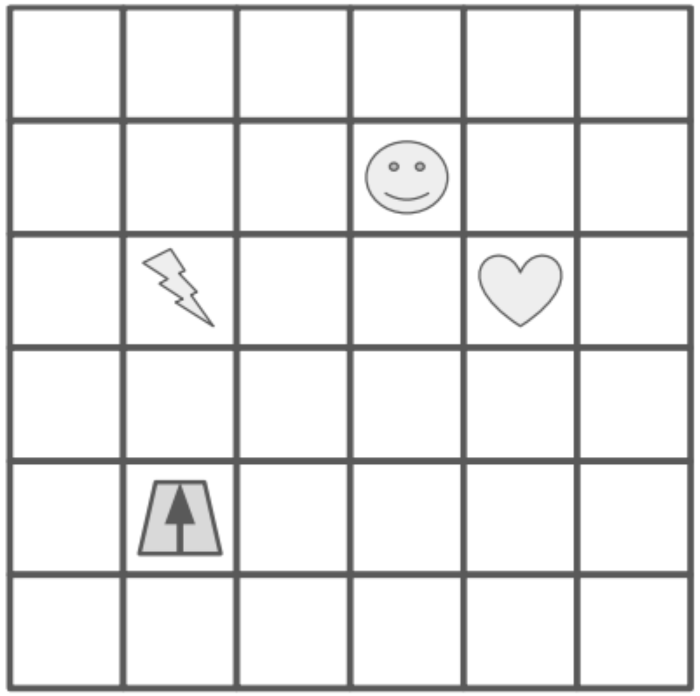
B. Move the robot forward one square, in the direction the arrow is pointing

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
```

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

It takes one parameter, “x”

Math to Python

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

Python:

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

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):
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```

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
```

In Python, indent before the statement(s)

Math to Python

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

Python:

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

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
```

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

Math to Python

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

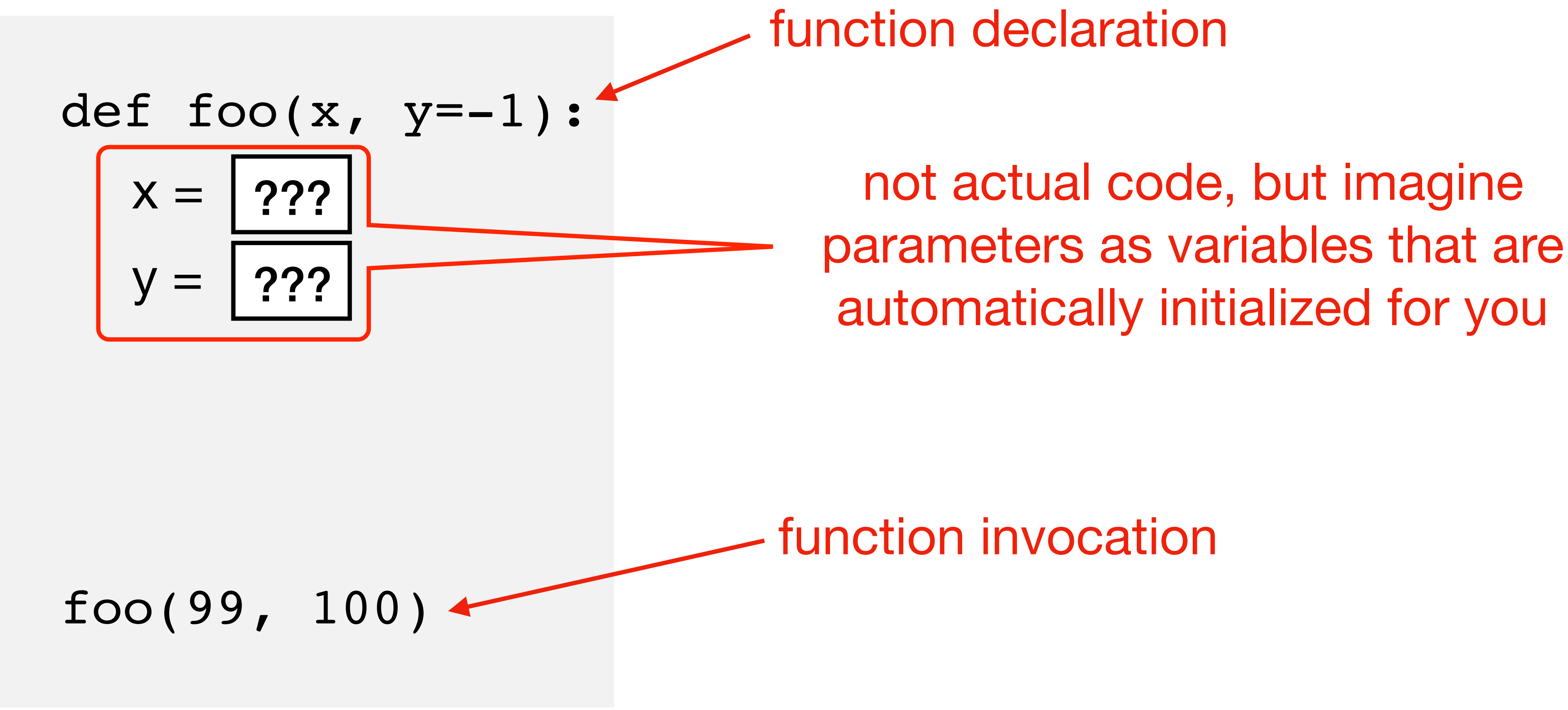
Python:

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

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

demos

How are parameter variables initialized?



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



foo(99, 100)
```

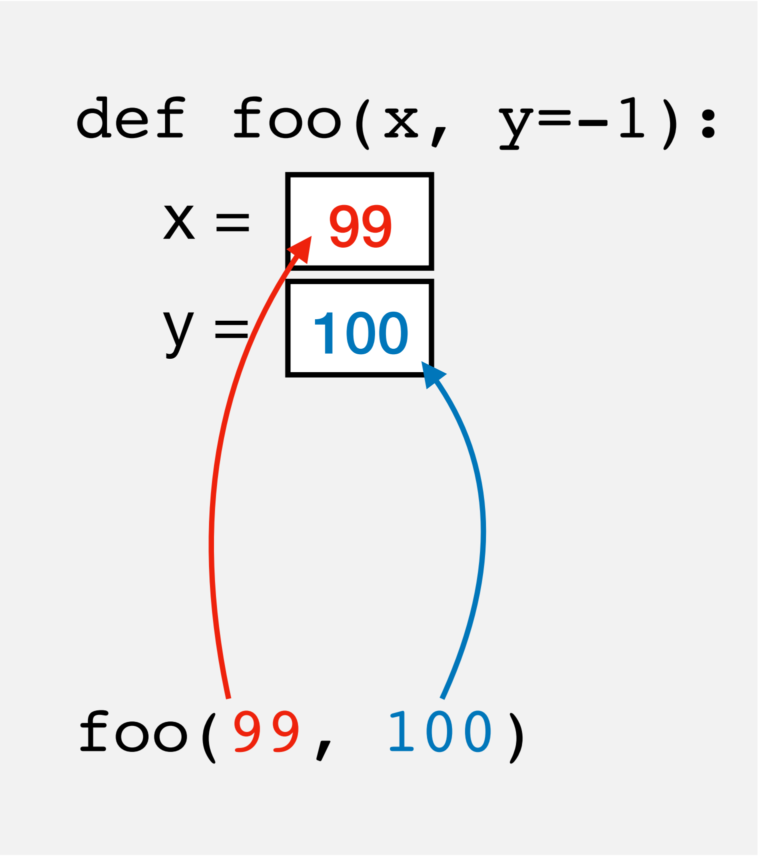
function declaration

not actual code, but imagine parameters as variables that are automatically initialized for you

function invocation

1 positional arguments

How are parameter variables initialized?



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```
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1 positional arguments

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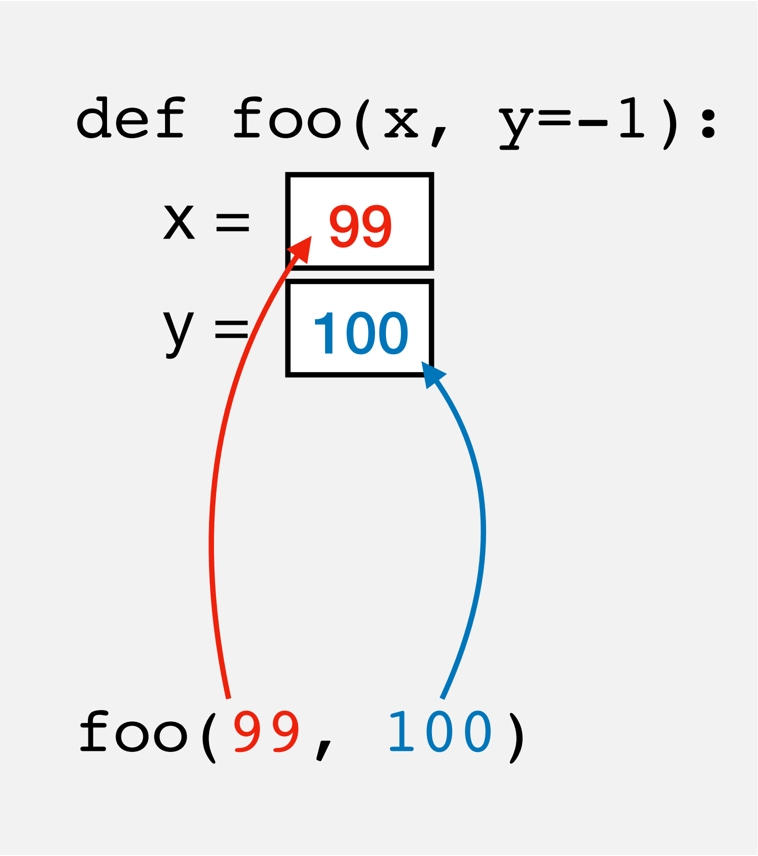
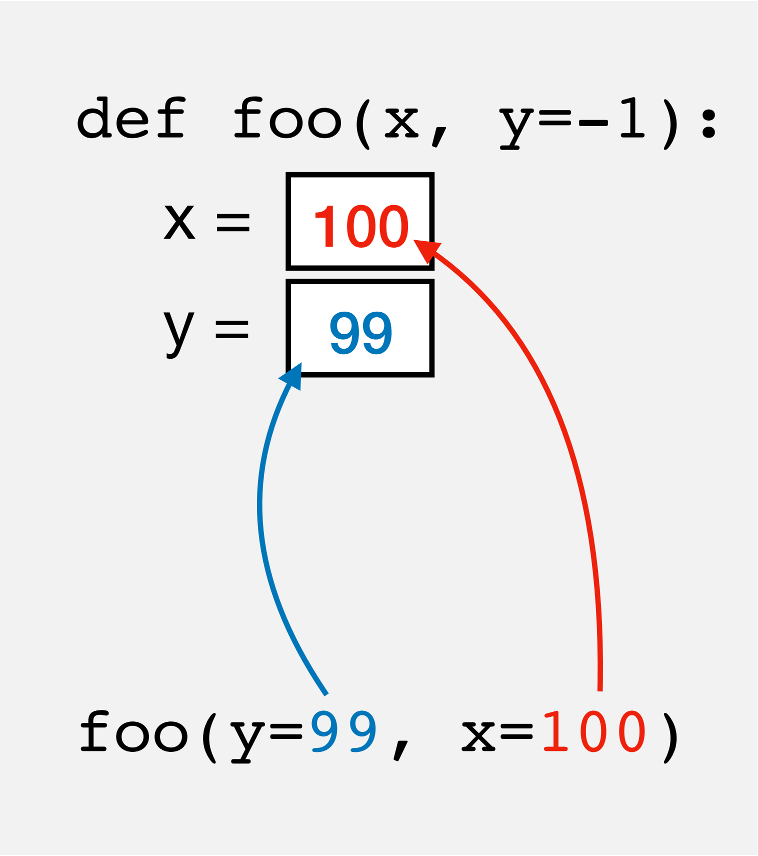


```
def foo(x, y=-1):
    x = 99
    y = 100

foo(99, 100)
```



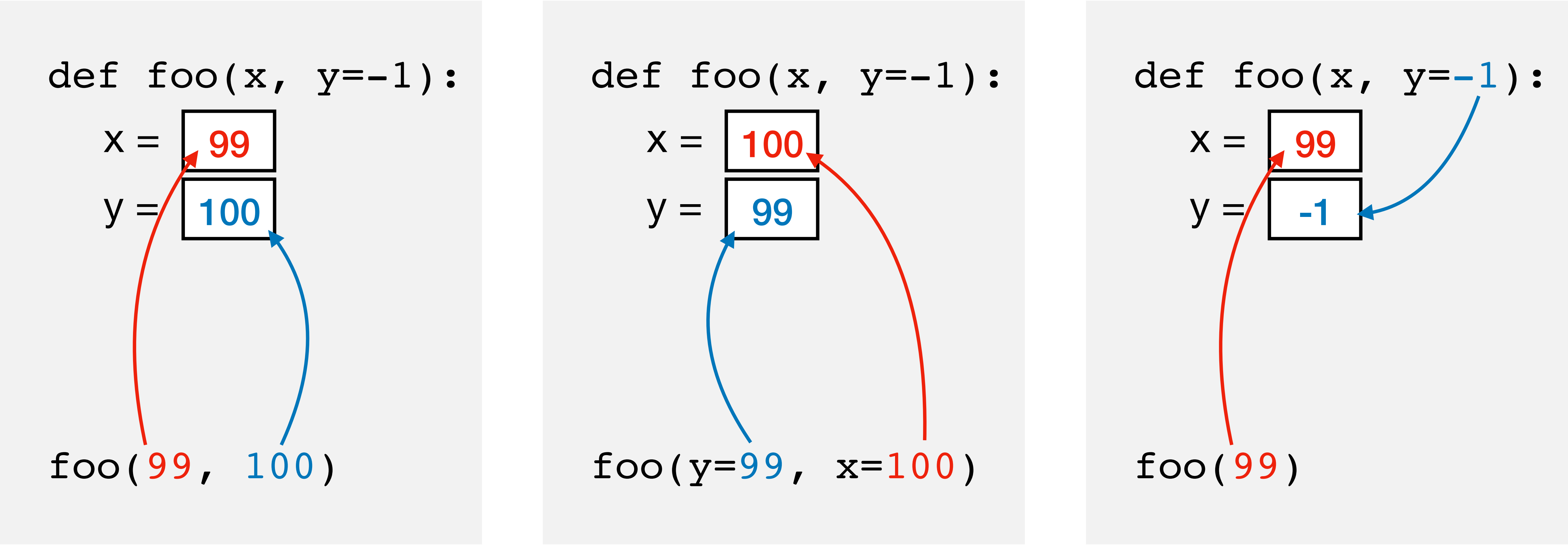
```
def foo(x, y=-1):
    x = 100
    y = 99

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

1 positional arguments

2 keyword arguments

How are parameter variables initialized?



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

```
foo(99)
```

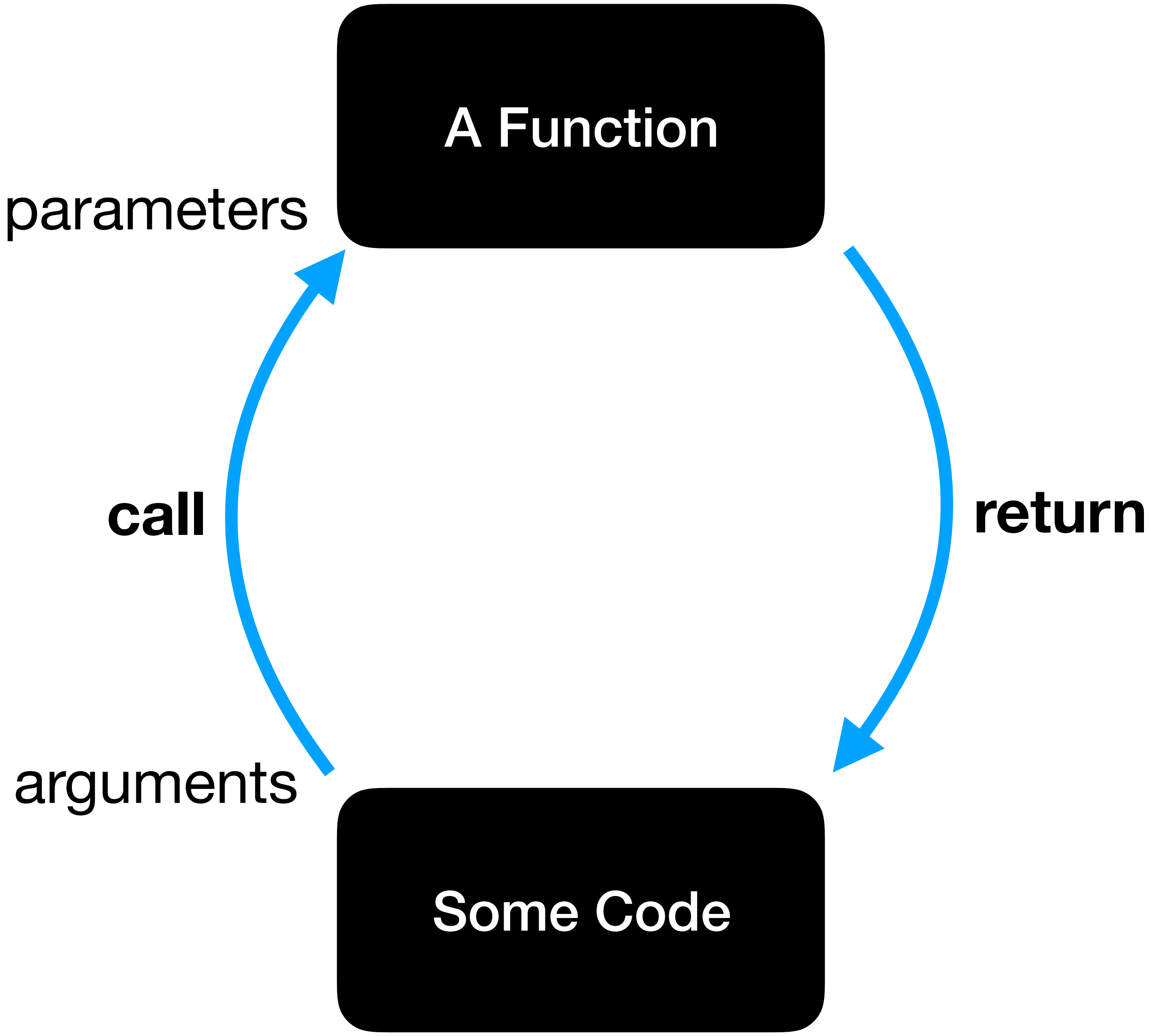
1 positional arguments

2 keyword arguments

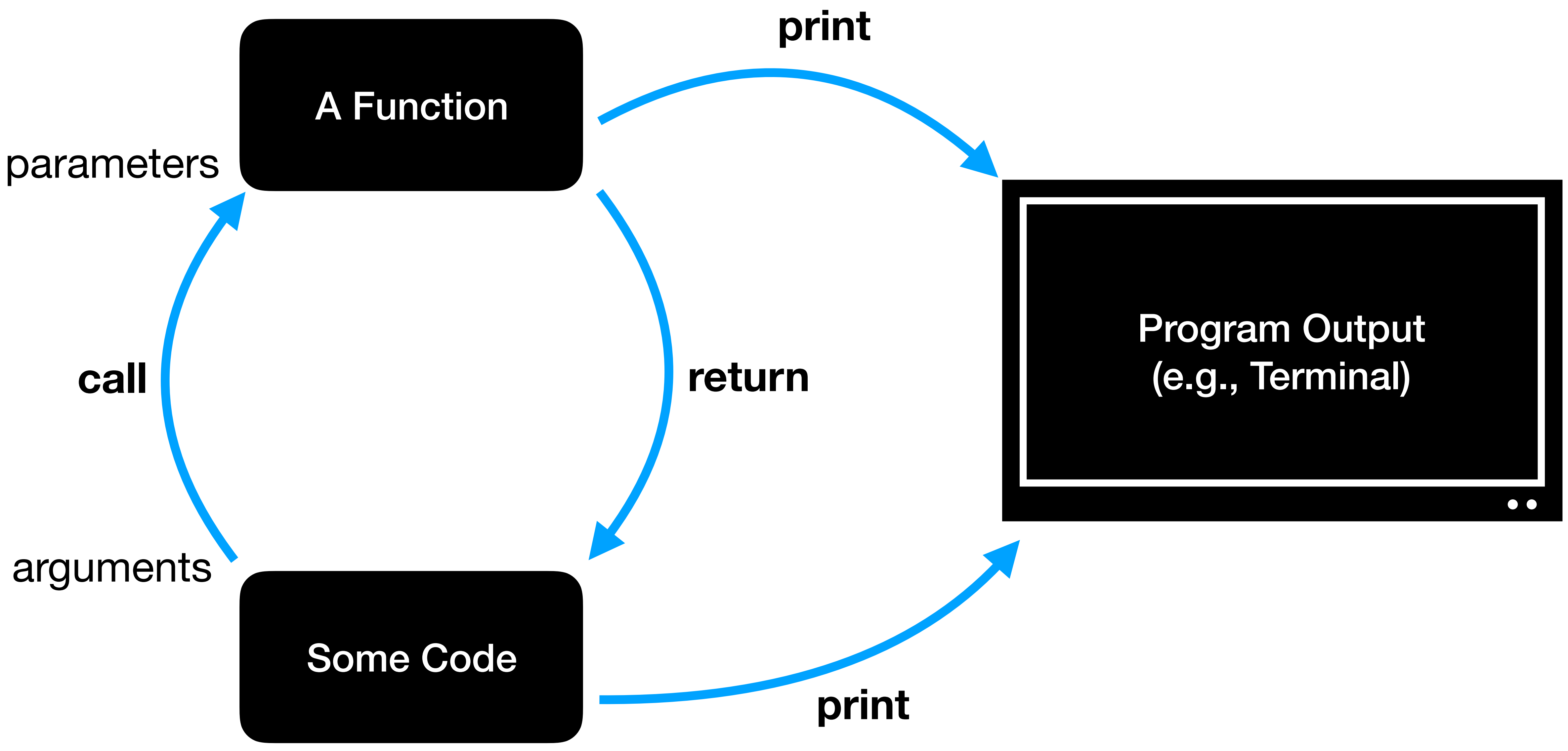
3 default arguments

demos

Print vs. Return

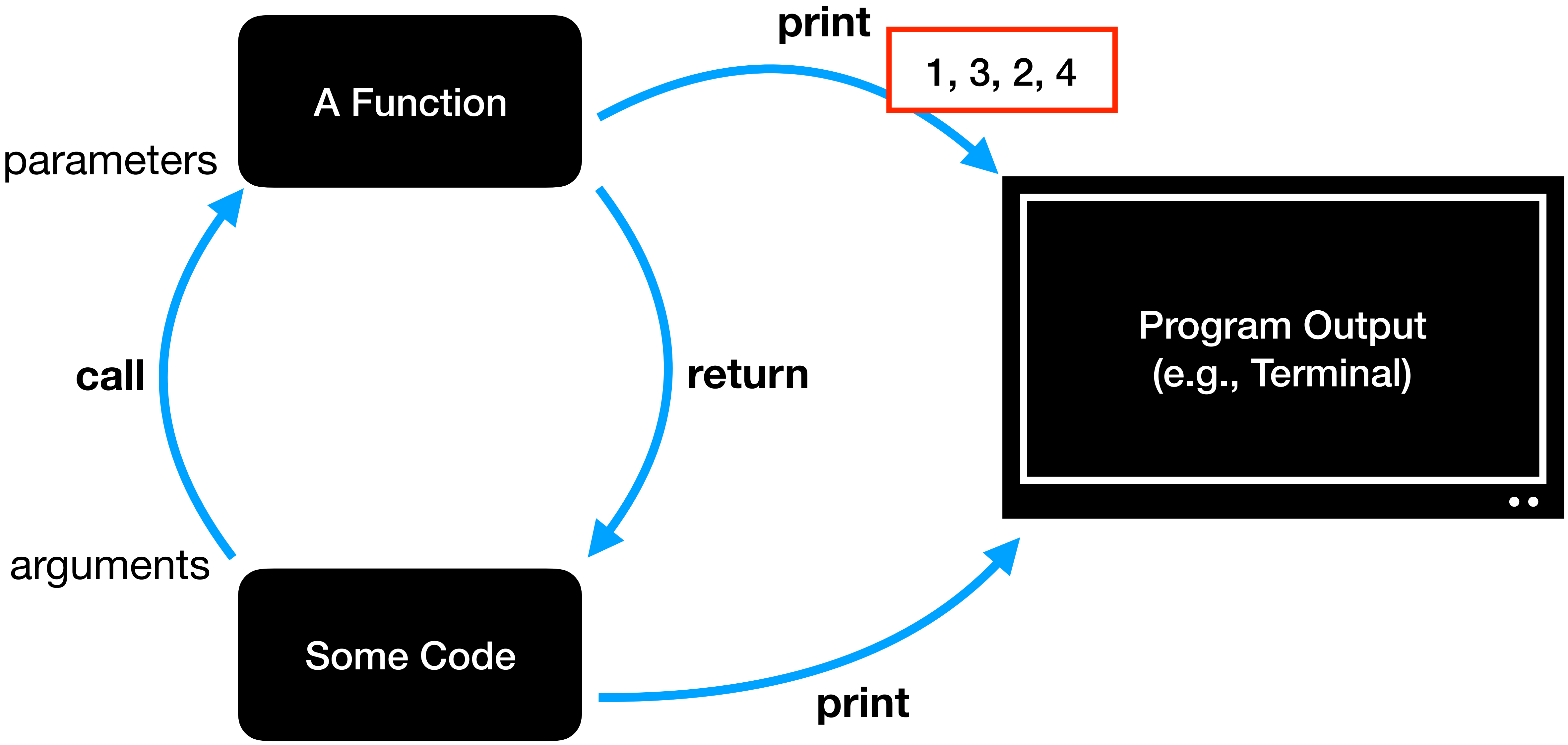


Print vs. Return



we could call print from multiple places

Print vs. Return



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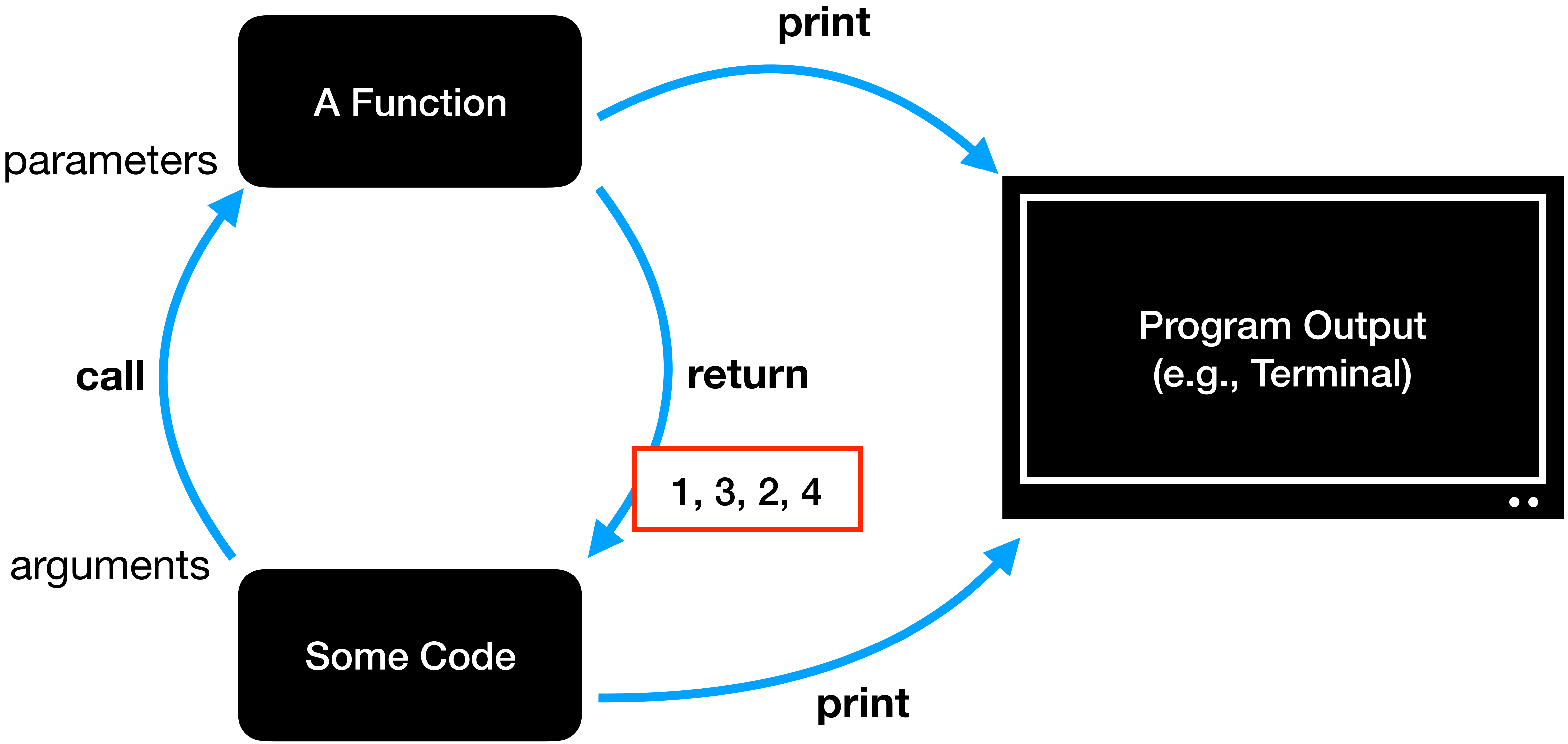
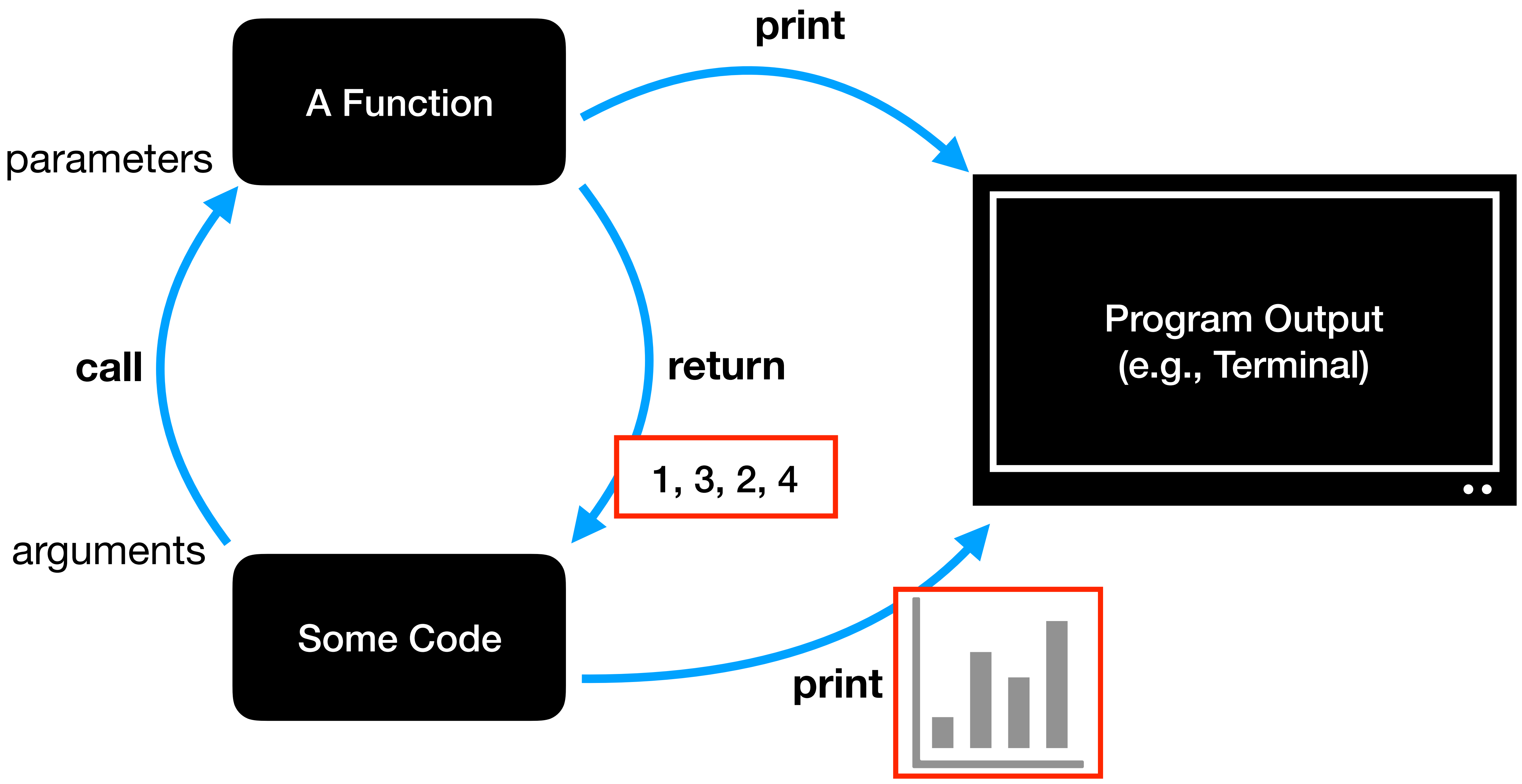


returning, instead of **printing**, gives callers different options for how to use the result

Print vs. Return



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

demos

Demo: Approximation Program

input: a number from user

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

```
python approx.py
please enter a number: 3.14
close to zero?  False
close to Pi?    True
```

```
python approx.py
please enter a number: 0.000001
close to zero?  True
close to Pi?    False
```

```
python approx.py
please enter a number: 3
close to zero?  False
close to Pi?    False
```

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what is error between 4 and 8?

- 100%
- 50%

?

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- 100%
- $\boxed{50\%}$

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