Python Basic Course

Part II

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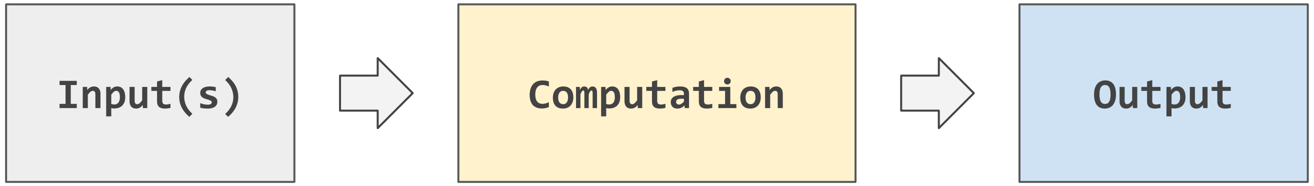
Outline

- Part I: introduction and basics
  - What is Python
  - Tools and “hello world”
  - Basic syntax and data types
    - assignments, types and operators
    - conditional blocks and loops
- Part II: architecture
  - Functions
  - Scope
  - Built-ins
  - Modules
- Part IV: manipulating data
  - List operations
  - String operations
  - Reading and writing files
  - Dealing with wrong data
- Part VI: Pandas
  - Series and Dataframes
  - Common operations
  - How to read documentation

Functions

→ *What are functions*

- Functions are computational units which, given an input, produce an output



Functions

→ *What are functions*

- Functions are defined in Python with:
    - the *def* keyword:
    - a list of (optional) arguments
    - an indented block
    - the (optional) *return* keyword

```
def square(number):
    result = number*number
    return result
```

Functions

→ *Examples*

- A function with multiple arguments:

```
def rescale_number(number,factor):
    result = number / factor
    return result
```

```
print(rescale_number(5,10))
0.5
```

Functions

→ *Examples*

- A function with multiple return values:

```python
def string_to_chars(string):
    chars = []
    for char in string:
        chars.append(char)
    return chars
```

```
print(string_to_chars('hello'))
['h', 'e', 'l', 'l', 'o']
```

Functions

→ Examples

- A function with multiple return values:

```
def count_chars(string):
    chars_count = {}
    for char in string:
        if char not in chars_count:
            chars_count[char] = 1
        else:
            chars_count[char] += 1
    return chars_count
```

```
print(count_chars('hello'))
{'h': 1, 'e': 1, 'l': 2, 'o': 1}
```

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    for number in number_list:
        number = number/factor
    return number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
...?
```

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    for number in number_list:
        number = number/factor
    return number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
[1,2,3]
```

WRONG

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    for i in range(len(number_list)):
        number_list[i] = number_list[i]/factor
    return number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
...?
```

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    for i in range(len(number_list)):
        number_list[i] = number_list[i]/factor
    return number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
[0.1, 0.2, 0.3]   OK
print(my_list)
...?
```

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    for i in range(len(number_list)):
        number_list[i] = number_list[i]/factor
    return number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
[0.1, 0.2, 0.3]  OK
print(my_list)
[0.1, 0.2, 0.3]  WRONG
```

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    rescaled_number_list = []
    for number in number_list:
        rescaled_number_list.append(number/factor)
    return rescaled_number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
...?
```

Functions

→ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    rescaled_number_list = []
    for number in number_list:
        rescaled_number_list.append(number/factor)
    return rescaled_number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
[0.1, 0.2, 0.3]
```
OK

Functions

➔ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    rescaled_number_list = []
    for number in number_list:
        rescaled_number_list.append(number/factor)
    return rescaled_number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
[0.1, 0.2, 0.3]   OK
print(my_list)
...?
```

Functions

➔ *Examples*

- Level up: a function which modifies something

```
def rescale_numbers(number_list, factor):
    rescaled_number_list = []
    for number in number_list:
        rescaled_number_list.append(number/factor)
    return rescaled_number_list
```

```
my_list = [1,2,3]
print(rescale_numbers(my_list, 10))
[0.1, 0.2, 0.3]   OK
print(my_list)
[1, 2, 3]    OK
```

Functions

➜ *Arguments by value or by reference*

- In most programming languages, arguments in functions can be passed by:
    - *value*, where values are “copied” inside the functions
    - *reference*, where only a reference is passed to the function

→ If I change an argument passed by value inside a function, I do not change it outside

→ If I instead change an argument passed by reference inside a function, I am actually changing the original and therefore it changes even outside the function

Functions

→ *Arguments by value or by reference*

- In Python, immutable types are passed by value, all the others by reference.
- In short, this means that:
  - integers, strings, tuples etc., which are immutable types, are passed by value and can be freely manipulated inside the functions
  - lists, dictionaries, sets etc., which are mutable types, are passed by reference and should *never* be changed inside the functions

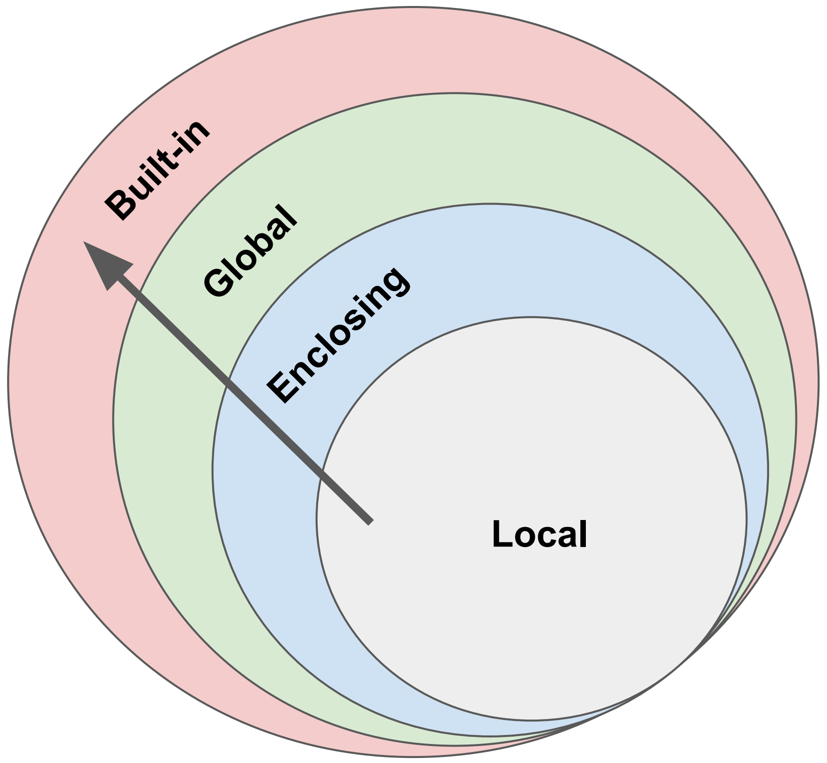
The scope

➔ *The LEGB rule*

- The scope is how variables, functions and in general “names” are resolved.
- The rule is the so called “LEGB”:
  - Local if defined “where you are”, as for example inside a function or code block.
  - Enclosing if defined in the upper levels with respect to “where you are”.
  - Global if defined globally (not covered here)
  - Built-in if defined inside Python itself

The scope

→ *The LEGB rule*



The scope

→ *And the functions*

- Explanatory, tricky example:

```
def sum_arg(arg):
    arg += arg
    return arg
```

```
arg = 1
print(sum_arg(arg))
2
print(arg)
1
```

The scope

→ *And the functions*

- Explanatory, tricky example:

```
def sum_arg(arg):
    arg += arg
    return arg
```

```
arg = [1]
print(sum_arg(arg))
[1,1]
print(arg)
[1,1]
```

The scope

→ *How to write good functions*

- Always operate on local variables only:

```
number = 5

def square():
    result = number*number
    return result
```

NO

```
def square(number):
    result = number*number
    return result
```

YES!

The scope

→ *How to write good functions*

- Always return the result:

```python
result = None

def square(number, result):
    result = number*number
```

NO

```python
def square(number):
    result = number*number
    return result
```

YES!

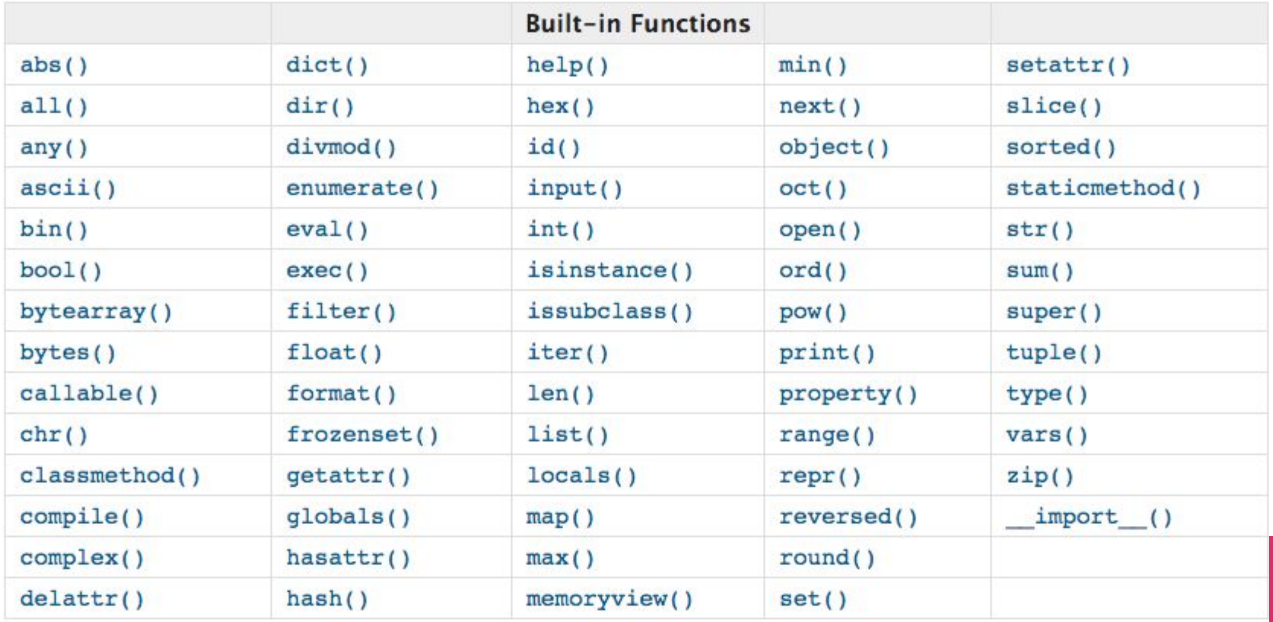
The built-ins

➜ *What are the built-ins*

- The built-ins are the functions, keywords and objects that are always available
- This is because they are defined in Python itself
- They include all the operators and keywords seen so far
- Also all the errors are built-ins, and constants as True of False

The built-ins

→ *Python built-in functions*



		Built-in Functions		
abs()	dict()	help()	min()	setattr()
all()	dir()	hex()	next()	slice()
any()	divmod()	id()	object()	sorted()
ascii()	enumerate()	input()	oct()	staticmethod()
bin()	eval()	int()	open()	str()
bool()	exec()	isinstance()	ord()	sum()
bytearray()	filter()	issubclass()	pow()	super()
bytes()	float()	iter()	print()	tuple()
callable()	format()	len()	property()	type()
chr()	frozenset()	list()	range()	vars()
classmethod()	getattr()	locals()	repr()	zip()
compile()	globals()	map()	reversed()	__import__()
complex()	hasattr()	max()	round()	
delattr()	hash()	memoryview()	set()	

Modules

→ *What are modules*

- Python modules are basically files containing Python definitions and statements.
- They can be organized in a structured, hierarchical way composing a package.
- Packages are the format in which nearly all Python libraries are distributed.
- Python provides a set of “pre-installed”, or built-in modules, which compose the so called “standard library”.

  → however, they need to be imported to be used

Modules

➜ *How to use modules*

- Does Python provide a square root function as a built-in? **NO**

- Does Python provide a square root function as part of the standard library? **YES!**

  → as part of the **math** module.

```
import math
math.sqrt(9)
```

OR

```
from math import sqrt
sqrt(9)
```

End of part II

- *Questions?*

Next: exercise 2

Exercise 2

Write a function that sums all the numbers of a list.

- Name it “sum_list” and accept a parameter for the list

- If the list is empty, the function must return “None”

- Think about how to handle non numerical values in the list, or a parameter which is not a list:

  → can you detect them and return “None”?

  hint: have a look at the *type()* built-in