



PyQB

Monga

Dictionaries

Sets

Comprehensions

Types,
docstrings,
doctests

Files

Programming in Python¹

Mattia Monga

Dip. di Informatica
Università degli Studi di Milano, Italia
mattia.monga@unimi.it

Academic year 2025/26, I semester

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Lecture VIII: Other Composite Objects

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State of the homework

- ① Click on the link and accept the assignment: this will create your own git repository on GitHub with the homework
- ② Clone the repository on your machine (the easiest way is to use the GitHub Desktop app)
- ③ Work on the solution in the file `exercise.py`
- ④ Commit your work (again with GitHub Desktop it is easy)
- ⑤ Push (again with GitHub Desktop it is easy) the solution on GitHub so I can comment on it
- ⑥ Read my comments
- ⑦ If the solution can be improved, go back to step 3

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Dictionaries

A composite type `dict` that implements a mapping between immutable keys and values.

```
d = {'key': 'foo', 3: 'bar'}
```

```
print(d['key']) # 'foo'
print(d[3])     # 'bar'
print(d[2])     # error!
```

Notation is similar to lists/tuples, but `dicts` are not sequences indexed by numbers, you must use only the existing keys (`d.keys()`).

```
if x in d.keys():
    print(d[x])
```

A sequence of values can be obtained with `d.values()`. A sequence of 2-tuples (key, value) with `d.items()`.

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Sets



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A **set** is a composite object with no duplicate (non mutable) elements. Common set operations are possible.

- Set literals: `{1,2,3}` `set()`
- `{1,2,3}.union({3,5,6})`
`{1,2,3}.intersection({3,5,6})`

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Comprehensions



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Comprehensions are a concise way to create lists, sets, maps... It resembles the mathematical notation used for sets $A = \{a^2 | a \in \mathbb{N}\}$.

```
squares = [x**2 for x in range(10)]
```

equivalent to:

```
squares = []  
for x in range(10):  
    squares.append(x**2)
```

filtering is possible

```
odds = [x for x in range(100) if x % 2 != 0]
```

with a set

```
s = {x for x in range(50+1) if x % 5 == 0}
```

with a dict

```
d = {x: x**2 for x in range(10)}
```

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Make a program readable



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You never write a program only for a machine! You, others, tools will *read* the program for different purposes. Every minute spent in making a program more understandable pays off hours saved later.

- Type hinting makes clear what a function needs to work properly, and what it produces
- Documentation helps understanding without the need to read implementation details
- Examples of use make easy to remember how to use a function and can be used for verification

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Example



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```
Num = int | float
```

```
def cube(x: Num) -> Num:  
    """Return the cube of x."""
```

```
>>> cube(-3)  
-27
```

```
>>> abs(cube(0.2) - 0.008) < 10e-5  
True  
"""
```

```
return x * x * x
```

Examples can be tested by:

```
python -m doctest filename.py.
```

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Files

A file is an abstraction the operating system uses to preserve data among the execution of programs. Data must be accessed **sequentially**. (Italian reading people might enjoy this)

- We need commands to ask to the OS to give access to a file (`open`).
- It is easy to read or write data **sequentially**, otherwise you need special commands (`seek`) to move the file “cursor”
- The number of open files is limited ($\approx$ thousands), thus it is better to `close` files when they are not in use

Files contain bits (normally considered by group of bytes, 8 bits), the interpretation (“format”) is given by the programs which manipulate them. However, “lines of printable characters” (plain text) is a rather universal/predefined interpretation, normally the easiest to program.

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```
f = open('filename.txt', 'r') # read only

# iterating on a file reads (all) the lines
for i in f:
    print(i)

# End of file already reached, result is ''
f.readline()

f.close()

# File closed, error!
f.readline()

To avoid remembering to close explicitly, Python provides the
context manager syntax.
with open('filename.txt', 'r') as f:
    for i in f:
        print(i)
```

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