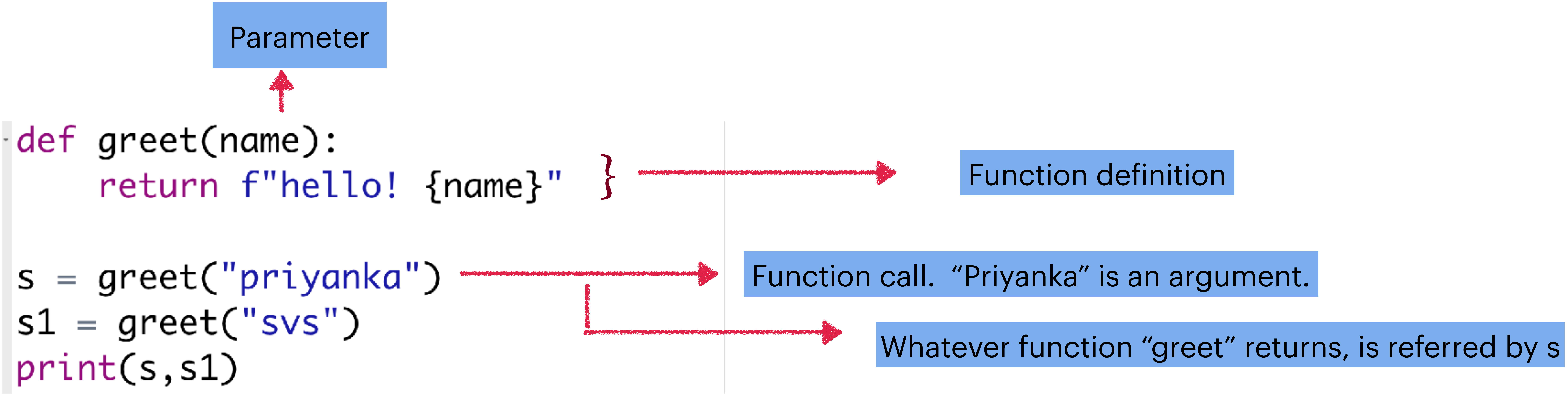
COL1000
Introduction to Programming

Priyanka Golia

Most (if not all) of the content is borrowed from Prof. Subodh Kumar's slides

Recall: Functions



Parameter

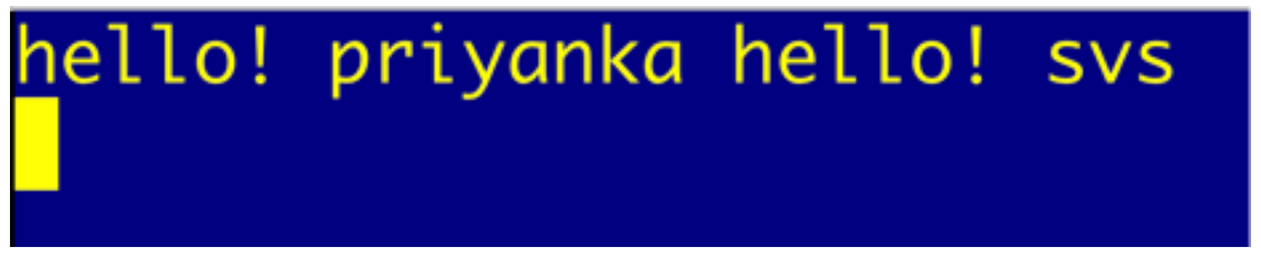
```
def greet(name):
    return f"hello! {name}"

s = greet("priyanka")
s1 = greet("svs")
print(s,s1)
```

Function definition

Function call. “Priyanka” is an argument.

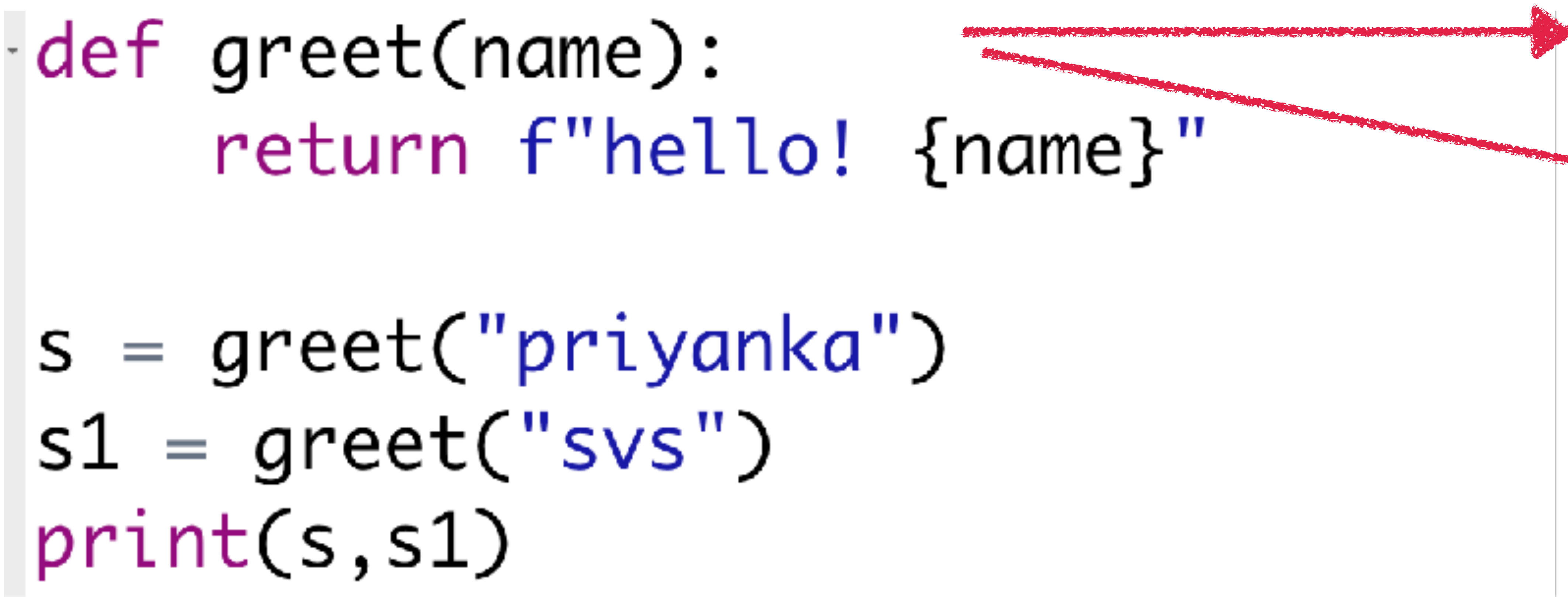
Whatever function “greet” returns, is referred by s



```
hello! priyanka hello! svs
```

- **def** starts a function definition.
- greet is the **function name** (same rules as variable names).
- (name) are the **parameters**.
- **:** ends the header line; the indented block is the function body.
- **return** sends a value back to the caller (optional).

Recall: Functions



```python
def greet(name):
    return f"hello! {name}"

s = greet("priyanka")
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print(s,s1)
```

Creates a function object.

The “greet” name is referring to that function.

```python
print(type(greet))   ##<class 'function'>
```

Recall: Functions

```
def outer():
    x = 10
    def inner():
        return x + 1
    return inner
outer()
```

- When outer is *defined*, Python just creates a function object. The code for inner is *inside* that function but not executed yet.

- Everytime outer is *called*, a **new local frame** is created with its own variable x = 10.

- Inside outer, Python creates another function object inner. While creating inner, it sees that inner uses a variable x which is *not local* to it, but exists in an **enclosing scope** (outer's frame).

- So Python attaches a **reference** to that variable x — not its value, but *reference (think how it will behave for mutable and immutable objects)*.

- When outer() returns, it returns the inner function object.
  But that returned function still carries with it a reference to the variable x — even though outer has finished executing. That's called "closure" — A closure is a function that "remembers" variables from its enclosing scope, even after that scope is gone.

Recall: Functions

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def outer():
    x = 10
    def inner():
        return x + 1
    return inner

f = outer()
print(f())
print(f())
```

```
outer() frame:
    x → 10
    inner → function object
          └── closure cell referencing x
```

Recall: Functions

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```
11
11
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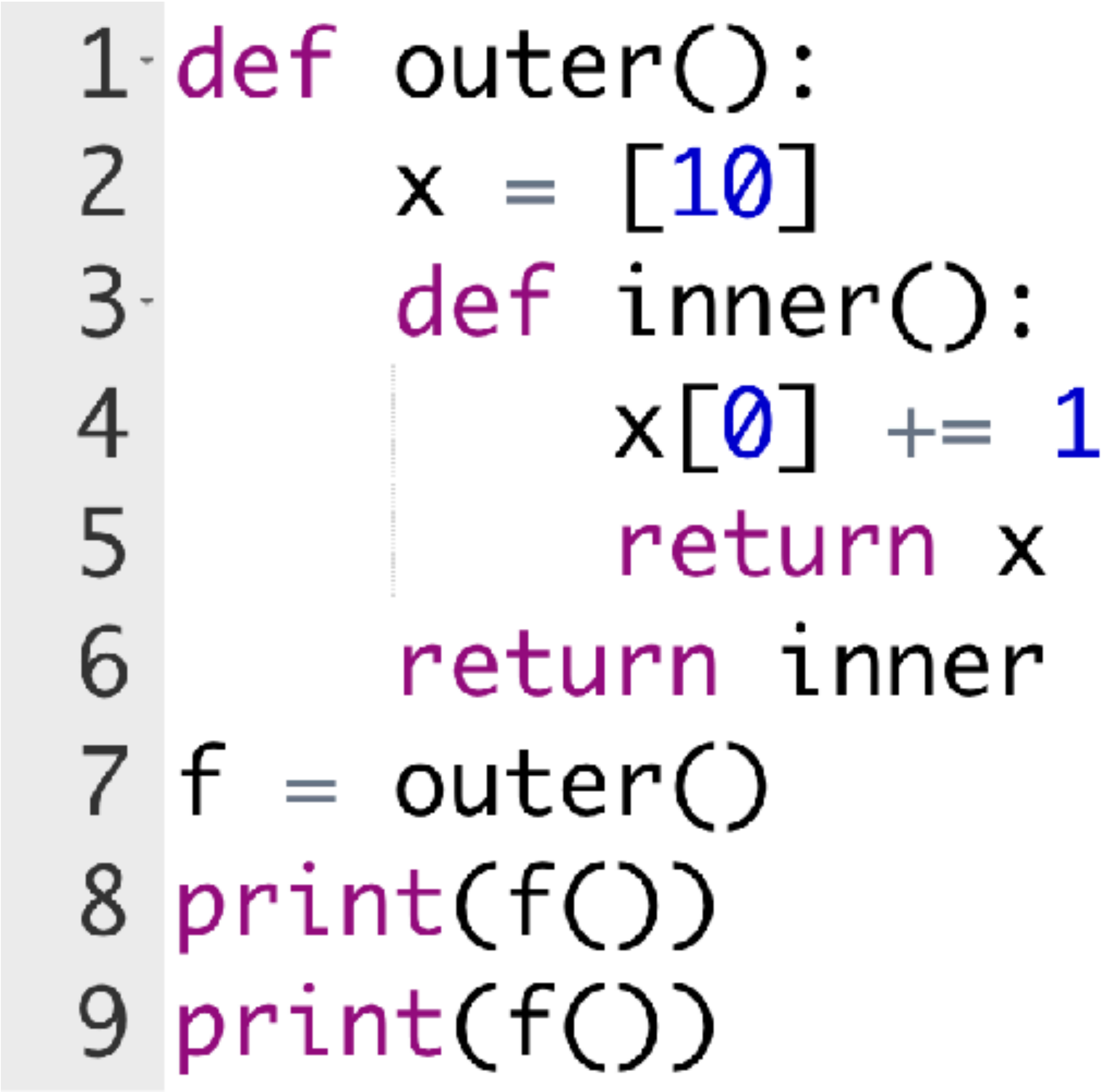

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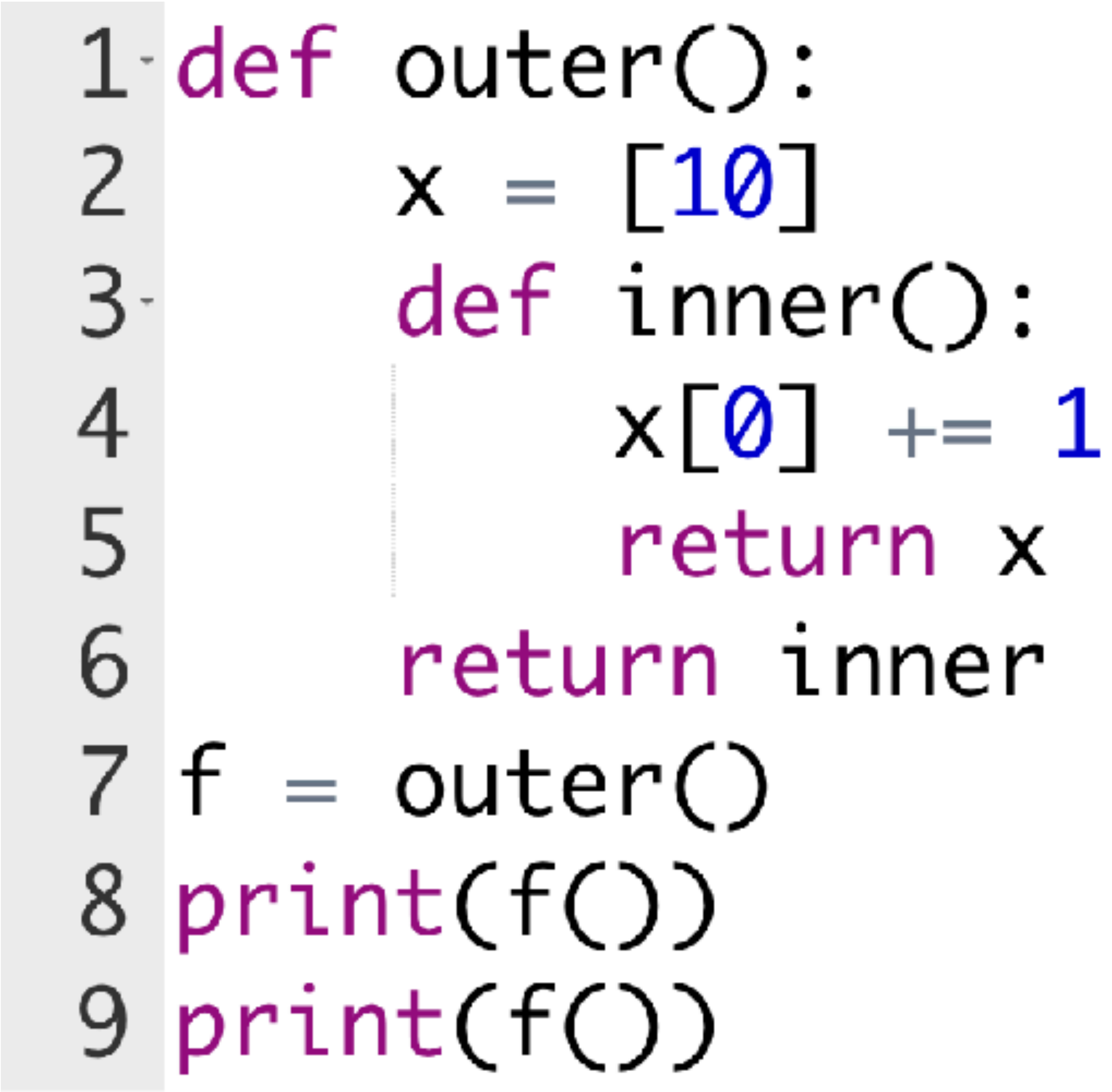
Recall: Functions



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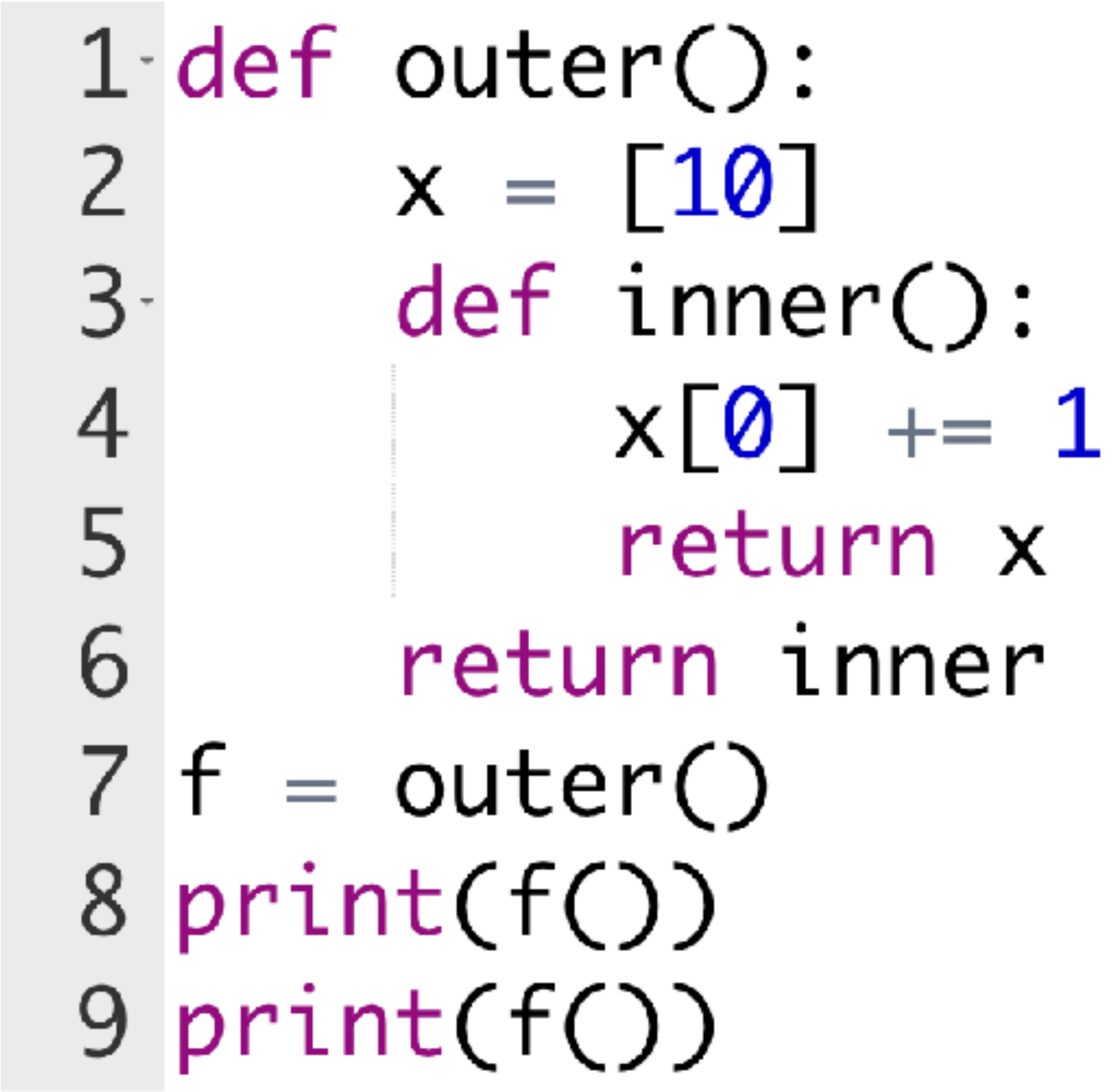
[11]
[12]
```

x is mutable, changes inside the inner function affect the same underlying object.

Recall: Functions



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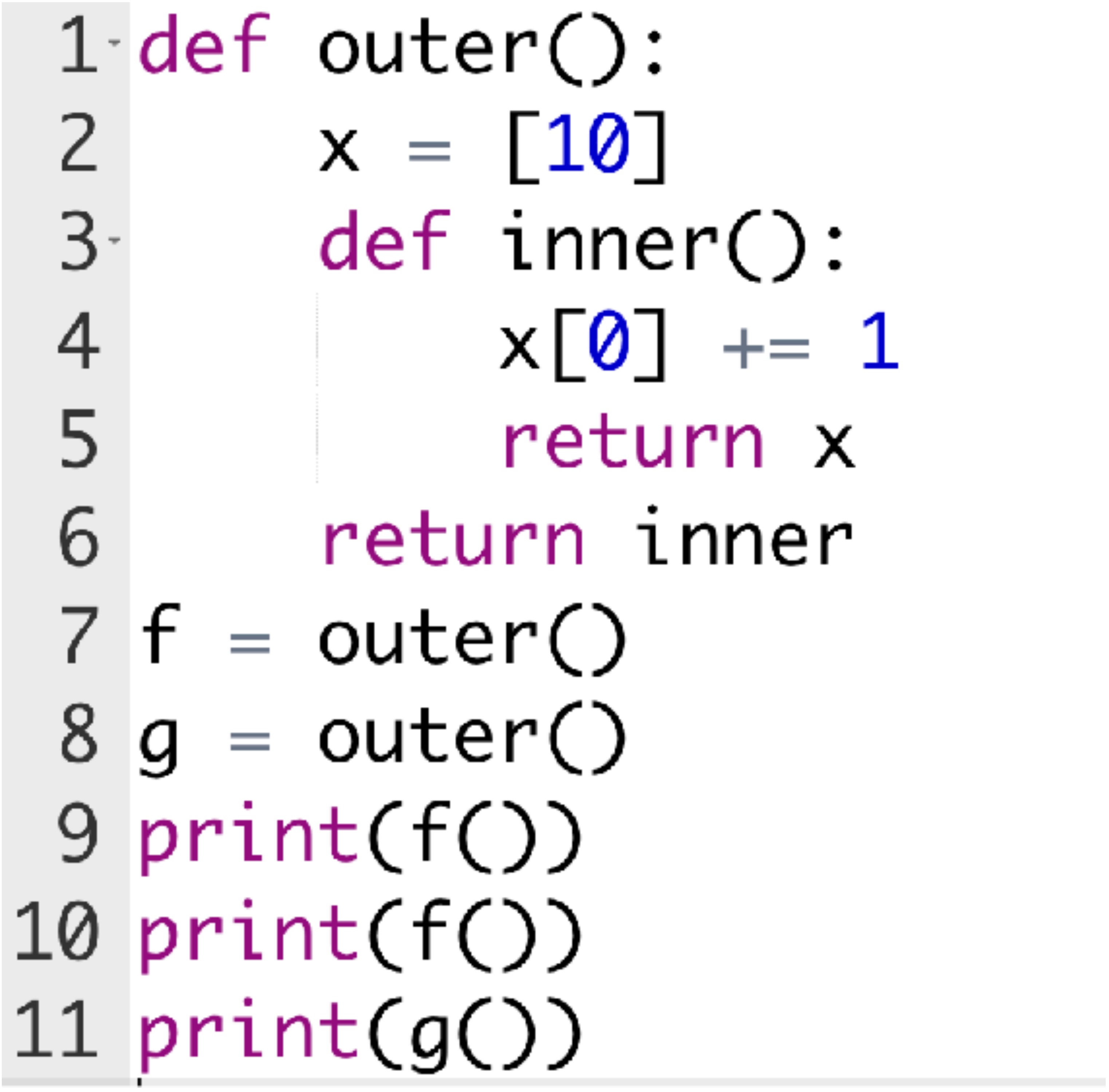

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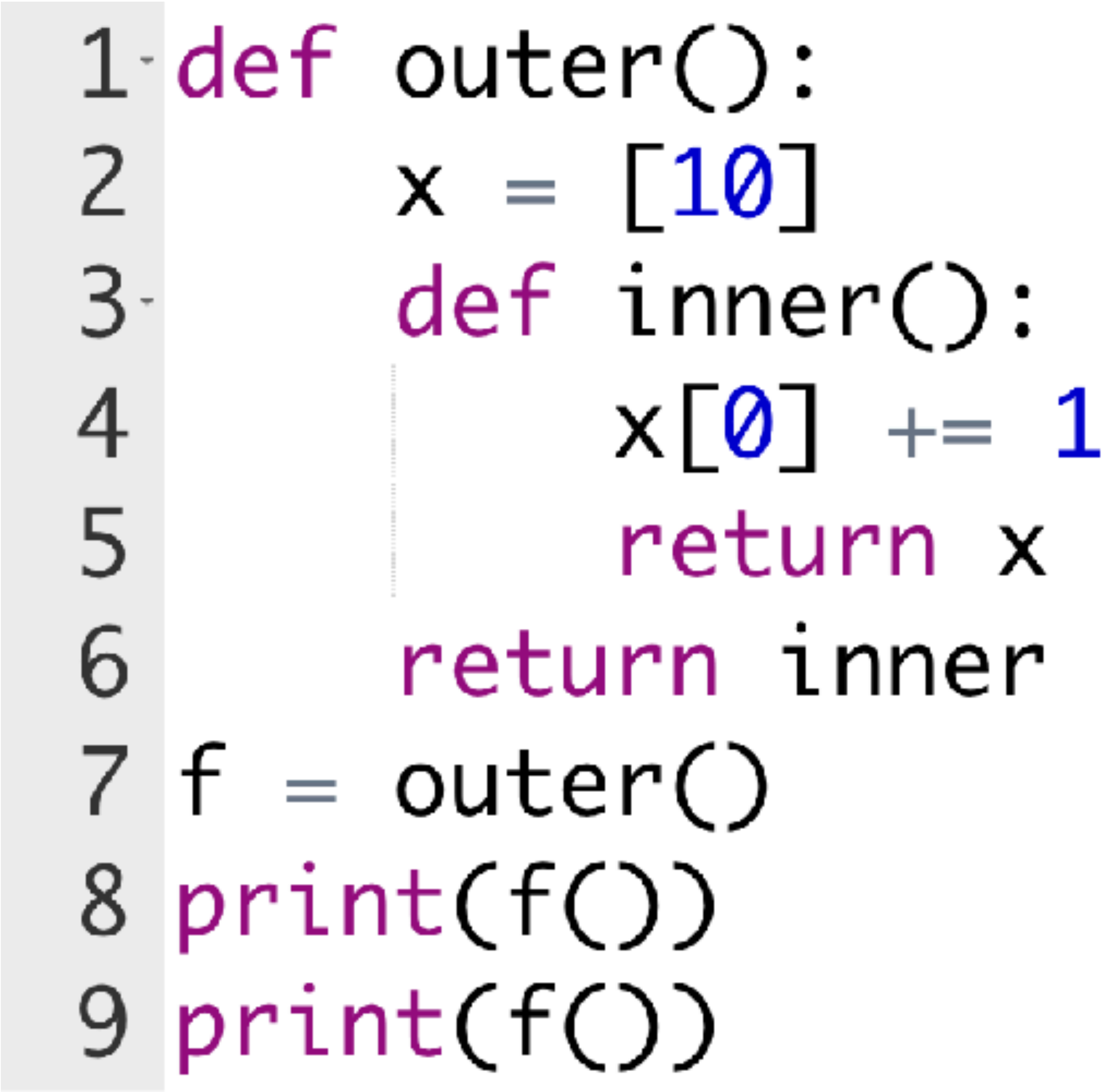
Recall: Functions



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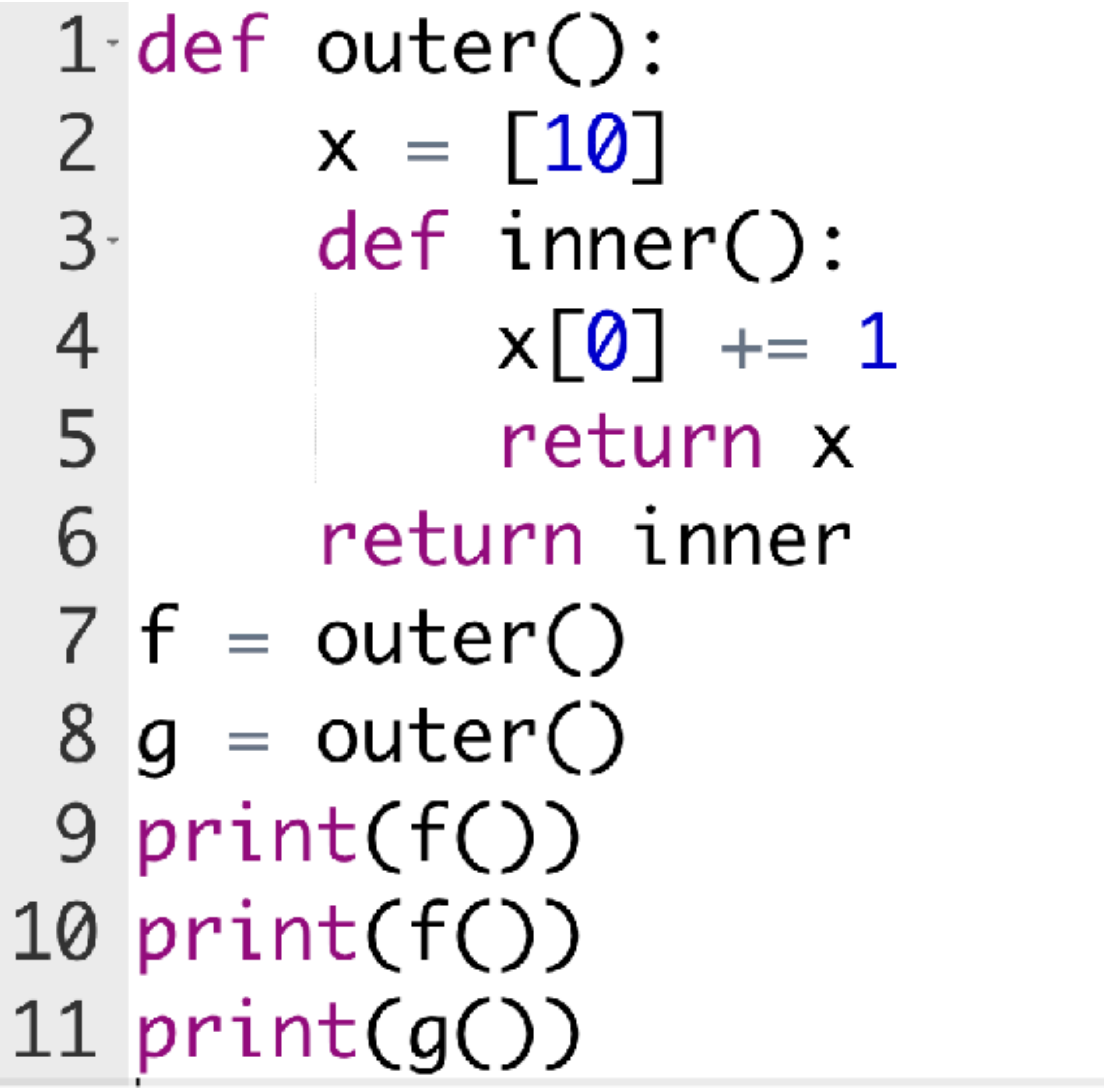

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```

[11]
[12]
[11]

F and g have independent internal states.

Revision!!

A function can return another function

```
def outer():
    def inner():
        print("I am inner")
    print("I am outer”)
    return inner

f = outer()
print(f())
```

```
def power_factory(n):
    def power(x):
        return x ** n
    return power

square = power_factory(2)
cube = power_factory(3)

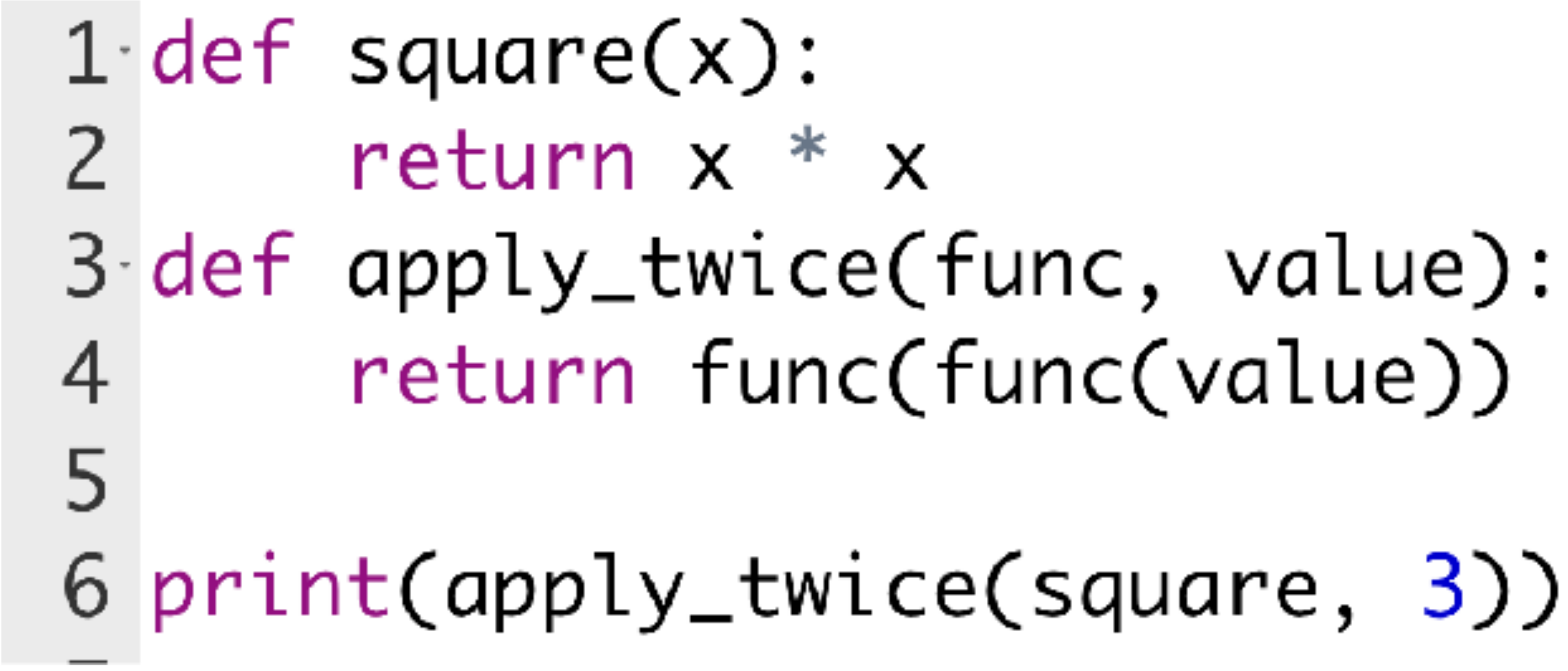
print(square(5))   # 25
print(cube(2))     # 8
```

The function power_factory *creates* and *returns* new functions — one that squares, one that cubes.
Each returned function remembers the value of n used when it was created.

A closure is a function that remembers the environment in which it was created, even after that environment is gone

Higher Order Functions

A higher-order function is a function that takes another function as input, or **returns a function as output**, or both



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def square(x):
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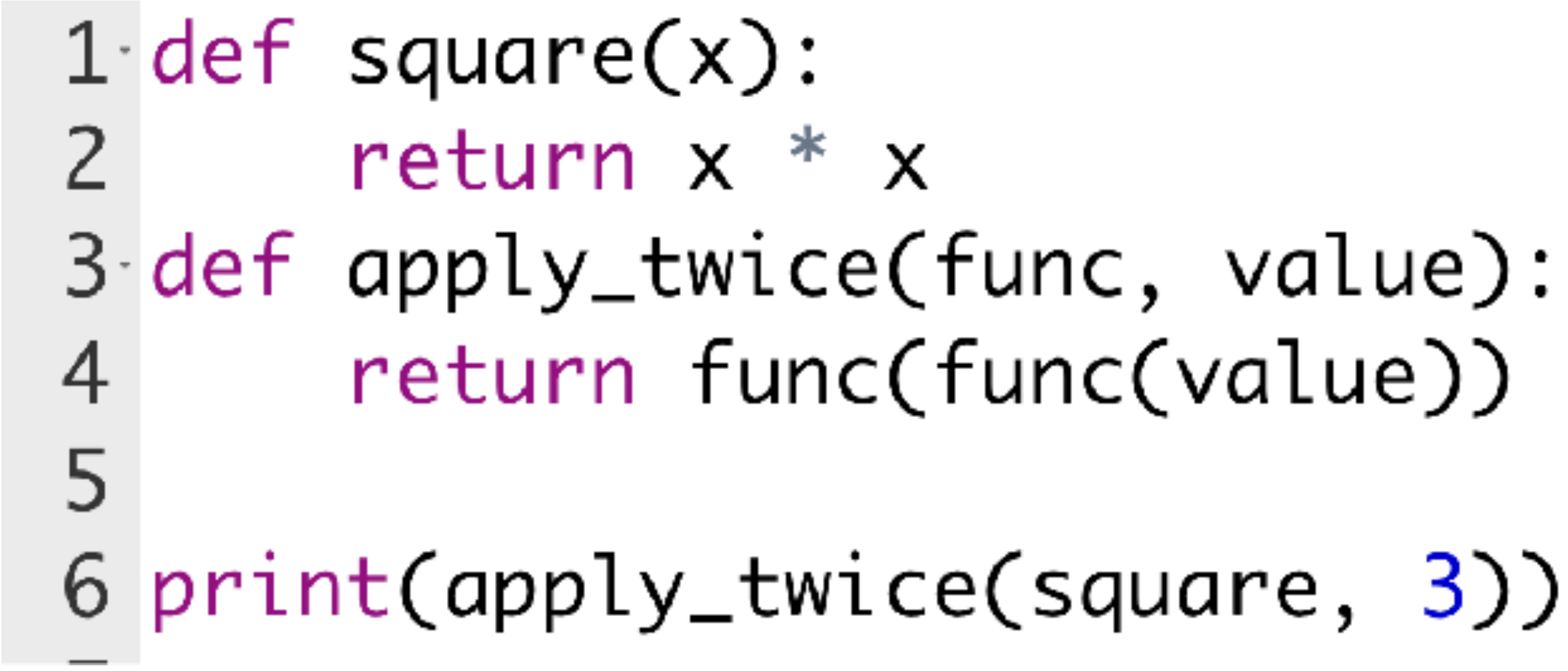

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Line 6

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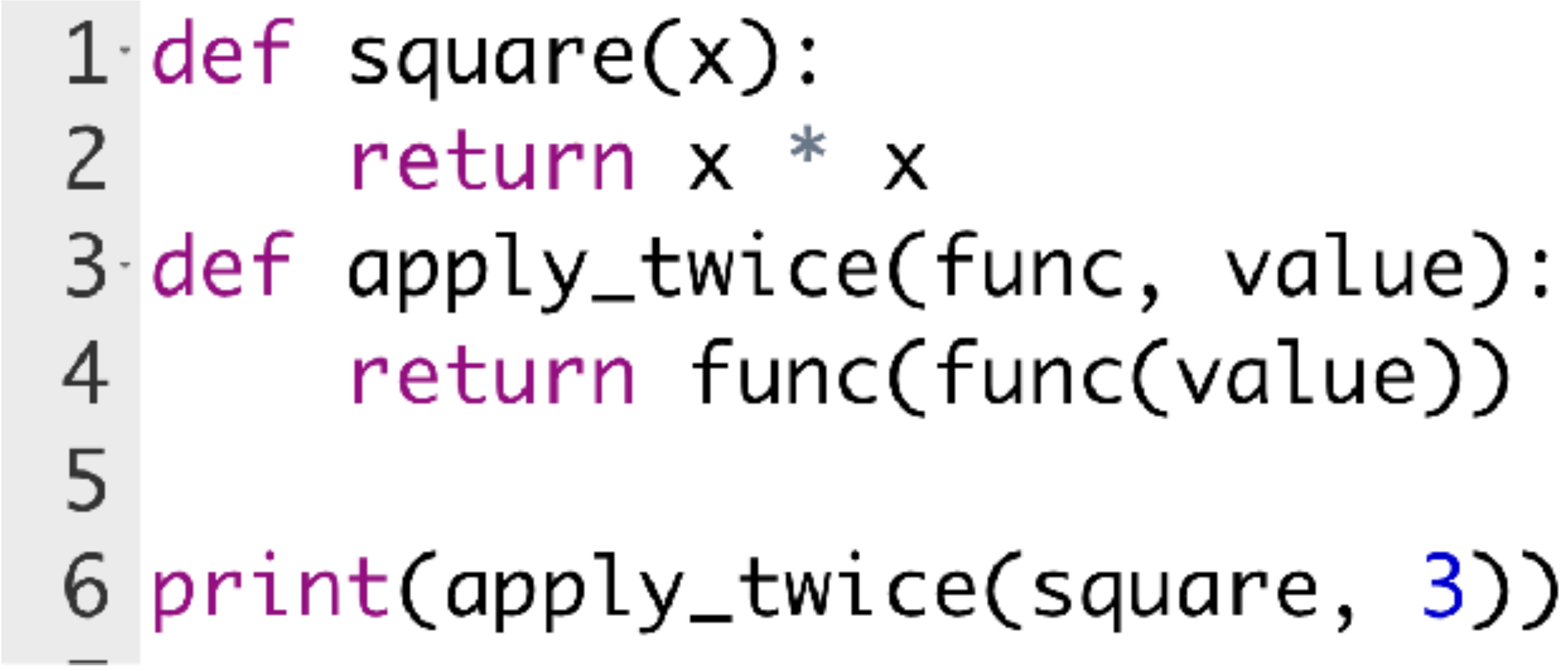

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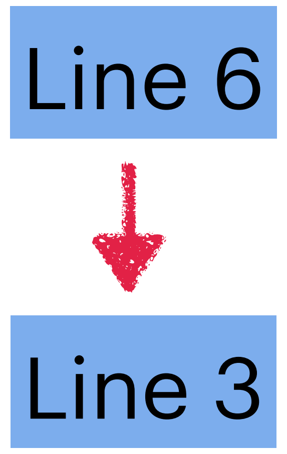

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Line 3

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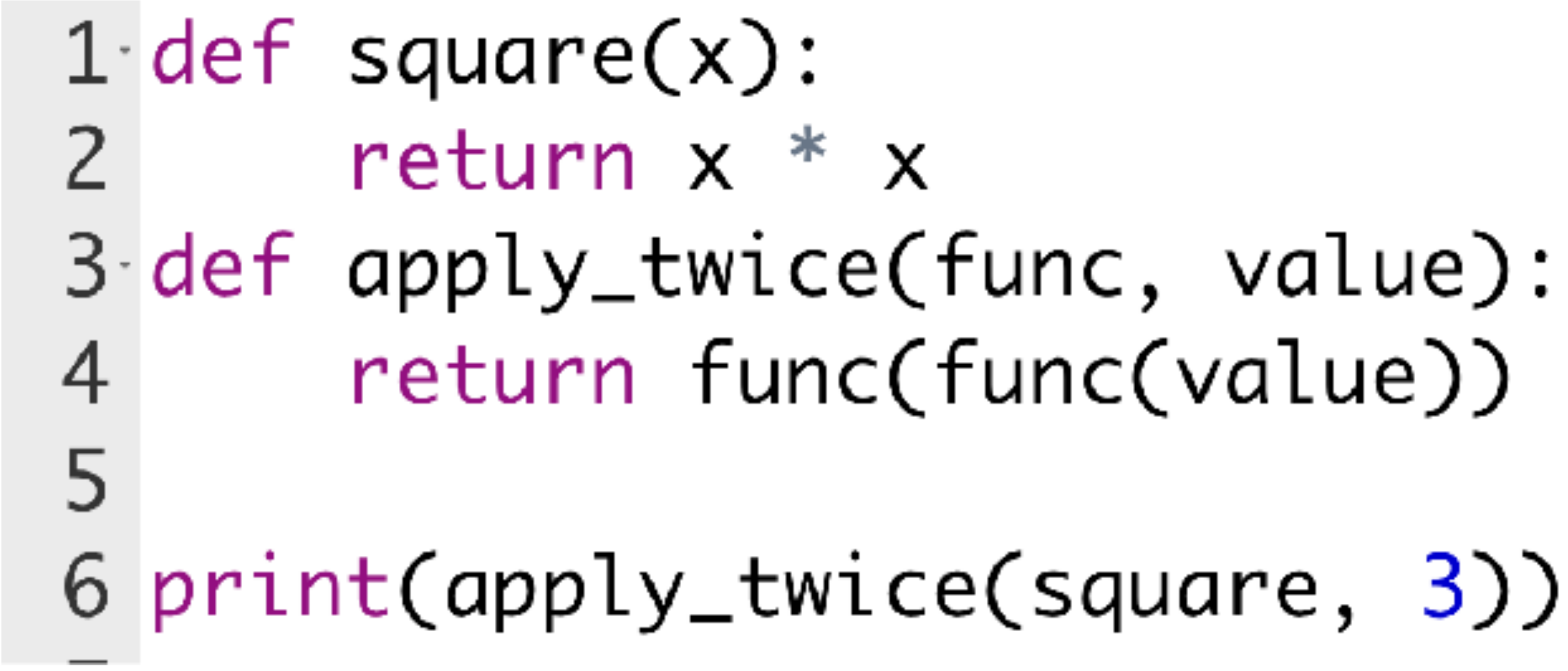

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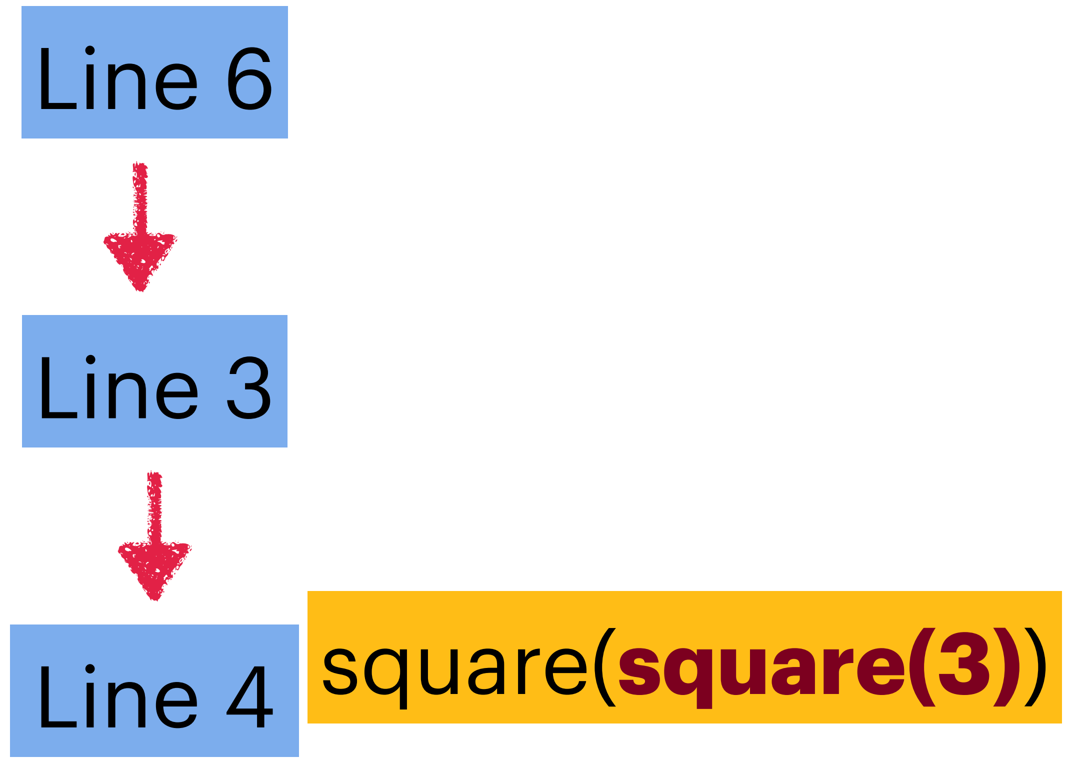

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Line 4 square(**square(3)**)

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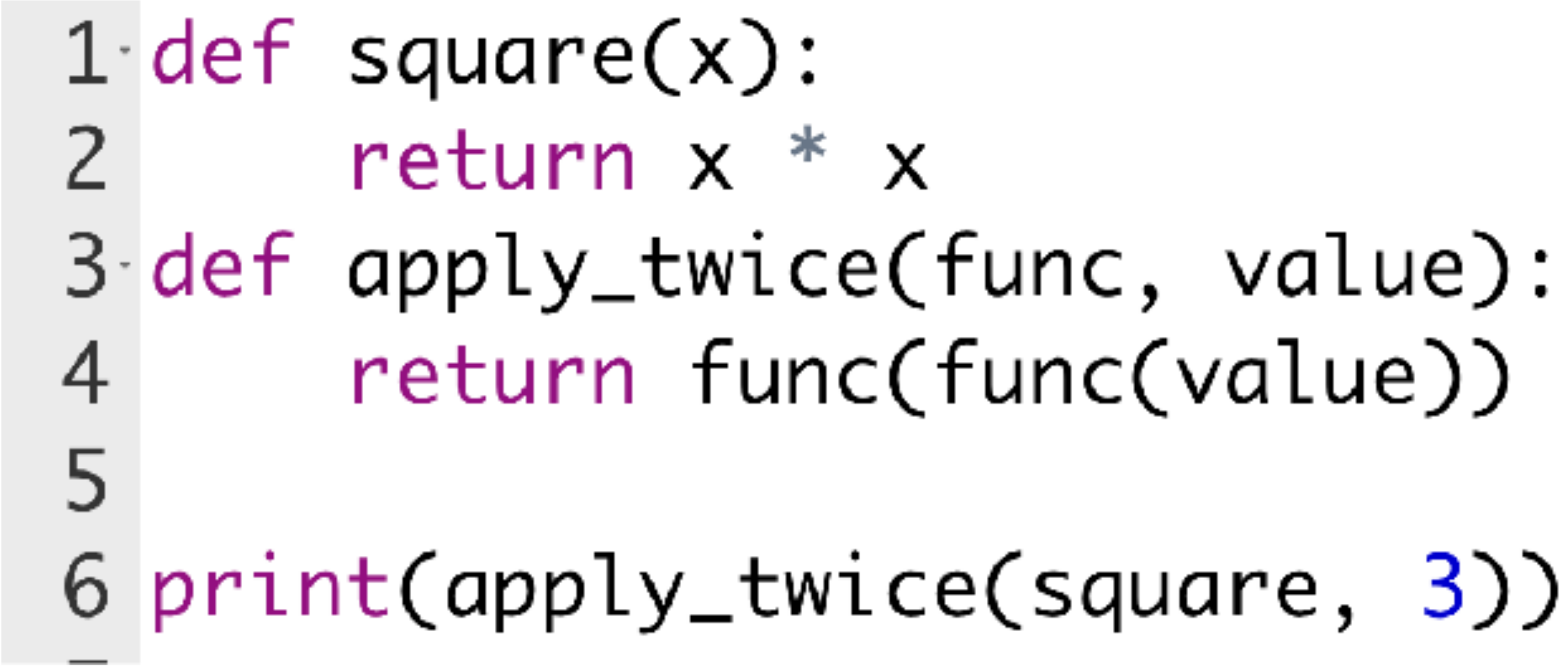

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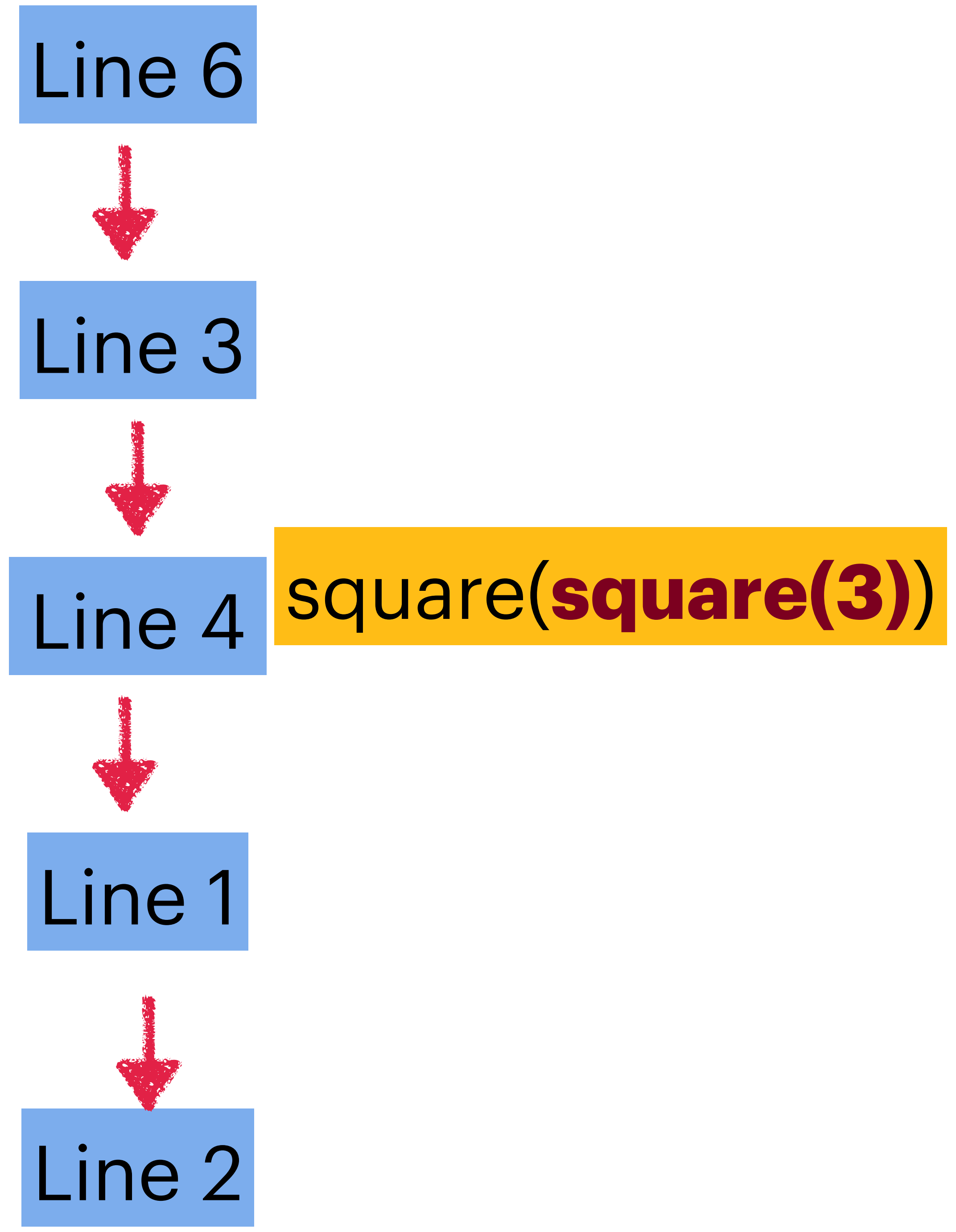

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Line 1

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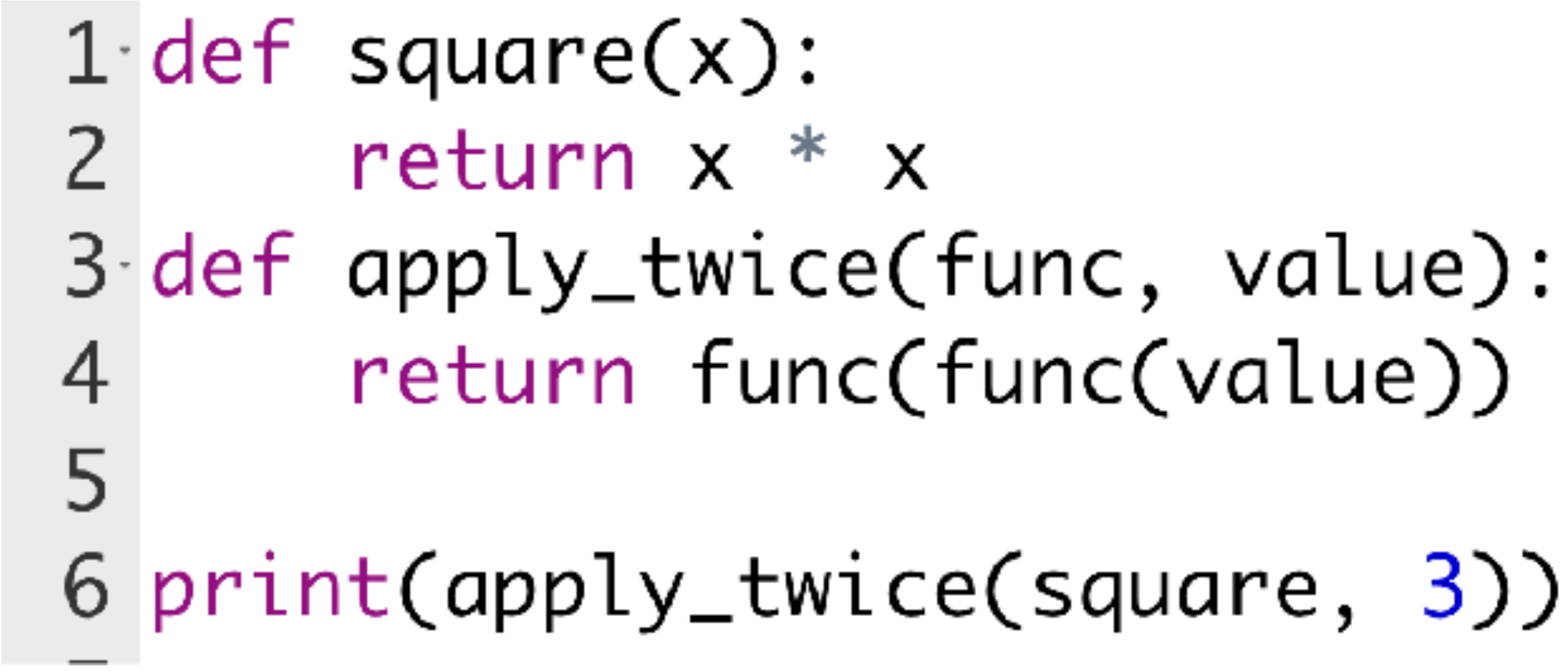

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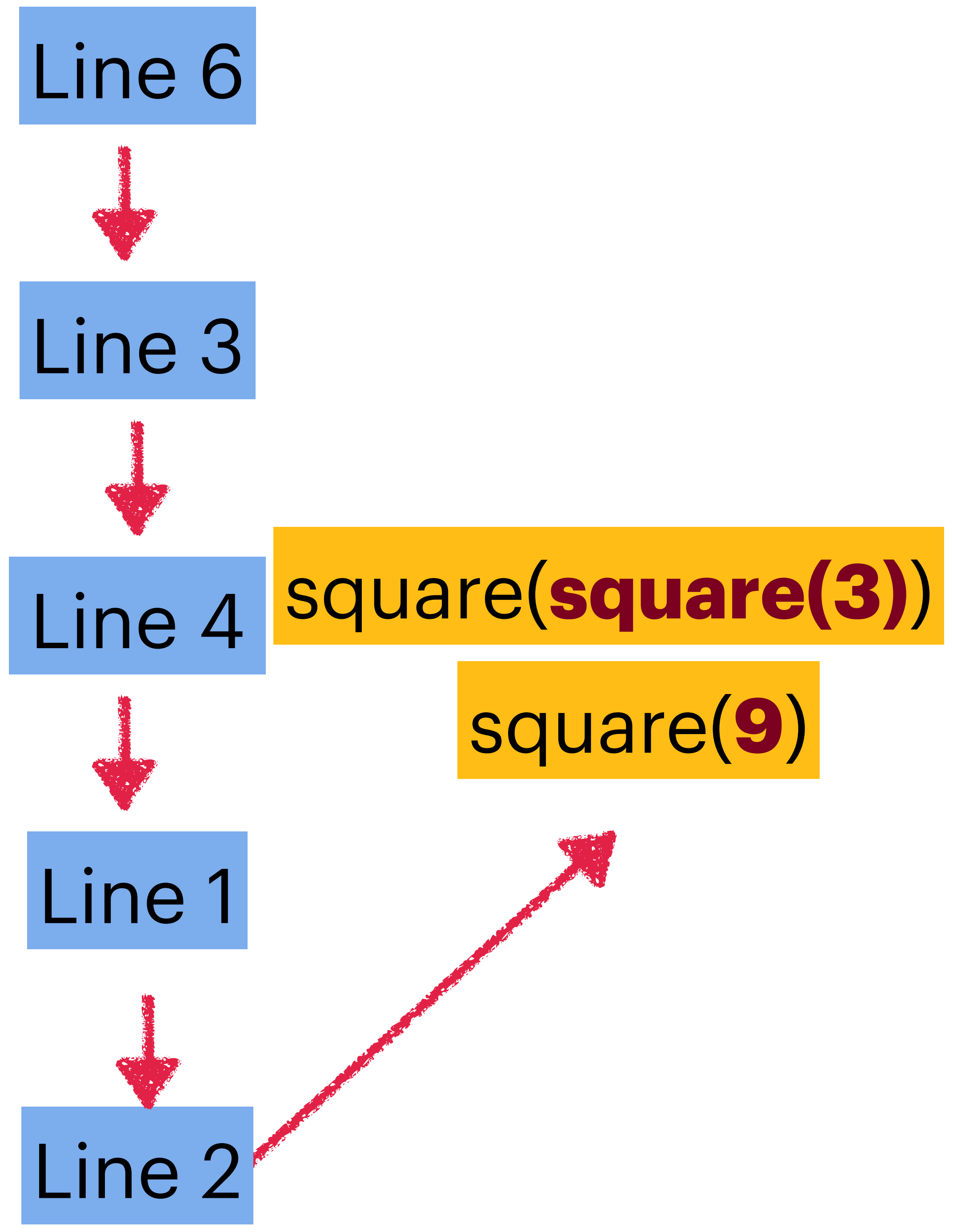

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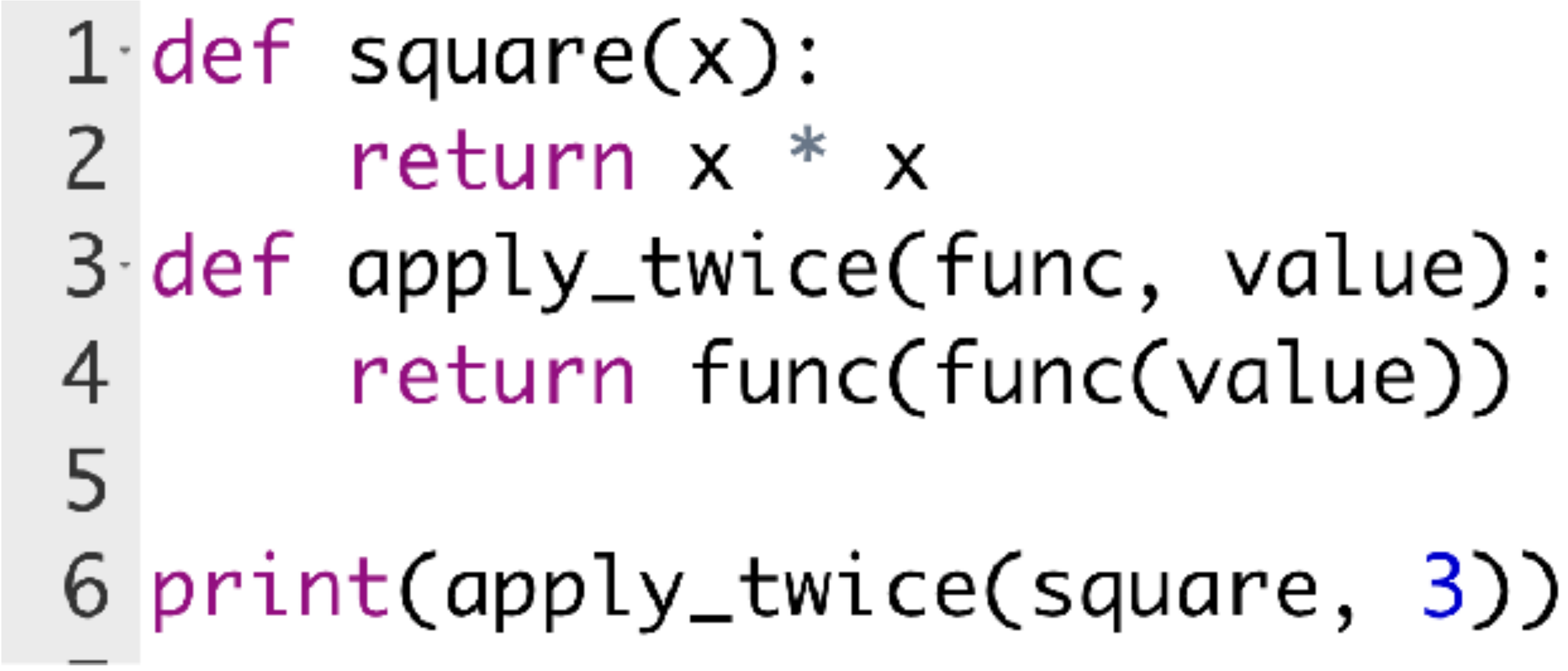

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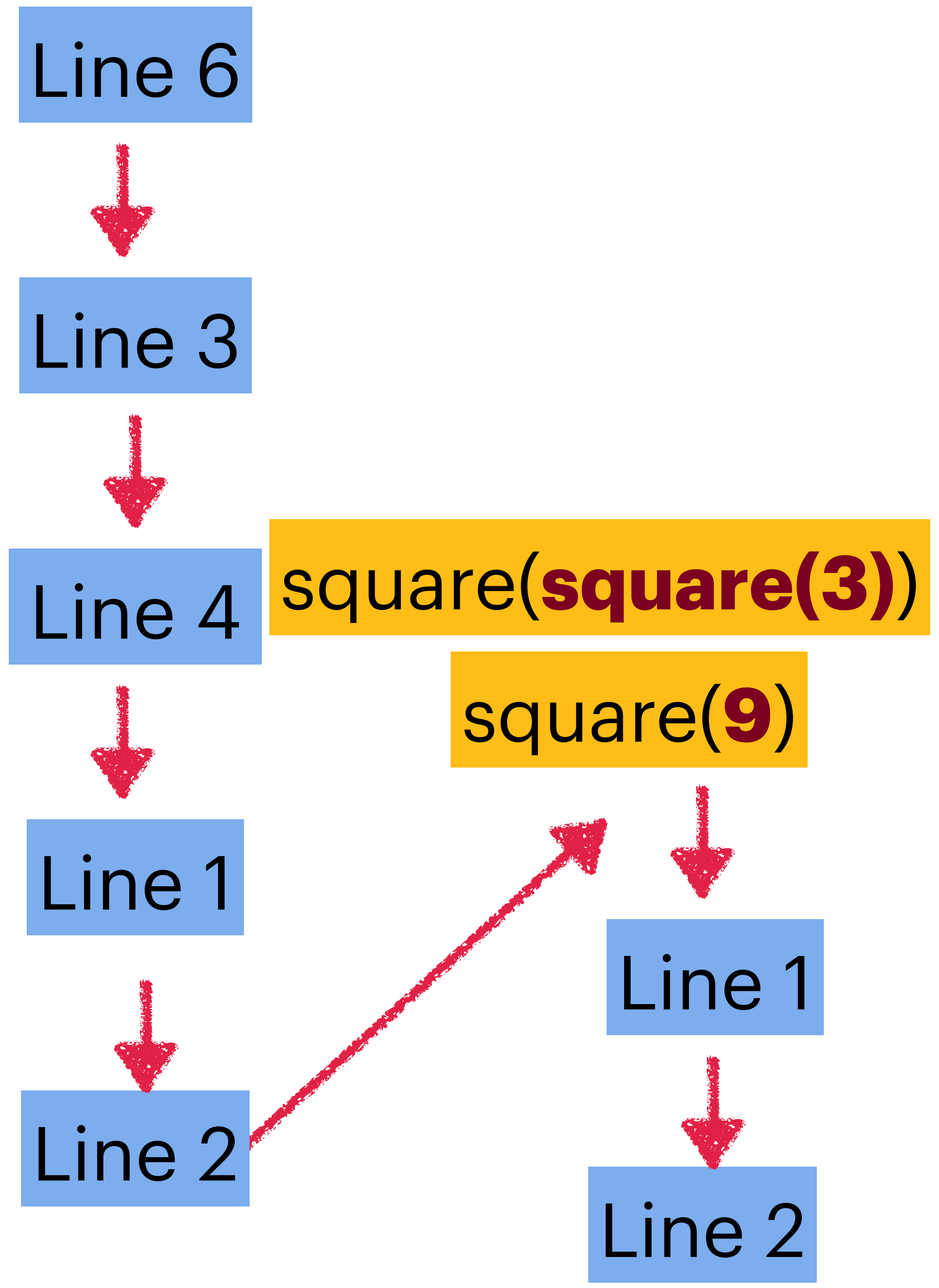

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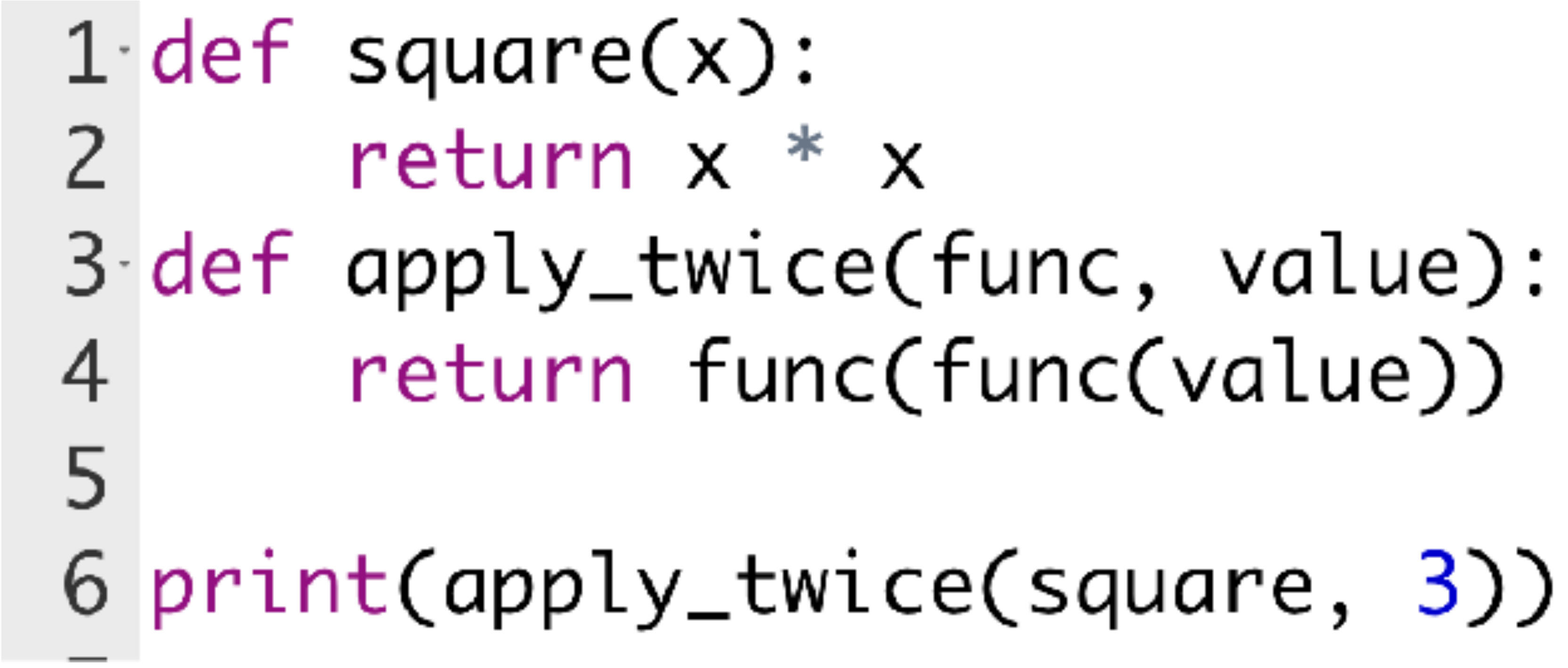

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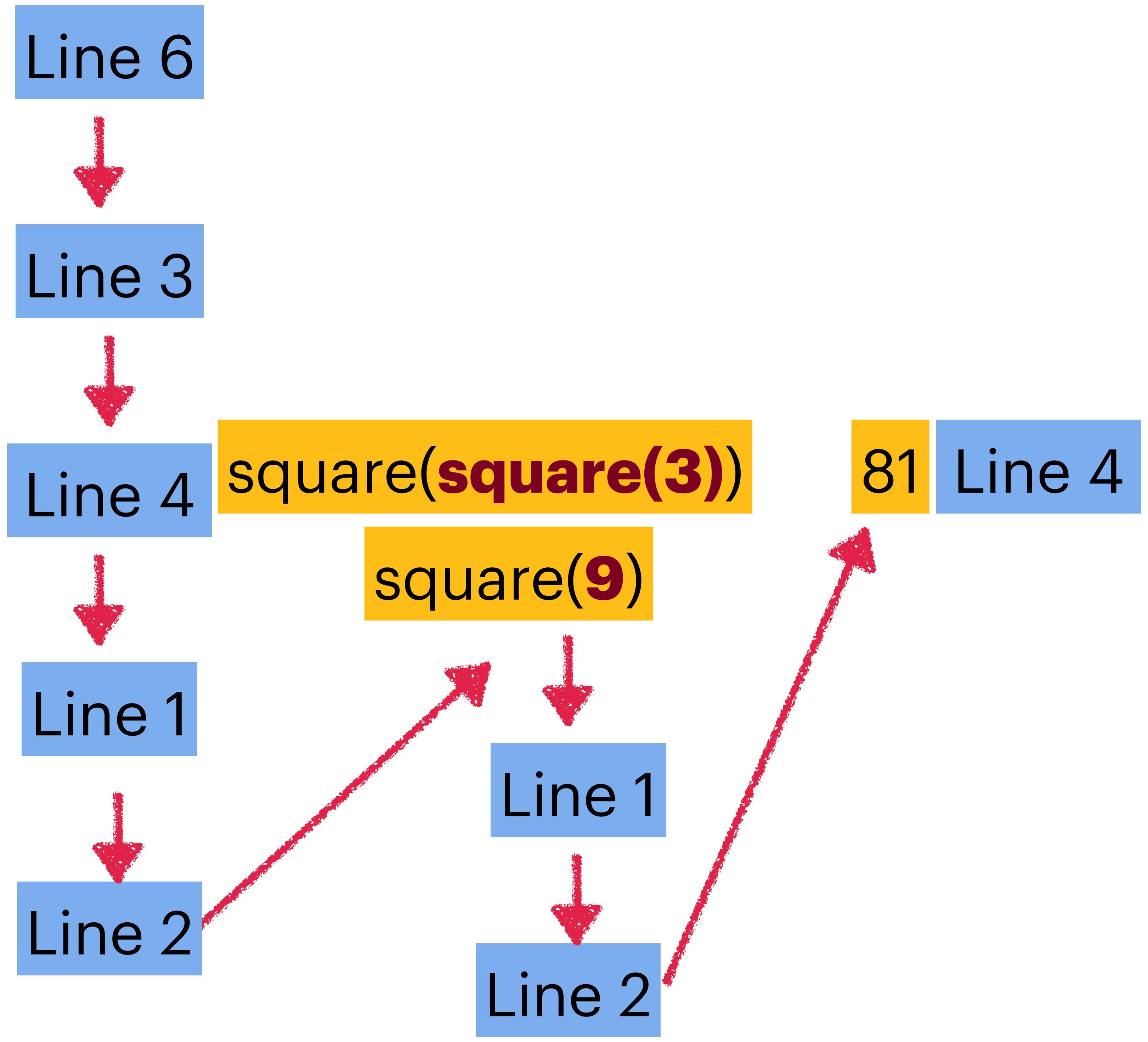

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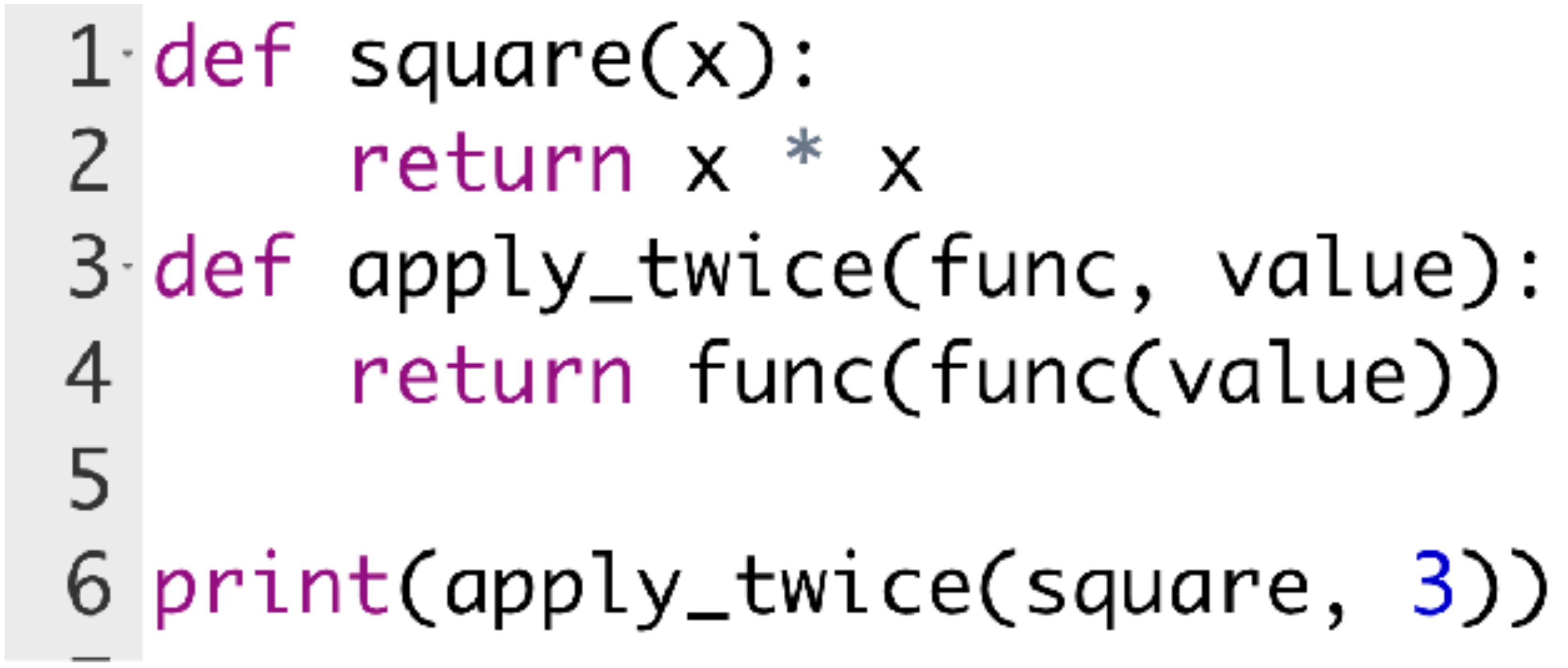

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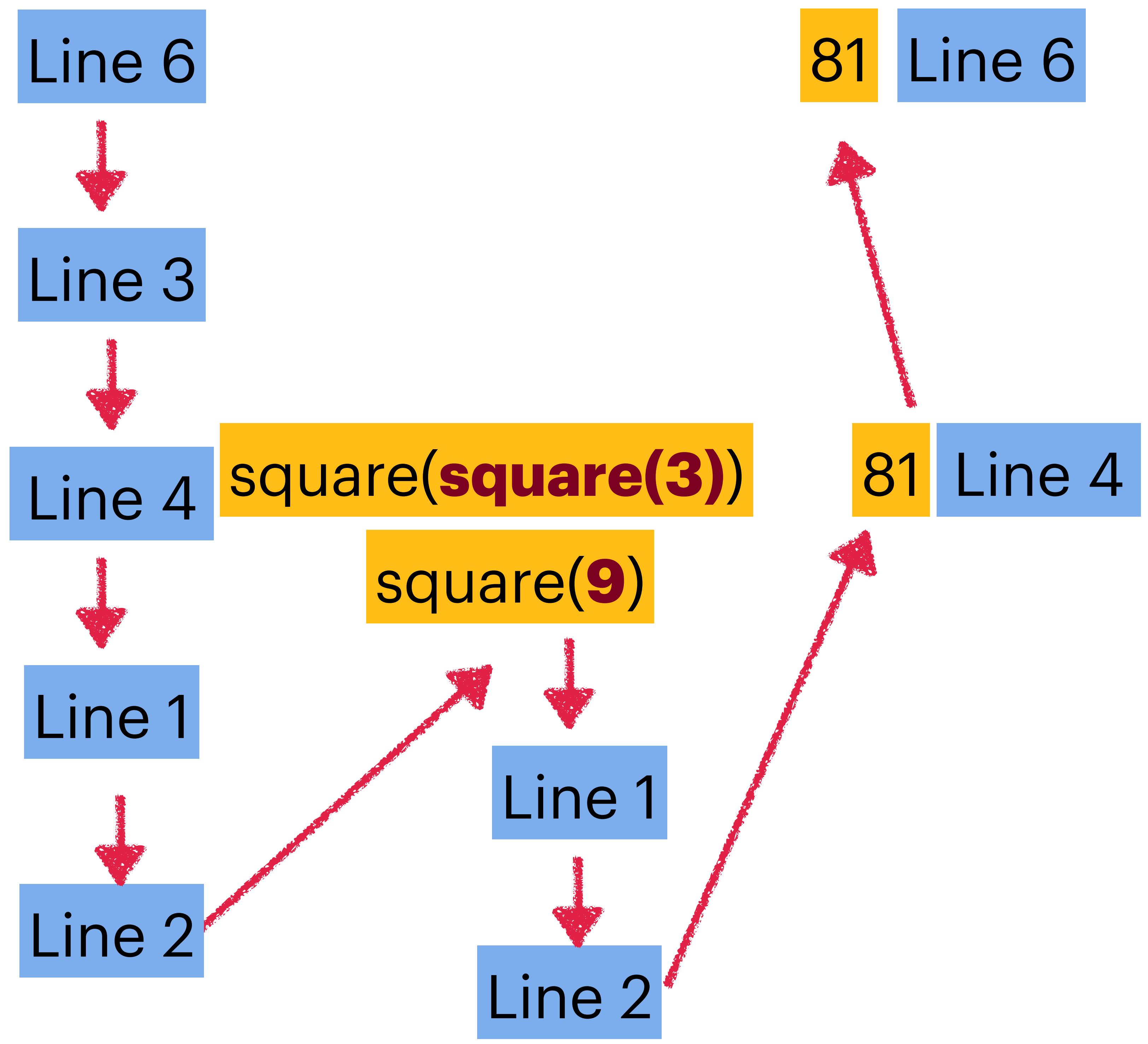

Higher Order Functions

We are using higher order functions since day 1 — print(sum(x)), print(len(x)) —

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Built-in higher order functions!

map(function , iterable)

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nums = [1, 2, 3, 4, 5]
s = map(square, nums)
print(list(s))  # [1, 4, 9, 16, 25]
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For each item of nuts, applies function square. creates an iterator (just like range), which can be converted to list.

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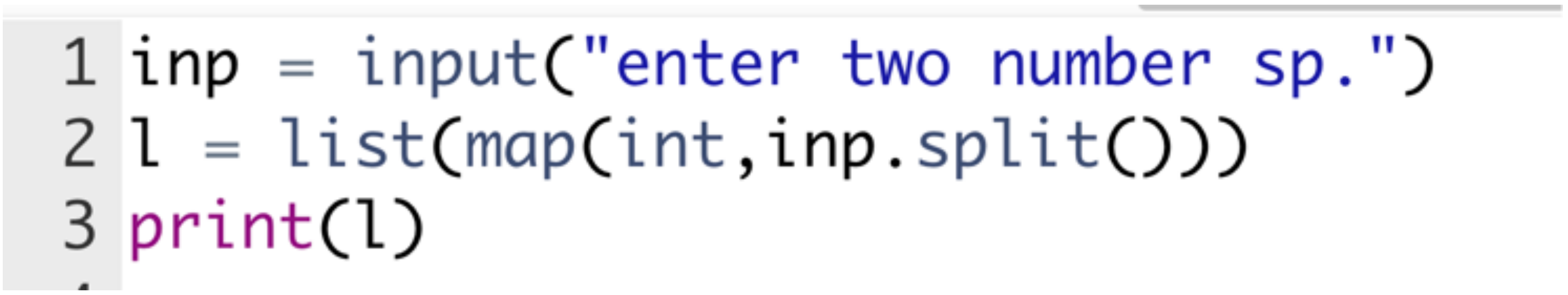
You have been using map in the labs!



```
inp = input("enter two number sp.")
l = list(map(int,inp.split()))
print(l)
```

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Higher Order Functions

filter(function, iterable)

```
def is_even(x):
    return x % 2 == 0

nums = [1, 2, 3, 4, 5, 6]
evens = filter(is_even, nums)
print(list(evens))  # [2, 4, 6]
```

Keeps only the elements where the function (is_even) returns True.

Higher Order Functions

reduce(function, iterable)

```
import functools

def add(a, b):
    return a + b

nums = [1, 2, 3, 4]
print(reduce(add, nums))  # (((1+2)+3)+4) = 10
```

Higher Order Functions

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It reduces a sequence to a single value by repeatedly applying the function.

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Recall to use pi, we had to import math. Similarly, to use reduce, import functools.

It reduces a sequence to a single value by repeatedly applying the function.

Lambda Functions

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f = lambda x: x + 1
print(f(5))    # 6
```

=

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print(list(map(lambda x: x * x, [1, 2, 3, 4])))
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