Python

Fabrice BOISSIER

EPITA - Apprentissage

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Version 1

License

- (LaTeX source code partially reused from Gabriel Laskar)
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Part I

Introduction

1: Introduction

1 Course outline

What are we trying to learn?

Python language

What are the objectives of the course:

- Discovering Python
- Writing small Python's scripts
- Understanding main Python's concepts
- Writing functions and programs in Python
- Being autonomous while writing code

Course organization

- Lecture (30 mins $\sim$ 1h per day)

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- Labs (full day)

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monday 5th september 2022
monday 12th september 2022

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monday 5th september 2022
monday 12th september 2022

Evaluation

Evaluation will only be on submitted exercices

Part II

Python Basics

2: Python Basics

1 Python Language

Discovering Python

- Interpreter

Discovering Python

- Interpreter
  `/usr/bin/python`

Discovering Python

- Interpreter
  `/usr/bin/python`
- Imperative programming language

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- Interpreter
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- Object Oriented Programming language

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- Multiple versions (currently major version 3)

Discovering Python

- Interpreter
  `/usr/bin/python`
- Imperative programming language
- Object Oriented Programming language
- Multiple versions (currently major version 3)
  Beware, version 2.7 is still running on some machines

Calling Python

Simply like any program

```
$
```

Calling Python

Simply like any program

```
$ python
```

Calling Python

Simply like any program

```
$ python
Python 3.10.4 (main, Apr  2 2022, 09:04:19) [
   GCC 11.2.0] on linux
Type "help", "copyright", "credits" or "license
   " for more information.
>>>
```

Calling Python

Quit by typing "**exit()**" or by pressing **Ctrl + D**

```
$ python
Python 3.10.4 (main, Apr  2 2022, 09:04:19) [
   GCC 11.2.0] on linux
Type "help", "copyright", "credits" or "license
   " for more information.
>>> exit()
```

Calling Python

You can call a script by calling python with an argument

```
$ python my_script.py
```

Calling Python

You can call a script by calling python with an argument

```
$ python my_script.py
Hello World!
```

Versions

Beware of versions !
We currently use the major version 3 (3.8, 3.10, ...)

```
$ python
```

Versions

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We currently use the major version 3 (3.8, 3.10, ...)

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Versions

Beware of versions !
We currently use the major version 3 (3.8, 3.10, ...)

```
$ python
Python 3.10.4 (main, Apr  2 2022, 09:04:19) [
   GCC 11.2.0] on linux
Type "help", "copyright", "credits" or "license
   " for more information.
>>> exit()
```

Do not use the obsolete 2.7 (**python2**, **python27**, **python2.7**)

Versions

```
$ python
Python 3.10.4 (main, Apr  2 2022, 09:04:19)

$ python3
Python 3.10.4 (main, Apr  2 2022, 09:04:19)

$ python3.10
Python 3.10.4 (main, Apr  2 2022, 09:04:19)
```

Versions

```
$ python
Python 3.10.4 (main, Apr  2 2022, 09:04:19)

$ python3
Python 3.10.4 (main, Apr  2 2022, 09:04:19)

$ python3.10
Python 3.10.4 (main, Apr  2 2022, 09:04:19)

$ python2
Python 2.7.18 (default, Jan  2 2021, 09:22:32)
```

Versions

Please, check right now which default version of Python you have when you type **`python`**

Part III

Python Quick Scripting

3: Python Quick Scripting

1 First scripts

2 Quick overview of types

3 Overview of syntax and control flow

Hello World!

```
#! /usr/bin/python

print("Hello World!")
```

Hello World!

```
#! /usr/bin/python

print("Hello World!")
```

L1: The interpreter can be ajdusted

Hello World!

```
#! /usr/bin/python

print("Hello World!")
```

L1: The interpreter can be ajdusted
L3: **`print`** takes a string as a parameter

Hello World!

```
#! /usr/bin/python

print("Hello World!")
```

L1: The interpreter can be ajdusted
L3: **`print`** takes a string as a parameter
L3: Strings are enclosed within quotes (`'`) or double quotes (`"`)

Concatenation & Printing integers

```
#! /usr/bin/python

var = 42
print("Hello World! " + str(var))
```

Concatenation & Printing integers

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Semicolons (;) at the end of statements are optional (rarely used)

Concatenation & Printing integers

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L3: Declare variables and assign value directly (type not needed)

Concatenation & Printing integers

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#! /usr/bin/python

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Semicolons (;) at the end of statements are optional (rarely used)
L3: Declare variables and assign value directly (type not needed)
L4: String concatenation with **+**

Concatenation & Printing integers

```
#! /usr/bin/python

var = 42
print("Hello World! " + str(var))
```

Semicolons (**;**) at the end of statements are optional (rarely used)
L3: Declare variables and assign value directly (type not needed)
L4: String concatenation with **+**
L4: Conversion from integer or float to string with **`str()`** function

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

args.py

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

args.py

```
$ python args.py
```

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

args.py

```
$ python args.py
Hello World! args.py
```

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
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L3: Includes an external module (**`import module`**)

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

L3: Includes an external module (**`import module`**)
L3: Access to arguments is made through **`sys`** module
L4: Access to an attribute is made with a dot (`.`)

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

L3: Includes an external module (**`import module`**)
L3: Access to arguments is made through **`sys`** module
L4: Access to an attribute is made with a dot (**`.`**)
L4: **`argv`** is an array (like in C and others)

Read arguments

```
#! /usr/bin/python

import sys
print("Hello World! " + sys.argv[0])
```

L3: Includes an external module (**`import module`**)
L3: Access to arguments is made through **`sys`** module
L4: Access to an attribute is made with a dot (**`.`**)
L4: **`argv`** is an array (like in C and others)
L4: Arrays begin at index **`0`**

3: Python Quick Scripting

1 First scripts

2 Quick overview of types

3 Overview of syntax and control flow

Show types/Quick debug

```
#! /usr/bin/python
type(42)
type("Hello World!")
```

types1.py

```
$ python types1.py
```

Show types/Quick debug

```
#! /usr/bin/python
type(42)
type("Hello World!")
```

types1.py

```
$ python types1.py
<class 'int'>
<class 'str'>
```

Show types/Quick debug

```
#! /usr/bin/python
type(42)
type("Hello World!")
```

types1.py

```
$ python types1.py
<class 'int'>
<class 'str'>
```

Function **`type()`** writes the type of the parameter

Show types/Quick debug

```
#! /usr/bin/python
import sys
type(sys)
type(print("lol"))
```

types2.py

```
$ python types2.py
```

Show types/Quick debug

```
#! /usr/bin/python
import sys
type(sys)
type(print("lol"))
```

types2.py

```
$ python types2.py
<class 'module'>
lol
<class 'NoneType'>
```

3: Python Quick Scripting

1 First scripts

2 Quick overview of types

3 Overview of syntax and control flow

Functions overview

```
print("Hello World!")
```

functions1.py

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)
```

functions1.py

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

functions1.py

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

functions1.py

```
$ python functions1.py
```

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

functions1.py

```
$ python functions1.py
Hello World!
```

Functions overview

```
def MyFunction():
  print("Hello World!")
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MyFunction()
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Functions overview

```
def MyFunction():
  print("Hello World!")
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MyFunction()
```

L1: Functions begin by a **def** and are followed by their parameters

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

L1: Functions begin by a **def** and are followed by their parameters
L1: Definition of functions are terminated by a semicolon (:)

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

L1: Functions begin by a **def** and are followed by their parameters
L1: Definition of functions are terminated by a semicolon (:)
L2: Indentation defines in which scope the line is

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

L1: Functions begin by a **`def`** and are followed by their parameters
L1: Definition of functions are terminated by a semicolon (**:**)
L2: Indentation defines in which scope the line is
L2: **Indentation is VERY IMPORTANT!**

Functions overview

```
def MyFunction():
  print("Hello World!")
  return (0)

MyFunction()
```

L1: Functions begin by a **`def`** and are followed by their parameters
L1: Definition of functions are terminated by a semicolon (`:`)
L2: Indentation defines in which scope the line is
L2: **Indentation is VERY IMPORTANT!**
L3 & L5: Returning and calling are similar to C

Conditions overview

if ... **elif** ... **else** ...

```
def MyOtherFunction():
  var = 42
  if (var < 42):
    print("Oh no...")
  elif (var > 42):
    print("WT...")
  else:
    print("OK")
```

Conditions overview

if ... **elif** ... **else** ...

```
def MyOtherFunction():
  var = 42
  if (var < 42):
    print("Oh no...")
  elif (var > 42):
    print("WT...")
  else:
    print("OK")
```

L3 & L5 & L6: Conditions are followed by a semicolon (:)

Conditions overview

match ... **case** ... *(only since Python 3.10)*

```
var = "Hello World!"
match var:
   case ['Hello']:
     print("Beginning")
   case ['World!' | 'Hello World!']:
     print("End")
   case _:
     print("In any other cases")
```

Conditions overview

match ... **case** ... *(only since Python 3.10)*

```
var = "Hello World!"
match var:
   case ['Hello']:
     print("Beginning")
   case ['World!' | 'Hello World!']:
     print("End")
   case _:
     print("In any other cases")
```

Similar to *switch-case* in C, without needing *return* or *break*

Conditions overview

match ... **case** ... *(only since Python 3.10)*

```
var = "Hello World!"
match var:
   case ['Hello']:
     print("Beginning")
   case ['World!' | 'Hello World!']:
     print("End")
   case _:
     print("In any other cases")
```

Similar to *switch-case* in C, without needing *return* or *break*
More complex than that (check the documentation after the course)

Loops overview

while

```
var = 0
while var < 42:
  print("Hi Nations!")
  var += 1
```

Loops overview

while

```
var = 0
while var < 42:
   print("Hi Nations!")
   var += 1
```

L2: Regular **while** loop
L4: **+=** operator acts like **var = var + 1**

Loops overview

while

```
var = 0
while var < 42:
  print("Hi Nations!")
  var += 1
```

L2: Regular **while** loop
L4: **+=** operator acts like **var = var + 1**
Don't forget indentation

Loops overview

for (1)

```
for var in range(0, 10):
  print("Hi Nations!")

my_text = "Yo Countries!"
for char in my_text:
  print(char)
```

Loops overview

for (1)

```
for var in range(0, 10):
  print("Hi Nations!")

my_text = "Yo Countries!"
for char in my_text:
  print(char)
```

L1: **range** calculates values from **0** to **10**

Loops overview

for (1)

```
for var in range(0, 10):
  print("Hi Nations!")

my_text = "Yo Countries!"
for char in my_text:
  print(char)
```

L1: **range** calculates values from **0** to **10**
L1: **in** iterates through each value of a list
L1: Each value will be put into the variable before **in**

Loops overview

for (1)

```
for var in range(0, 10):
  print("Hi Nations!")

my_text = "Yo Countries!"
for char in my_text:
  print(char)
```

L1: **range** calculates values from **0** to **10**
L1: **in** iterates through each value of a list
L1: Each value will be put into the variable before **in**
L4 & L5: Strings are considered as characters lists

Loops overview

for (2)

```
my_list = [ 5, 2, 3, 1, 4 ]
for var in range(len(my_list)):
  if (var < 2):
    break
  else:
    print("Hi Nations!")
```

Loops overview

for (2)

```
my_list = [ 5, 2, 3, 1, 4 ]
for var in range(len(my_list)):
  if (var < 2):
    break
  else:
    print("Hi Nations!")
```

L1: Declaration of a list

Loops overview

for (2)

```
my_list = [ 5, 2, 3, 1, 4 ]
for var in range(len(my_list)):
  if (var < 2):
    break
  else:
    print("Hi Nations!")
```

L1: Declaration of a list
L1: Never put a dash (**-**) in variables name (use an underscore _)

Loops overview

for (2)

```
my_list = [ 5, 2, 3, 1, 4 ]
for var in range(len(my_list)):
  if (var < 2):
    break
  else:
    print("Hi Nations!")
```

L1: Declaration of a list
L1: Never put a dash (**-**) in variables name (use an underscore _)
L2: **len** gets the length of a list

Loops overview

for (2)

```
my_list = [ 5, 2, 3, 1, 4 ]
for var in range(len(my_list)):
  if (var < 2):
    break
  else:
    print("Hi Nations!")
```

L1: Declaration of a list
L1: Never put a dash (**-**) in variables name (use an underscore _)
L2: **len** gets the length of a list
L4: **break** ends the loop

Exceptions overview

try ... **except** ...

```
var = 3
try:
  var = 42 / var
except Exception as exc:
  print("Error: " + str(exc))
```

Exceptions overview

try ... **except** ...

```
var = 3
try:
  var = 42 / var
except Exception as exc:
  print("Error: " + str(exc))
```

L3: Begin the block of code to check with a **try**

Exceptions overview

try ... **except** ...

```
var = 3
try:
  var = 42 / var
except Exception as exc:
  print("Error: " + str(exc))
```

L3: Begin the block of code to check with a **try**
L6: Catch exceptions with a **except**

Exceptions overview

try ... **except** ...

```
var = 3
try:
  var = 42 / var
except Exception as exc:
  print("Error: " + str(exc))
```

L3: Begin the block of code to check with a **try**
L6: Catch exceptions with a **except**
L6: Catch any exception with **Exception** and put it in **exc**

Exceptions overview

try ... **except** ...

```
var = 3
try:
  var = 42 / var
except Exception as exc:
  print("Error: " + str(exc))
```

L3: Begin the block of code to check with a **try**
L6: Catch exceptions with a **except**
L6: Catch any exception with **Exception** and put it in **exc**
L6 & L7: Write the actions to take if an exception occurs

Exceptions overview

try ... **except** ...

```
var = 3
try:
  var = 42 / var
except Exception as exc:
  print("Error: " + str(exc))
```

L3: Begin the block of code to check with a **try**
L6: Catch exceptions with a **except**
L6: Catch any exception with **Exception** and put it in **exc**
L6 & L7: Write the actions to take if an exception occurs
L7: Don't forget to convert to a string with **str()**

Exceptions overview

try ... except ... else ... finally

```
try:
  var = 42 / 3
except ZeroDivisionError:
  print("There was a division by zero")
else:
  print("It worked, result: ", var)
finally:
  print("--After everything--")
```

Exceptions overview

try ... **except** ... **else** ... **finally**

```
try:
  var = 42 / 3
except ZeroDivisionError:
  print("There was a division by zero")
else:
  print("It worked, result: ", var)
finally:
  print("--After everything--")
```

L4: Check for a specific exception (division by zero)

Exceptions overview

try ... **except** ... **else** ... **finally**

```
try:
  var = 42 / 3
except ZeroDivisionError:
  print("There was a division by zero")
else:
  print("It worked, result: ", var)
finally:
  print("--After everything--")
```

L4: Check for a specific exception (division by zero)

L6: If no exception was raised, it executes the **else**

Exceptions overview

try ... **except** ... **else** ... **finally**

```
try:
  var = 42 / 3
except ZeroDivisionError:
  print("There was a division by zero")
else:
  print("It worked, result: ", var)
finally:
  print("--After everything--")
```

L4: Check for a specific exception (division by zero)
L6: If no exception was raised, it executes the **else**
L8: In any case (exception or not), it executes the **finally** clause

```
def FragileFunction():
  var = 42
  if (var == 42):
    raise ValueError("Argf")
  else:
    return (0)

def MainFunction():
  print("--Before--")
  try:
    FragileFunction()
  except ValueError as exp:
    print("Exception caught: ", exp)
  print("--After--")
```

```
class MyCustomError(Exception):
  pass

def FragileFunction():
  raise MyCustomError("Argf")

def MainFunction():
  print("--Before--")
  try:
    FragileFunction()
  except MyCustomError as exp:
    print("Exception caught: ", exp)
  print("--After--")
```

Exceptions overview

`raise` and custom exceptions

Exceptions overview

`raise` and custom exceptions

- **`raise`** instruction triggers an exception

Exceptions overview

`raise` and custom exceptions

- **`raise`** instruction triggers an exception
- Use **`ValueError`** in order to customize the message...

Exceptions overview

`raise` and custom exceptions

- **`raise`** instruction triggers an exception
- Use **`ValueError`** in order to customize the message...
- ...or create a class with the name of your exception and **`Exception`** as a parameter

Exceptions overview

`raise` and custom exceptions

- **`raise`** instruction triggers an exception
- Use **`ValueError`** in order to customize the message...
- ...or create a class with the name of your exception and **`Exception`** as a parameter
- When raising a custom exception, the message is optional

Exceptions overview

raise and custom exceptions

- **raise** instruction triggers an exception
- Use **ValueError** in order to customize the message...
- ...or create a class with the name of your exception and **Exception** as a parameter
- When raising a custom exception, the message is optional

```
class MyCustomError(Exception):
  pass

def FragileFunction():
  raise MyCustomError
```

Part IV

Functions, Imports & Modules

4: Functions, Imports & Modules

1. Functions
   - Parameters
   - Scope of variables
   - Return values
2. Modules & Imports

Functions

Usual function definition and call:

Functions

Usual function definition and call:

```
def MyFunction(name):
  print("Hello " + str(name) + "!")
  return (0)
```

Functions

Usual function definition and call:

```
def MyFunction(name):
  print("Hello " + str(name) + "!")
  return (0)

MyFunction("Fabrice")
```

Functions

Usual function definition and call:

```
def MyFunction(name):
  print("Hello " + str(name) + "!")
  return (0)

MyFunction("Fabrice")
MyFunction(42)
```

Functions

Usual function definition and call:

```
def MyFunction(name):
  print("Hello " + str(name) + "!")
  return (0)

MyFunction("Fabrice")
MyFunction(42)
```

MyFunction is the function name

Functions

Usual function definition and call:

```
def MyFunction(name):
  print("Hello " + str(name) + "!")
  return (0)

MyFunction("Fabrice")
MyFunction(42)
```

MyFunction is the function name
name is a parameter (without a type)

Functions

Usual function definition and call:

```
def MyFunction(name):
  print("Hello " + str(name) + "!")
  return (0)

MyFunction("Fabrice")
MyFunction(42)
```

MyFunction is the function name
name is a parameter (without a type)
"Fabrice" and *42* are arguments

4: Functions, Imports & Modules

1. Functions
   - Parameters
   - Scope of variables
   - Return values
2. Modules & Imports

Parameters

- Positional arguments

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- Positional arguments
  - `def MyFun(param1, param2, param3)`

Parameters

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  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`

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Parameters

- Positional arguments
  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(42, "abc", 1337)`
- Keywords arguments

Parameters

- Positional arguments
  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(42, "abc", 1337)`
- Keywords arguments (with default values)
  - `def MyFun(p1="A", p2=1, p3=9)`

Parameters

- Positional arguments
  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(42, "abc", 1337)`
- Keywords arguments (with default values)
  - `def MyFun(p1="A", p2=1, p3=9)`
  - `MyFun("abc", 42, 1337)`

Parameters

- Positional arguments
  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(42, "abc", 1337)`
- Keywords arguments (with default values)
  - `def MyFun(p1="A", p2=1, p3=9)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(p1="abc", p2=42, p3=1337)`

Parameters

- Positional arguments
  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(42, "abc", 1337)`
- Keywords arguments (with default values)
  - `def MyFun(p1="A", p2=1, p3=9)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(p1="abc", p2=42, p3=1337)`
  - `MyFun(p3=1337, p2=42, p1="abc")`

Parameters

- Positional arguments
  - `def MyFun(param1, param2, param3)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(42, "abc", 1337)`
- Keywords arguments (with default values)
  - `def MyFun(p1="A", p2=1, p3=9)`
  - `MyFun("abc", 42, 1337)`
  - `MyFun(p1="abc", p2=42, p3=1337)`
  - `MyFun(p3=1337, p2=42, p1="abc")`
  - `MyFun(p2=42)`

Positional arguments

Positional arguments

```
from datetime import date
def GreetingsPos(Name, Year):
  print("Hi " + Name + "!")
  if (Year <= 0):
    print("(unknown age)")
  else:
    age = date.today().year - Year
    print("(" + str(age) + " years)")
```

Positional arguments

```
from datetime import date
def GreetingsPos(Name, Year):
  print("Hi " + Name + "!")
  if (Year <= 0):
    print("(unknown age)")
  else:
    age = date.today().year - Year
    print("(" + str(age) + " years)")

GreetingsPos("Fabrice", 1988)
```

Positional arguments

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from datetime import date
def GreetingsPos(Name, Year):
  print("Hi " + Name + "!")
  if (Year <= 0):
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  else:
    age = date.today().year - Year
    print("(" + str(age) + " years)")

GreetingsPos("Fabrice", 1988) # OK
GreetingsPos("Fabrice")
```

Positional arguments

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from datetime import date
def GreetingsPos(Name, Year):
  print("Hi " + Name + "!")
  if (Year <= 0):
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  else:
    age = date.today().year - Year
    print("(" + str(age) + " years)")

GreetingsPos("Fabrice", 1988) # OK
GreetingsPos("Fabrice")       # error
```

Positional arguments

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from datetime import date
def GreetingsPos(Name, Year):
  print("Hi " + Name + "!")
  if (Year <= 0):
    print("(unknown age)")
  else:
    age = date.today().year - Year
    print("(" + str(age) + " years)")

GreetingsPos("Fabrice", 1988) # OK
GreetingsPos("Fabrice")       # error
```

All of the parameters are required if positional arguments

Keywords arguments

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)
```

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)

GreetingsKey("Fabrice", 1988)
```

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)

GreetingsKey("Fabrice", 1988)   # OK
GreetingsKey("Fabrice")
```

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)

GreetingsKey("Fabrice", 1988)   # OK
GreetingsKey("Fabrice")         # OK
GreetingsKey(BYear=1988, FName="Fabrice")
```

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)

GreetingsKey("Fabrice", 1988)   # OK
GreetingsKey("Fabrice")         # OK
GreetingsKey(BYear=1988, FName="Fabrice") # OK
GreetingsKey("Fabrice", BYear=1988)
```

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)

GreetingsKey("Fabrice", 1988)   # OK
GreetingsKey("Fabrice")         # OK
GreetingsKey(BYear=1988, FName="Fabrice") # OK
GreetingsKey("Fabrice", BYear=1988) # OK
```

Keywords arguments

```
def GreetingsKey(FName="Unknown", BYear=0):
  GreetingsPos(FName, BYear)

GreetingsKey("Fabrice", 1988)   # OK
GreetingsKey("Fabrice")         # OK
GreetingsKey(BYear=1988, FName="Fabrice") # OK
GreetingsKey("Fabrice", BYear=1988) # OK
```

Keywords arguments are more flexibles

Keywords arguments

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)  # OK
GreetingsKey2(BYear=1988, FName="Fabrice")
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)  # OK
GreetingsKey2(BYear=1988, FName="Fabrice") # OK
GreetingsKey2(BYear=1988)
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)  # OK
GreetingsKey2(BYear=1988, FName="Fabrice") # OK
GreetingsKey2(BYear=1988)  # OK
GreetingsKey2()
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)  # OK
GreetingsKey2(BYear=1988, FName="Fabrice") # OK
GreetingsKey2(BYear=1988)  # OK
GreetingsKey2() # error
GreetingsKey2("Fabrice")
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)  # OK
GreetingsKey2(BYear=1988, FName="Fabrice") # OK
GreetingsKey2(BYear=1988)  # OK
GreetingsKey2() # error
GreetingsKey2("Fabrice") # error
```

Keywords arguments

```
def GreetingsKey2(FName="", BYear=""):
  GreetingsPos(FName, BYear)

GreetingsKey2("Fabrice", 1988)  # OK
GreetingsKey2(BYear=1988, FName="Fabrice") # OK
GreetingsKey2(BYear=1988)  # OK
GreetingsKey2() # error
GreetingsKey2("Fabrice") # error
```

Keywords arguments forces a default value

4: Functions, Imports & Modules

1. Functions
   - Parameters
   - Scope of variables
   - Return values
2. Modules & Imports

Scope of variables

Variables are searched within scopes in a specific order:

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LGI rule

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- Local (scope of the current function)
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- Internal (variables of the interpreter)

LGI rule

Constants are global variables (uppercase name)

4: Functions, Imports & Modules

1. Functions
   - Parameters
   - Scope of variables
   - Return values
2. Modules & Imports

Multiple return of values

Multiple return of values

```
def ConvertTemperature(kelvin):
  celsius = kelvin - 273
  fahrenheit = ((celsius * 9) / 5) + 32
  reaumur = (kelvin * 4) / 5
  return celsius, fahrenheit, reaumur
```

Multiple return of values

```
def ConvertTemperature(kelvin):
    celsius = kelvin - 273
    fahrenheit = ((celsius * 9) / 5) + 32
    reaumur = (kelvin * 4) / 5
    return celsius, fahrenheit, reaumur

temps = ConvertTemperature(42)
```

Multiple return of values

```
def ConvertTemperature(kelvin):
  celsius = kelvin - 273
  fahrenheit = ((celsius * 9) / 5) + 32
  reaumur = (kelvin * 4) / 5
  return celsius, fahrenheit, reaumur

temps = ConvertTemperature(42)
print("°K : " + str(42))
print("°C : " + str(temps[0]))
print("°F : " + str(temps[1]))
print("°Re: " + str(temps[2]))
```

Multiple return of values

```
def ConvertTemperature(kelvin):
  celsius = kelvin - 273
  fahrenheit = ((celsius * 9) / 5) + 32
  reaumur = (kelvin * 4) / 5
  return celsius, fahrenheit, reaumur

temps = ConvertTemperature(42)
print("°K : " + str(42))          # 42
print("°C : " + str(temps[0])) # -231
print("°F : " + str(temps[1])) # -383
print("°Re: " + str(temps[2])) # 33
```

Multiple return of values

```
def ConvertTemperature(kelvin):
    celsius = kelvin - 273
    fahrenheit = ((celsius * 9) / 5) + 32
    reaumur = (kelvin * 4) / 5
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temps = ConvertTemperature(42)
print("°K : " + str(42))          # 42
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```

Multiple return values uses tuples

Multiple return of values

Multiple affectations are also possible

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def ConvertTemperature(kelvin):
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Multiple affectations are also possible

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def ConvertTemperature(kelvin):
  celsius = kelvin - 273
  fahrenheit = ((celsius * 9) / 5) + 32
  reaumur = (kelvin * 4) / 5
  return celsius, fahrenheit, reaumur

tC, tF, tR = ConvertTemperature(42)
```

Multiple return of values

Multiple affectations are also possible

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def ConvertTemperature(kelvin):
  celsius = kelvin - 273
  fahrenheit = ((celsius * 9) / 5) + 32
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  return celsius, fahrenheit, reaumur

tC, tF, tR = ConvertTemperature(42)
print("°K : " + str(42))
print("°C : " + str(tC))
print("°F : " + str(tF))
print("°Re: " + str(tR))
```

Multiple return of values

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print("°K : " + str(42)) # 42
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```

4: Functions, Imports & Modules

1 Functions

2 Modules & Imports
- Modules
- Imports
- Packages

4: Functions, Imports & Modules

1 Functions

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Modules

A module contains functions and variables (and classes)

Module name is the filename withtout `.py`

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- Begin your module with a *docstring*
  - triple quotes `""" docstring """`
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  - write the description of your module
  - docstring can be on multiple lines
- Within each function, write a docstring about it
- Eventually, add useful constants

Check result with **`help(module)`** (after importing it)

Modules

`MyModule.py` (module name: **`MyModule`**)

Modules

MyModule.py (module name: **MyModule**)

```
""" Module for explaining modules """
```

Modules

MyModule.py (module name: **MyModule**)

```
""" Module for explaining modules """
MYCONST=42
```

Modules

MyModule.py (module name: **MyModule**)

```
""" Module for explaining modules """
MYCONST=42

def MyFunc(test):
  print("Hello World!")


def OtherFunc(var):
  print("Test.")
```

Modules

MyModule.py (module name: **MyModule**)

```
""" Module for explaining modules """
MYCONST=42

def MyFunc(test):
  """ Function for explaining modules """
  print("Hello World!")

def OtherFunc(var):
  """ Another function """
  print("Test.")
```

4: Functions, Imports & Modules

1 Functions

2 Modules & Imports
- Modules
- Imports
- Packages

Imports

Multiple ways for importing modules:

- Method 1: **`import MyModule`**

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Variables and constants can be imported too

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Multiple ways for importing modules:

- Method 1: **`import MyModule`**
- Method 2: **`import MyModule as MyM`**
- Method 3: **`from MyModule import MyFunc`**

Variables and constants can be imported too

Beware: with method 1, *everything* is imported

Imports

Method 1: **MyModule.py**

Imports

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```
import MyModule
# function: def MyFunc(test)
```

Imports

Method 1: **MyModule.py**

```
import MyModule
# function: def MyFunc(test)

MyModule.MyFunc(42)
```

Imports

Method 2: **MyModule.py**

Imports

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```
import MyModule as MyM
# function: def MyFunc(test)
```

Imports

Method 2: **MyModule.py**

```
import MyModule as MyM
# function: def MyFunc(test)

MyM.MyFunc(42)
```

Imports

Method 3: **MyModule.py**

Imports

Method 3: **MyModule.py**

```
from MyModule import MyFunc
# function: def MyFunc(test)
```

Imports

Method 3: **MyModule.py**

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from MyModule import MyFunc
# function: def MyFunc(test)

MyFunc(42)
```

4: Functions, Imports & Modules

1 Functions

2 Modules & Imports
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Packages

Packages contain multiple modules and dependencies

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(see documentation and tutorials about how to build one)

Part V

Class, Files, and Directories

5: Class, Files, and Directories

1 Classes

2 Files and Directories

OOP

Object Oriented Programming (OOP) vocabulary

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- Class: the type and structure

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- Class: the type and structure
- Attribute: a variable that is a member of the class

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Object Oriented Programming (OOP) vocabulary

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- Object: an instance of a class
- Constructor: the first method called when creating an object

OOP

Object Oriented Programming (OOP) vocabulary

- Class: the type and structure
- Attribute: a variable that is a member of the class
- Method: a function/procedure that is a member of the class
- Object: an instance of a class
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- Destructor: the method called when deleting an object

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Object Oriented Programming (OOP) vocabulary

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- Inheritance: structure of a class reused as a basis for a new one

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- Private: when a member is accessible only by the object itself

OOP

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- Class: the type and structure
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- Method: a function/procedure that is a member of the class
- Object: an instance of a class
- Constructor: the first method called when creating an object
- Destructor: the method called when deleting an object
- Inheritance: structure of a class reused as a basis for a new one
- Private: when a member is accessible only by the object itself
- Public: when a member is accessible by any object

Classes

Specificities of classes in Python:

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- Only one constructor: `__init__`

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Specificities of classes in Python:

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Specificities of classes in Python:

- Only one constructor: `__init__`
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- Attributes are at least *read-only*, and eventually *writable*
- Writable attributes can be deleted from the object
- Member beginning by an underscore (_) aren't strictly private, but should be considered internal to the class
- **`self`** keyword is required as the first parameter of each method

Classes

Classes

```
class Vehicle:
   """ General vehicles """
```

Classes

```
class Vehicle:
   """ General vehicles """
   __speed = 0
   Passengers = 0
```

Classes

```
class Vehicle:
  """ General vehicles """
  __speed = 0
  Passengers = 0
  # Constructor
  def __init__(self):
    self.Passengers = 1
```

Classes

```
class Vehicle:
   """ General vehicles """
   __speed = 0
   Passengers = 0
   # Constructor
   def __init__(self):
      self.Passengers = 1
   # Method
   def getSpeed(self):
      return (self.__speed)
```

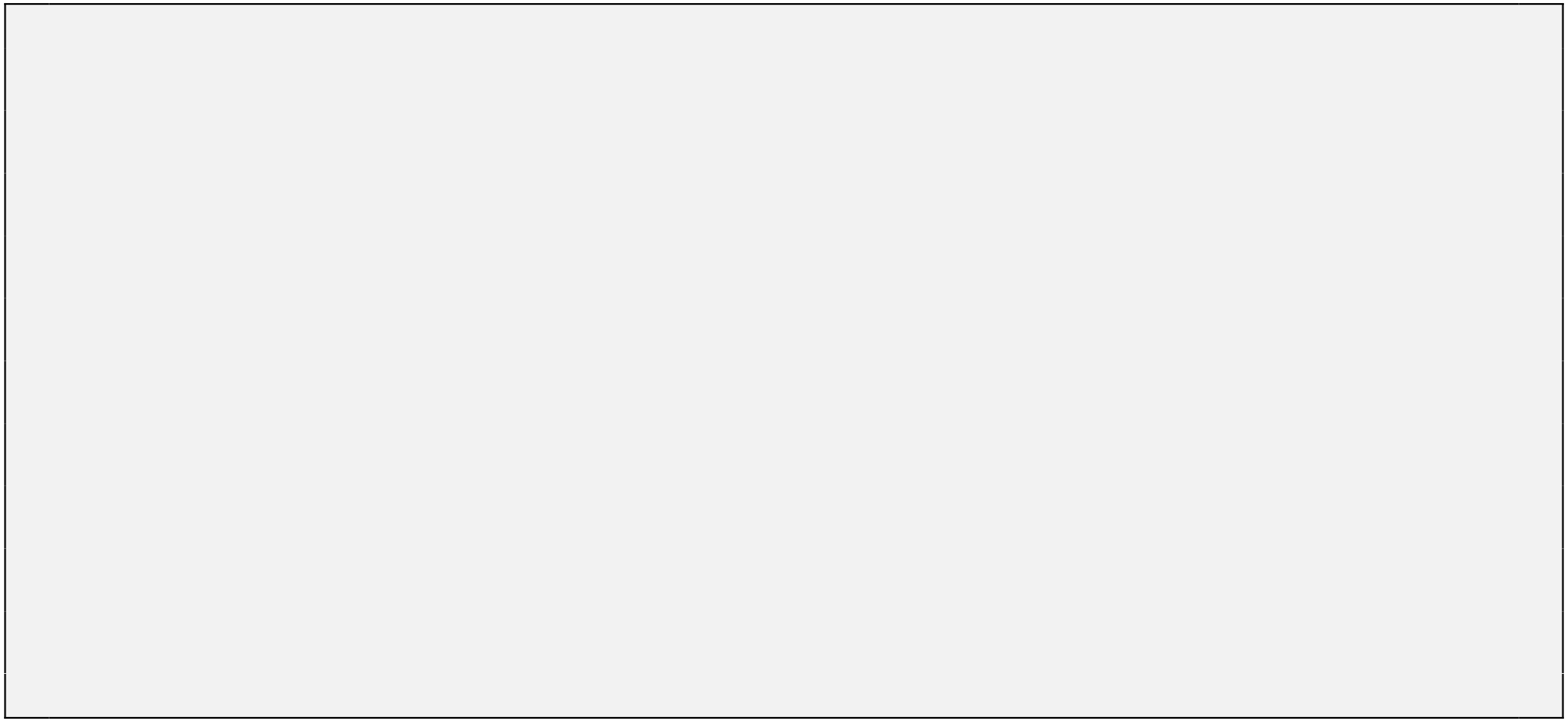
Classes

```
class Vehicle:
  """ General vehicles """
  __speed = 0
  Passengers = 0
  # Constructor
  def __init__(self):
    self.Passengers = 1
  # Methods
  def getSpeed(self):
    return (self.__speed)
  def Accelerate(self, x):
    self.__speed += x
```

Classes

```
class Vehicle:
  """ General vehicles """
  __speed = 0
  Passengers = 0
  # Constructor
  def __init__(self):          # Constructor
    self.Passengers = 1
  # Methods
  def getSpeed(self):          # Accessor
    return (self.__speed)
  def Accelerate(self, x):     # Mutator
    self.__speed += x
```

Classes



Classes

```
class Car(Vehicle):
  """ Cars inherit from Vehicle """
  __CV = 0
```

Classes

```
class Car(Vehicle):
  """ Cars inherit from Vehicle """
  __CV = 0
  # Constructor
  def __init__(self, CO2, P):
    self.Passengers = 1
    self.__CV = (CO2 / 45) + (P / 40)
```

Classes

```
class Car(Vehicle):
  """ Cars inherit from Vehicle """
  __CV = 0
  # Constructor
  def __init__(self, CO2, P):
    self.Passengers = 1
    self.__CV = (CO2 / 45) + (P / 40)
  # Method
  def getCV(self):
    return (self.__CV)
```

Classes

Classes

```
Peugeot206Plus = Car(110, 44)   # 110g/km  44kW
AirbusA340 = Vehicle()
```

Classes

```
Peugeot206Plus = Car(110, 44)   # 110g/km  44kW
AirbusA340 = Vehicle()

Peugeot206Plus.Accelerate(80)
AirbusA340.Accelerate(260)
```

Classes

```
Peugeot206Plus = Car(110, 44)   # 110g/km  44kW
AirbusA340 = Vehicle()

Peugeot206Plus.Accelerate(80)
AirbusA340.Accelerate(260)

Peugeot206Plus.getSpeed()   # 80
AirbusA340.getSpeed()       # 260

Peugeot206Plus.getCV()
AirbusA340.getCV()
```

Classes

```
Peugeot206Plus = Car(110, 44)   # 110g/km  44kW
AirbusA340 = Vehicle()

Peugeot206Plus.Accelerate(80)
AirbusA340.Accelerate(260)

Peugeot206Plus.getSpeed()   # 80
AirbusA340.getSpeed()       # 260

Peugeot206Plus.getCV()
AirbusA340.getCV()   # Error
```

Classes

Summary of vocabulary:

Classes

Summary of vocabulary:

- **`Vehicle`**: class

Classes

Summary of vocabulary:

- **`Vehicle`**: class
- **`Car`**: class (inherits from **`Vehicle`**)

Classes

Summary of vocabulary:

- **`Vehicle`**: class
- **`Car`**: class (inherits from **`Vehicle`**)
- **`Peugeot206Plus`**: instance of **`Car`**

Classes

Summary of vocabulary:

- **`Vehicle`**: class
- **`Car`**: class (inherits from **`Vehicle`**)
- **`Peugeot206Plus`**: instance of **`Car`**
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Classes

Summary of vocabulary:

- **`Vehicle`**: class
- **`Car`**: class (inherits from **`Vehicle`**)
- **`Peugeot206Plus`**: instance of **`Car`**
- **`AirbusA340`**: instance of **`Vehicle`**
- **`Peugeot206Plus`** can calculate and give **`CV`**

Classes

Summary of vocabulary:

- **`Vehicle`**: class
- **`Car`**: class (inherits from **`Vehicle`**)
- **`Peugeot206Plus`**: instance of **`Car`**
- **`AirbusA340`**: instance of **`Vehicle`**
- **`Peugeot206Plus`** can calculate and give **`CV`**
- **`AirbusA340`**: doesn't have **`CV`** method nor attribute

Classes

Summary of vocabulary:

- **`Vehicle`**: class
- **`Car`**: class (inherits from **`Vehicle`**)
- **`Peugeot206Plus`**: instance of **`Car`**
- **`AirbusA340`**: instance of **`Vehicle`**
- **`Peugeot206Plus`** can calculate and give **`CV`**
- **`AirbusA340`**: doesn't have **`CV`** method nor attribute

`https://docs.python.org/3/tutorial/classes.html`

5: Class, Files, and Directories

1 Classes

2 Files and Directories
- Open, Read, Write, Close
- File existence and management

5: Class, Files, and Directories

1 Classes

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Files

Files are managed as usual:

Files

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- **`open`**
- **`read`**
- **`write`**
- **`close`**

Files

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- `open(filename, flags`
- `read`
- `write`
- `close`

Files

Files are managed as usual:

- `open(filename, flags`
- `read(NbCharacters)`
- `write`
- `close`

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- `open(filename, flags`
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- `write(String)`
- `close`

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Always close files in order to be sure to write changes on the physical support

Files

Files are managed as usual:

- `open(filename, flags`
- `read(NbCharacters)`
- `write(String)`
- `close()`

Always close files in order to be sure to write changes on the physical support

Files are managed by an internal python's **class**

Files

Open flags:

Files

Open flags:

- `"r"` - open for reading

Files

Open flags:

- `"r"` - open for reading
- `"w"` - truncate the file for overwriting

Files

Open flags:

- `"r"` - open for reading
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Files

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- `"r"` - open for reading
- `"w"` - truncate the file for overwriting
- `"a"` - append/begin from the end for writing
- `"x"` - create a new file, fail if it already exists

Files

Open flags:

- `"r"` - open for reading
- `"w"` - truncate the file for overwriting
- `"a"` - append/begin from the end for writing
- `"x"` - create a new file, fail if it already exists
- `"r+"` - open for reading and writing

Files

Open flags:

- `"r"` - open for reading
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Read variants:

Files

Open flags:

- **`"r"`** - open for reading
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- **`"a"`** - append/begin from the end for writing
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Read variants:

- **`read()`** - get the whole text

Files

Open flags:

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Read variants:

- **`read()`** - get the whole text
- **`read(Nb)`** - get the next *Nb* characters

Files

Open flags:

- **`"r"`** - open for reading
- **`"w"`** - truncate the file for overwriting
- **`"a"`** - append/begin from the end for writing
- **`"x"`** - create a new file, fail if it already exists
- **`"r+"`** - open for reading and writing

Read variants:

- **`read()`** - get the whole text
- **`read(Nb)`** - get the next *Nb* characters
- **`readline()`** - get the next line

Files

Open existing file for reading

Files

Open existing file for reading

```
f = open("file.txt", "r")
```

Files

Open existing file for reading

```
f = open("file.txt", "r")
chars = f.read(10)
print(chars)
```

Files

Open existing file for reading

```
f = open("file.txt", "r")
chars = f.read(10)
print(chars)
line = f.readline()
print(line)
```

Files

Open existing file for reading

```
f = open("file.txt", "r")
chars = f.read(10)
print(chars)
line = f.readline()
print(line)
f.close()
```

Files

Read line by line a file with python specificities

Files

Read line by line a file with python specificities

```
f = open("file.txt", "r")
```

Files

Read line by line a file with python specificities

```
f = open("file.txt", "r")
for x in f:
  print(x)
```

Files

Read line by line a file with python specificities

```
f = open("file.txt", "r")
for x in f:
  print(x)
f.close()
```

Files

Write at the end of a file (add content)

Files

Write at the end of a file (add content)

```
f = open("file.txt", "a")
```

Files

Write at the end of a file (add content)

```
f = open("file.txt", "a")
nb = f.write("-add content-")
```

Files

Write at the end of a file (add content)

```
f = open("file.txt", "a")
nb = f.write("-add content-")
f.close()
```

Files

Write at the end of a file (add content)

```
f = open("file.txt", "a")
nb = f.write("-add content-")
f.close()
print(nb)   # 13 chars were added
```

Files

Check documentation for more informations

https://docs.python.org/3/tutorial/inputoutput.html

5: Class, Files, and Directories

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Files and Directories

Management of files is done through the **os** module

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- **`os.remove(filename)`** - remove the file

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- **`os.rmdir(dirname)`** - remove the directory

Files and Directories

Management of files is done through the **`os`** module

- **`os.remove(filename)`** - remove the file
- **`os.rmdir(dirname)`** - remove the directory
- **`os.path.exist(path)`** - test if *path* is an existing file

Files and Directories

Management of files is done through the **`os`** module

- **`os.remove(filename)`** - remove the file
- **`os.rmdir(dirname)`** - remove the directory
- **`os.path.exist(path)`** - test if *path* is an existing file
- **`os.path.isfile(path)`** - test if *path* is a file

Files and Directories

Management of files is done through the **os** module

- **os.remove(filename)** - remove the file
- **os.rmdir(dirname)** - remove the directory
- **os.path.exist(path)** - test if *path* is an existing file
- **os.path.isfile(path)** - test if *path* is a file
- **os.path.isdir(path)** - test if *path* is a directory

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Management of files is done through the **os** module

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- **os.path.abspath(path)** - get absolute pathname

Files and Directories

Management of files is done through the **os** module

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Files and Directories

Management of files is done through the **os** module

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- **os.path.basename(path)** - get basename of pathname

Files and Directories

Management of files is done through the **os** module

- **os.remove(filename)** - remove the file
- **os.rmdir(dirname)** - remove the directory
- **os.path.exist(path)** - test if *path* is an existing file
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- **os.path.dirname(path)** - get dirname of pathname
- **os.path.basename(path)** - get basename of pathname

https://docs.python.org/3/library/os.path.html

Part VI

Python's Main Concepts

Built-in types

- Numerics
- Sequences
- Mappings
- Classes
- Instances
- Exceptions

6: Python's Main Concepts

1. Numeric types
2. Sequence types
3. Mapping types
4. Other types

Numeric types

- int
- float
- complex

Numeric types

- int
  - booleans - *(subtype of int)*
- float
- complex

Numeric types

- int
  - booleans - *(subtype of int)*
- float
- complex
  - *(pair of floats for real and imaginary parts)*

Numeric types

Type	**Examples**		
int	0	42	1337
float	0.0	1.8e30	1.
complex	3j	2J	5+7j

"1.8e30" is equivalent to "$1{,}8 \times 10^{30}$"

"5j" is equivalent in french to "5i"

Numeric operations

Operation	Result
x + y	sum of x and y
x − y	difference of x and y
x ∗ y	product of x and y
x / y	quotient of x and y
x // y	floored quotient of x and y
x % y	remainder of x/y
pow(x, y)	x to the power y
x ∗ ∗ y	x to the power y
−x	x negated
+x	x unchanged
abs(x)	absolute value or magnitude of x

"/" gives a float as a result

"//" gives an integer as a result (euclidean division)

Numeric operations

Operation	Result
abs(x)	absolute value or magnitude of x
floor(x)	the largest integer not greater than x
ceil(x)	the smallest integer greater than or equal to x

```
import math

Absolue = abs(-42.7)   # 42.7
ParDefaut1 = math.floor(3.2)   # 3
ParDefaut2 = math.floor(3.7)   # 3
ParExces1 = math.ceil(5.2)   # 6
ParExces2 = math.ceil(5.7)   # 6
```

Numeric operations

Constructors and type conversion:

Operation	**Result**
int(x)	*x* converted to integer
float(x)	*x* converted to floating point
complex(re, im)	a complex number with real part *re*, imaginary part *im*. (*im* defaults to zero)

```
entier = int(42.7)        # 42
flottant = float(3)       # 3.0
complexe1 = complex(4)        # 4+0j
complexe2 = complex(5, 6)     # 5+6j
```

Other numeric types

Booleans values:

- **`False`** (equivalent to **`int(0)`**)
- **`True`** (equivalent to **`int(1)`**)

More details on types

`https://docs.python.org/3/library/stdtypes.html`

6: Python's Main Concepts

1 Numeric types

2 Sequence types
- Sequence operations
- Lists
- Tuples
- Ranges

3 Mapping types

4 Other types

Sequence types

- list
- tuple
- range

Sequence types

- list
- tuple
- range
- str - *(text sequence type)*

Sequence types

- list
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- range
- str - *(text sequence type)*
- *binary sequence types*

Sequence types

- list
- tuple
- range
- str - *(text sequence type)*
- *binary sequence types*

index begins at 0

6: Python's Main Concepts

1 Numeric types

2 Sequence types
- Sequence operations
- Lists
- Tuples
- Ranges

3 Mapping types

4 Other types

Sequence operations

Sequences do have common operations:

- Access
- Search
- Concatenation
- min/max/len
- ...

Sequence operations

Operation	Result
x in s	**`True`** if an item of s is equal to x, else **`False`**
x not in s	**`False`** if an item of s is equal to x, else **`True`**
s + t	the concatenation of s and t
s * n	equivalent to adding s to itself n times
s[i]	access to the ith item of s (first index: 0)
s[i:j]	slice of s from i (included) to j (excluded)
s[i:j:k]	slice of s from i to j (excluded) with step k
len(x)	length of s
min(x)	smallest item of s
max(x)	largest item of s

s and t are sequences of the same type

n, i, j and k are integers

x is an arbitrary object

Sequence operations

Access to items:

```
mylist = [ 42, 1337, 42, 666, 15 ]
```

Sequence operations

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```
mylist = [ 42, 1337, 42, 666, 15 ]
print(len(mylist)) # length: 5
```

Sequence operations

Access to items:

```
mylist = [ 42, 1337, 42, 666, 15 ]
print(len(mylist)) # length: 5
print(min(mylist)) # smallest: 15
print(max(mylist)) # biggest: 1337
```

Sequence operations

Access to items:

```
mylist = [ 42, 1337, 42, 666, 15 ]
print(len(mylist)) # length: 5
print(min(mylist)) # smallest: 15
print(max(mylist)) # biggest: 1337
print(42 in mylist)  # test presence 42: True
print(mylist[3])       # 4th item: 666
```

Sequence operations

Access to items:

```
mylist = [ 42, 1337, 42, 666, 15 ]
print(len(mylist)) # length: 5
print(min(mylist)) # smallest: 15
print(max(mylist)) # biggest: 1337
print(42 in mylist)  # test presence 42: True
print(mylist[3])       # 4th item: 666
print(mylist[1:3])     # slice: 1337, 42
```

Sequence operations

Access to items:

```
mylist = [ 42, 1337, 42, 666, 15 ]
print(len(mylist)) # length: 5
print(min(mylist)) # smallest: 15
print(max(mylist)) # biggest: 1337
print(42 in mylist)  # test presence 42: True
print(mylist[3])       # 4th item: 666
print(mylist[1:3])     # slice: 1337, 42
print(mylist[0:4:2])   # slice: 42, 42
```

Sequence operations

Operation	Result
s[i]	access to the *i*th item of *s* [first index: 0]
s[i:j]	slice beginning at *i* ending before *j* [ends at *j* - *1*]
s[i:j:k]	slice beginning at *i* ending before *j* by steps of *k*
s.count(x)	total number of occurrences of *x* in *s*
s.index(x)	index of the first occurrence of *x* in *s*
s.index(x, i)	index of the first occurrence of *x* in *s* at or after index *i*
s.index(x, i, j)	index of the first occurrence of *x* in *s* at or after index *i* and before index *j*

s and *t* are sequences of the same type

n, *i*, *j* and *k* are integers

x is an arbitrary object

Sequence operations

Slicing tips (1):

- s[:3] is equivalent to s[0:3]
  (prints everything from start until 3)

Sequence operations

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- s[5:] is equivalent to s[5:*(last index + 1)*]
  (prints everything from 5)

Sequence operations

Slicing tips (1):

- s[:3] is equivalent to s[0:3]
  (prints everything from start until 3)
- s[5:] is equivalent to s[5:*(last index + 1)*]
  (prints everything from 5)
- s[:] is equivalent to s[0:*(last index + 1)*]
  (prints everything)

Sequence operations

Slicing tips (1):

- s[:3] is equivalent to s[0:3]
  (prints everything from start until 3)
- s[5:] is equivalent to s[5:*(last index + 1)*]
  (prints everything from 5)
- s[:] is equivalent to s[0:*(last index + 1)*]
  (prints everything)
- s[::2] is equivalent to s[0:*(last index + 1)*:2]
  (prints everything by steps of 2)

Sequence operations

Slicing tips (1):

- s[:3] is equivalent to s[0:3]
  (prints everything from start until 3)
- s[5:] is equivalent to s[5:*(last index + 1)*]
  (prints everything from 5)
- s[:] is equivalent to s[0:*(last index + 1)*]
  (prints everything)
- s[::2] is equivalent to s[0:*(last index + 1)*:2]
  (prints everything by steps of 2)

(last index + 1) is equivalent to *len(s)*

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)









#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)             # 42, 37, 42, 66, 15
print(mylist[:])









#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)            # 42, 37, 42, 66, 15
print(mylist[:])         # 42, 37, 42, 66, 15
print(mylist[1:4])



#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)              # 42, 37, 42, 66, 15
print(mylist[:])           # 42, 37, 42, 66, 15
print(mylist[1:4])         #     37, 42, 66
print(mylist[2:])



#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)            # 42, 37, 42, 66, 15
print(mylist[:])         # 42, 37, 42, 66, 15
print(mylist[1:4])       #     37, 42, 66
print(mylist[2:])        #         42, 66, 15
print(mylist[:3])



#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)            # 42, 37, 42, 66, 15
print(mylist[:])         # 42, 37, 42, 66, 15
print(mylist[1:4])       #     37, 42, 66
print(mylist[2:])        #         42, 66, 15
print(mylist[:3])        # 42, 37, 42
print(mylist[::2])

#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)            # 42, 37, 42, 66, 15
print(mylist[:])         # 42, 37, 42, 66, 15
print(mylist[1:4])       #     37, 42, 66
print(mylist[2:])        #         42, 66, 15
print(mylist[:3])        # 42, 37, 42
print(mylist[::2])       # 42,     42,     15
print(mylist[1:5:3])
#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (1): Positive indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist)            # 42, 37, 42, 66, 15
print(mylist[:])         # 42, 37, 42, 66, 15
print(mylist[1:4])       #     37, 42, 66
print(mylist[2:])        #         42, 66, 15
print(mylist[:3])        # 42, 37, 42
print(mylist[:2])        # 42,     42,     15
print(mylist[1:5:3])     #     37,             15
#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

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Sequence operations

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- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items
- s[:-1] prints all of the items, except the last one

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items
- s[:-1] prints all of the items, except the last one
- s[-4:-1] prints the last 4 items, except the last one *(stop at -1)*

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items
- s[:-1] prints all of the items, except the last one
- s[-4:-1] prints the last 4 items, except the last one *(stop at -1)*
- s[2:-1] prints all the items from index 2, except the last one

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items
- s[:-1] prints all of the items, except the last one
- s[-4:-1] prints the last 4 items, except the last one *(stop at -1)*
- s[2:-1] prints all the items from index 2, except the last one
- s[-4:3] prints all the items from index -4 to index 2 *(stop at 3)*

Sequence operations

Slicing tips (2):

you can go back from the last item thanks to negative values

- s[-1] is equivalent to s[*(last index + 1)*] *(last item)*
- s[-4:] prints the last 4 items
- s[:-1] prints all of the items, except the last one
- s[-4:-1] prints the last 4 items, except the last one *(stop at -1)*
- s[2:-1] prints all the items from index 2, except the last one
- s[-4:3] prints all the items from index -4 to index 2 *(stop at 3)*

don't forget that the second index is not selected/it is the limit

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])       # 42, 37, 42, 66, 15




#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])        # 42, 37, 42, 66, 15
print(mylist[-1])
```

```
#                          [0] [1] [2] [3] [4]
```

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])        # 42, 37, 42, 66, 15
print(mylist[-1])       #                 15
print(mylist[:-1])



#                        [-5][-4][-3][-2][-1]
```

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])       # 42, 37, 42, 66, 15
print(mylist[-1])      #                 15
print(mylist[:-1])     # 42, 37, 42, 66
print(mylist[2:-1])



#                        [-5][-4][-3][-2][-1]
```

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])       # 42, 37, 42, 66, 15
print(mylist[-1])      #                 15
print(mylist[:-1])     # 42, 37, 42, 66
print(mylist[2:-1])    #         42, 66
print(mylist[-4:-1])

#                        [-5][-4][-3][-2][-1]
```

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])       # 42, 37, 42, 66, 15
print(mylist[-1])      #                 15
print(mylist[:-1])     # 42, 37, 42, 66
print(mylist[2:-1])    #         42, 66
print(mylist[-4:-1]) #      37, 42, 66
print(mylist[-4:4])
#                        [-5][-4][-3][-2][-1]
```

Sequence operations

Slicing (2): Negative indexes

```
mylist = [ 42, 37, 42, 66, 15 ]
#                          [0] [1] [2] [3] [4]
print(mylist[:])       # 42, 37, 42, 66, 15
print(mylist[-1])      #                 15
print(mylist[:-1])     # 42, 37, 42, 66
print(mylist[2:-1])    #         42, 66
print(mylist[-4:-1]) #     37, 42, 66
print(mylist[-4:4])    #     37, 42, 66
#                        [-5][-4][-3][-2][-1]
```

Sequence operations

Beware of **references**!

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It "*creates bindings between a target and an object*"

Sequence operations

Beware of **references**!

Python does not copy everything
It "*creates bindings between a target and an object*"

Modifying a sequence will change the assigned values in other sequences where it is referenced

Sequence operations

`id()` is a builtin that gives the identifier of an object

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(in a specific context, it gives the memory address of the object)

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(in a specific context, it gives the memory address of the object)

```
L1 = [ 42, 37, 42 ]          #   [0] [1] [2] [3] [4]
L2 = L1                      #   42, 37, 42
```

```
                             #   [0] [1] [2] [3] [4]
```

Sequence operations

`id()` is a builtin that gives the identifier of an object
(in a specific context, it gives the memory address of the object)

```
L1 = [ 42, 37, 42 ]          #   [0] [1] [2] [3] [4]
L2 = L1                      #   42, 37, 42
print(id(L1))
print(id(L2))
print(L1 == L2)
print(id(L1) == id(L2))




                             #   [0] [1] [2] [3] [4]
```

Sequence operations

`id()` is a builtin that gives the identifier of an object
(in a specific context, it gives the memory address of the object)

```
L1 = [ 42, 37, 42 ]       #   [0] [1] [2] [3] [4]
L2 = L1                   #   42, 37, 42
print(id(L1))
print(id(L2))
print(L1 == L2)           #   True
print(id(L1) == id(L2))   #   True




                          #   [0] [1] [2] [3] [4]
```

Sequence operations

`id()` is a builtin that gives the identifier of an object
(in a specific context, it gives the memory address of the object)

```
L1 = [ 42, 37, 42 ]       #   [0] [1] [2] [3] [4]
L2 = L1                   #   42, 37, 42
print(id(L1))
print(id(L2))
print(L1 == L2)           #   True
print(id(L1) == id(L2))   #   True
L2[0] = 88
print(L1)
print(L2)
                          #   [0] [1] [2] [3] [4]
```

Sequence operations

`id()` is a builtin that gives the identifier of an object
(in a specific context, it gives the memory address of the object)

```
L1 = [ 42, 37, 42 ]          #  [0] [1] [2] [3] [4]
L2 = L1                      #  42, 37, 42
print(id(L1))
print(id(L2))
print(L1 == L2)              #  True
print(id(L1) == id(L2))      #  True
L2[0] = 88
print(L1)                    #  88, 37, 42
print(L2)                    #  88, 37, 42
                             #  [0] [1] [2] [3] [4]
```

Sequence operations

Lists are not copied, only their references are used

```
L1 = [ 42, 37, 42 ]       #  [0] [1] [2] [3] [4]
L2 = L1                   #  42, 37, 42
print(id(L1))
print(id(L2))
print(L1 == L2)           #  True
print(id(L1) == id(L2))   #  True
L2[0] = 88
print(L1)                 #  88, 37, 42
print(L2)                 #  88, 37, 42
                          #  [0] [1] [2] [3] [4]
```

Sequence operations

```
L1 = [ 2, 7, [4, 3] ]    #   [0] [1] [2] [3] [4]
```

```
                         #   [0] [1] [2] [3] [4]
```

Sequence operations

```
L1 = [ 2, 7, [4, 3] ]     #   [0] [1] [2] [3] [4]
L2 = L1.copy()            #    2   7 [4,3]
print(L1 == L2)
print(id(L1) == id(L2))
```

```
                          #   [0] [1] [2] [3] [4]
```

Sequence operations

```
L1 = [ 2, 7, [4, 3] ]    #   [0] [1] [2] [3] [4]
L2 = L1.copy()           #    2   7 [4,3]
print(L1 == L2)          #   True
print(id(L1) == id(L2)) #   False
L2[0] = 8
```

```
                         #   [0] [1] [2] [3] [4]
```

Sequence operations

```
L1 = [ 2, 7, [4, 3] ]     #   [0] [1] [2] [3] [4]
L2 = L1.copy()            #    2   7 [4,3]
print(L1 == L2)           #   True
print(id(L1) == id(L2))   #   False
L2[0] = 8
print(L1)
print(L2)



                          #   [0] [1] [2] [3] [4]
```

Sequence operations

```
L1 = [ 2, 7, [4, 3] ]     #   [0] [1] [2] [3] [4]
L2 = L1.copy()            #    2   7 [4,3]
print(L1 == L2)           #   True
print(id(L1) == id(L2))   #   False
L2[0] = 8
print(L1)                 #    2   7 [4,3]
print(L2)                 #    8   7 [4,3]
L2[2][0] = 9
print(L1)
print(L2)
                          #   [0] [1] [2] [3] [4]
```

Sequence operations

```
L1 = [ 2, 7, [4, 3] ]     #   [0] [1] [2] [3] [4]
L2 = L1.copy()            #    2   7 [4,3]
print(L1 == L2)           #   True
print(id(L1) == id(L2))   #   False
L2[0] = 8
print(L1)                 #    2   7 [4,3]
print(L2)                 #    8   7 [4,3]
L2[2][0] = 9
print(L1)                 #    2   7 [9,3]
print(L2)                 #    8   7 [9,3]
                          #   [0] [1] [2] [3] [4]
```

Sequence operations

Module *copy*

Sequence operations

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- **Shallow copy**: creates a new sequence and inserts references to each contained object of the original sequence

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`NewList1 = list(MyList)` works as a shallow copy

Sequence operations

Module *copy*

- **Shallow copy**: creates a new sequence and inserts references to each contained object of the original sequence
- **Deep copy**: creates a new sequence and recursively inserts copies of each object of the original sequence

`NewList1 = list(MyList)` works as a shallow copy
`NewList2 = MyList[:]` works as a shallow copy

Sequence operations

Module *copy*

- **Shallow copy**: creates a new sequence and inserts references to each contained object of the original sequence
- **Deep copy**: creates a new sequence and recursively inserts copies of each object of the original sequence

`NewList1 = list(MyList)` works as a shallow copy
`NewList2 = MyList[:]` works as a shallow copy
`NewList3 = MyList.copy()` works as a shallow copy

Sequence operations

Major difficulties concern containers containing containers

```
import copy

L1 = [ [1,1], [2,2], [3,3] ]
```

Sequence operations

Major difficulties concern containers containing containers

```
import copy

L1 = [ [1,1], [2,2], [3,3] ]
L2 = copy.copy(L1)      # shallow copy
L3 = copy.deepcopy(L1) # deep copy
```

Sequence operations

Major difficulties concern containers containing containers

```
import copy

L1 = [ [1,1], [2,2], [3,3] ]
L2 = copy.copy(L1)      # shallow copy
L3 = copy.deepcopy(L1) # deep copy
L1[1][1] = 9
print(L2)
print(L3)
```

Sequence operations

Major difficulties concern containers containing containers

```
import copy

L1 = [ [1,1], [2,2], [3,3] ]
L2 = copy.copy(L1)      # shallow copy
L3 = copy.deepcopy(L1) # deep copy
L1[1][1] = 9
print(L2)    # [ [1,1], [2,9], [3,3] ]
print(L3)    # [ [1,1], [2,2], [3,3] ]
```

Sequence operations

Major difficulties concern containers containing containers

```
import copy

L1 = [ [1,1], [2,2], [3,3] ]
L2 = copy.copy(L1)      # shallow copy
L3 = copy.deepcopy(L1) # deep copy
L1[1][1] = 9
print(L2)    # [ [1,1], [2,9], [3,3] ]
print(L3)    # [ [1,1], [2,2], [3,3] ]
L1[1] = [0,0]
print(L2)
```

Sequence operations

Major difficulties concern containers containing containers

```
import copy

L1 = [ [1,1], [2,2], [3,3] ]
L2 = copy.copy(L1)      # shallow copy
L3 = copy.deepcopy(L1) # deep copy
L1[1][1] = 9
print(L2)    # [ [1,1], [2,9], [3,3] ]
print(L3)    # [ [1,1], [2,2], [3,3] ]
L1[1] = [0,0]
print(L2)    # [ [1,1], [2,9], [3,3] ]
```

6: Python's Main Concepts

1 Numeric types

2 Sequence types
- Sequence operations
- Lists
- Tuples
- Ranges

3 Mapping types

4 Other types

Lists

- mutable (can be modified after creation)

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  - *beware of shallow and deep copies*
- ordered (only the functions of reorganization change the order)
- same value can be recorded multiple times
- different types of items are allowed in the same list

Lists

Creation of a list:

```
vide = []
```

Lists

Creation of a list:

```
vide = []
initialisee1 = [ 42 ]
initialisee2 = [ 42, 1337, 666 ]
```

Lists

Creation of a list:

```
vide = []
initialisee1 = [ 42 ]
initialisee2 = [ 42, 1337, 666 ]
comprehension = [ x for x in range(0, 10) ]
```

Lists

Creation of a list:

```
vide = []
initialisee1 = [ 42 ]
initialisee2 = [ 42, 1337, 666 ]
comprehension = [ x for x in range(0, 10) ]
constructeurVide = list()
constructeur1 = list("abc")
constructeur2 = list( (58, "abc", 58) )
```

Lists

Creation of a list:

```
vide = []
initialisee1 = [ 42 ]
initialisee2 = [ 42, 1337, 666 ]
comprehension = [ x for x in range(0, 10) ]
constructeurVide = list()
constructeur1 = list("abc")
constructeur2 = list( (58, "abc", 58) )
```

- list initialized by comprehension or with a constructor can use any *iterable* object

Lists operations

Operation	Result
list.append(x)	add an item *x* to the end of the list
list.insert(pos, x)	insert an item *x* at position *pos* (items are pushed back/+1 applied to indexes)
list.extend(L)	concatenates lists : *L* added at the end of *list* (any iterable objects can be concatenated)
list.pop(pos)	remove the item at position *pos* (if no parameter given, it removes the last one)
list.remove(x)	remove the first item *x* found in the list
list.copy()	copy the list
list.reverse()	reverse the order of the list
list.sort()	sort alphabetically the list (add the parameter *reverse* = *True* to reverse)

x is an arbitrary object, *pos* is an integer, and *L* is a list

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)       # 99, 37, 42, 66
mylist.reverse()
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)       # 99, 37, 42, 66
mylist.reverse()        # 66, 42, 37, 99
mylist.sort()
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)       # 99, 37, 42, 66
mylist.reverse()        # 66, 42, 37, 99
mylist.sort()           # 37, 42, 66, 99
mylist.pop()
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)       # 99, 37, 42, 66
mylist.reverse()        # 66, 42, 37, 99
mylist.sort()           # 37, 42, 66, 99
mylist.pop()            # 37, 42, 66
mylist.pop(1)
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)       # 99, 37, 42, 66
mylist.reverse()        # 66, 42, 37, 99
mylist.sort()           # 37, 42, 66, 99
mylist.pop()            # 37, 42, 66
mylist.pop(1)           # 37, 66
l2 = mylist.copy()
l2.append(88)
mylist.extend(l2)
```

Lists

```
mylist = [ 42, 37, 42 ] # [0] [1] [2] [3] [4]
mylist.append(66)       # 42, 37, 42, 66
mylist.insert(1, 99)    # 42, 99, 37, 42, 66
mylist.remove(42)       # 99, 37, 42, 66
mylist.reverse()        # 66, 42, 37, 99
mylist.sort()           # 37, 42, 66, 99
mylist.pop()            # 37, 42, 66
mylist.pop(1)           # 37, 66
l2 = mylist.copy()   # 37, 66
l2.append(88)        # 37, 66, 88
mylist.extend(l2)       # 37, 66, 37, 66, 88
```

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initialisee1 = ( 42, )
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Creation of a tuple:

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vide = ()
initialisee1 = ( 42, )
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constructeurVide = tuple()
constructeur1 = tuple("abc",)
constructeur2 = tuple( (58, "abc", 58) )
```

Tuples

Creation of a tuple:

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vide = ()
initialisee1 = ( 42, )
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- Tuple with only 1 element must have a comma (,)

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Creation of a tuple:

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initialisee1 = ( 42, )
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```

- Tuple with only 1 element must have a comma (,)
- Tuples can be initialized with any iterable object

Tuples

Creating a tuple requires commas OR the iterable property

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Parenthesis are mandatory when a tuple is used as an argument or when creating an empty tuple

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```
my_tuple = tuple('a', 2)      # ('a', 2)
```

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Creating a tuple requires commas OR the iterable property
Parenthesis are mandatory when a tuple is used as an argument or when creating an empty tuple

```
my_tuple = tuple('a', 2)      # ('a', 2)
nb_tuple = tuple([1, 2, 3])
```

Tuples

Creating a tuple requires commas OR the iterable property
Parenthesis are mandatory when a tuple is used as an argument or when creating an empty tuple

```
my_tuple = tuple('a', 2)       # ('a', 2)
nb_tuple = tuple([1, 2, 3])    # (1, 2, 3)
str_tuple = tuple('abc')
```

Tuples

Creating a tuple requires commas OR the iterable property
Parenthesis are mandatory when a tuple is used as an argument or when creating an empty tuple

```
my_tuple = tuple('a', 2)       # ('a', 2)
nb_tuple = tuple([1, 2, 3])    # (1, 2, 3)
str_tuple = tuple('abc')       # ('a', 'b', 'c')
f('a', 'b', 'c')
f( ('a','b','c') )
```

Tuples

Creating a tuple requires commas OR the iterable property
Parenthesis are mandatory when a tuple is used as an argument or when creating an empty tuple

```
my_tuple = tuple('a', 2)       # ('a', 2)
nb_tuple = tuple([1, 2, 3])    # (1, 2, 3)
str_tuple = tuple('abc')       # ('a', 'b', 'c')
f('a', 'b', 'c')    # Calls f with 3 arguments
f( ('a','b','c') ) # Calls f with 1 argument
```

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- only for integers numbers
- always takes the same amount of memory
  - only 3 parameters are used (**`start`**, **`stop`**, **`step`**)

Ranges

Ranges are defined at least by the *stop* boundary

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Start defines the first value to take, by default it is 0
Step defines the step between each value, by default it is 1

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Start defines the first value to take, by default it is 0
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```
list(range(6))
```

Ranges

Ranges are defined at least by the *stop* boundary
Start defines the first value to take, by default it is 0
Step defines the step between each value, by default it is 1

```
list(range(6))          # 0 1 2 3 4 5
list(range(1, 6))
```

Ranges

Ranges are defined at least by the *stop* boundary
Start defines the first value to take, by default it is 0
Step defines the step between each value, by default it is 1

```
list(range(6))          # 0 1 2 3 4 5
list(range(1, 6))       #   1 2 3 4 5
list(range(0, 6, 2))
```

Ranges

Ranges are defined at least by the *stop* boundary
Start defines the first value to take, by default it is 0
Step defines the step between each value, by default it is 1

```
list(range(6))          # 0 1 2 3 4 5
list(range(1, 6))       #   1 2 3 4 5
list(range(0, 6, 2)) # 0   2   4
```

Ranges

Main range formulae: $r[i] = \text{start} + \text{step} \cdot i$

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Constraint: $i \geq 0$ and $r[i] < \text{stop}$

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Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

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Constraint: $i \geq 0$ and $r[i] < \text{stop}$
Ranges can go backward with negative steps!
Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))
```

Ranges

Main range formulae: $r[i] = \text{start} + \text{step} \cdot i$
Constraint: $i \geq 0$ and $r[i] < \text{stop}$
Ranges can go backward with negative steps!
Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))      # -5 -4 -3 -2 -1
list(range(0, -5, -1))
```

Ranges

Main range formulae: $r[i] = \text{start} + \text{step} \cdot i$

Constraint: $i \geq 0$ and $r[i] < \text{stop}$

Ranges can go backward with negative steps!

Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))       # -5 -4 -3 -2 -1
list(range(0, -5, -1)) #  0 -1 -2 -3 -4
list(range(5,  0, -1))
```

Ranges

Main range formulae: $r[i] = \text{start} + \text{step} \cdot i$

Constraint: $i \geq 0$ and $r[i] < \text{stop}$

Ranges can go backward with negative steps!

Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))       # -5 -4 -3 -2 -1
list(range(0, -5, -1)) #  0 -1 -2 -3 -4
list(range(5,  0, -1)) #  5  4  3  2  1
list(range(0))
```

Ranges

Main range formulae: $r[i] = \text{start} + \text{step} \cdot i$
Constraint: $i \geq 0$ and $r[i] < \text{stop}$
Ranges can go backward with negative steps!
Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))       # -5 -4 -3 -2 -1
list(range(0, -5, -1)) #  0 -1 -2 -3 -4
list(range(5,  0, -1)) #  5  4  3  2  1
list(range(0))           # []  step+  0 == stop
list(range(1,  0))
```

Ranges

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Ranges can go backward with negative steps!

Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))       # -5 -4 -3 -2 -1
list(range(0, -5, -1)) #  0 -1 -2 -3 -4
list(range(5,  0, -1)) #  5  4  3  2  1
list(range(0))           # []  step+  0 == stop
list(range(1,  0))       # []  step+  1 > stop
list(range(0, -1))
```

Ranges

Main range formulae: $r[i] = \text{start} + \text{step} \cdot i$

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Ranges can go backward with negative steps!

Constraint (negative step): $i \geq 0$ and $r[i] > \text{stop}$

```
list(range(-5, 0))       # -5 -4 -3 -2 -1
list(range(0, -5, -1)) #  0 -1 -2 -3 -4
list(range(5,  0, -1)) #  5  4  3  2  1
list(range(0))           # []  step+  0 == stop
list(range(1,  0))       # []  step+  1 > stop
list(range(0, -1))       # []  step+  0 > stop
```

Ranges

Ranges are a type, and can be compared with **==** and **!=**

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They are equal if they represent the same sequence of values

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Ranges

Ranges are a type, and can be compared with **==** and **!=**
They are equal if they represent the same sequence of values (**start**, **stop**, and **step** might be differents)

```
r0 = range(0)
r1 = range(0, 5, 1)
r2 = range(0, 3, 2)
r3 = range(0, 4, 2)
```

Ranges

Ranges are a type, and can be compared with **==** and **!=**
They are equal if they represent the same sequence of values (**start**, **stop**, and **step** might be differents)

```
r0 = range(0)                # []
r1 = range(0, 5, 1)          # 0 1 2 3 4
r2 = range(0, 3, 2)          # 0     3
r3 = range(0, 4, 2)          # 0     3
```

Ranges

Ranges are a type, and can be compared with **==** and **!=**
They are equal if they represent the same sequence of values (**start**, **stop**, and **step** might be differents)

```
r0 = range(0)                # []
r1 = range(0, 5, 1)          # 0 1 2 3 4
r2 = range(0, 3, 2)          # 0     3
r3 = range(0, 4, 2)          # 0     3
print(r0 == r1)
```

Ranges

Ranges are a type, and can be compared with **==** and **!=**
They are equal if they represent the same sequence of values (**start**, **stop**, and **step** might be differents)

```
r0 = range(0)                # []
r1 = range(0, 5, 1)          # 0 1 2 3 4
r2 = range(0, 3, 2)          # 0     3
r3 = range(0, 4, 2)          # 0     3
print(r0 == r1)        # False
print(r1 == r2)
```

Ranges

Ranges are a type, and can be compared with **==** and **!=**
They are equal if they represent the same sequence of values (**start**, **stop**, and **step** might be differents)

```
r0 = range(0)                # []
r1 = range(0, 5, 1)          # 0 1 2 3 4
r2 = range(0, 3, 2)          # 0     3
r3 = range(0, 4, 2)          # 0     3
print(r0 == r1)          # False
print(r1 == r2)          # False
print(r2 == r3)
```

Ranges

Ranges are a type, and can be compared with **==** and **!=**
They are equal if they represent the same sequence of values (**start**, **stop**, and **step** might be differents)

```
r0 = range(0)                # []
r1 = range(0, 5, 1)          # 0 1 2 3 4
r2 = range(0, 3, 2)          # 0     3
r3 = range(0, 4, 2)          # 0     3
print(r0 == r1)          # False
print(r1 == r2)          # False
print(r2 == r3)          # True
```

6: Python's Main Concepts

1 Numeric types

2 Sequence types

3 Mapping types
- Dictionnaries

4 Other types

Mapping types

- dict *(dictionnary)*

Mapping types

- dict *(dictionnary)*
- "*maps hashable values to arbitrary objects*"

Mapping types

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- "*maps hashable values to arbitrary objects*"
  - keys = hashable values

Mapping types

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  - keys must be hashable (a list can't be a key)

Mapping types

- dict *(dictionnary)*
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  - if two values are equal, they refer to the same key

Mapping types

- dict *(dictionnary)*
- "*maps hashable values to arbitrary objects*"
  - keys = hashable values
  - keys must be hashable (a list can't be a key)
  - if two values are equal, they refer to the same key
- mutable

6: Python's Main Concepts

1 Numeric types

2 Sequence types

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4 Other types

Dictionnaries

Creation of a dict:

Dictionnaries

Creation of a dict:

```
vide = dict()
dict1 = {"one": 1, "two": 2, "three": 3}
```

Dictionnaries

Creation of a dict:

```
vide = dict()
dict1 = {"one": 1, "two": 2, "three": 3}
dict2 = dict(one=1, two=2, three=3)
```

Dictionnaries

Creation of a dict:

```
vide = dict()
dict1 = {"one": 1, "two": 2, "three": 3}
dict2 = dict(one=1, two=2, three=3)
dict3 = dict({'three': 3, 'one': 1, 'two': 2})
```

Dictionnaries

Creation of a dict:

```
vide = dict()
dict1 = {"one": 1, "two": 2, "three": 3}
dict2 = dict(one=1, two=2, three=3)
dict3 = dict({'three': 3, 'one': 1, 'two': 2})
dict4 = dict({'one': 1, 'three': 3}, two=2)
```

Dictionnaries

Creation of a dict:

```
vide = dict()
dict1 = {"one": 1, "two": 2, "three": 3}
dict2 = dict(one=1, two=2, three=3)
dict3 = dict({'three': 3, 'one': 1, 'two': 2})
dict4 = dict({'one': 1, 'three': 3}, two=2)
dict5 = dict([('two',2),('one',1), ('three',3)
   ])
```

Dicts operations

Operation	Result
list(d)	return a list of all the keys of *d*
len(d)	number of items in *d*
d.get(key, default)	like **`d[key]`**, but return *default* if *key* not found
d.keys()	return the dictionnary's keys
iter(d)	return an iterator over the keys of *d*
d[key] = value	set *value* at key *key*
del d[key]	Remove the value at **`d[key]`** (Raise a KeyError if *key* not found)
d.pop(key)	remove *key* and return the associated value
d.clear()	remove all items from the dictionnary
d.copy()	shallow copy of the dictionnary *d*

Dicts operations

```
dict1 = {"one": 1, "two": 2, "three": 3}
dict1["one"]
dict1["one"] + dict1["two"]
len(dict1)
```

Dicts operations

```
dict1 = {"one": 1, "two": 2, "three": 3}
dict1["one"]          # 1
dict1["one"] + dict1["two"] # 3
len(dict1)            # 3
list(dict1)
```

Dicts operations

```
dict1 = {"one": 1, "two": 2, "three": 3}
dict1["one"]          # 1
dict1["one"] + dict1["two"] # 3
len(dict1)            # 3
list(dict1)           # ['one','two','three']
```

Dicts operations

```
dict1 = {"one": 1, "two": 2, "three": 3}
dict1["one"]          # 1
dict1["one"] + dict1["two"] # 3
len(dict1)            # 3
list(dict1)           # ['one','two','three']
dict1.get("one")
dict1.get("A", 42)
```

Dicts operations

```
dict1 = {"one": 1, "two": 2, "three": 3}
dict1["one"]          # 1
dict1["one"] + dict1["two"] # 3
len(dict1)            # 3
list(dict1)           # ['one','two','three']
dict1.get("one")      # 1
dict1.get("A", 42) # 42
dict1["A"] = 8
dict1.get("A", 42)
```

Dicts operations

```
dict1 = {"one": 1, "two": 2, "three": 3}
dict1["one"]          # 1
dict1["one"] + dict1["two"] # 3
len(dict1)            # 3
list(dict1)           # ['one','two','three']
dict1.get("one")      # 1
dict1.get("A", 42) # 42
dict1["A"] = 8
dict1.get("A", 42) # 8
```

Dicts operations

Operation	Result
d | e	new dict with merged keys and values from *d* and *e* (values of *e* erase those from *d* if same key)
d |= e	like **d | e** except that *d* is updated (values of *e* erase those from *d* if same key)

Dicts operations

```
dict1 = {"one": 1, "two": 2}
dict2 = {"one": 4, "six": 6}
```

Dicts operations

```
dict1 = {"one": 1, "two": 2}
dict2 = {"one": 4, "six": 6}
dict1["one"] + dict2["one"]
```

Dicts operations

```
dict1 = {"one": 1, "two": 2}
dict2 = {"one": 4, "six": 6}
dict1["one"] + dict2["one"]    # 5
NewD = dict1 | dict2
```

Dicts operations

```
dict1 = {"one": 1, "two": 2}
dict2 = {"one": 4, "six": 6}
dict1["one"] + dict2["one"]    # 5
NewD = dict1 | dict2
NewD["two"]
NewD["six"]
NewD["one"]
```

Dicts operations

```
dict1 = {"one": 1, "two": 2}
dict2 = {"one": 4, "six": 6}
dict1["one"] + dict2["one"]    # 5
NewD = dict1 | dict2
NewD["two"]    # 2
NewD["six"]    # 6
NewD["one"]    # 4
```

6: Python's Main Concepts

1. Numeric types
2. Sequence types
3. Mapping types
4. Other types
   - Set and FrozenSet
   - Text sequence type

Other Built-in types

- Set (and FrozenSet)
- Text sequence type - **`str`**
- Binary sequence type

More details on types

`https://docs.python.org/3/library/stdtypes.html`

Other Built-in types

- Set (and FrozenSet)
- Text sequence type - **`str`**
- Binary sequence type
  - *(we won't see it)*

More details on types

`https://docs.python.org/3/library/stdtypes.html`

6: Python's Main Concepts

1 Numeric types

2 Sequence types

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4 Other types
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- Text sequence type

Set

- mutable

Set

- mutable
  - *FrozenSet are immutables*

Set

- mutable
  - *FrozenSet are immutables*
- unordered

Set

- mutable
  - *FrozenSet are immutables*
- unordered
  - *sequences cannot be used (index, slicing, ...)*

Set

- mutable
  - *FrozenSet are immutables*
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  - *sequences cannot be used (index, slicing, ...)*
- distinct values only

Set

- mutable
  - *FrozenSet are immutables*
- unordered
  - *sequences cannot be used (index, slicing, ...)*
- distinct values only
- only hashable objects can be added

Set

```
set1 = {'world', 'hello'}
set2 = set( [4, 42, 6] )
set3 = {x for x in 'abracadabra'
          if x not in 'abc'}
set3
```

Set

```
set1 = {'world', 'hello'}  # {'hello', 'world'}
set2 = set( [4, 42, 6] )
set3 = {x for x in 'abracadabra'
          if x not in 'abc'}
set3
```

Set

```
set1 = {'world', 'hello'}  # {'hello', 'world'}
set2 = set( [4, 42, 6] )   # {42, 4, 6}
set3 = {x for x in 'abracadabra'
          if x not in 'abc'}
set3
```

Set

```
set1 = {'world', 'hello'}  # {'hello', 'world'}
set2 = set( [4, 42, 6] )   # {42, 4, 6}
set3 = {x for x in 'abracadabra'
          if x not in 'abc'}
set3                       # {'d', 'r'}
```

Set

```
set1 = {'world', 'hello'}  # {'hello', 'world'}
set2 = set( [4, 42, 6] )   # {42, 4, 6}
set3 = {x for x in 'abracadabra'
          if x not in 'abc'}
set3                       # {'d', 'r'}
```

Main usages: membership testing, removing duplicates from a sequence, mathematical operations (union, intersection, ...)

Set operations

Operation	Result
add(e)	add an element to a set
remove(e)	remove an element from a set
len(s)	number of elements in set *s*
x in s	test *x* for membership in *s*
copy()	shallow copy of set
isdisjoint(s2)	test if no element are in common with *s2*
issubset(s2)	test if every element is in the set *s2*
issuperset(s2)	test if every element of *s2* is in the set
	new set with elements:
union(s2)	- from the set and *s2*
intersection(s2)	- common to the set and *s2*
difference(s2)	- in the set that are not in *s2*
symmetric_difference(s2)	- in either the set or *s2* but not both

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)      # False
s2.isdisjoint(s3)
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)       # False
s2.isdisjoint(s3)       # True
s3.issubset(s1)
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)       # False
s2.isdisjoint(s3)       # True
s3.issubset(s1)         # True
s3.issuperset(s1)
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)       # False
s2.isdisjoint(s3)       # True
s3.issubset(s1)         # True
s3.issuperset(s1)       # False
s4.issubset(s1)
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)       # False
s2.isdisjoint(s3)       # True
s3.issubset(s1)         # True
s3.issuperset(s1)       # False
s4.issubset(s1)         # False
s4.issuperset(s1)
```

Set operations

```
s1 = { 1, 2, 3, 4 }
s2 = { 3, 4, 5, 6 }
s3 = { 1, 2 }
s4 = { 1, 2, 3, 4, 5}
s2.isdisjoint(s1)       # False
s2.isdisjoint(s3)       # True
s3.issubset(s1)         # True
s3.issuperset(s1)       # False
s4.issubset(s1)         # False
s4.issuperset(s1)       # True
```

6: Python's Main Concepts

1 Numeric types

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- Set and FrozenSet
- Text sequence type

Text sequence type

- immutable (when created, cannot be modified)

Text sequence type

- immutable (when created, cannot be modified)
- ordered

Text sequence type

- immutable (when created, cannot be modified)
- ordered
- same value can be recorded multiple times

Text sequence type

- immutable (when created, cannot be modified)
- ordered
- same value can be recorded multiple times
- only **`str`** objets can be used inside

Text sequence type

Three ways to write literals:

- Single quotes: `'Text'`

Text sequence type

Three ways to write literals:

- Single quotes: `'Text'`
  - *(may embed double quotes* `'The "only" Text'` *)*

Text sequence type

Three ways to write literals:

- Single quotes: `'Text'`
  - *(may embed double quotes* `'The "only" Text'` *)*
- Double quotes: `"Text"`

Text sequence type

Three ways to write literals:

- Single quotes: `'Text'`
  - *(may embed double quotes* `'The "only" Text'` *)*
- Double quotes: `"Text"`
  - *(may embed single quotes* `"The 'only' Text"` *)*

Text sequence type

Three ways to write literals:

- Single quotes: `'Text'`
  - *(may embed double quotes `'The "only" Text'`)*
- Double quotes: `"Text"`
  - *(may embed single quotes `"The 'only' Text"`)*
- Triple quotes: `'''Text'''` or `"""Text"""`

Text sequence type

Three ways to write literals:

- Single quotes: `'Text'`
  - *(may embed double quotes `'The "only" Text'`)*
- Double quotes: `"Text"`
  - *(may embed single quotes `"The 'only' Text"`)*
- Triple quotes: `'''Text'''` or `"""Text"""`
  - *(triple quotes can be on multiple lines)*

Text sequence type

As strings are immutables, you must:

Text sequence type

As strings are immutables, you must:

- concatenate strings into a new string

Text sequence type

As strings are immutables, you must:

- concatenate strings into a new string
- extract substrings with slices

Text sequence type

As strings are immutables, you must:

- concatenate strings into a new string
- extract substrings with slices

`str()` constructor converts native types into strings

Text sequence type

```
A = str('My String')
B = str("A sentence")
C = str('''The giant
text with a lot of
lines''')
```

Text sequence type

```
A = str('My String')
B = str("A sentence")
C = str('''The giant
text with a lot of
lines''')
D = B[0:2] + A[3:10]

print(D)
```

Text sequence type

```
A = str('My String')
B = str("A sentence")
C = str('''The giant
text with a lot of
lines''')
D = B[0:2] + A[3:10]

print(D)          #  "A String"
```

Text sequence type

Operation	Result
`str.isprintable()`	**True** if only printable characters and more than one char
`str.isascii()`	**True** if only ASCII characters and more than one char
`str.isalpha()`	**True** if only alphabetic characters and more than one char
`str.isalnum()`	**True** if only alphanumeric characters and more than one char
`str.isdigit()`	**True** if only numbers characters and more than one char
`str.isnumeric()`	**True** if only numeric characters and more than one char

Text sequence type

```
"abc42".isprintable()   #  True
"abc42".isascii()       #  True
"abc42".isalpha()       # False
"abc".isalpha()         #  True
"abc42".isalnum()       #  True
"42".isdigit()          #  True
"42.2".isdigit()        # False
"-42".isdigit()         # False
"-42".isnumeric()       # False
```

Text sequence type

Operation	Result
`str.lower()`	Put the string into lowercase
`str.upper()`	Put the string into uppercase
`str.capitalize()`	1st character is capitalized, other are lowercased
`str.title()`	Same as capitalized, but on each word
`str.swapcase()`	Reverse upper to lower case characters, and lower to upper
`str.isspace()`	**True** if there are only whitespaces and at least one character
`str.isupper()`	**True** if all characters are uppercase and at least one character

Don't forget: a string is immutable!

All of the string methods *always* return a copy of the string

Text sequence type

```
A = str('tHis is A TExT wIth')
print(A.capitalize())
```

Text sequence type

```
A = str('tHis is A TExT wIth')
print(A.capitalize()) # "This is a text with"
print(A.title())
```

Text sequence type

```
A = str('tHis is A TExT wIth')
print(A.capitalize()) # "This is a text with"
print(A.title())      # "THis Is A TExT WIth"
print(A.swapcase())
```

Text sequence type

```
A = str('tHis is A TExT wIth')
print(A.capitalize()) # "This is a text with"
print(A.title())      # "THis Is A TExT WIth"
print(A.swapcase())   # "ThIS IS a teXt WiTH"
```

Text sequence type

```
A = str('tHis is A TExT wIth')
print(A.capitalize()) # "This is a text with"
print(A.title())      # "THis Is A TExT WIth"
print(A.swapcase())   # "ThIS IS a teXt WiTH"

B = str("    ")
print(B.isspace())
print(B.isupper())
```

Text sequence type

```
A = str('tHis is A TExT wIth')
print(A.capitalize()) # "This is a text with"
print(A.title())      # "THis Is A TExT WIth"
print(A.swapcase())   # "ThIS IS a teXt WiTH"

B = str("    ")
print(B.isspace())    # True
print(B.isupper())    # False
```

Text sequence type

Operation	Result
`str.`**`removeprefix(p)`**	If the string begins with prefix *p*, then it is removed
`str.`**`removesuffix(s)`**	If the string ends with suffix *s*, then it is removed
`str.`**`lstrip(`*`[chars]`*`)`**	Remove leading characters present in *chars*. If no argument, remove whitespaces.
`str.`**`rstrip(`*`[chars]`*`)`**	Remove trailing characters present in *chars*. If no argument, remove whitespaces.
`str.`**`strip(`*`[chars]`*`)`**	Apply **`lstrip()`** and **`rstrip()`**

Text sequence type

```
'TestHook'.removeprefix('Test')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')  # three!
'Arthur: three!'.lstrip('Arthur: ')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')  # three!
'Arthur: three!'.lstrip('Arthur: ')        # ee!

'www.example.com'.lstrip('cmowz.')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')  # three!
'Arthur: three!'.lstrip('Arthur: ')        # ee!

'www.example.com'.lstrip('cmowz.')  # 'example.com'
'   spacious   '.lstrip()
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')  # three!
'Arthur: three!'.lstrip('Arthur: ')        # ee!

'www.example.com'.lstrip('cmowz.')  # 'example.com'
'   spacious   '.lstrip()          # 'spacious   '

'Monty Python'.rstrip(' Python')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')  # three!
'Arthur: three!'.lstrip('Arthur: ')        # ee!

'www.example.com'.lstrip('cmowz.')  # 'example.com'
'   spacious   '.lstrip()           # 'spacious   '

'Monty Python'.rstrip(' Python')       # M
'Monty Python'.removesuffix(' Python')
```

Text sequence type

```
'TestHook'.removeprefix('Test')      # Hook
'BaseTestCase'.removeprefix('Test')  # BaseTestCase

'Arthur: three!'.removeprefix('Arthur: ')  # three!
'Arthur: three!'.lstrip('Arthur: ')        # ee!

'www.example.com'.lstrip('cmowz.')  # 'example.com'
'   spacious   '.lstrip()           # 'spacious   '

'Monty Python'.rstrip(' Python')        # M
'Monty Python'.removesuffix(' Python')  # Monty
```

Text sequence type

Operation	Result
`str.`**`find(sub)`** ***`find(sub,start,end)`***	Find 1st index of substring *sub* within the slice **`[start:end]`**, or return **`-1`**
`str.`**`index(sub)`** ***`index(sub,start,end)`***	Like **`find`**, but raise **`ValueError`** instead of returning **`-1`**
`str.`**`replace(old,new)`** ***`replace(old,new,count)`***	Replace all (or the *count* firsts) of the occurrencies of *old* by *new*

Text sequence type

```
"ballo" in "C'est ballo"
```

Text sequence type

```
"ballo" in "C'est ballo"        # True
"C'est ballo".find("ballo")
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")                    # -1
"alalala".index("la", 2, 5)
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")                    # -1
"alalala".index("la", 2, 5)       #  3
"ah".index("b")
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")                    # -1
"alalala".index("la", 2, 5)       #  3
"ah".index("b")                   # [Exception]
"ahehih".replace("ih", "oh")
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")                    # -1
"alalala".index("la", 2, 5)       #  3
"ah".index("b")                   # [Exception]
"ahehih".replace("ih", "oh")      #  "ahehoh"
"hohoho".replace("ho", "ha")
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")                    # -1
"alalala".index("la", 2, 5)       #  3
"ah".index("b")                   # [Exception]
"ahehih".replace("ih", "oh")      #  "ahehoh"
"hohoho".replace("ho", "ha")      #  "hahaha"
"hohoho".replace("ho", "ha",2)
```

Text sequence type

```
"ballo" in "C'est ballo"          # True
"C'est ballo".find("ballo")       #  6
"alalala".find("la", 2, 5)        #  3
"ah".find("b")                    # -1
"alalala".index("la", 2, 5)       #  3
"ah".index("b")                   # [Exception]
"ahehih".replace("ih", "oh")      #  "ahehoh"
"hohoho".replace("ho", "ha")      #  "hahaha"
"hohoho".replace("ho", "ha",2)    #  "hahaho"
```

Text sequence type

Operation	Result
`str.join(iterable)`	Separate each element of *iterate* with the calling string
`str.partition(sep)`	Separate the string in a 3-tuple: - the substring before the 1st *sep* - *sep* - the substring after the 1st *sep*
`str.split(sep,maxsplit)` ***split(sep=None,maxsplit=-1)***	Split the string into a list of words Split *maxsplit* times (-1 for all) *(Whitespaces are treated differently)*
`str.splitlines(keepends)` ***splitlines(keepends=False)***	Split a string by lines *(see manual for line boundaries)*

Text sequence type

```
"|".join("alo alo")
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ")
```

Text sequence type

```
"|".join("alo alo")         # 'a|l|o| |a|l|o'
"alo alo".partition(" ") # ('alo', ' ', 'alo')
"a b c".partition(" ")
```

Text sequence type

```
"|".join("alo alo")         # 'a|l|o| |a|l|o'
"alo alo".partition(" ") # ('alo', ' ', 'alo')
"a b c".partition(" ")    # ('a', ' ', 'b c')
"a b c".split()
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ") # ('alo', ' ', 'alo')
"a b c".partition(" ")    # ('a', ' ', 'b c')
"a b c".split()              # ['a', 'b', 'c']
"abcbdbe".split()
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ") # ('alo', ' ', 'alo')
"a b c".partition(" ")    # ('a', ' ', 'b c')
"a b c".split()              # ['a', 'b', 'c']
"abcbdbe".split()            # ['abcbdbe']
"abcbdbe".split("b", 1)
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ")     # ('alo', ' ', 'alo')
"a b c".partition(" ")       # ('a', ' ', 'b c')
"a b c".split()              # ['a', 'b', 'c']
"abcbdbe".split()            # ['abcbdbe']
"abcbdbe".split("b", 1)      # ['a', 'cbdbe']
"abcbdbe".split("b", -1)
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ")     # ('alo', ' ', 'alo')
"a b c".partition(" ")       # ('a', ' ', 'b c')
"a b c".split()              # ['a', 'b', 'c']
"abcbdbe".split()            # ['abcbdbe']
"abcbdbe".split("b", 1)      # ['a', 'cbdbe']
"abcbdbe".split("b", -1)     # ['a','c','d','e']
'::1:2:'.split(':')
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ")     # ('alo', ' ', 'alo')
"a b c".partition(" ")       # ('a', ' ', 'b c')
"a b c".split()              # ['a', 'b', 'c']
"abcbdbe".split()            # ['abcbdbe']
"abcbdbe".split("b", 1)      # ['a', 'cbdbe']
"abcbdbe".split("b", -1)     # ['a','c','d','e']
'::1:2:'.split(':')          # ['','','1','2', '']
"   a   b c   ".split()
```

Text sequence type

```
"|".join("alo alo")          # 'a|l|o| |a|l|o'
"alo alo".partition(" ")     # ('alo', ' ', 'alo')
"a b c".partition(" ")       # ('a', ' ', 'b c')
"a b c".split()              # ['a', 'b', 'c']
"abcbdbe".split()            # ['abcbdbe']
"abcbdbe".split("b", 1)      # ['a', 'cbdbe']
"abcbdbe".split("b", -1)     # ['a','c','d','e']
'::1:2:'.split(':')          # ['','','1','2', '']
"   a   b c   ".split()      # ['a', 'b', 'c']
```

Text sequence type

Operation	Result
`str.center(width)`	Center the string with leading and trailing whitespaces and make its length equal to *fill*
`str.zfill(width)`	Put leading 0 to fill the string and make its length equal to *fill* (eventually add − as a prefix)
`str.ljust(width)` `ljust(width,fillchar)`	Left justify for length *width*, and fill with *fillchar* characters
`str.rjust(width)` `rjust(width,fillchar)`	Right justify like **`str.ljust()`**

Text sequence type

```
"abc".center(7)
```

Text sequence type

```
"abc".center(7)    # '   abc   '
"abc".center(2)
```

Text sequence type

```
"abc".center(7)    # '  abc  '
"abc".center(2)    # 'abc'
"abc".center(4)
```

Text sequence type

```
"abc".center(7)    # '  abc  '
"abc".center(2)    # 'abc'
"abc".center(4)    # 'abc '
"  abc".center(7)
```

Text sequence type

```
"abc".center(7)    # '  abc  '
"abc".center(2)    # 'abc'
"abc".center(4)    # 'abc '
"  abc".center(7)  # '   abc '
"abc".rjust(7)
"abc".ljust(7)
```

Text sequence type

```
"abc".center(7)    # '  abc  '
"abc".center(2)    # 'abc'
"abc".center(4)    # 'abc '
"  abc".center(7)  # '   abc '
"abc".rjust(7)     # '    abc'
"abc".ljust(7)     # 'abc    '
"42".zfill(5)
```

Text sequence type

```
"abc".center(7)    # '  abc  '
"abc".center(2)    # 'abc'
"abc".center(4)    # 'abc '
"  abc".center(7)  # '   abc '
"abc".rjust(7)     # '    abc'
"abc".ljust(7)     # 'abc    '
"42".zfill(5)      # '00042'
"42.3".zfill(5)
```

Text sequence type

```
"abc".center(7)    # '  abc  '
"abc".center(2)    # 'abc'
"abc".center(4)    # 'abc '
"  abc".center(7)  # '   abc '
"abc".rjust(7)     # '    abc'
"abc".ljust(7)     # 'abc    '
"42".zfill(5)      # '00042'
"42.3".zfill(5)    # '042.3'
```

Thank you for your attention