Unit testing with Python

An introduction on how to unit test in Python. This talk is for Python developers who want to make sure their apps are tested correctly. It steps you through the libraries to user, how to do testing, mocking of external libraries, an overview of testing web apps and how to integrate with continuous integration.

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http://github.com/andymckay/presentations

Unit test

A method by which individual units of source are tested to determine if they are fit for use. A unit is the smallest testable part of an application.*

* Wikipedia: definitive source of everything

Sample Code

```
def sorted_ci(words):
    return sorted(words, key=lambda x: x.lower)
```

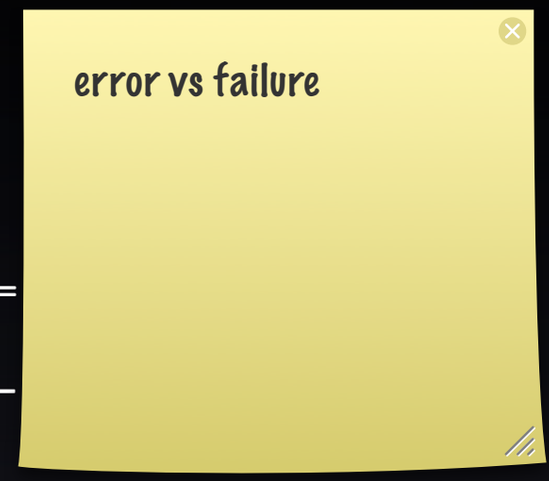
```
>>> sorted(['apple', 'Orange'])
['Orange', 'apple']
>>> from unittest_example import sorted_ci
>>> sorted_ci(['apple', 'Orange'])
['apple', 'Orange']
```

Unit tests

```
import unittest

class Test(unittest.TestCase):

    def test_basic(self):
        assert (sorted_ci(['apple', 'Orange'])
                == ['apple', 'Orange'])

if __name__ == '__main__':
    unittest.main()
```

Output

```
.EF
======================================================================
ERROR: test_zero (__main__.Test)
----------------------------------------------------------------------
Traceback (most recent call last):
  File "example.py", line 35, in test_zero
    1/0
ZeroDivisionError: integer division or modulo by zero

======================================================================
FAIL: test_failure (__main__.Test)
----------------------------------------------------------------------
Traceback (most recent call last):
  File "example.py", line 40, in test_failure
    assert not 1 == 0
AssertionError

----------------------------------------------------------------------
Ran 3 tests in 0.001s

FAILED (errors=1, failures=1)
```



Testing for failure

```
>>> sorted_ci([4,5])
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "unittest_example.py", line 6, in sorted_ci
    return sorted(words, key=lambda x: x.lower)
  File "unittest_example.py", line 6, in <lambda>
    return sorted(words, key=lambda x: x.lower)
AttributeError: 'int' object has no attribute 'lower'
```

Testing for failure

```
class Test(unittest.TestCase):

    def test_basic(self):
        assert (sorted_ci(['apple', 'Orange'])
                == ['apple', 'Orange'])

    def test_not_strings(self):
        self.assertRaises(AttributeError,
                          sorted_ci, [4, 5])
```

unittest

http://docs.python.org/library/unittest.html

Basic starting library and should be your first stop for learning about unit tests.

Organizing tests

```
class Test(unittest.TestCase):

    def test_some_test(self):
        ... # Do a test.
```

Organize similar tests into classes. All methods starting with test will be run.

Organizing tests

```
class Test(unittest.TestCase):

    def setUp(self):
        ... # Before every test.
        super(Test, self).setUp()

    def tearDown(self):
        ... # Always runs after every test.
        super(Test, self).tearDown()
```

Runs before and after every test.

Example setUp

```
class TestPersonalLookup(unittest.TestCase):

    def setUp(self):
        self.today = date.today()
        self.addon = Addon(type=amo.ADDON_EXTENSION,
                           slug='foo')
```

Gotchas

Some things that always* go wrong.

* Actual results may vary.

Dates

```
class Test(unittest.TestCase):

    def test_yesterday(self):
        yesterday = invoice.date()
        assert datetime.date(2012, 2, 10) == \
               yesterday
```

Dates

```
class Test(unittest.TestCase):

    def test_yesterday(self):
        yesterday = invoice.date()
        assert datetime.date() - timedelta(days=1) == \
               yesterday
```

Use timedelta to make your dates relative.

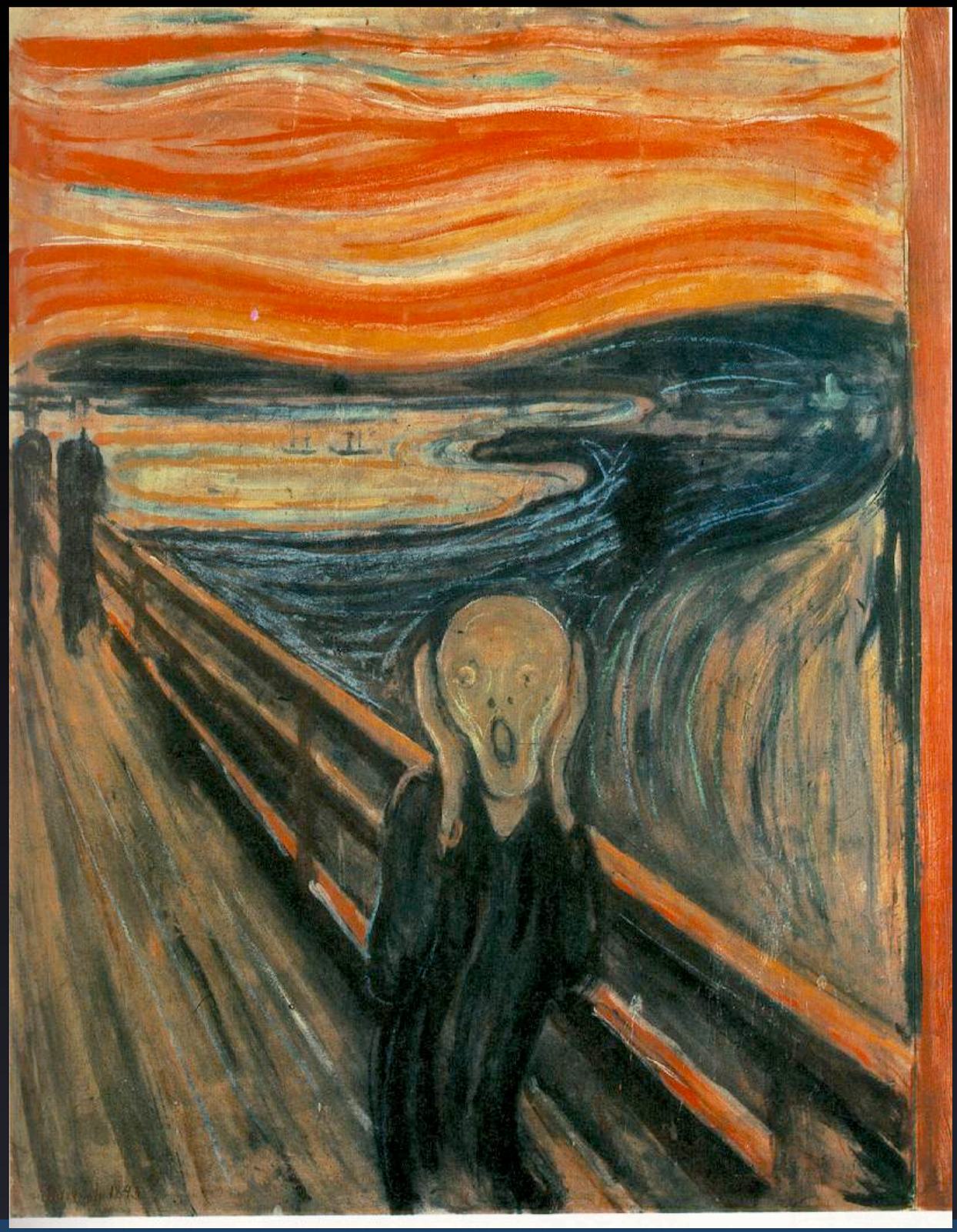
Unicode

```
class Test(unittest.TestCase):

    ...

    def test_unicode(self):
        utf8_str = u'বাংলা'.encode('utf-8')
        assert (sorted_ci([utf8_str, 'Orange'])
                == ['Orange', utf8_str])
```

Python 2

Unicode is still a pain and you need to check to prevent:

UnicodeError



Order

```
x = {'a':'Apple', 'b':'Banana'}


class TestSomething(...):

    def test_order(self):
        assert x.keys()[0] == 'a'
```

Order

```
x = {'a':'Apple', 'b':'Banana'}


class TestSomething(...):

    def test_order(self):
        assert sorted(x.keys()[0]) == 'a'
```

mysql, nosql, redis

intermittent and annoying

Not just for dictionaries. Databases?

Leaking

```
from constants.base import some_dictionary


class TestSomething(...):

    def setUp(self):
        del some_dictionary['some_key']
```

Leaking

```
from constants.base import some_dictionary


class TestSomething(...):

    def setUp(self):
        our_dictionary = some_dictionary.copy()
        del our_dictionary['some_key']
```

Make sure to copy mutable data.

External

Unit tests should not rely on external sources. *

* A foolish consistency is the hobgoblin of little minds.

Examples

APIs from other servers
File system stuff
Anything over HTTP
Payment providers

Examples

APIs from other servers
File system stuff
Anything over HTTP
Payment providers
Databases?
Internal APIs?

External

1. Anything I can't control or fix, within reason.

---

2. Anything that slows the tests down.

Specific mock

https://github.com/mozilla/nuggets/

```
class MockRedis(object):
    """A fake redis we can use for testing."""
    ...
    def incr(self, key):
        bump = (self.get(key) or 0) + 1
        self.set(key, bump)
        return bump
```

Sadly means writing all the methods etc...

Mock to the rescue

http://www.voidspace.org.uk/python/mock/
http://pypi.python.org/pypi/mock

...allows you to replace parts of your system under test with mock objects and make assertions about how they have been used.

Mock object

```
>>> mock = Mock()
>>> mock.method(1, test='wow')
<Mock name='mock.method()' id='...'>
```

Patch

Alternative to setUp and tearDown.

Altering a method to use the Mock instead of the actual method.

@patch

```
good_response = ('responseEnvelope.timestamp='
                 '2011-01-28T06%3A16...')
```

```
@mock.patch('urllib2.OpenerDirector.open')
def test_get_key(self, opener):
    opener.return_value = StringIO(good_response)
    assert paypal.get_paykey(self.data) == (
           ('AP-9GD...', 'CREATED'))
```

@patch

```
auth_error = ('error(0).errorId=520003'
              '&error(0).message=Authentication’
              ‘+failed...')

@mock.patch('urllib2.OpenerDirector.open')
def test_auth_fails(self, opener):
    opener.return_value = StringIO(auth_error)
    self.assertRaises(paypal.AuthError,
                      paypal.get_paykey, self.data)
```

@patch

```
@mock.patch('paypal._call')
class TestRefundPermissions(amo.tests.TestCase):

    def test_get_permissions_url(self, _call):
        _call.return_value = {'token': 'foo'}
        assert 'foo' in paypal.get_permission_url\
                (self.addon, '', [])
```

Every method is called with the mock.

Testing calling

```
class TestRefundPermissions(amo.tests.TestCase):

    def test_get_permissions_url_scope(self, _call):
        _call.return_value = {'token': '...'}
        paypal.get_permission_url(self.addon, '',
                                  ['REFUND', 'FOO'])
        assert _call.call_args[0][1]['scope'], \
               ['REFUND', 'FOO'])
```

Multiple different call test functions.

Fudge

http://farmdev.com/projects/fudge/index.html

Fudge is a Python module for using fake objects (mocks and stubs) to test real ones.

Alternative to mock.

Fudge

```
def sorted_ci(words):
    return sorted(words, key=lambda x: x.lower)
```

```
def sorted_numbers(numbers):
    return sorted_ci([str(num) for num in numbers])
```

Fudge

```
class Test(unittest.TestCase):

    @fudge.patch('example.sorted_ci')
    def test_with_fudge(self, sorted_ci):
        sorted_ci.expects_call().returns(('4', '5'))
        assert sorted_numbers((5, 4)) == ('4', '5')
```

And so much more...

doc tests

http://docs.python.org/library/doctest.html

Documentation in the comments.
Personally don't like them.
Hard to refactor.
Code is the documentation.

doc tests

```
def minus(numbers):
    return reduce(lambda x, y: x - y, numbers)
```

```
>>> from doctest_example import minus
>>> minus([3,1])
2
```

doc tests

```
def minus(numbers):
    """
    Subtract a list of numbers.
    >>> minus([3, 1])
    2
    >>> minus([3, 2, 4])
    -3
    """
    return reduce(lambda x, y: x - y, numbers)

if __name__ == '__main__':
    import doctest
    doctest.testmod()
```

Nose

http://readthedocs.org/docs/nose/en/latest/

...extends unittest to make testing easier.

Adds in lots of plugins.

Plugins

xunit: outputs CI specific results
progressive: tells you errors right away
coverage: outputs the amount of coverage

And the all important...

pdb

```
$ nosetests example.py --pdb
.F..> /Users/andy/sandboxes/presentations/confoo-2012/
unittest_example/example.py(16)test_zero()
-> 1/0
(Pdb)
```

Drops you into pdb on a failure.

Continuous Integration

Jenkins - use xunit with nose
Buildbot
TeamCity
etc...

Jenkins

Jenkins » amo-master

ENABLE AUTO REFRESH

- Back to Dashboard
- **Status**
- Changes
- Build Now
- GitHub
- Git Polling Log

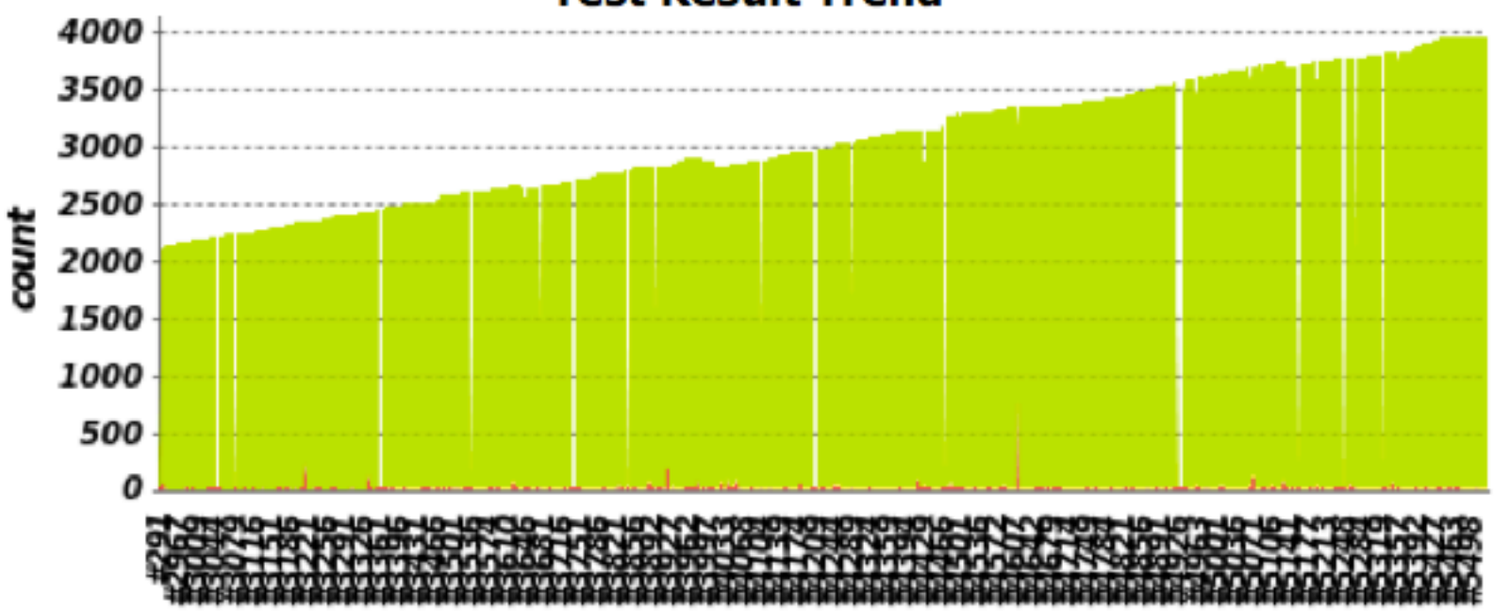
Build History (trend)

- #5531 Feb 21, 2012 7:00:56 PM
- #5530 Feb 21, 2012 5:00:55 PM
- #5529 Feb 21, 2012 4:30:55 PM
- #5528 Feb 21, 2012 3:30:56 PM
- #5527 Feb 21, 2012 2:30:55 PM

Project amo-master

This build is tracking the master branch (trunk). It has the most up to date code and can be seen on addons-dev.allizom.org.

Test Result Trend



(just show failures) enlarge

Questions?

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http://github.com/andymckay/presentations