Review

- Abstraction

- Expression and evaluation
- Operator and operand
- Value and type
- Name and variable

- Assignment

- Memory model

Computing Bootcamp

Functions

Lecture 2-1

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Defining Our Own Functions

- Python does provide useful built-in functions (e.g., max, min…), but they are not enough

- For example, assume that we want to covert celsius degree to fahrenheit degree
  - convert_to_fahrenheit(10)
  - We want to get 50 (Equation: fahrenheit = celsius * 9/5 + 32)
  - But we get an error when typing it, which means that there is **no function** named "convert_to_fahrenheit"

Defining Our Own Functions

- Let's make our own function "convert_to_fahrenheit"
  - def convert_to_fahrenheit(celsius):
  - return celsius * 9 / 5 + 32

- Function body is indented! Without the indentation, you will see an error
  - **Indentation** must be the same block of codes

- Let's do this again
  - convert_to_fahrenheit(10)
  - And change the argument freely!

Defining Our Own Functions – Exercise

- Define “convert_to_celsius(fahrenheit),” which converts fahrenheit degree to celsius degree

- Can someone screen-capture and share on the chat?

Defining Our Own Functions – Generalization

- def <<function_name>> (<<parameters>>):
- <<function_body>>

function header

- Parameters are variables

- Most functions have a return statement at the end of the function body
  - return <<expression>>
  - It evaluates the expression, produces a value, which is the result of the function call

Local Variables

- Implement “convert_to_fahrenheit” in a different way
  - def convert_to_fahrenheit(celsius):
  -   a = 9 / 5
  -   b = 32
  -   return celsius * a + b

- **Local variables**: Variables created within a function
  - Parameters are also local variables
  - There are erased when the function returns (**cannot** be used outside of the function)

Namespace

- When Python executes a function call, it creates a **namespace** in which to store **local variables** for that call

- If a variable name in the namespace is same as a variable in another namespace, Python just considers **the current namespace**!

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Memory Models for Function Calls

Lecture 2-2

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So… what happens when you call a function?

Execute a Function Call

- max(3+8, 5)
  - Step 1: Evaluate the **arguments** left to right.
  - Step 2: Create a **namespace** to hold the function call's **local variables**, including the parameters.
  - Step 3: Pass the resulting **argument values** into the function by assigning them to the **parameters**
  - Step 4: Execute the **function body**. When a **return** statement is executed, the function terminates and the value of the expression in the return statement is used as the value of the function call

Memory Model for Function Call

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

x = 5
x = doubling(x+5)
```

frames

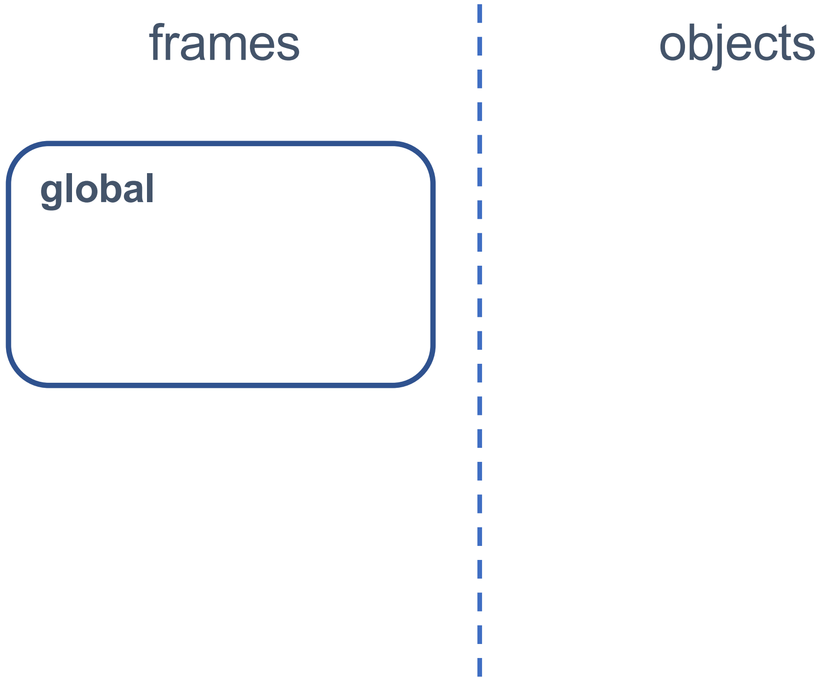
Frames for namspaces

objects

Memory objects

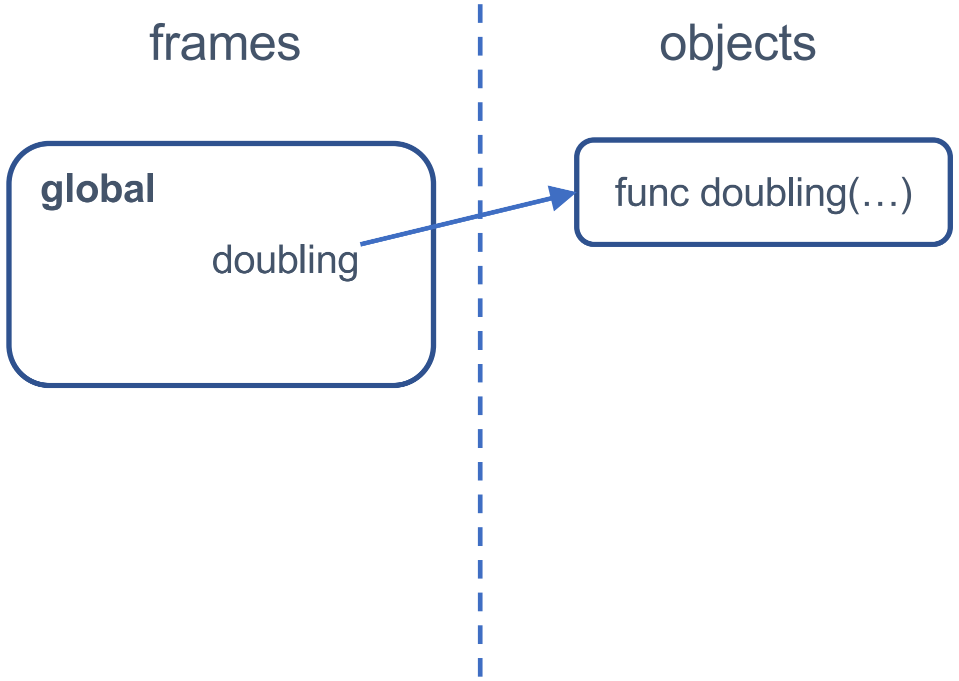
Memory Model for Function Call

- def doubling(x):
-     return 2*x
-
- x = 5
- x = doubling(x+5)



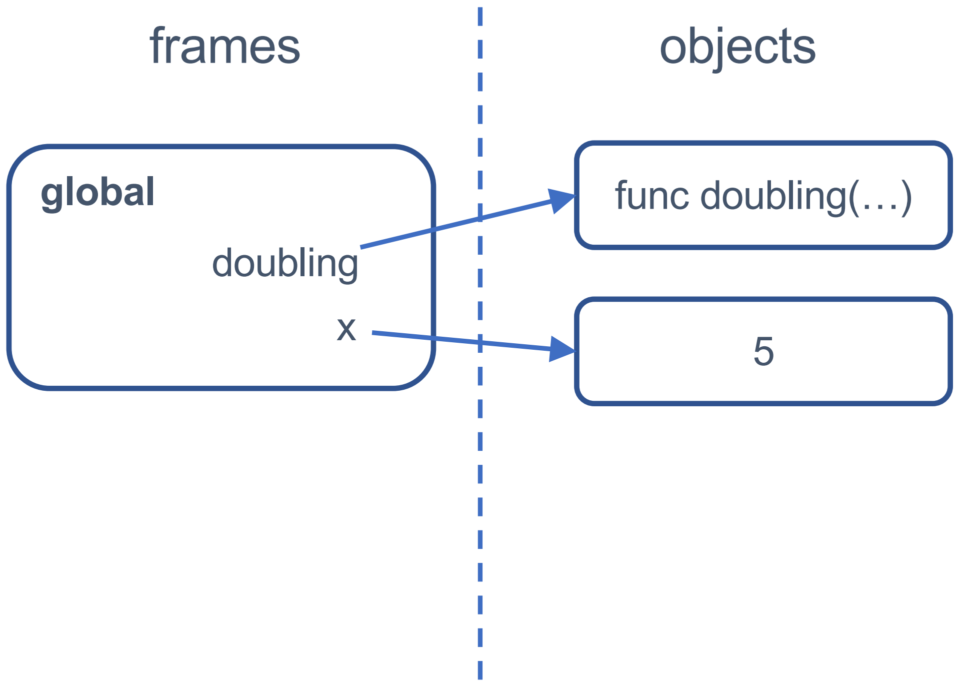
Memory Model for Function Call

- **def doubling(x):**
- **return 2*x**
-
- x = 5
- x = doubling(x+5)



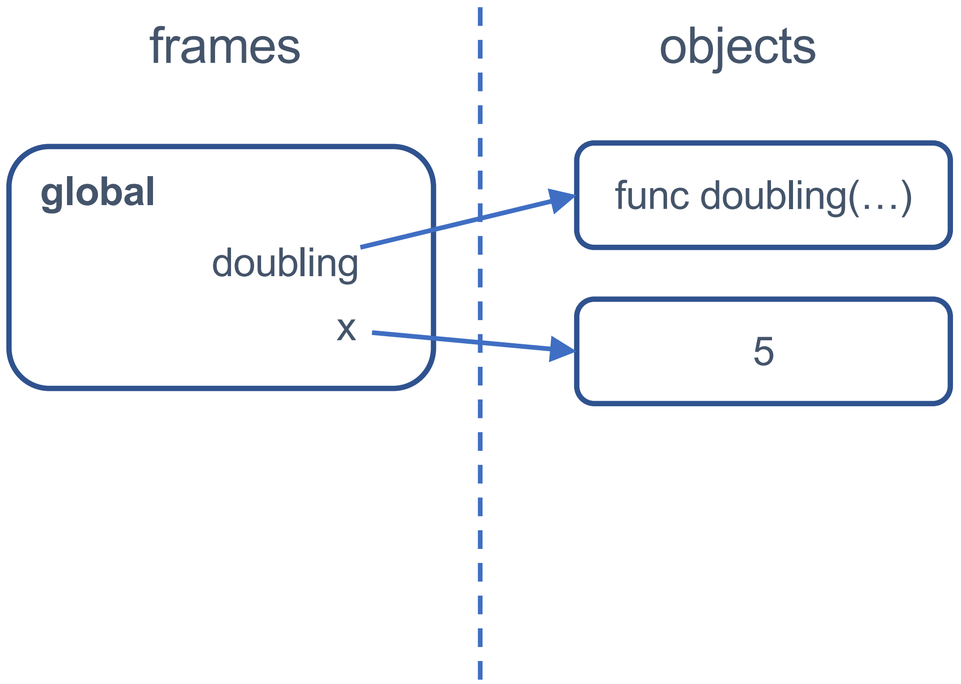
Memory Model for Function Call

- def doubling(x):
- return 2*x
-
- **x = 5**
- x = doubling(x+5)



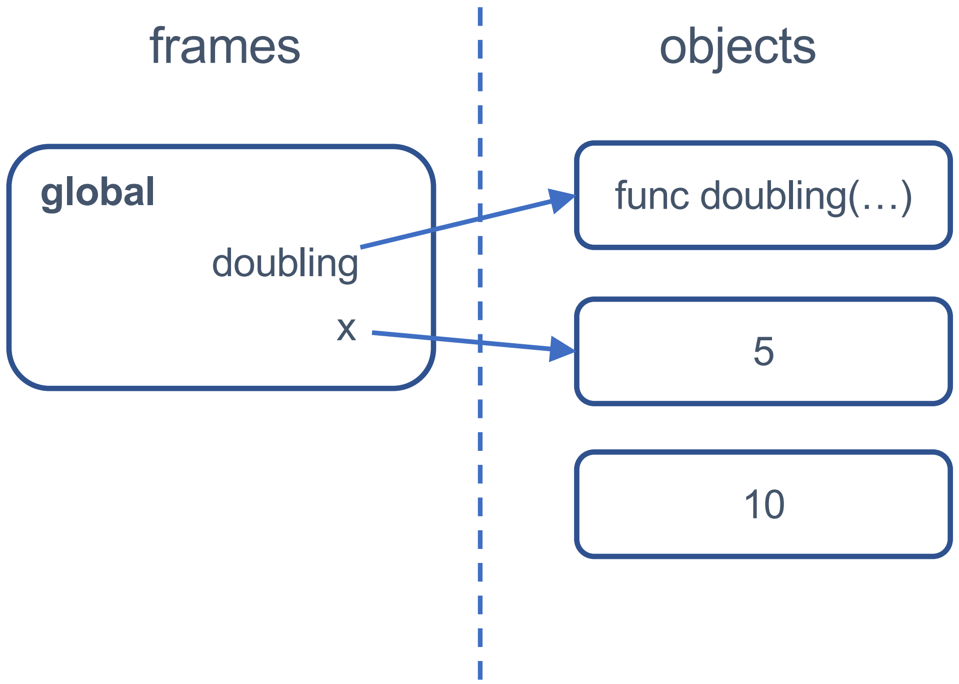
Memory Model for Function Call

- def doubling(x):
-     return 2*x
-
- x = 5
- x = doubling(x+5)



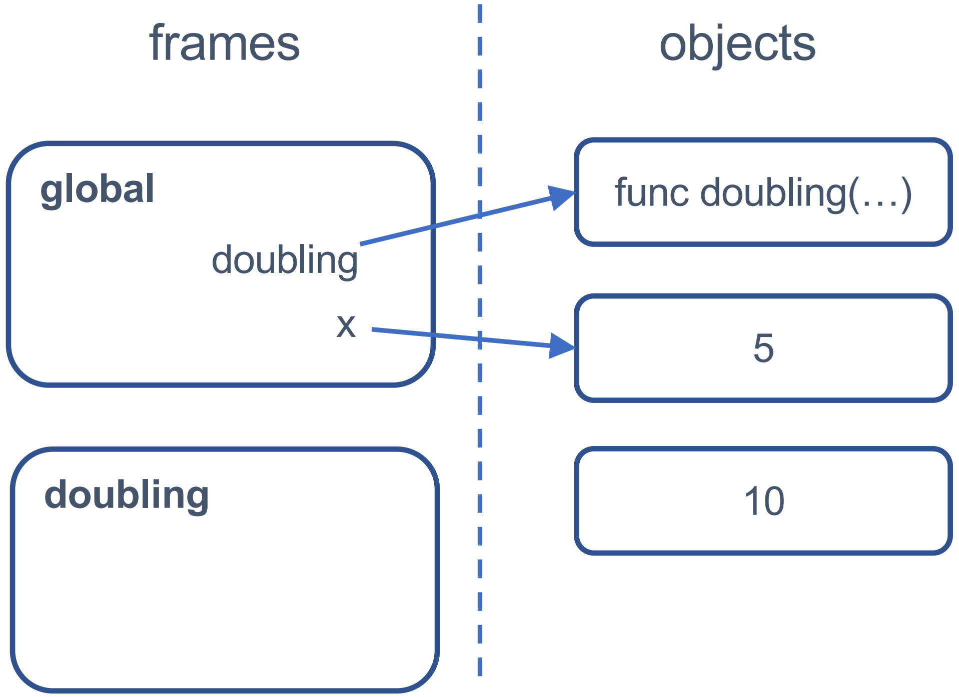
Memory Model for Function Call

- def doubling(x):
-     return 2*x
-
- x = 5
- x = doubling(**x+5**)
  - Evaluate argument and get a value (10)
    - Using x in the global namespace



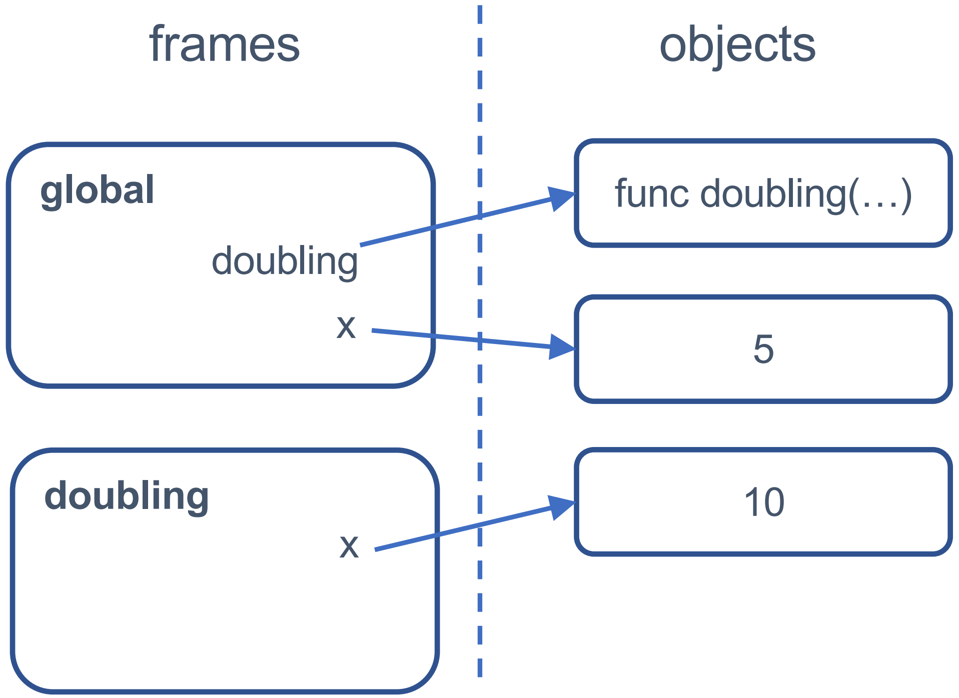
Memory Model for Function Call

- def doubling(x):
-     return 2*x
-
- x = 5
- x = **doubling**(x+5)
    - Evaluate argument and get a value (10)
        - Using x in the global namespace
    - Creating a namespace



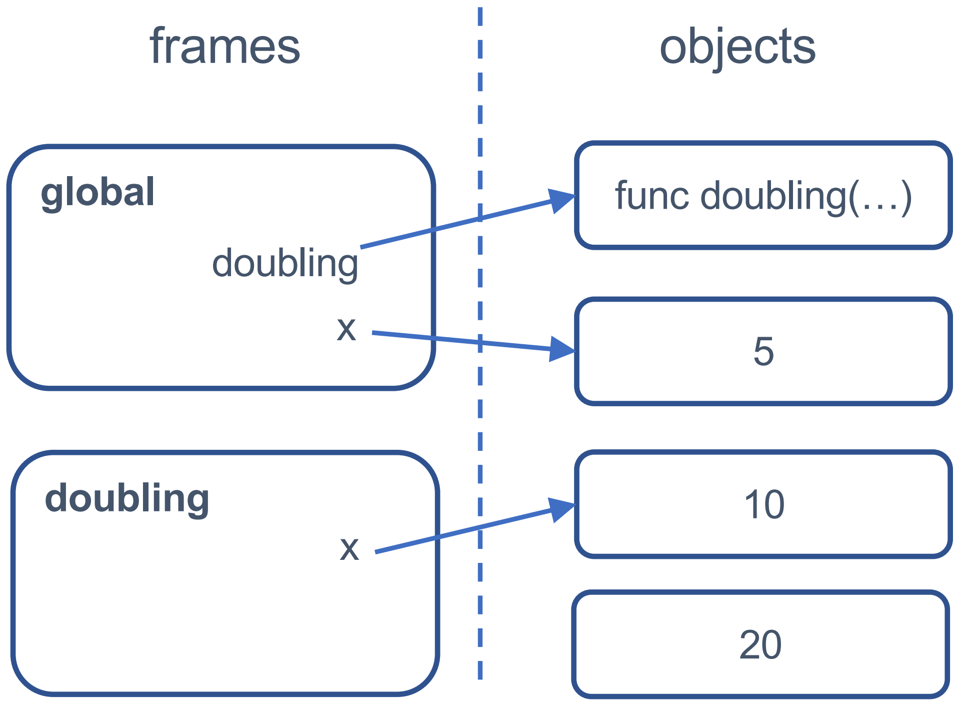
Memory Model for Function Call

- def doubling(x):
-     return 2*x
-
- x = 5
- x = doubling(x+5)
  - Evaluate argument and get a value (10)
    - Using x in the global namespace
  - Creating a namespace
  - Assign the argument value to the function parameter



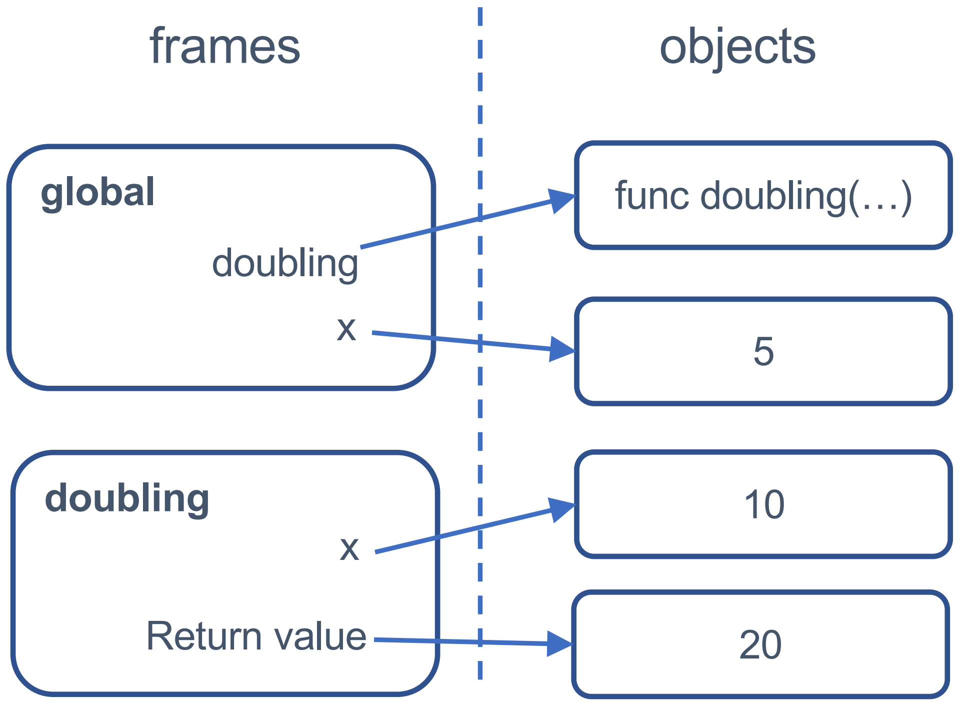
Memory Model for Function Call

- def doubling(x):
-     return **2*x**
-
- x = 5
- x = doubling(x+5)
  - Evaluate argument and get a value (10)
    - Using x in the global namespace
  - Creating a namespace
  - Assign the argument value to the function parameter
  - Get the return value of the function



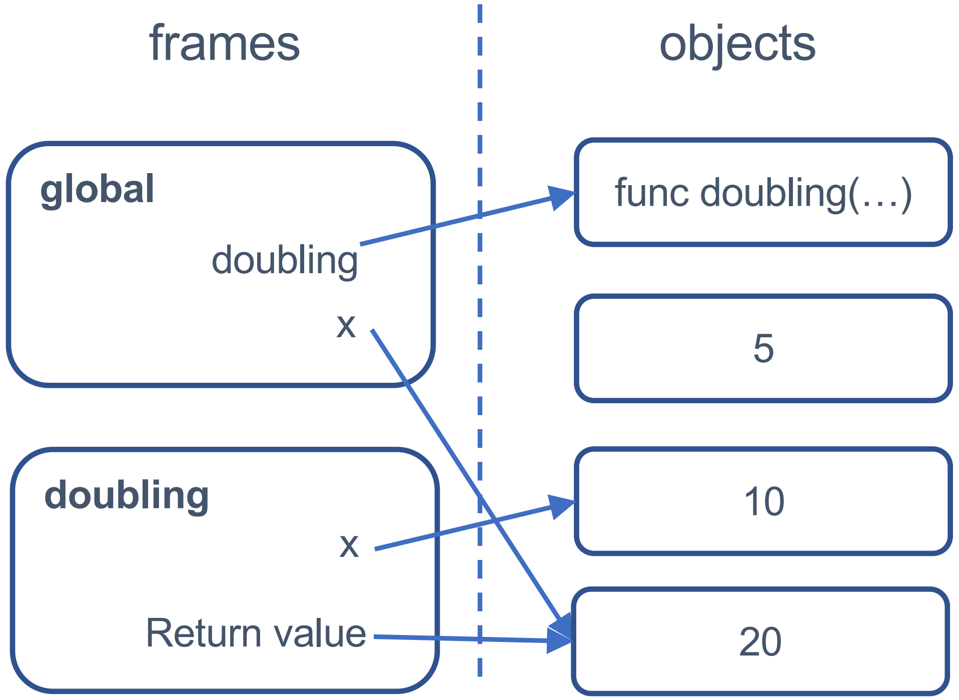
Memory Model for Function Call

- def doubling(x):
-     **return** 2*x
-
- x = 5
- x = doubling(x+5)
  - Evaluate argument and get a value (10)
    - Using x in the global namespace
  - Creating a namespace
  - Assign the argument value to the function parameter
  - Get the return value of the function



Memory Model for Function Call

- def doubling(x):
-     return 2*x
-
- x = 5
- **x =** doubling(x+5)
  - Evaluate argument and get a value (10)
    - Using x in the global namespace
  - Creating a namespace
  - Assign the argument value to the function parameter
  - Get the return value of the function
  - Terminate the function and assign the result to x



전혀
어렵지 않아요
어때요 ? 참 쉽죠 ?

Computing Bootcamp

Function Design

Lecture 2-3

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To write your own functions…

Guidelines for Designing New Functions

- Recall what coding is…
  - Coding is writing an algorithm using programming language
  - Meaning that you must have an algorithm (a plan) in advance!

- Writing a good essay/paper requires planning
  - Topic, background material, outline, body

- Writing a good function does need a plan!

Guidelines for Designing New Functions

- Whenever writing a new function, you need to answer the following questions
  - **Name:** What do you name the function?
  - **Param:** What are the parameters, and what types of information do they refer to?
  - **Body:** What calculations are you doing with that information?
  - **Return:** What information does the function return?
  - **Test:** Does it work like you expect it to?

Example of Function Design

- We want to write a function for calculating difference between two days

- Step 1: Determine function name according to what it does
  - days_difference
- Step 2: Determine parameters and return value
  - Parameters: day1 (int), day2 (int)
  - Return value: difference between the two days
- Step 3: Make some test cases (your expectation)
  - days_difference(200, 224) $\Rightarrow$ 24
  - days_difference(27, 27) $\Rightarrow$ 0
  - days_difference(18, 30) $\Rightarrow$ 12

Example of Function Design

- Step 4: Write the function header
  - def days_difference(day1: int, day2: int) -> int:
- Step 5: Write a short description
  - # Return the number of days between day1 and day2, which are both in the range 1-365 (thus indicating the day of the year)
  - This is a very important step, both for you and your co-workers!
- Step 6: Write the function body
  - return day2 – day1
- Step 7: Test
  - Confirm if your function works well for the test cases you made

Summary

- Function structure (header and body)
- Namespace and local variable
- What happens when you call a function
- Guidelines for writing a new function

Thanks!