Python

BASICS

Introduction to Python programming, basic concepts: formatting, naming conventions, variables, etc.
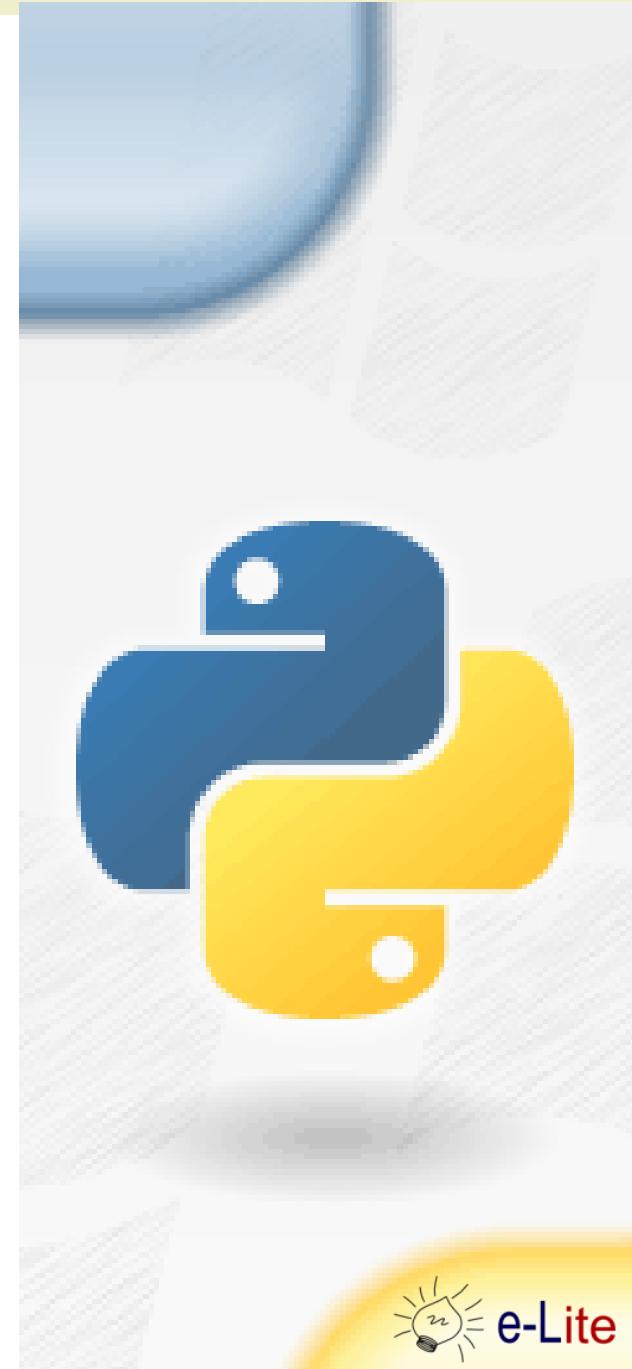
```c
#include <stdio.h>

int main()
{
    printf("Hello, world!");
    return 0;
}
```

```
print("Hello, world!")
```

inline comment

```
# this will print "Hello, world!"
print("Hello, world!")
```

Keywords

- and
- del
- from
- not
- while
- as
- elif
- global
- or
- with

- assert
- else
- if
- pass
- yield
- break
- except
- import
- class
- exec

- in
- raise
- continue
- finally
- is
- return
- def
- for
- lambda
- try

Variables

this is a string

```
language_name = "Python"
```

naming convention: joined_lower

Variables

```python
language_name = "Python"
version = '3.6.0'
introduced = 1991
is_awesome = True
```

Type Inference

```
language_name = "Python" # string
version = '3.6.0'    # another string
introduced = 1991    # integer
is_awesome = True    # boolean
```

actual type can be checked with `type()`

String

```
some_string = "I'm a string"


another_string = 'I'm a string, too'
```

String

```
some_string = "I'm a string"

another_string = 'I'm a string, too'
# SyntaxError: invalid syntax
```

String

```
another_string = 'I am a string, too'

another_strig = 'I\'m a string, too'
```

escape sequence

String

```
long_string = """I am a long string.
I span over two lines."""

long_string = '''I am another long string.
I span over three lines.
I am composed by three sentences.'''
```

If Statement

```
people = 20
cats = 30

if people < cats:
    print("Too many cats! We are doomed!")
```
4 spaces

```
if people > cats:
    print("Not many cats! We are safe!")
```
4 spaces

If Statement

```
people = 20
cats = 30

if people < cats:
    print("Too many cats! We are doomed!")
elif people > cats:
    print("Not many cats! We are safe!")
else:
    print("We can't decide.")
```

Comparators and Booleans Operators

```
print(2 == 1)

print('string' == "string")

print(not False)

print(2==1 and True)

print(2==1 or True)
```

Python basics

Comparators and Booleans Operators

```python
print(2 == 1) # False

print('string' == "string") # True

print(not False) # True

print(2==1 and True) # False

print(2==1 or True) # True
```

Characters

```
for char in "hello":
    print(char)
```

```
h
e
l
l
o
```

Characters

```
say_hello = "hello!"
print(say_hello[1])
```

index

e

Characters

```
say_hello = "hello!"
print(type(say_hello[1]))
```

```
<class 'str'>
```

Combining Strings

```
language_name = "Python"
version = '3.6.0'

python_version = language_name + version
# python_version is Python3.6.0

print("my " + "name") # my name
```

concatenation

Combining Strings

repetition

```
language_name = "Python"

a_lot_of_python = language_name*3
# a_lot_of_python is PythonPythonPython
```

Building Complex Strings

```
a = 3
b = 5

# 3 times 5 is 15
print(a, "times", b, "is", a*b)
```

works with `print()`, only

Building Complex Strings

```
a = 3
b = 5


# 3 times 5 is 15
result = a + " times " + b + " is " + a*b
```

Building Complex Strings

```
a = 3
b = 5

# 3 times 5 is 15
result = a + " times " + b + " is " + a*b
#TypeError: unsupported operand type(s)
```

Building Complex Strings

```
a = 3
b = 5

# 3 times 5 is 15
result = str(a) + " times " + str(b) + "
is " + str(a*b)
```

Python basics

String Interpolation

a = 3

b = 5

# 3 times 5 is 15
result = "%d times %d is %d" % (a, b, a*b)

Specifiers
- %s, format strings
- %d, format numbers
- %r, raw representation

tuple

```
specifiers.py
```
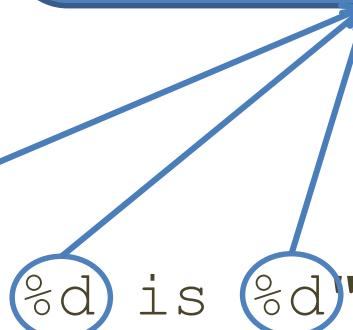
String Interpolation

```
a = 3
b = 5

# 3 times 5 is 15
result = "{} times {} is {}".format(a, b,
a*b)
```

new way!

String Immutability

```
# hello
say_hello = "helko"


# ops…
say_hello[3] = "l"
```

Python basics

String Immutability

```
# hello
say_hello = "helko"

# ops…
say_hello[3] = "l"
# TypeError
```

String Immutability

```
# hello
say_hello = "helko"


# ops…
say_hello = "hello"
```

Other operations with strings? ⟶ Python docs

Getting Input

```
print("How old are you?")
age = input() # age is a string

print("You are " + age + " years old")
```

Python basics

Getting Input

```python
print("How old are you?")
age = input() # age is a string

print("You are " + age + " years old")

# I want "age" to be a number!
age = int(input())
```

Getting Input

```python
age = input("How old are you? ")

print("You are " + age + " years old")
```

List

```
fruits = ["apples", "oranges", "pears"]
count = [1, 2, 3, 4, 5]
change = [1, "pennies", 2, "dimes"]
```

a datatype to store multiple items, in sequence

Dictionary

key, immutable

value

```
legs = {"ant": 6, "snake": 0, "cow": 4}
states = {"Italy": "IT", "Germany": "DE"}
```

a datatype to store multiple items, not in sequence

Loops

```
doctor = 1

while doctor <= 13:
    exterminate(doctor)
    doctor += 1
```

For Loop: Strings

```
for char in "hello":
    print(char)
```

```
h
e
l
l
o
```

For Loop: Ranges

```python
for number in range(0,5):
    print(number)
```

```
0
1
2
3
4
```

For Loop: Ranges

```
for number in range(0,25,5):
    print(number)
```

```
0
5
10
15
20
```

For Loop: Lists

```python
fruits = ["apples", "oranges", "pears"]

for fruit in fruits:
    print("I love", fruit)
```

```
I love apples
I love oranges
I love pears
```

For Loop: Dictionaries

```
legs = {"ant": 6, "snake": 0, "cow": 4}

for (animal, number) in legs.items():
    print("{} has {} legs".format(animal,
number))
```

```
ant has 6 legs
snake has 0 legs
cow has 4 legs
```

Printing a List

```
to_buy = ["eggs", "milk"]
print(to_buy)
```

```
['eggs', 'milk']
```

Printing a List

```
to_buy = ["eggs", "milk"]
print(to_buy[0])
```

```
eggs
```

Modifying a List

```python
to_buy = ["eggs", "milk"]
print(to_buy[0])


to_buy[0] = "butter"
print(to_buy[0])
```

```
eggs

butter
```

Modifying a List

```
to_buy = ["eggs", "milk"]

# I need to buy chocolate!
to_buy.append("chocolate")
```

```
['eggs', 'milk', 'chocolate']
```

Modifying a List

```
to_buy = ["eggs", "milk"]
to_buy.append("chocolate")

to_buy.extend(["flour", "cheese"])
```

```
['eggs', 'milk', 'chocolate', 'flour', 'cheese']
```

Modifying a List

```python
to_buy = ["eggs", "milk"]
to_buy.append("chocolate")

to_buy = to_buy + ["flour", "cheese"]
```

concatenation

```
['eggs', 'milk', 'chocolate', 'flour', 'cheese']
```

Modifying a List

```
to_buy = ["eggs", "milk", "chocolate",
"flour", "cheese"]
```

slice operator

```
print(to_buy[1:3])
```

```
['milk', 'chocolate']
```

Modifying a List

```
to_buy = ["eggs", "milk", "chocolate",
"flour", "cheese"]

# make a full copy of the list
remember = to_buy[:]
```
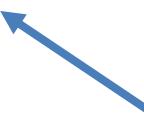
works with strings, too

Modifying a List

```python
to_buy = ["eggs", "milk", "chocolate",
"flour", "cheese"]

# I don't need cheese!
to_buy.pop()

# … neither milk, by the way!
to_buy.pop(1)
```

Python basics

Modifying a List

```python
to_buy = ["eggs", "milk", "chocolate",
"flour", "cheese"]

# I don't need cheese!
to_buy.remove("cheese")

# … neither milk, by the way!
to_buy.remove("milk")
```

Modifying a List

```python
to_buy = ["eggs", "milk", "chocolate",
"flour", "cheese"]


# I want my original list back!
del to_buy[2:6]
```

```
['eggs', 'milk']
```

Strings vs. Lists

A string is a sequence of characters...

... but a list of characters is <u>not</u> a string

```
language_name = "Python"

# string to list
name = list(language_name)
```

Strings vs. Lists

```python
sentence = "this is AmI"


# break a string into separate words
words = sentence.split()
```

```
['this', 'is', 'AmI']
```

Copying Lists

```python
fruits = ['apple', 'orange']
favorite_fruits = fruits

# add a fruit to the original list
fruits.append('banana')

print('The fruits now are:', fruits)
print('My favorite fruits are', favorite_fruits)
```

```
Fruits are: ['apple', 'orange', 'banana']
My favorite fruits are: ['apple', 'orange',
'banana']
```

???

Copying Lists

```
fruits = ['apple', 'orange']
favorite_fruits = fruits

# add a fruit to the original
fruits.append('banana')

print('The fruits now are:', fruits)
print('My favorite fruits are', favorite_fruits)
```

We **do not** make a copy of the entire list, but we only make a **reference** to it!


```
Frames                  Objects

Global frame            list
        fruits           0            1             2
    favorite_fruits      "apple"      "orange"      "banana"
```
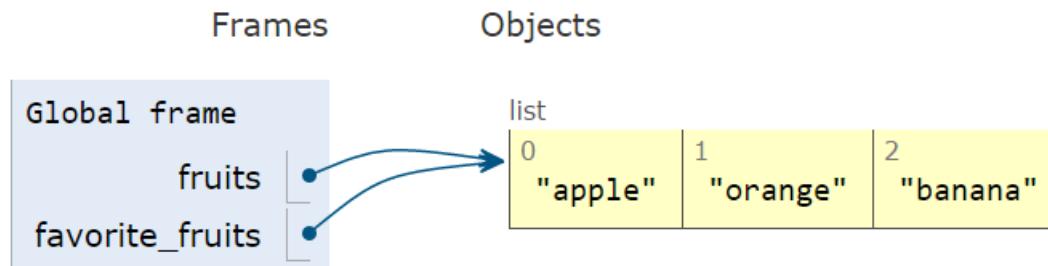
Copying Lists (For Real!)

```python
# option 1: slice
favorite_fruits = fruits[:]


#option 2: create a new list - best!
favorite_fruits = list(fruit)


#extend an empty list
favorite_fruits.extends(fruit)
```

Other operations with lists? ⟶   Python docs

Printing a Dictionary

```
legs = {"ant": 6, "snake": 0 }
print(legs)
```

```
{'ant': 6, 'snake': 0}
```

Python basics

Modifying a Dictionary

```python
legs = {"ant": 6, "snake": 0 }
legs["spider"] = 273
```

```
{'ant': 6, 'snake': 0, 'spider': 273}
```

Modifying a Dictionary

```
legs = {"ant": 6, "snake": 0 }
legs["spider"] = 273 # basically, run!
legs["spider"] = 8 # better!
```

```
{'ant': 6, 'snake': 0, 'spider': 8}
```

Modifying a Dictionary

```
legs = {"ant": 6, "snake": 0, "spider": 8}

# I don't like spiders
del legs["spider"]

# Clear all the things!
legs.clear()
```

Retrieving a Value from a Dictionary

```python
legs = {"ant": 6, "snake": 0}

# get "ant"!
legs["ant"] # 6

# get "spider"
legs["spider"]
```

Retrieving a Value from a Dictionary

```
legs = {"ant": 6, "snake": 0}

# get "ant"!
legs["ant"] # 6

# get "spider"
legs["spider"]
# KeyError: spider
```

Retrieving a Value from a Dictionary

```python
legs = {"ant": 6, "snake": 0}

# check if "spider" is in the dictionary
"spider" in legs # False

# get "spider" without throwing errors
legs.get("spider") # None

# get "spider" with a custom value
legs.get("spider", "Not present")
```

Functions

```
def say_hello():
    print("Hello!")
```
← definition

```
say_hello()
```
← call

Functions with Parameters

```
def say_hello_to(name):
    print("Hello", name)

say_hello_to("AmI students")
```

Default Parameter Values

```python
def say_hello_to(name="AmI"):
    print("Hello", name)


say_hello_to() # Hello AmI


say_hello_to("students") # Hello students
```

Python basics

Returning Values

```python
def build_greetings(name="AmI"):
    return "Hello" + name


greeting = build_greetings()
print(greeting) # Hello AmI
```

Returning Multiple Values

```python
def build_greetings(name="AmI"):
    return ("Hello", name)


(greeting, person) = build_greetings()
print(greeting + " to " + person)
# Hello to AmI
```

Documenting Functions

```
def build_greetings(name="AmI"):
    '''Build a greeting in the format
Hello plus a given name'''
    return ("Hello", name)
```

docstring

Modules

- A way to logically organize the code
- They are files consisting of Python code
  - they can define (and implement) functions, variables, etc.
  - typically, the file containing a module is called in the same way
    - e.g., the *math* module resides in a file named *math.py*

Importing a Module

```
import math # import the math module

print math.pi # print 3.141592…
```

```
from math import pi # import pi, only!

print pi # print 3.141592…
```

```
from math import * # import all the names

print pi                           DO NOT USE
```

Command Line Parameters

```
from sys import argv
```

unpacking

```
script, first = argv

print("The script is called:", script)
print("The parameter is:", first)
```

```
> python my_script.py one
The script is called: my_script.py
The parameter is: one
```

Reading Files

```python
from sys import argv

filename = argv[1]          ← open the file
txt = open(filename)

print("Here's your file %r:", % filename)
print(txt.read())           ← show the file content
```

Writing Files

```python
from sys import argv

filename = argv[1]
# open in write mode and empty the file
target = open(filename, "w")


# write a string into the file
target.write("This is the new content")

target.close() # close the file
```

Python basics

References and Links

- Python Documentation, http://docs.python.org/3
- The Python Tutorial, http://docs.python.org/3/tutorial/
- Online Python Tutor, http://pythontutor.com
- *«Think Python: How to think like a computer scientist»*, 2nd edition, Allen Downey, Green Tea Press, Needham, Massachusetts
- «*Dive into Python 3*», Mark Pilgrim
- «Learning Python» (5th edition), Mark Lutz, O'Reilly

Questions?

01QZP Ambient Intelligence

Luigi De Russis

luigi.derussis@polito.it
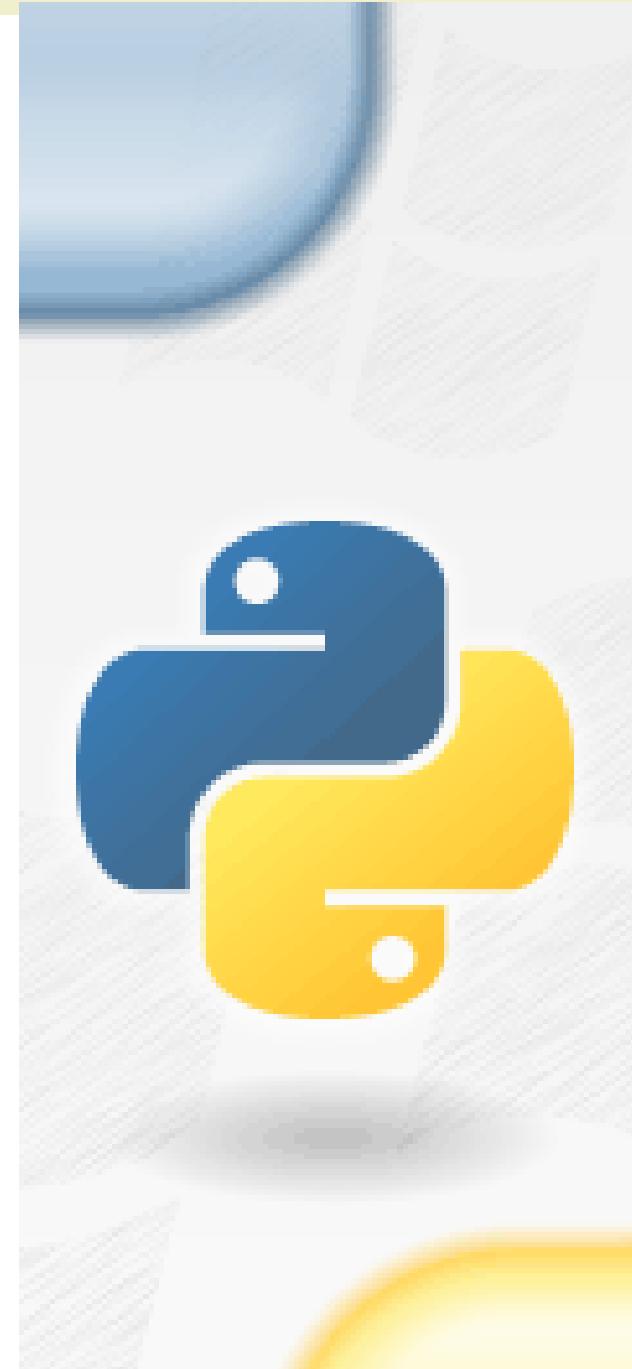
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