

[220 / 319] 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 220 bonus:
“Creating Fruitful Functions”



link on schedule

Main Code:

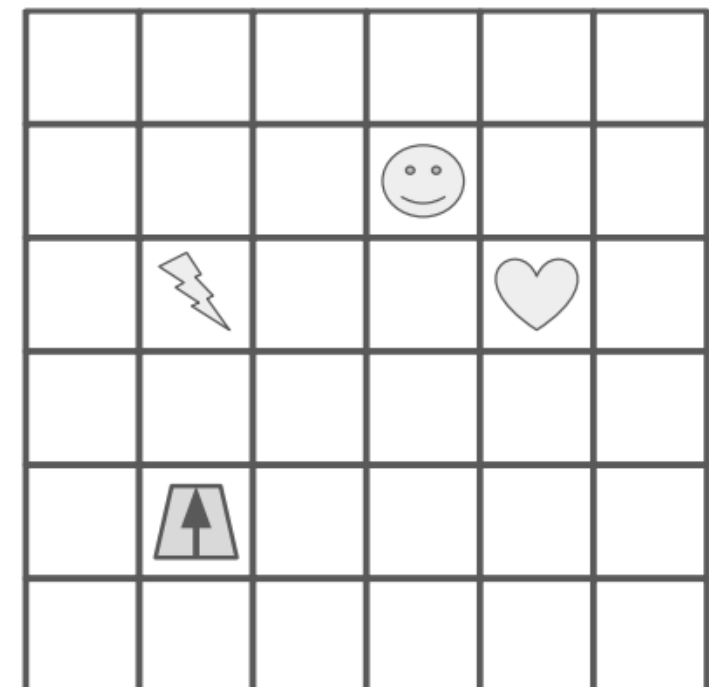
1. Put 2 in the “moves” box
2. Perform the steps under “Move Code”, then continue to step 3
3. Rotate the robot 90 degrees to the right (so arrow points to right)
4. Put 3 in the “moves” box
5. Perform the steps under “Move Code”, then continue to step 6
6. Whatever symbol the robot is sitting on, write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

Math to Python

Math:

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

Python:

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

Function name is “f”

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 (“=“)
- 2 In Python, put the “return” keyword before the expression associated with the function
- 3 In Python, indent before the statement(s)

Math to Python

Math:

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

Python:

4

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

or

5

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

4

Computing the area from the radius

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)

Can we implement our own version of popular math functions?

`abs(x)`

`sqrt(x)`

`pow(base, exp)`

demos...

Rules for filling parameters...

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

x = ???

y = ???

```
foo(99, 100)
```

function declaration

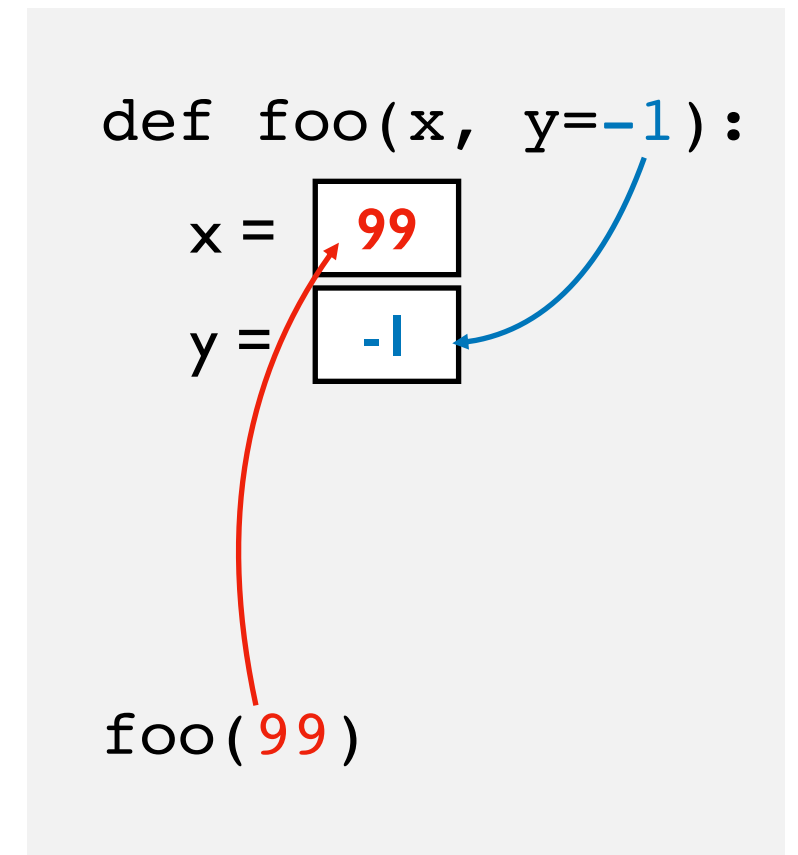
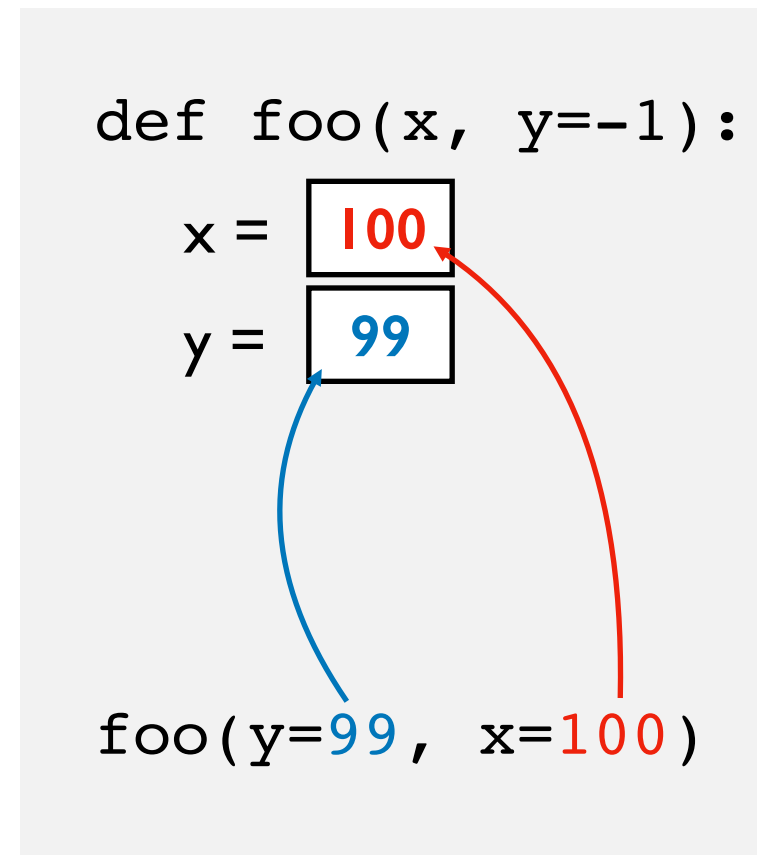
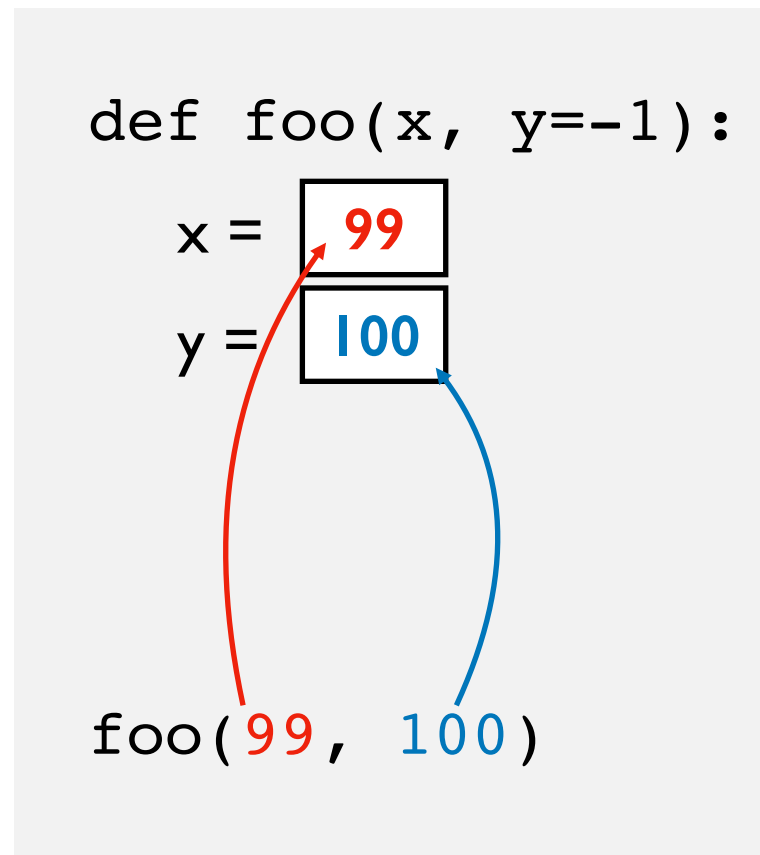
not actual code, but imagine
parameters as variables that are
automatically initialized for you

function invocation



positional arguments

Rules for filling parameters...



1

positional arguments

2

keyword arguments

3

default arguments

common pitfall: confusing keyword arguments and default arguments

worksheet practice...

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)

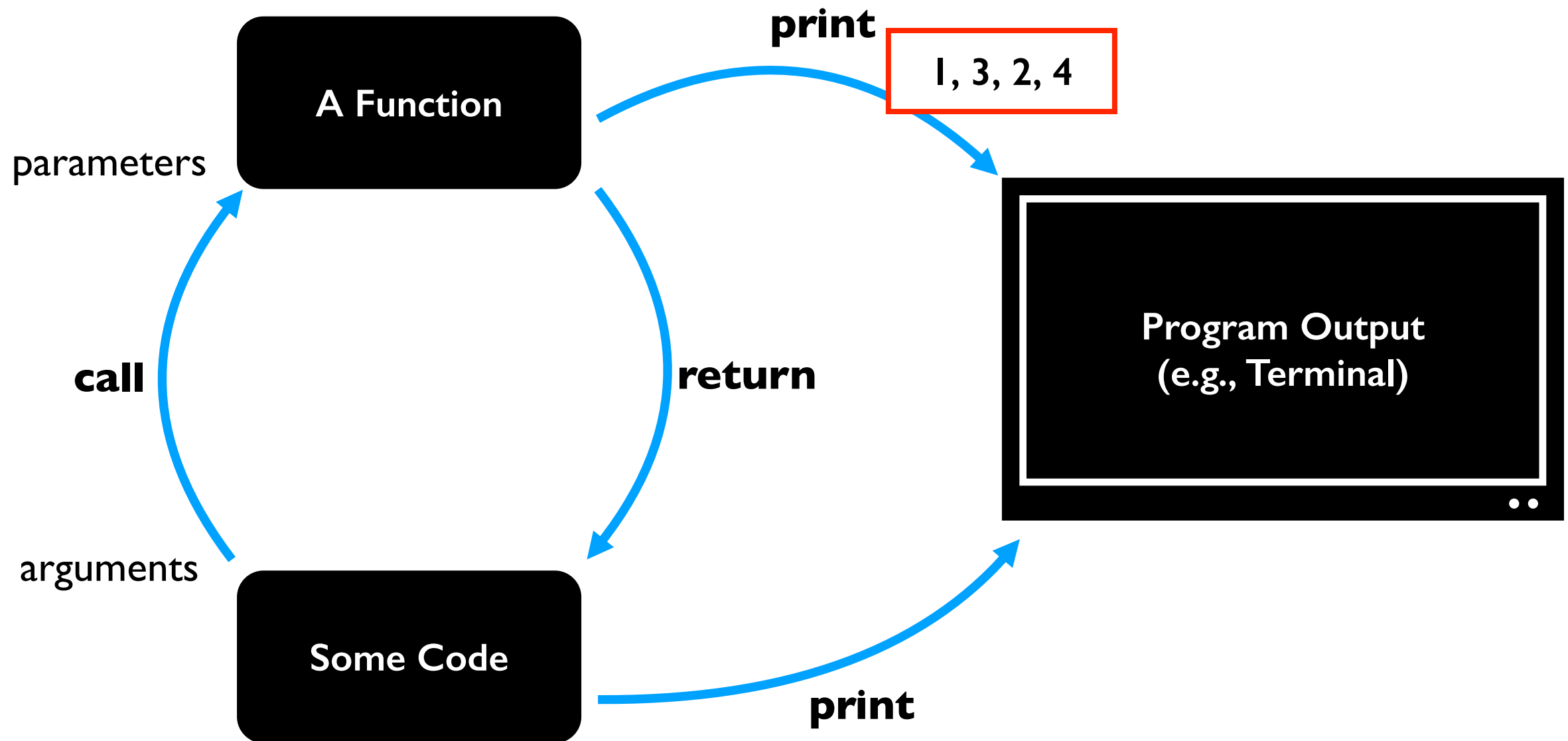
- pip install jupyter
- pip install ...

custom

- dog
- cat
- ...

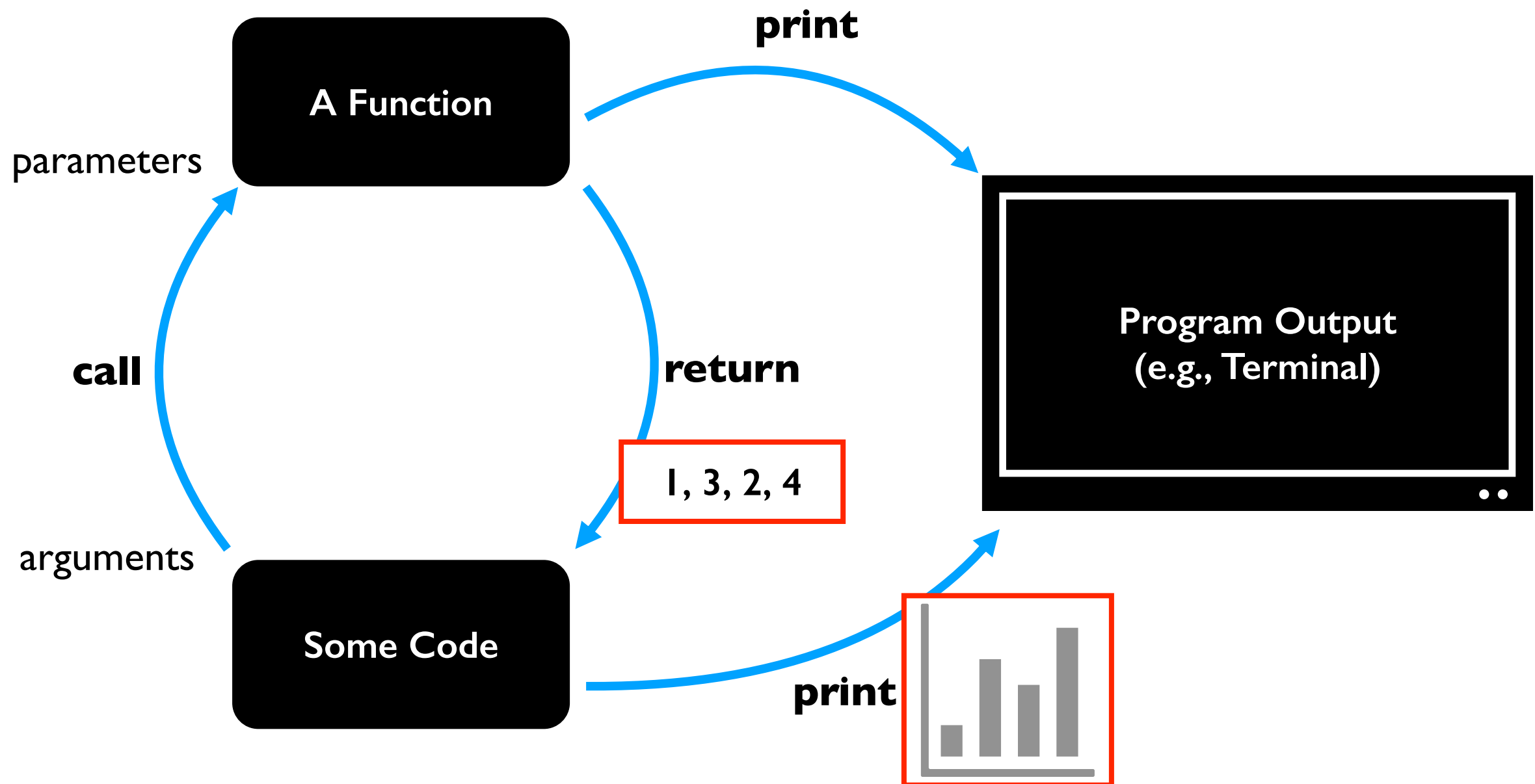
demos...

Print vs. Return



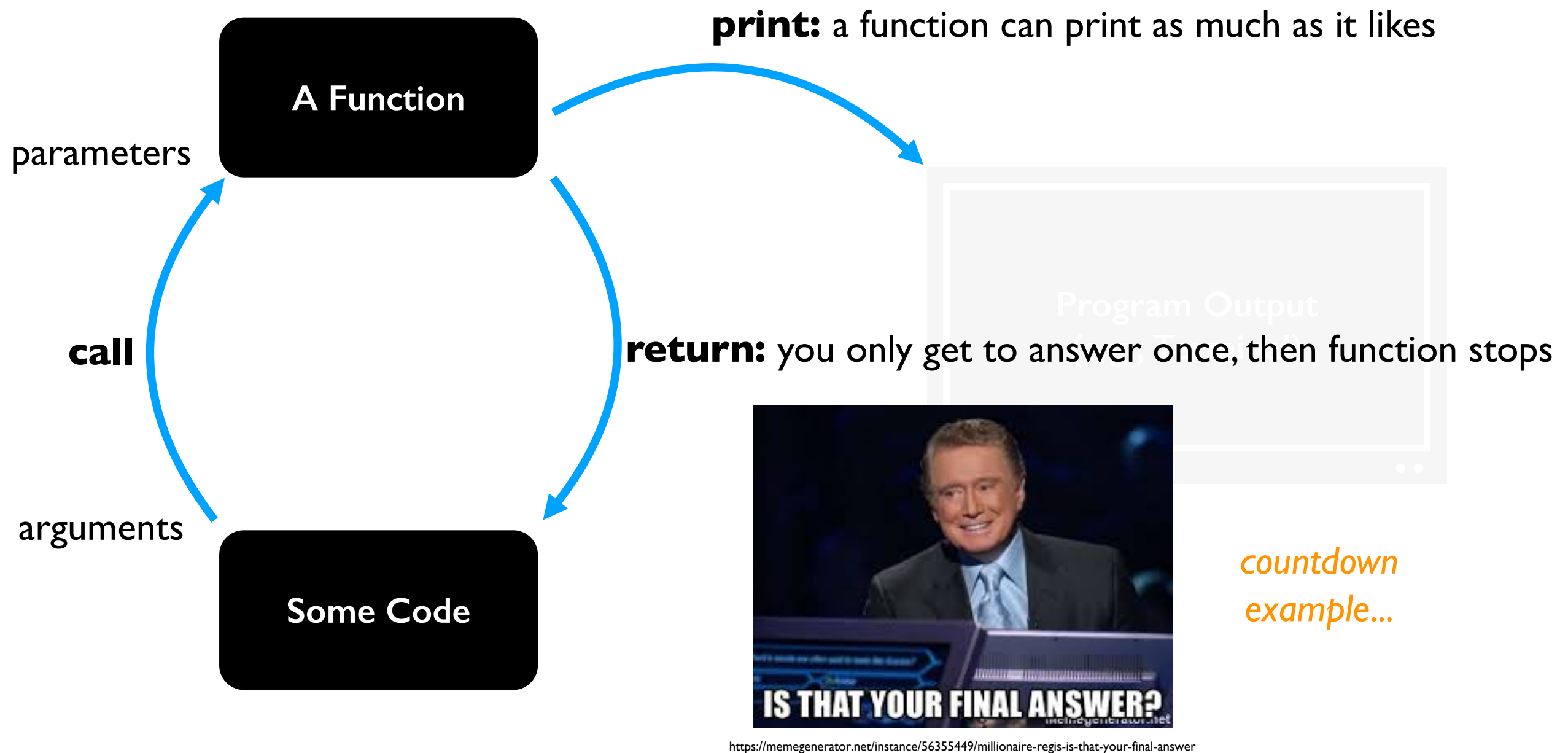
we could call print from multiple places

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

Checking Examples with PythonTutor

Mon: Creating Functions (Feb 08)

- Positional Params
- Keyword Params
- Return Values

Read: Downey Ch 3 ("Adding New Functions" to "Flow of Execution" and "Fruitful and Void Functions")

Read: [Creating Fruitful Functions](#)

[Link to Slides](#)

Link to worksheet: [pdf](#), [docx](#)

[Interactive Exercises](#)

Lecture: [code](#)

Lec 07 - Interactive Exercises

Worksheet Problem 19

Python 3.6

```
→ 1 print("A")
   2
   3 def foo():
   4     print("B")
   5 print("C")
   6 foo()
   7 print("D")
   8 foo()
```

Edit this code

→ line that has just executed

→ current line

Step 1 of 12

Print output (drag lower right corner to resize)

Frames

Objects

Demo: Approximation Program

input: a number from user

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

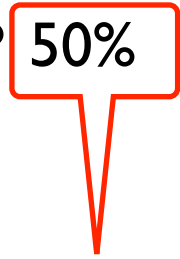
```
python approx.py
please enter a number: 3.14
close to zero? False
close to pi? True
```

```
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
```

what is error between 4 and 8?

- 100%
- 50%


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