Introduction to Python III

Overview

- OOP: classes and objects
- Iterators and generators
- Context managers
- Decorators
- Development process
- The Python Package Index
- IPython
- Python scientific packages (just a mention):
  - `numpy`
  - `matplotlib`
  - `scipy`
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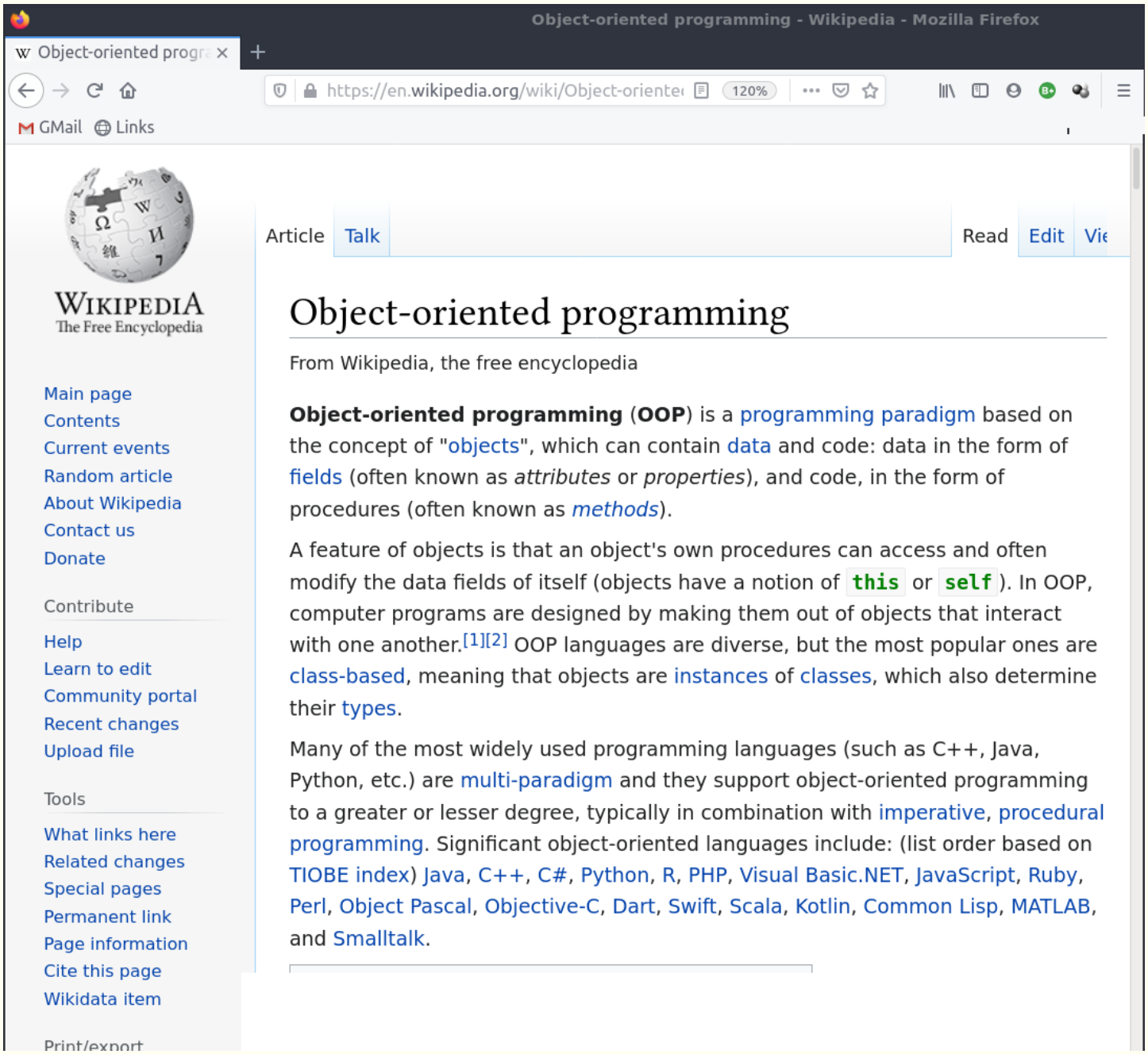
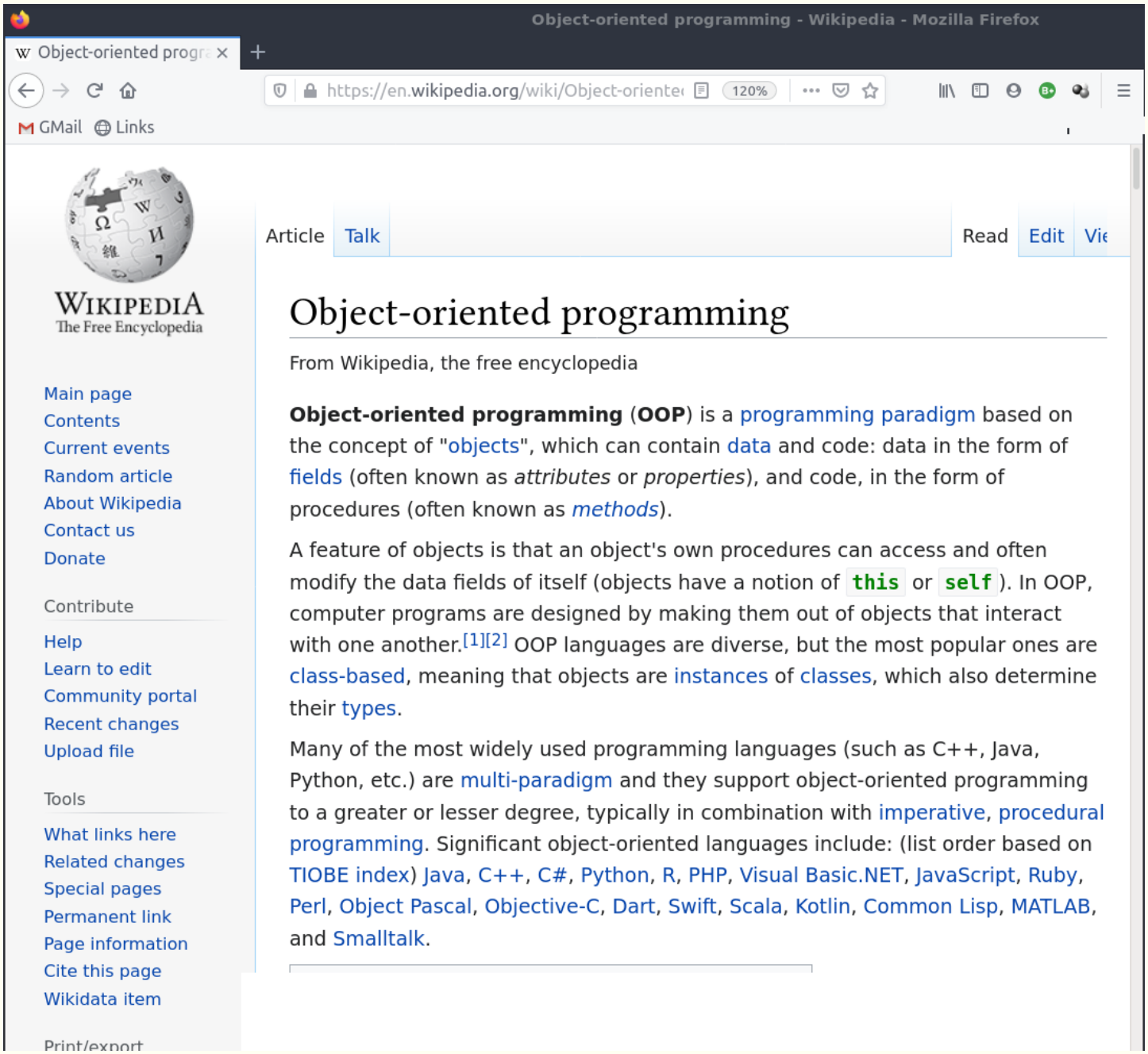
Object Oriented Programming -1

Introduction III - 2

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Object-oriented programming
From Wikipedia, the free encyclopedia
Object-oriented programming (OOP) is a programming paradigm based on the concept of "objects", which can contain data and code: data in the form of fields (often known as attributes or properties), and code, in the form of procedures (often known as methods).
A feature of objects is that an object's own procedures can access and often modify the data fields of itself (objects have a notion of this or self). In OOP, computer programs are designed by making them out of objects that interact with one another.[1][2] OOP languages are diverse, but the most popular ones are class-based, meaning that objects are instances of classes, which also determine their types.
Many of the most widely used programming languages (such as C++, Java, Python, etc.) are multi-paradigm and they support object-oriented programming to a greater or lesser degree, typically in combination with imperative, procedural programming. Significant object-oriented languages include: (list order based on TIOBE index) Java, C++, C#, Python, R, PHP, Visual Basic.NET, JavaScript, Ruby, Perl, Object Pascal, Objective-C, Dart, Swift, Scala, Kotlin, Common Lisp, MATLAB, and Smalltalk.

→

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class Number:
    "An example of class: Number()"
    names=('zero','one','two','three','four',
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    def __init__(self, n):
       self.name=Number.names[n]
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How to use class `Number`:

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>>> b.upper()
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>>> a.lower()
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class NumberPlus(Number):
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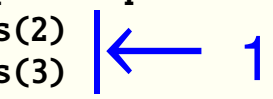

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>>> from numberplus import NumberPlus
>>> a=NumberPlus(2)
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>>> a+b
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unsupported operand type(s) for +: 'NumberPlus' and 'NumberPlus'
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Emulating standard types -1

Python applies the **duck typing** principle:

> If it walks like a duck and it quacks like a duck, then it must be a duck

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>>> a = 1
>>> dir(a)
['__abs__', '__add__', '__and__', '__bool__', '__ceil__', '__class__',
'__delattr__', '__dir__', '__divmod__', '__doc__', '__eq__', '__float__',
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Let's see how we can improve our class to support addition using the + sign.

file: `numberplus1.py` (class `NumberPlus` revised)

```
from number import Number

class NumberPlus(Number):
    "Number with addition"
    def __add__(self, x):
        return NumberPlus(self.value+x.value)

    def __str__(self):
        return self.name

    def upper(self):
        return self.name.capitalize()
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Emulating standard types -3

And here's what we get:

```
>>> from numberplus1 import NumberPlus
>>> a=NumberPlus(2)
>>> b=NumberPlus(5)
>>> print(a)
two
>>> print(a+b)
seven
>>> a
<numberplus1.NumberPlus object at 0x7f6bbcdf3748>
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   `a+b` is equivalent to: `a.__add__(b)`

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Iterables & iterators -1

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```
>>> a=(1,2,3,4,5)
>>> type(a)
<class 'tuple'>
>>> dir(a)
['__add__', ....., '__init__', ...., '__iter__', ..., 'count', 'index']
>>> for k in a:
...   print(k, end=" - ")
...
1 - 2 - 3 - 4 - 5 - >>>
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1,2

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→

Iterables & iterators -2

Let's make a class wich can be used as an iterable

file: `fibo1.py`

```
class Fibo:
    "Iterator for the Fibonacci series"
    def __init__(self, maxv):
        self.maxv = maxv

    def __iter__(self):
        self.a = 0
        self.b = 1
        return self

    def __next__(self):
        fib = self.a
        if fib > self.maxv:
            raise StopIteration
        self.a, self.b = self.b, self.a + self.b
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Iterables & iterators -3

Let's see the `Fibo` class in action:

Iterables & iterators -3

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```
>>> from fibo1 import Fibo
>>> for f in Fibo(1000):
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...
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>>> fb = Fibo(900)
>>> fb
<fibo1.Fibo object at 0x7f669bc0c048>
>>> list(fb)
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1. Natural use of iterators is in **for** loops

Iterables & iterators -3

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1. Natural use of iterators is in **for** loops
2. `fb` is an instance of class `Fibo`
3. The built-in function `list()` creates a list from an iterator

Iterables & iterators -3

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Generators -1

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file: `fibo2.py`

```
def fibo(maxv):
    a, b = 0, 1
    while a < maxv:
        yield a
        a, b = b, a+b
```

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1. A `generator` looks like a function ...

Generators -1

A generator is a syntax construct designed to create simple `iterators`

file: `fibo2.py`

```
def fibo(maxv):          <-- 1
    a, b = 0, 1
    while a < maxv:
        yield a          <-- 2
        a, b = b, a+b
```

1. A `generator` looks like a function ...
2. ... returning values with the **yield** statement

```
>>> from fibo2 import fibo
>>> for f in fibo(1000):
...     print(f, end=" ")
...
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987 >>>
>>> fb=fibo(900)
>>> fb
<generator object fibo at 0x7f5c47901c50>
>>> list(fb)
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610]
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Generators -2

Comprehensions are another form of simple iterators

```
>>> [x for x in range(30) if not x%2]
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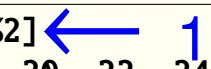

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['_CHUNK_SIZE', '__class__', ..., '__iter__', ..., '__next__', ...]
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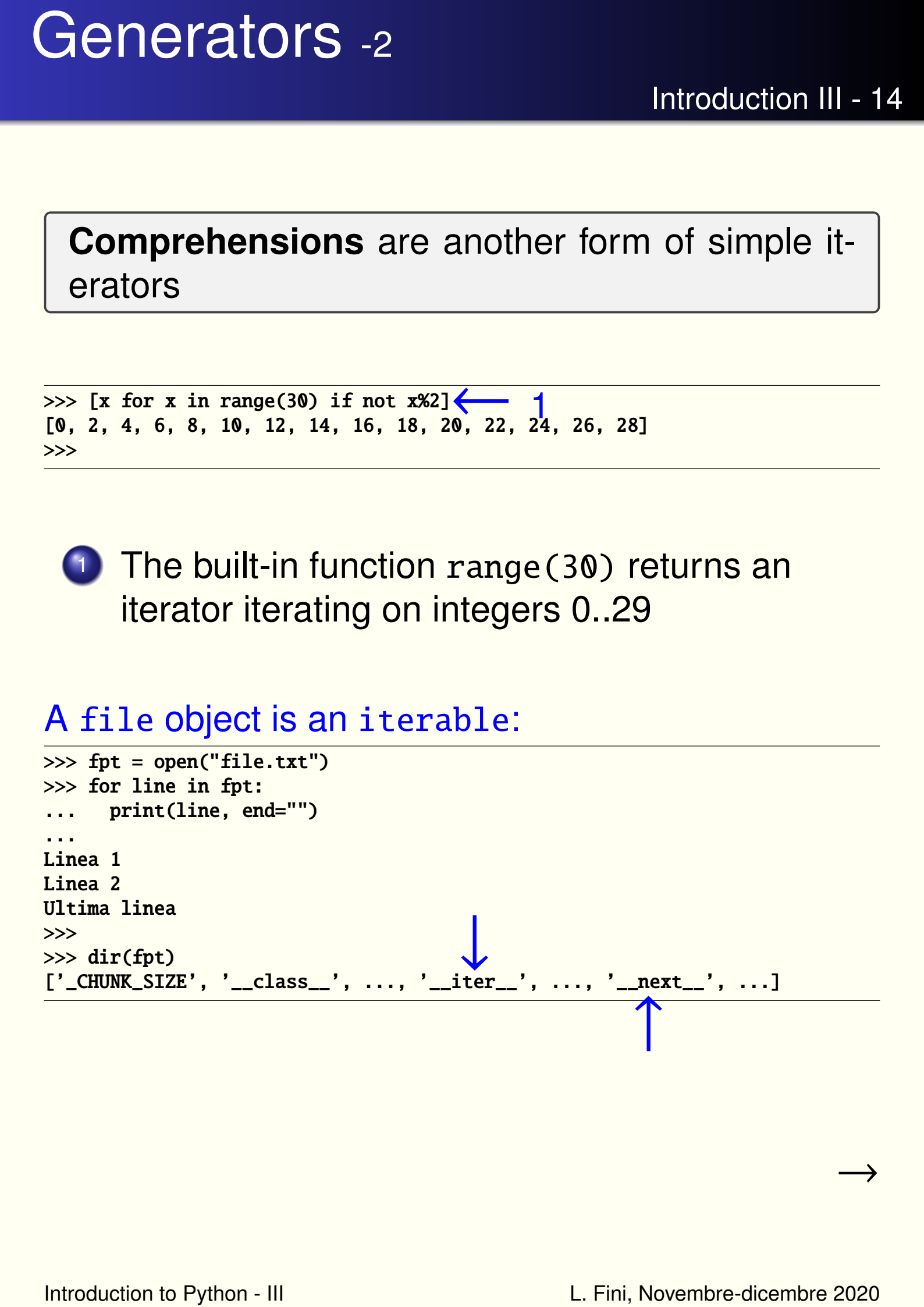

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You can build your own context manager by creating a class as in the following example:

Example: a `File` object

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class File():
    def __init__(self, filename, mode):
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import time

def my_timer(f):
    def wrapper(*pw, **kw):
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        ret = f(*pw, **kw)
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Decorators -2

Example: decorating a function - File: fibo3.py

```
from decorator import my_timer

@my_timer
def fibo_print(n):
    "Prints n elements of the Fibonacci series"
    result = []
    a, b = 0, 1
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Static analysis tools -1

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import time

a = 502
i = 0
while a > 0:
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    print(a)
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    a -= 1
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1. Using **pylint** to analyze a Python file

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def fibo(maxv: int):
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if __name__ == "__main__":
    for f in fibo(300.5):
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        with self.assertRaises(IndexError):
            NumberPlus(12)

if __name__ == "__main__":
    unittest.main()                           <-- 3
```

1. A “test case” is a class derived from `TestCase`
2. The test case is made up of a set of tests (methods named `test_...`)
3. Here’s where the test is run

→

Testing tools -2

Now we run the test:

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...
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Ran 3 tests in 0.000s

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IPython 7.3.0 -- An enhanced Interactive Python. Type '?' for help.
Using matplotlib backend: TkAgg

In [1]: a=3

In [2]: a+1
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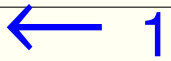

prompt

user input

ipython output

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---------------------------
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In [4]: !pwd
/home/lfini/Personale/CorsiSeminari/2019-Python
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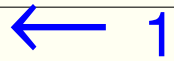

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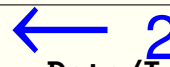

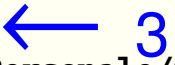

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Signature: np.max(a, axis=None, out=None, keepdims=<class 'numpy._globals._NoVal
Docstring:
Return the maximum of an array or maximum along an axis.

Parameters
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    - **Linux**: You may install from the distribution repository or from PyPI.
  - `astroquery`:
    - **Windows**: Can be installed from PyPI repository
    - **MacOS**: You may either use *Homebrew* or install from PyPI repository
    - **Linux**: You may install from the distribution repository (but not all of them provide this package) or from PyPI.

→

The End

End of Part III