Python Idioms
to help you write good code

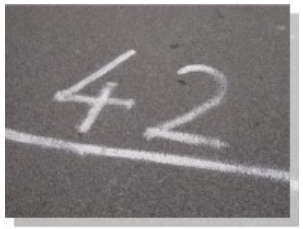
EuroPython 2015
Bilbao, Spain

Marc-André Lemburg

Speaker Introduction

Marc-André Lemburg

- Python since 1993/1994
- Studied Mathematics
- eGenix.com GmbH
- Senior Software Architect
- Consultant / Trainer
- Python Core Developer
- Python Software Foundation
- EuroPython Society
- Based in Düsseldorf, Germany





Python Idioms for cooking better Code

Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Python Coding Conventions: The Basics

PEP 8 – Python Coding Conventions

- Document:
  http://www.python.org/dev/peps/pep-0008/
- Many useful tips on how to write
  readable Python code
- Guideline, not law :-)
- Can be used as basis for a
  corporate Python style guide
- Tool: pep8 package for checking
  PEP 8 compliance

Coding Conventions: Python Module Layout

Generic Python module structure:

- Header
- Tools
- Body

Module Layout: Header Section

- Module Doc String
- Imports
  - Python ones first
  - 3rd party modules
  - application modules
- Constants
  - usually simple types (strings, integers)
- Globals
  - often private to the module
  - used for e.g. caches, static mappings, etc.

Module Layout: Tools Section

- Exceptions
  - used in the module
  - derived from standard exceptions
  - allow easily tracking origin of exceptions
  - often part of the module API
- Helper Functions
  - usually private to the module

Module Layout: Body Section

- Functions
  - usually part of the module API
- Classes
  - usually part of the module API
- Module execution (usually for testing or scripting)
  - if __name__ == '__main__':
    main()

Module Layout: Overview

- Doc String
- Imports
- Constants & Globals
- Exceptions
- Helper Functions
- Functions & Classes
- Module execution (usually for testing or scripting)
  - if __name__ == '__main__':
    main()

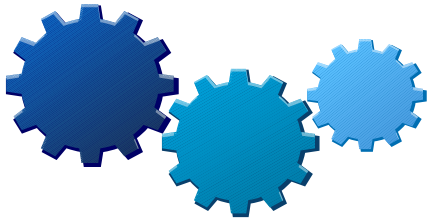
Module Guidelines

- Use descriptive names for modules
  - try to name after the most important class or function
- Try not to use executable code at the module top-level
  - put all such code into functions to make the module import side-effect free
  - this is especially true for package __init__.py modules
- Always use absolute imports

Python Idioms

We're now going to take a tour

from high level



to low level

Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Common Patterns in Python

- Duck Typing
  - API interface counts, not type
  - *"When I see a bird that walks like a duck and swims like a duck and quacks like a duck, I call that bird a duck."* – James W. Riley

- Examples:
  - Python sequence API, iterator API, index API, mapping API, file API
  - ElementTree API for XML, Python DB-API
  - collections module provides ABCs

Common Patterns in Python

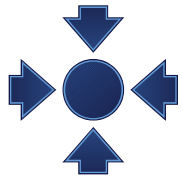
- Facade / Adapter
  - Make an object API compatible with another object
  - *Turn any bird into a duck*
  - API based, not class based

- Examples:
  - StringIO module (turn strings into file-like objects)
  - DB-API compatible modules (adapt database C APIs to a standard Python API)

Common Patterns in Python

- Singletons
  - Objects that only exist once
  - usually not enforced in Python
    (e.g. True, False are not protected in Py2, None is protected, all in Py3)

- Examples:
  - True, False, None, NotImplemented
  - Small integers



Common Patterns in Python

- Factories
  - Build objects in multiple ways
  - Python only has one .__init__() method per class
  - use factory functions returning instances, or class methods to the same effect

- Examples:
  - mx.DateTime.DateTimeFrom()
  - datetime.fromtimestamp()

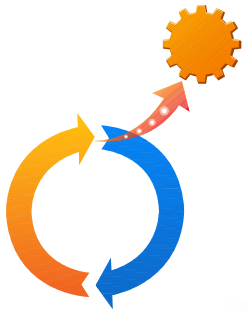
Common Patterns in Python

- Wrappers / Proxies
  - hide / control APIs
  - add information / verification to APIs
  - decorators often create wrappers (try to avoid this)

- Examples:
  - decorators, functools.partial, weakref, mxProxy

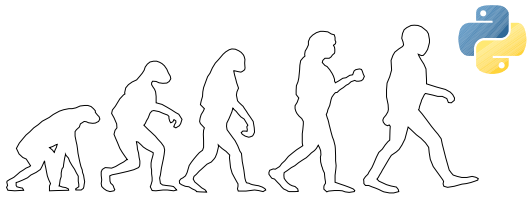
Common Patterns in Python

- Callbacks
  - functions/methods called when an event triggers
  - usually methods on a processing object (handler) or on a subclass (handler method)
  - hooks to extend / customize APIs
  - very common:
    runtime introspection for finding handlers
- Examples:
  - SAX parser, HTML parser, urllib2, threading
  - command line option processing
  - asynchronous processing



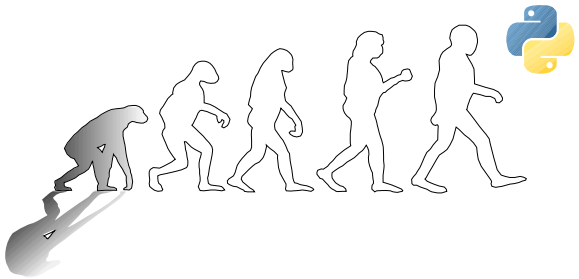
Common Patterns in Python

There's also a typical code evolution pattern in Python ...



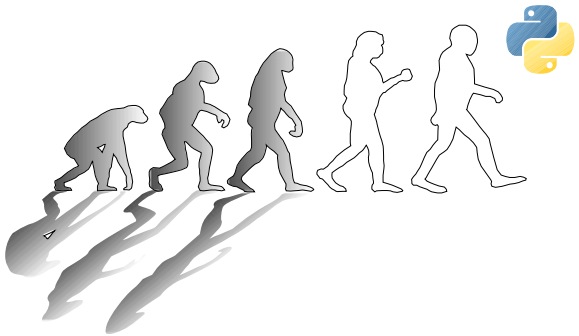
Code Evolution: From scripts to functions

- Typical situation:
  - Start with a script using top-level commands
  - Turn common script sections into functions
  - Pass around common parameters (e.g. context related variables)
  - Group functions



Code Evolution: Abstracting functions to classes

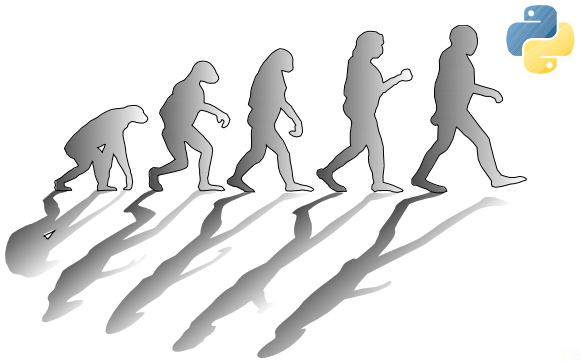
- Next level:
  - Refactor function sections into methods of classes
  - Instantiate classes to drive the application
  - Provide a user interface (e.g. command line, web or GUI)
  - Add more input/output channels
  - More user customization



Code Evolution: Abstracting classes into components

- Evolution:
  - Create subclasses to provide more features
  - Split code into modules to more clarity
  - Group modules in packages
  - Build loosely coupled components based on classes

  - Add packaging for better deployment
  - Add automated tests and builds
  - Enter build-test-release cycle
  - Enter the code refactor cycle

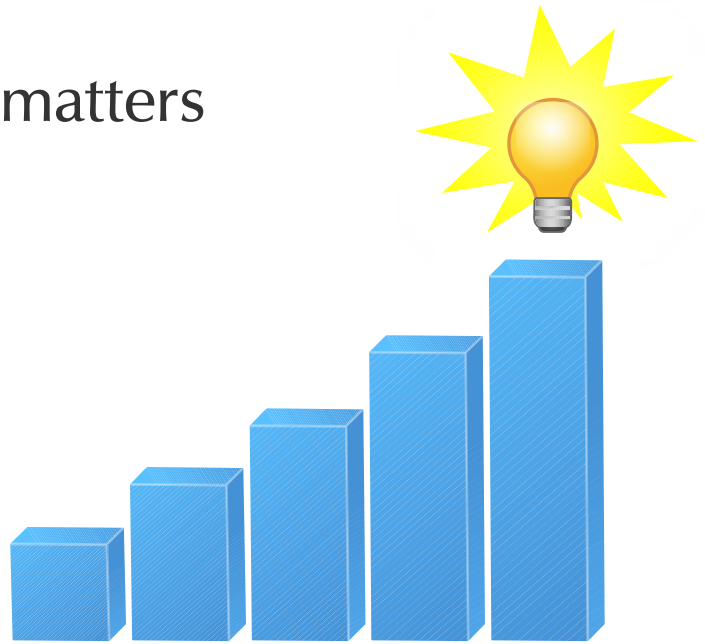


Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Performance Idioms

… when performance matters



Looping over sequences

- Different methods possible:
  - for-loop, map(), list comprehensions, generator

- Fastest:

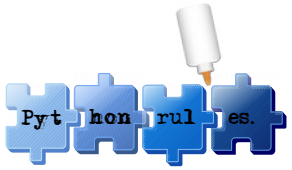
  Use list comprehensions

  [op(x) for x in seq]

  when operating on sequences

Joining strings

- Using + (concat)
  - Good when concatenating a few strings
  - Copies strings together
- Using ''.join()
  - Great for concatenating many strings
  - Copies strings, but only once
- Using StringIO.write(), array.fromstring() or %-formatting
  - Much slower than the above two



Exceptions

- Expensive in Python (but cheap in Python's C API)
- Exceptions should only be used for exceptional cases …

```
# Not a good idea:
try:
    fails_often()
except ValueError:
    runs_often()
```

More performance hints

- Python wiki page:
  - https://wiki.python.org/moin/PythonSpeed/PerformanceTips
- My talk "When performance matters..."
  - http://www.egenix.com/library/presentations/PyCon-UK-2014-When-performance-matters/
- Examples:
  - localizing variables: x = global_x
  - localizing method lookups: m = list.append
  - dict.setdefault() and collections.defaultdict

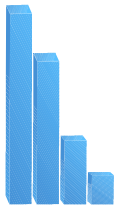
Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Deeply nested if statements in loops

- Typical situation:

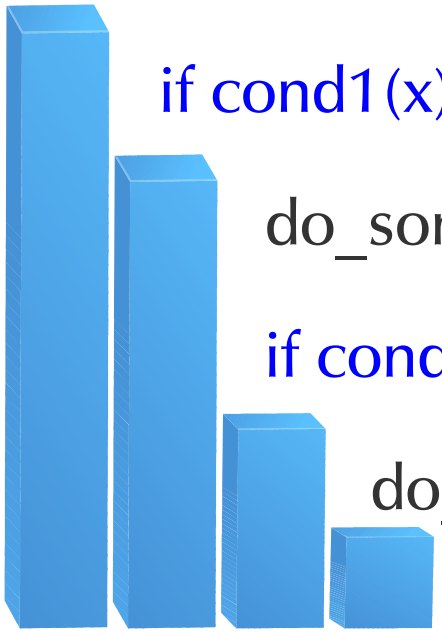
```
for x in items:
    if cond1(x):
        do_something()
        if cond2(x):
            do_something_else()
```



Deeply nested if statements in loops

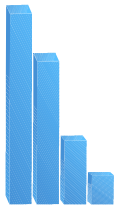
- Staircase Syndrom:

```
for x in items:
    if cond1(x):
        do_something()
        if cond2(x):
            do_something_else()
```



Better: Use continue to avoid nesting

```
for x in items:
    if not cond1(x):
        continue
    do_something()
    if not cond2(x):
        continue
    do_something_else()
```



Avoiding Gotchas

… mutable or not, that is the question
(well, at least one of them)

Avoid mutable state in module globals

- Typical situations at module scope:

  ```
  db = database.connect(...)

  settings = dict(verbose=1, log=False)
  ```

- Not thread safe

  … and no, *thread locals* are not a good idea

- Difficult to manage
  (access, resources, validations)

- Dangerous in larger projects

Better: Place mutable state in context objects

- Keep state in context objects
- Pass context to methods and functions as first parameter

```
def read_data(context, key): ...
def get_config(context): ...
```

or refactor code to use instance attributes:

```
class Application:
    def __init__(self):
        self.context = ApplicationContext()
```

Function/method default parameters

- Use only immutable types
- For mutable types:
  - fallback to None or
  - immutable alternatives
  - Add mutable defaults at the top of the function/method:

```
def func(x, a=None):
    if a is None:
        a = []
    return x(a)
```

Class default attributes

- Only use immutable types
  - unless you really know what you're doing
- For mutable types:
  - fallback to *None* or
  - immutable alternatives
  - Add mutable type defaults in .__init__()
- Document all attributes using comments:

```
# List of file names
files = None
```

Avoiding Gotchas

… and finally, some very basic hints to
to write better code

Use the *in* operator in Python

- Interface to the obj.__contains__() method
- if x in some_list: …
  - better than using some_list.index(x) with try-except
- if x in some_dict: …
  - better than using some_dict.has_key(x)
- if x in some_set: …
  - better than ??? (only way to test membership :-))
- Function equivalent:
  a in b = operator.contains(b, a)

Boolean testing in Python

- Boolean singletons:
  True (=integer 1), False (= integer 0)
- Use: if x: print("x is true")
  Not: if x == True: print("x is true")
  Not: if x is True: print("x is true")
- Use: if not x: print("x is false")
  Not: if x == False: print("x is false")
  Not: if x is False: print("x is false")
- Function equivalent: bool(x)

Container empty testing in Python

- Empty containers (sequences, mappings, sets) are considered false in Python
- Use: if container: print("not empty")

  Not: if len(container): print("not empty")

  Not: if len(container) > 0: print("not empty")

Commas in Python: 1-Tuples

- Nasty in 1-tuples:

```
x = (1,)
x = 1,        ← note the comma
```

- Weird errors when not intended…

```
>>> s = 'abc',
>>> len(s)
1
>>> s[2]
IndexError: tuple index out of range
```

Commas in Python: Listings

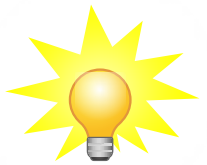
- Great in argument/parameter/item listings:

  Python allows trailing "," at end of listings...

```
d = {'a': 1,
     'b': 2,
     # insert something new here
    }
```

  even in functions/methods...

```
f(x, y, z,
  a=1,
  # insert more keyword args here
)
```



Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Tools

- The Python community has created some really good tools to help with developing good code

Let's have a look at some …

Code Checking Tools

- pylint: https://pypi.python.org/pypi/pylint/
  - style/typo checking
  - good documentation: http://docs.pylint.org/
- pep8: https://pypi.python.org/pypi/pep8/
  - style checking
  - dohttps://pypi.python.org/pypi/flake8/cumentation: http://pep8.readthedocs.org/en/latest/)
- pyflakes:https://pypi.python.org/pypi/pyflakes/
  - logical checking
  - no documentation

Code Checking Tools

- flake8:
  - combines pep8, pyflakes and a complexity checker
  - documentation: http://flake8.readthedocs.org/en/latest/)
- pychecker: http://pychecker.sourceforge.net/
  - note: imports modules
  - not maintained anymore (predates the other tools), but can still be useful

Agenda

- Coding Conventions
- Common Patterns in Python
- Performance Idioms
- Coding Idioms
- Avoiding Gotchas
- Tools
- Questions

Questions

Thank you for listening

Beautiful is better than ugly.

Photo References

CC BY / CC BY-SA licensed photos:

https://www.flickr.com/photos/runlevel0/6297898421/

Public domain clip arts:

https://openclipart.org/detail/8879/rubber-duck
https://openclipart.org/detail/215201/evolution

All other photos and images are used by permission.

Contact

eGenix.com Software, Skills and Services GmbH
Marc-André Lemburg
Pastor-Löh-Str. 48
D-40764 Langenfeld
Germany

eMail: mal@egenix.com
Phone: +49 211 9304112
Fax: +49 211 3005250
Web: http://www.egenix.com/