Functions

- write reusable pieces/chunks of code, called **functions**
- functions are not run in a program until they are "**called**" or "**invoked**" in a program
- function characteristics:
  - has a **name**
  - has **parameters**(0 or more)
  - has a **docstring**(optional but recommended)
  - has a **body**
  - **returns** something

HOW TO WRITE and CALL/INVOKE A FUNCTION

keyword

name

Parameters or arguments

```
def is_even(i):
```

Specification, docstring

```
    """
    Input: i, a positive int
    Returns True if iis even, otherwise False
    """
```

body

```
    print("inside is_even")
    return i%2 == 0
```

later in the code, you call the functionn using its name and values for parameters

```
is_even (3)
```

IN THE FUNCTION BODY

```
def   is_even ( i )

    """
    Input: i, a positive int
    Returns True if i is even, otherwise False
    """

    print("inside is_even")

    return  i%2 == 0
```

run some commands

keyword

expression to evaluate and return

VARIABLE SCOPE

- **formal parameter** gets bound to the value of **actual parameter** when function is called
- new **scope/frame/environment** created when enter a function
- **Scope** is mapping of names to objects

```
Def f ( x ):
    x = x + 1
    print('in f(x): x =', x)
    return x

x = 3
z = f ( x )
```

formal parameter

actual parameter

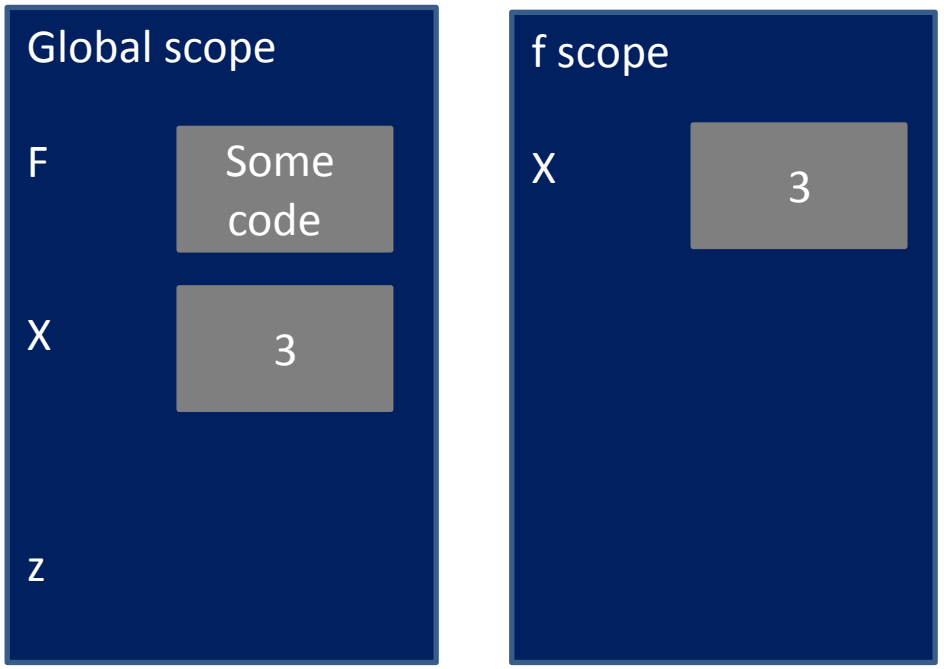
Function definition

Main program code
*initializes a varibale x
*makes a function call f(x)
*assigns return of function to variable z

VARIABLE SCOPE

```
def f ( x ):
        x = x + 1
        print('in f(x): x =', x)
        return x

x = 3
z = f ( x  )
```



VARIABLE SCOPE

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def f ( x ):
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        print('in f(x): x =', x)
        return x

x = 3
z = f ( x  )
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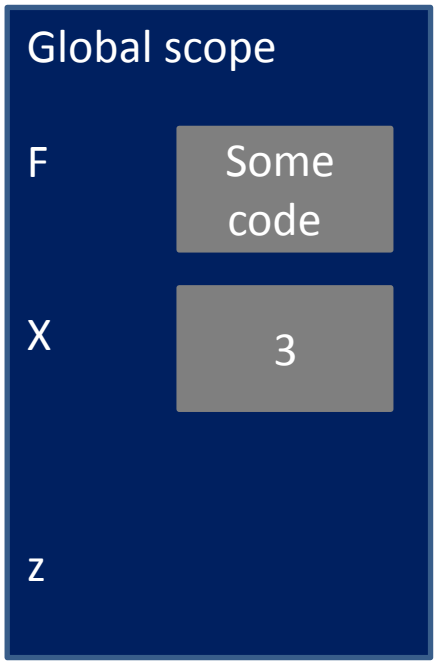

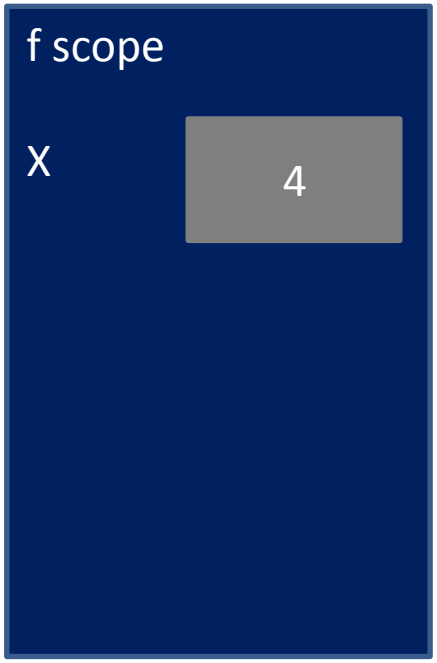

VARIABLE SCOPE

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def f ( x ):
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x = 3
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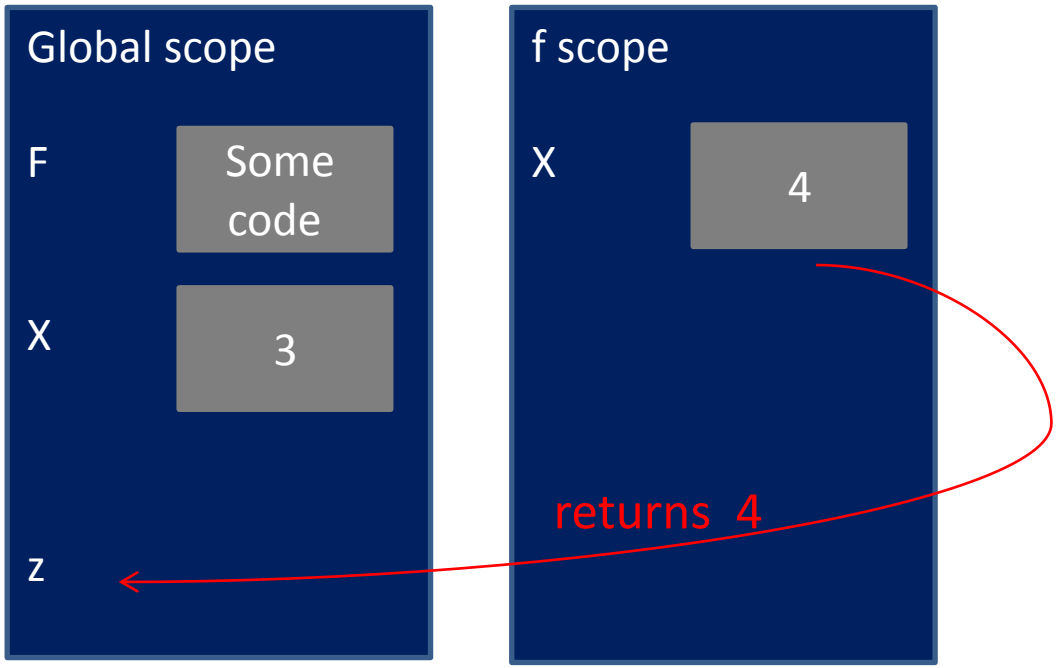

VARIABLE SCOPE

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def f ( x ):
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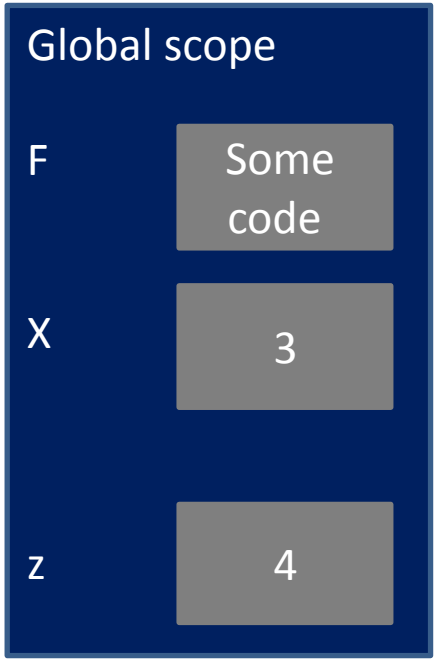


ONE WARNING IF NO return STATEMENT

```
def is_even(  i)
    """
    Input: i, a positive int

    Does not return anything
    """
    i%2 == 0
```

without a return statement

- Python returns the value **None, if no returngiven**
- represents the absence of a value

return vs. Print

- return only has meaning **inside** a function
- only **one** return executed inside a function
- code inside function but after return statement not executed
- has a value associated with it, **given to function caller**

- print can be used **outside** functions
- can execute **many** print statements inside a function
- code inside function can be executed after a print statement
- has a value associated with it, **outputted** to the console

FUNCTIONS AS ARGUMENTS

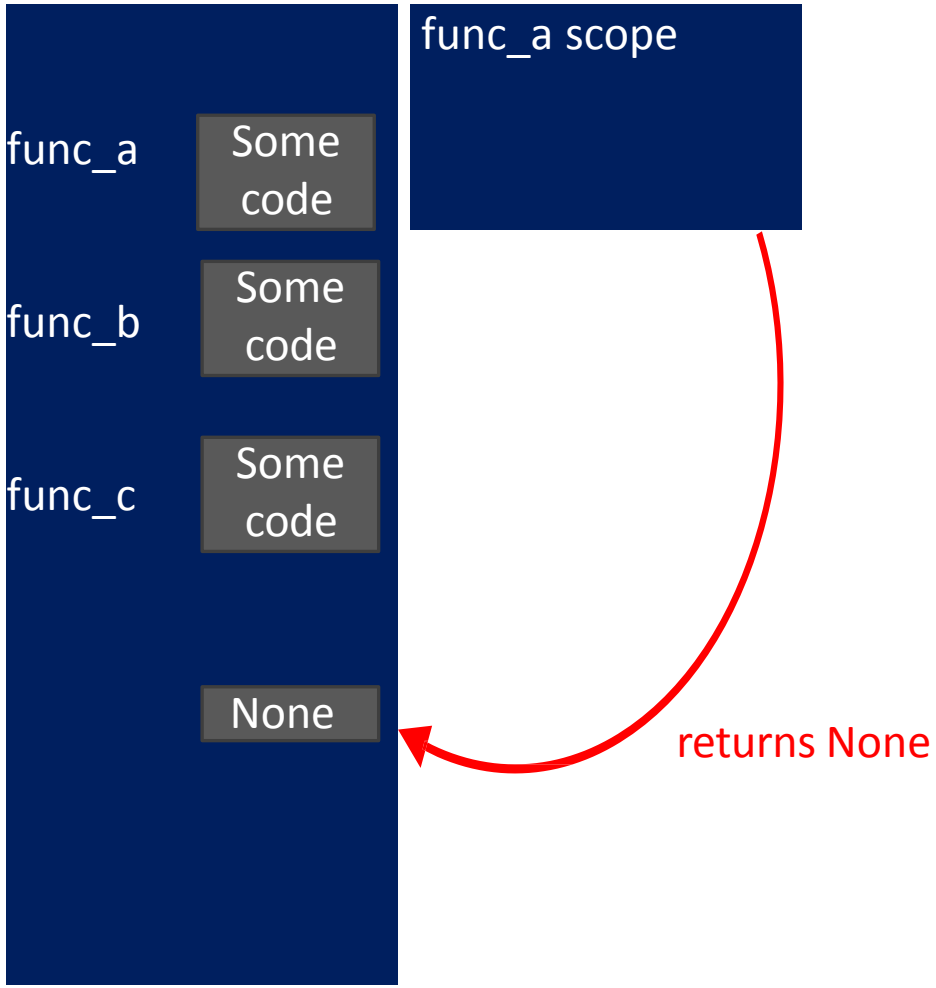
- **arguments can take on any type, even functions**

```
def func_a():
    print 'inside func_a'
def func_b(y):
    print 'inside func_b'
    return y
def func_c (z) :
    print 'inside func_c'
    return z ()
print  func_a()
print  5 + func_b (2)
print  func_c (func_a)
```

call func_a,takes no parameters
call func_b, takes one parameter
Call func_c, takes one parameter, another function

FUNCTIONS AS ARGUMENTS

```
def func_a () :
    print 'inside func_a‘
def func_b (y):
    print 'inside func_b'
    return y
def func_c (z) :
    print 'inside func_c'
    return z()
print func_a()
print 5 + func_b(2)
print func_c(func_a)
```



FUNCTIONS AS ARGUMENTS

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def func_a () :
    print 'inside func_a‘
def func_b (y):
    print 'inside func_b'
    return y
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    print 'inside func_c'
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print func_a()
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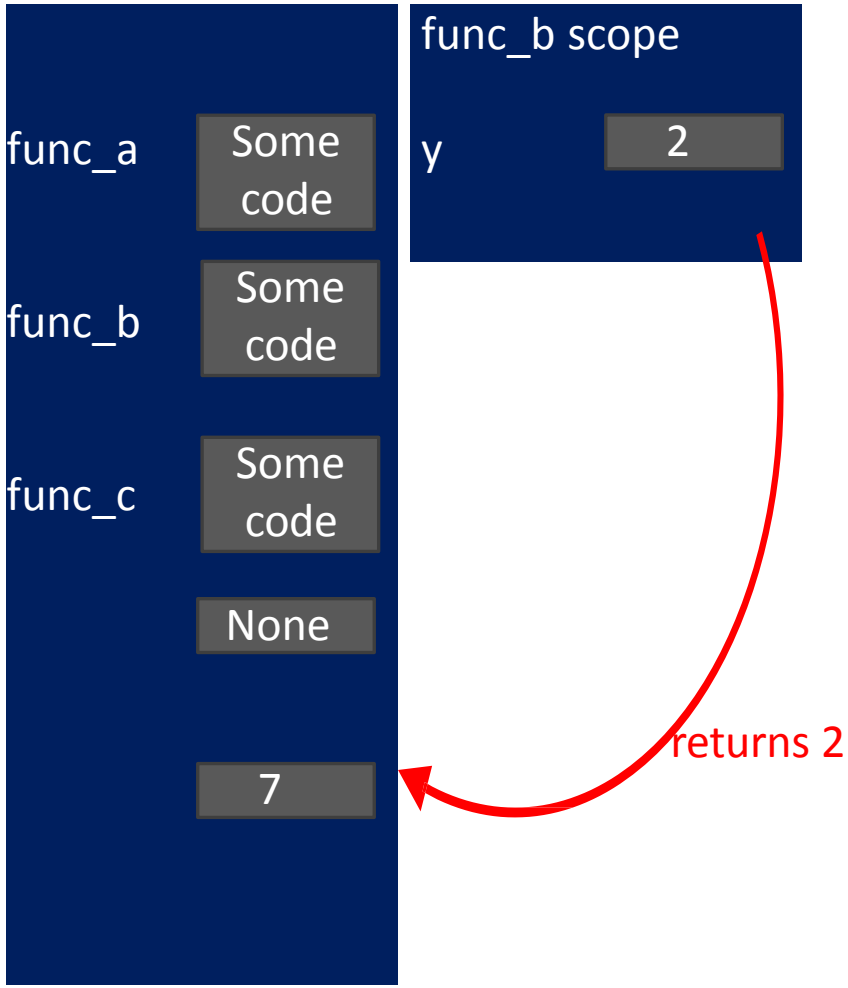
```



FUNCTIONS AS ARGUMENTS

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def func_a () :
    print 'inside func_a‘
def func_b (y):
    print 'inside func_b'
    return y
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    print 'inside func_c'
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print func_a()
print 5 + func_b(2)
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```
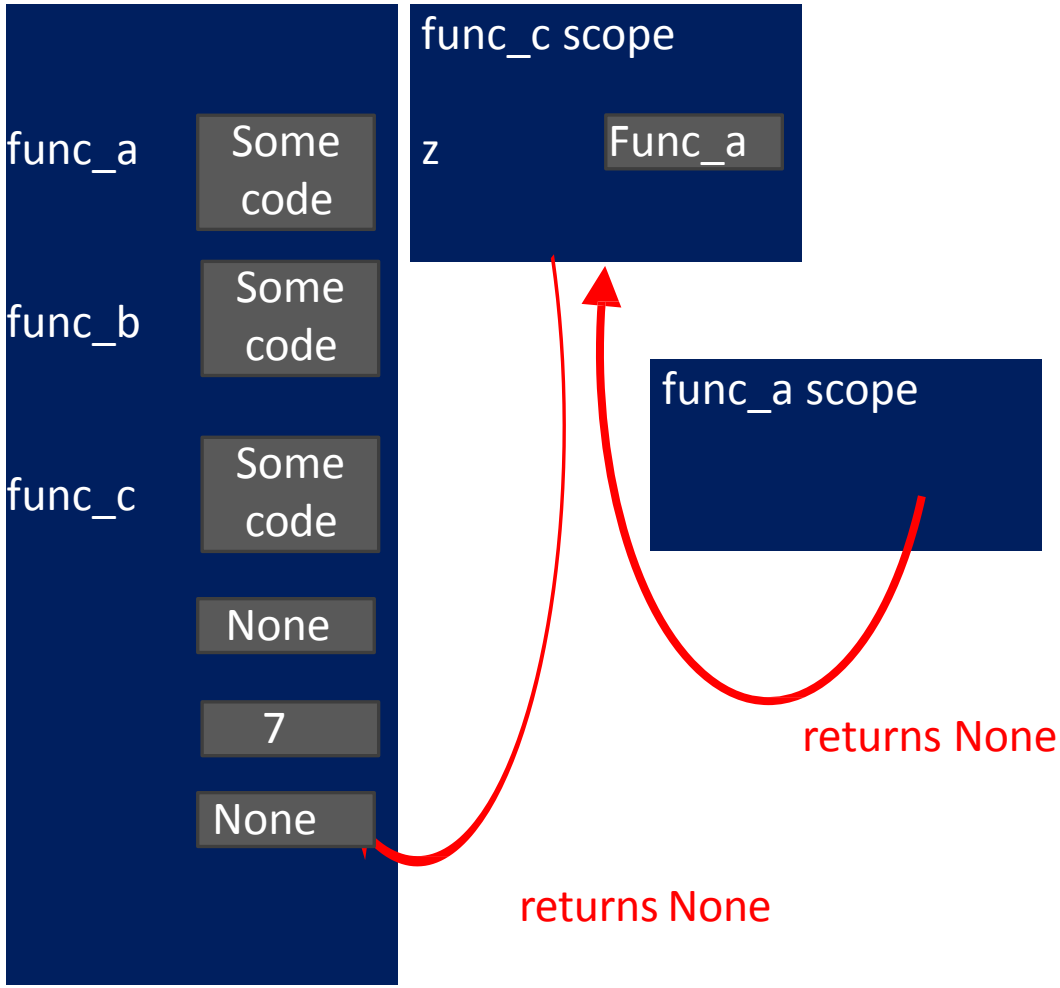



FUNCTIONS EXAMPLES

Create and calling function:

```
def  my_function():
      print("Hello from a function")

my_function()
```

Parameters:

```
def  my_function(fname):
      print("Hello " + fname)

my_function("SystemAdmin")
```

FUNCTIONS EXAMPLES

Default Parameter Value

```
def  my_function(track = "System Admin"):
        print("Track : " + track)
my_function("OS")
my_function()
```

FUNCTIONS EXAMPLES

Passing a List as a Parameter:

```
def  my_function(lis):
        for x in lis:
            print(x)
lis = ["SystemAdmin",  "UI",  "OS",  "Mobile"]
my_function("lis")
def  my_function(var1, *vargs):
        print(var1)
        for x in vargs:
            print(x)
my_function(10)
my_function(70, 60, 50 )
```

SCOPE EXAMPLE

- inside a function, **can access** a variable defined outside
- inside a function, **cannot modify** a variable defined outside --can using **global variables**, but frowned upon

```
def f(y) :
    x  = 1
    x += 1
    print(x)
x = 5
f(x)
print(x)
```

x is re-defined in scope of f

different x objects

```
def g(y):
    print(x)
    print(x + 1)
x = 5
g(x)
print(x)
```

x from outside g

X inside g is picked up from scope that called function g

```
def h (y) :
    x += 1
x = 5
h(x)
print(x)
```

UnboundLocalError: local variable 'x' referenced before assignment

SCOPE EXAMPLE

- inside a function, **can access** a variable defined outside
- inside a function, **cannot modify** a variable defined outside -- can using **global variables**, but frowned upon

```
def f(y):
    x = 1
    x += 1
    print(x)

x = 5
f(x)
print(x)
```

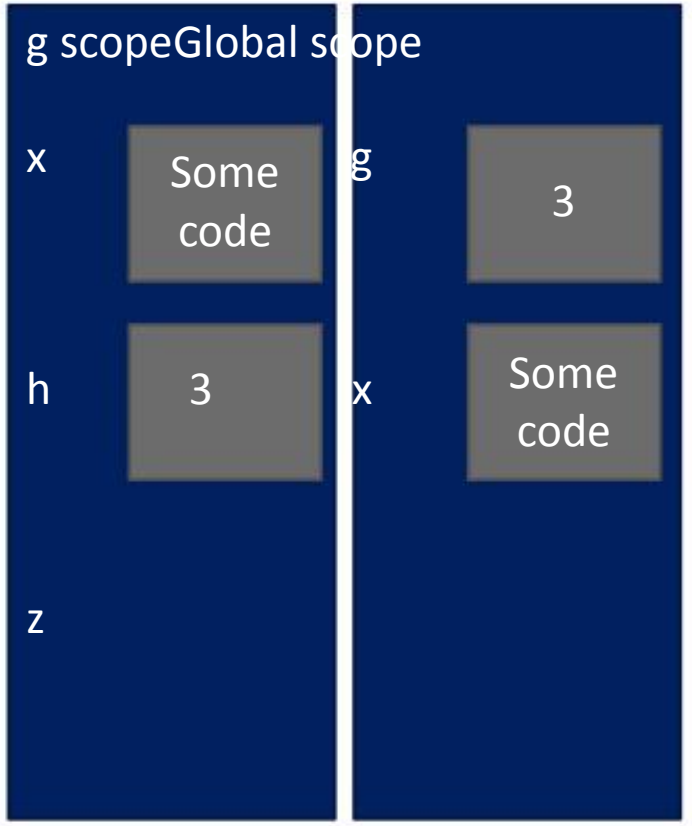
```
def g(y):
    print(x)

x = 5
g(x)
print(x)
```

```
def h(y):
    x += 1

x = 5
h(x)
print(x)
```

x from global/main program scope

SCOPE DETAILS

```
def g(x):
    def h():
        x = 'abc'
    x = x + 1
    print('g: x =', x)
    h()
    return x

x = 3
z = g(x)
```



SCOPE DETAILS

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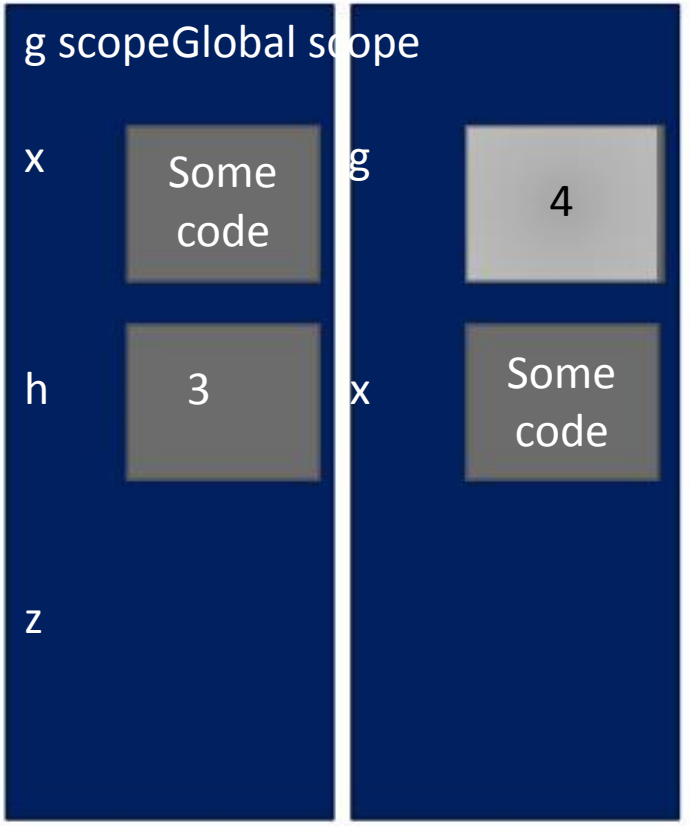

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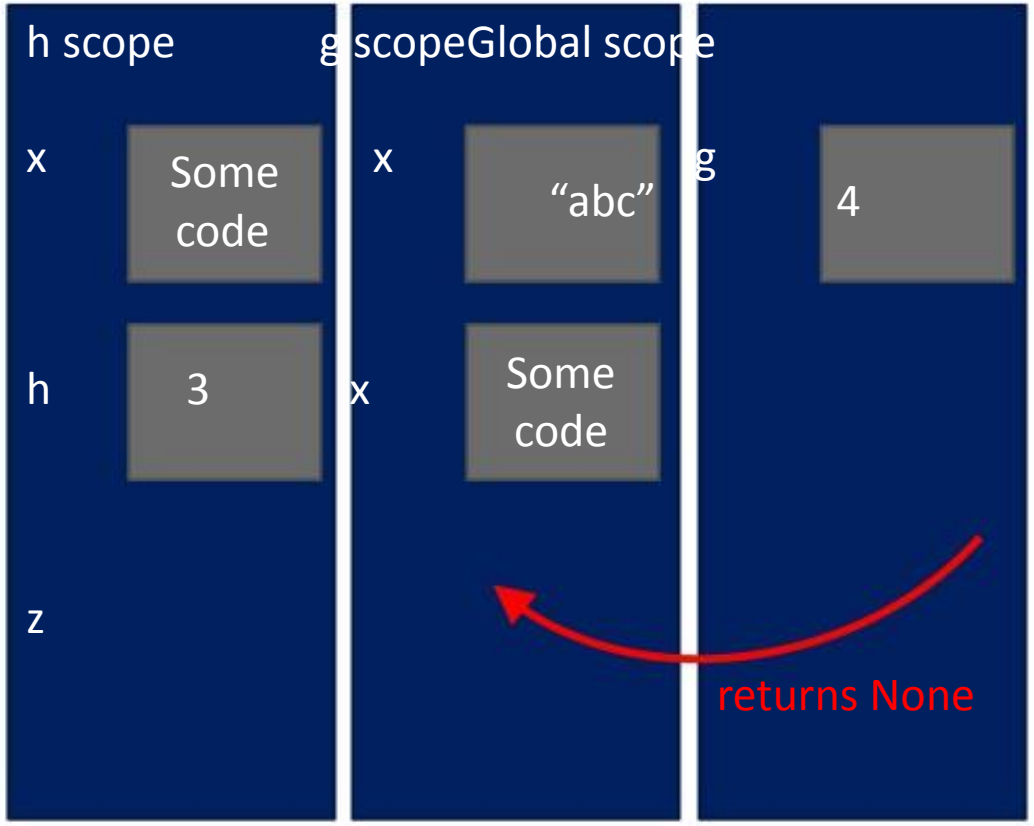

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    x = x + 1
    print('g: x =', x)
    h()
    return x

x = 3
z = g(x)
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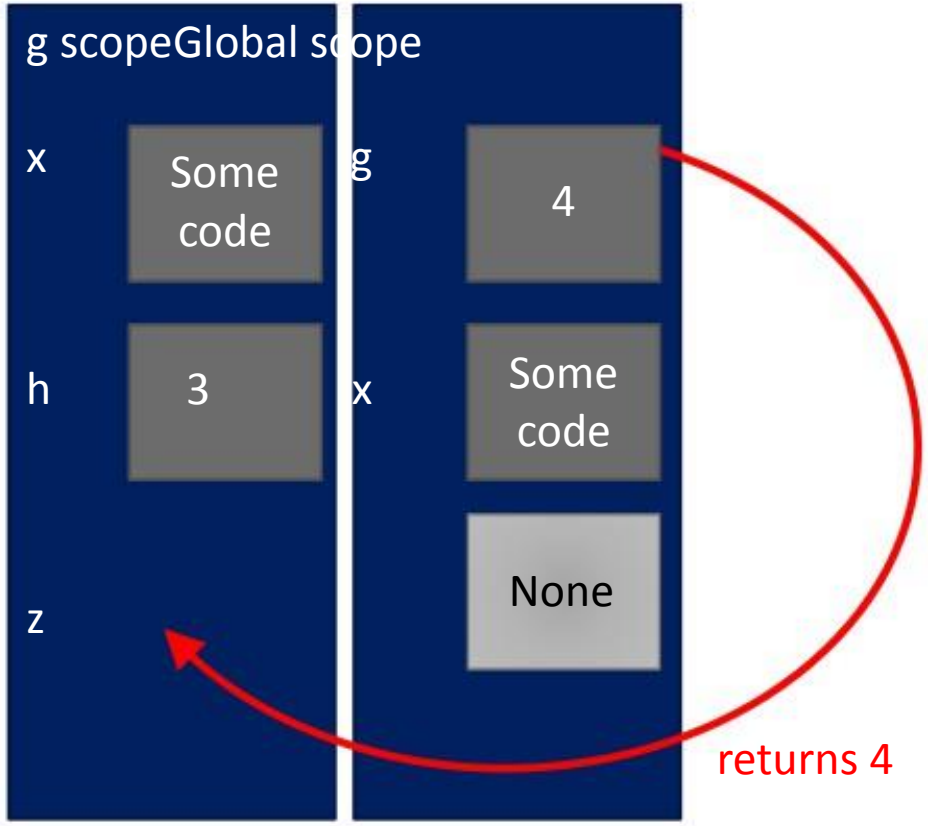

SCOPE DETAILS

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        x = 'abc'
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