
aspectlib

Release 0.9.0

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`aspectlib` is an aspect-oriented programming, monkey-patch and decorators library. It is useful when changing behavior in existing code is desired.

Introduction

aspectlib provides two core tools to do AOP: Aspects and a weaver.

1.1 The aspect

An *aspect* can be created by decorating a generator with an `Aspect`. The generator yields *advices* - simple behavior changing instructions.

An `Aspect` instance is a simple function decorator. Decorating a function with an *aspect* will change the function's behavior according to the *advices* yielded by the generator.

Example:

```
@aspectlib.Aspect
def strip_return_value():
    result = yield aspectlib.Proceed
    yield aspectlib.Return(result.strip())

@strip_return_value
def read(name):
    return open(name).read()
```

You can use these *advices*:

- `Proceed` or `None` - Calls the wrapped function with the default arguments. The *yield* returns the function's return value or raises an exception. Can be used multiple times (will call the function multiple times).
- `Proceed(*args, **kwargs)` - Same as above but with different arguments.
- `Return` - Makes the wrapper return `None` instead. If `aspectlib.Proceed` was never used then the wrapped function is not called. After this the generator is closed.
- `Return(value)` - Same as above but returns the given `value` instead of `None`.
- `raise exception` - Makes the wrapper raise an exception.

1.2 The weaver

Patches classes and functions with the given *aspect*. When used with a class it will patch all the methods. In AOP parlance these patched functions and methods are referred to as *cut-points*.

Returns a `Rollback` object that can be used a context manager. It will undo all the changes at the end of the context.

Example:

```
@aspectlib.Aspect
def mock_open():
    yield aspectlib.Return(StringIO("mystuff"))

with aspectlib.weave(open, mock_open):
    assert open("/doesnt/exist.txt").read() == "mystuff"
```

You can use `aspectlib.weave()` on: classes, instances, builtin functions, module level functions, methods, classmethods, staticmethods, instance methods etc.

Installation

```
pip install aspectlib
```

Or, if you live in the stone age:

```
easy_install aspectlib
```

For your convenience there is a [python-aspectlib](#) meta-package that will just install [aspectlib](#), in case you run `pip install python-aspectlib` by mistake.

2.1 Requirements

OS Any

Runtime Python 2.6, 2.7, 3.3, 3.4 or PyPy

Python 3.2, 3.1 and 3.0 are *NOT* supported (some objects are too crippled).

Rationale

There are perfectly sane use cases for monkey-patching (aka *weaving*):

- Instrumenting existing code for debugging, profiling and other measurements.
- Testing less flexible code. In some situations it's infeasible to use dependency injection to make your code more testable.

Then in those situations:

- You would need to handle yourself all different kinds of patching (patching a module is different than patching a class, a function or a method for that matter). `aspectlib` will handle all this gross patching mumbo-jumbo for you, consistently, over many Python versions.
- Writing the actual wrappers is repetitive, boring and error-prone. You can't reuse wrappers but *you can reuse function decorators*.

Frequently asked questions

4.1 Why is it called weave and not patch ?

Because it does more things than just patching. Depending on the *target* object it will patch and/or create one or more subclasses and objects.

4.2 Why doesn't aspectlib implement AOP like in framework X and Y ?

Some frameworks don't resort to monkey patching but instead force the user to use ridiculous amounts of abstractions and wrapping in order to make weaving possible. Notable example: [spring-python](#).

For all intents and purposes I think it's wrong to have such high amount of boilerplate in Python.

Also, `aspectlib` is targeting a different stage of development: the maintenance stage - where the code is already written and needs additional behavior, in a hurry :)

Where code is written from scratch and AOP is desired there are better choices than both `aspectlib` and `spring-python`.

4.3 Why was aspectlib written ?

`aspectlib` was initially written because I was tired of littering other people's code with prints and logging statements just to fix one bug or understand how something works. `aspectlib.debug.log` is `aspectlib`'s *crown jewel*. Of course, `aspectlib` has other applications, see the *Rationale*.

5.1 Retry decorator

TODO: Make a more configurable retry decorator and add it in `aspectlib.contrib`.

```
class Client(object):
    def __init__(self, address):
        self.address = address
        self.connect()
    def connect(self):
        # establish connection
    def action(self, data):
        # do some stuff

def retry(retries=(1, 5, 15, 30, 60), retry_on=(IOError, OSError), prepare=None):
    assert len(retries)

    @aspectlib.Aspect
    def retry_aspect(*args, **kwargs):
        durations = retries
        while True:
            try:
                yield aspectlib.Proceed
                break
            except retry_on as exc:
                if durations:
                    logging.warn(exc)
                    time.sleep(durations[0])
                    durations = durations[1:]
                if prepare:
                    prepare(*args, **kwargs)
            else:
                raise

        return retry_aspect

    return retry_aspect
```

Now patch the `Client` class to have the retry functionality on all its methods:

```
aspectlib.weave(Client, retry())
```

or with different retry options (reconnect before retry):

```
aspectlib.weave(Client, retry(prepare=lambda self, *_: self.connect()))
```

or just for one method:

```
aspectlib.weave(Client.action, retry())
```

You can see here the advantage of having reusable retry functionality. Also, the retry handling is decoupled from the Client class.

5.2 Debugging

... those damn sockets:

```
>>> import aspectlib, socket, sys
>>> with aspectlib.weave(
...     socket.socket,
...     aspectlib.debug.log(
...         print_to=sys.stdout,
...         stacktrace=None,
...     ),
...     lazy=True,
... ):
...     s = socket.socket()
...     s.connect(('example.com', 80))
...     s.send(b'GET / HTTP/1.1\r\nHost: example.com\r\n\r\n')
...     s.recv(8)
...     s.close()
...
{socket...}.connect(('example.com', 80))
{socket...}.connect => None
{socket...}.send(...'GET / HTTP/1.1\r\nHost: example.com\r\n\r\n')
{socket...}.send => 37
37
{socket...}.recv(8)
{socket...}.recv => ...HTTP/1.1...
...'HTTP/1.1'
...
```

The output looks a bit funky because it is written to be run by `doctest` - so you don't use broken examples :)

5.3 Testing

Mock behavior for tests:

```
class MyTestCase(unittest.TestCase):

    def test_stuff(self):

        @aspectlib.Aspect
        def mock_stuff(self, value):
            if value == 'special':
                yield aspectlib.Return('mocked-result')
            else:
                yield aspectlib.Proceed
```

```
with aspectlib.weave(foo.Bar.stuff, mock_stuff):  
    obj = foo.Bar()  
    self.assertEqual(obj.stuff('special'), 'mocked-result')
```


6.1 aspectlib

<code>aspectlib.ALL_METHODS</code>	Compiled regular expression objects
<code>aspectlib.NORMAL_METHODS</code>	Compiled regular expression objects
<code>aspectlib.weave</code>	Send a message to a recipient
<code>aspectlib.Rollback</code>	When called, rolls back all the patches and changes the <code>weave()</code> has done.
<code>aspectlib.Aspect</code>	Container for the advice yielding generator.
<code>aspectlib.Proceed</code>	Instructs the Aspect Calls to call the decorated function.
<code>aspectlib.Return</code>	Instructs the Aspect to return a value.

class `aspectlib.Aspect` (*advising_function*)

Container for the advice yielding generator. Can be used as a decorator on other function to change behavior according to the advices yielded from the generator.

class `aspectlib.Proceed` (**args, **kwargs*)

Instructs the Aspect Calls to call the decorated function. Can be used multiple times.

If not used as an instance then the default args and kwargs are used.

class `aspectlib.Return` (*value*)

Instructs the Aspect to return a value.

class `aspectlib.Rollback` (*rollback=None*)

When called, rolls back all the patches and changes the `weave()` has done.

`__enter__()`

Returns self.

`__exit__(*_)`

Performs the rollback.

`rollback(*)`

Alias of `__exit__`.

`__call__(*_)`

Alias of `__exit__`.

`aspectlib.ALL_METHODS` **Weave all magic methods. Can be used as the value for methods argument in weave.**

Compiled regular expression objects

`aspectlib.NORMAL_METHODS` **Only weave non-magic methods. Can be used as the value for methods argument in weave.**

Compiled regular expression objects

`aspectlib.weave` (*target*, *aspect*[, *subclasses=True*, *methods=NORMAL_METHODS*, *lazy=False*,
aliases=True])
Send a message to a recipient

Parameters

- **target** (`aspectlib.Aspect`, function decorator or list of) – The object to weave.
- **aspects** – The aspects to apply to the object.
- **subclasses** (*bool*) – If `True`, subclasses of target are weaved. *Only available for classes*
- **aliases** (*bool*) – If `True`, aliases of target are replaced.
- **lazy** (*bool*) – If `True` only target's `__init__` method is patched, the rest of the methods are patched after `__init__` is called. *Only available for classes.*
- **methods** (*list or regex or string*) – Methods from target to patch. *Only available for classes*

Returns `aspectlib.Rollback` instance

Raises `TypeError` If target is a unacceptable object, or the specified options are not available for that type of object.

Changed in version 0.4.0: Replaced *only_methods*, *skip_methods*, *skip_magicmethods* options with *methods*. Renamed *on_init* option to *lazy*. Added *aliases* option. Replaced *skip_subclasses* option with *subclasses*.

6.2 aspectlib.debug

<code>aspectlib.debug.log</code>	Decorates <i>func</i> to have logging.
<code>aspectlib.debug.format_stack</code>	Returns a one-line string with the current callstack.
<code>aspectlib.debug.frame_iterator</code>	Yields frames till there are no more.
<code>aspectlib.debug.strip_non_ascii</code>	Convert to string (using <i>str</i>) and replace non-ascii characters with a dot (.).

`aspectlib.debug.format_stack` (*skip=0*, *length=6*, *_sep=''*)
Returns a one-line string with the current callstack.

`aspectlib.debug.frame_iterator` (*frame*)
Yields frames till there are no more.

`aspectlib.debug.log` (*func=None*, *stacktrace=10*, *stacktrace_align=60*, *attributes=()*, *module=True*,
call=True, *call_args=True*, *call_args_repr=<built-in function repr>*, *result=True*,
exception=True, *exception_repr=<built-in function repr>*, *result_repr=<function strip_non_ascii at 0x32fe758>*,
use_logging='CRITICAL', *print_to=None*)
Decorates *func* to have logging.

Parameters

- **func** (*function*) – Function to decorate. If missing log returns a partial which you can use as a decorator.
- **stacktrace** (*int*) – Number of frames to show.
- **stacktrace_align** (*int*) – Column to align the framelist to.
- **attributes** (*list*) – List of instance attributes to show, in case the function is a instance method.
- **module** (*bool*) – Show the module.

- **call** (*bool*) – If True, then show calls. If False only show the call details on exceptions (if exception is enabled) (default: True)
- **call_args** (*bool*) – If True, then show call arguments. (default: True)
- **call_args_repr** (*bool*) – Function to convert one argument to a string. (default: repr)
- **result** (*bool*) – If True, then show result. (default: True)
- **exception** (*bool*) – If True, then show exceptions. (default: True)
- **exception_repr** (*function*) – Function to convert an exception to a string. (default: repr)
- **result_repr** (*function*) – Function to convert the result object to a string. (default: strip_non_ascii - like str but nonascii characters are replaced with dots.)
- **use_logging** (*string*) – Emit log messages with the given loglevel. (default: "CRITICAL")
- **print_to** (*fileobject*) – File object to write to, in case you don't want to use logging module. (default: None - printing is disabled)

Returns A decorator or a wrapper.

Example:

```
>>> @log(print_to=sys.stdout)
... def a(weird=False):
...     if weird:
...         raise RuntimeError('BOOM!')
>>> a()
a()
a => None
>>> try:
...     a(weird=True)
... except Exception:
...     pass # naughty code !
a(weird=True)
a ~ raised RuntimeError('BOOM!',)
```

You can conveniently use this to logs just errors, or just results, example:

```
>>> import aspectlib
>>> with aspectlib.weave(float, log(call=False, result=False, print_to=sys.stdout)):
...     try:
...         float('invalid')
...     except Exception as e:
...         pass # naughty code !
float('invalid')
float ~ raised ValueError(...float...invalid...)
```

This makes debugging naughty code easier.

PS: Without the weaving it looks like this:

```
>>> try:
...     log(call=False, result=False, print_to=sys.stdout)(float)('invalid')
... except Exception:
...     pass # naughty code !
float('invalid')
float ~ raised ValueError(...float...invalid...)
```

Changed in version 0.5.0: Renamed *arguments* to *call_args*. Renamed *arguments_repr* to *call_args_repr*. Added *call* option.

`aspectlib.debug.strip_non_ascii(val)`
Convert to string (using *str*) and replace non-ascii characters with a dot (.).

6.3 aspectlib.test

This module aims to be a lightweight and flexible alternative to the popular `mock` framework.

<code>aspectlib.test.record</code>	Factory or decorator (depending if <i>func</i> is initially given).
<code>aspectlib.test.mock</code>	Factory for a decorator that makes the function return a given <i>return_value</i> .
<code>aspectlib.test.Story</code>	This a simple yet flexible tool that can do “capture-replay mocking” or “test doubles” ¹ .
<code>aspectlib.test.Replay</code>	Object implementing the <i>replay transaction</i> .

6.3.1 Spy & mock toolkit: record/mock decorators

Lightweight spies and mock responses

Example usage, suppose you want to test this class:

```
>>> class ProductionClass(object):
...     def method(self):
...         return 'stuff'
>>> real = ProductionClass()
```

With `aspectlib.test`:

```
>>> from aspectlib import weave, test
>>> patch = weave(real.method, [test.mock(3), test.record])
>>> real.method(3, 4, 5, key='value')
3
>>> assert real.method.calls == [(real, (3, 4, 5), {'key': 'value'})]
```

As a bonus, you have an easy way to rollback all the mess:

```
>>> patch.rollback()
>>> real.method()
'stuff'
```

With `mock`:

```
>>> from mock import Mock
>>> real = ProductionClass()
>>> real.method = Mock(return_value=3)
>>> real.method(3, 4, 5, key='value')
3
>>> real.method.assert_called_with(3, 4, 5, key='value')
```

`aspectlib.test.record(func=None, recurse_lock_factory=<function allocate_lock at 0x3945398>, **options)`

Factory or decorator (depending if *func* is initially given).

Parameters

- **callback** (*list*) – An a callable that is to be called with *instance*, *function*, *args*, *kwargs*.

¹ <http://www.martinfowler.com/bliki/TestDouble.html>

- **calls** (*list*) – An object where the *Call* objects are appended. If not given and *callback* is not specified then a new list object will be created.
- **iscalled** (*bool*) – If `True` the *func* will be called. (default: `False`)
- **extended** (*bool*) – If `True` the *func*'s `__name__` will also be included in the call list. (default: `False`)
- **results** (*bool*) – If `True` the results (and exceptions) will also be included in the call list. (default: `False`)

Returns A wrapper that has a *calls* property.

The decorator returns a wrapper that records all calls made to *func*. The history is available as a `call` property. If access to the function is too hard then you need to specify the history manually.

Example:

```
>>> @record
... def a(x, y, a, b):
...     pass
>>> a(1, 2, 3, b='c')
>>> a.calls
[Call(self=None, args=(1, 2, 3), kwargs={'b': 'c'})]
```

Or, with your own history list:

```
>>> calls = []
>>> @record(calls=calls)
... def a(x, y, a, b):
...     pass
>>> a(1, 2, 3, b='c')
>>> a.calls
[Call(self=None, args=(1, 2, 3), kwargs={'b': 'c'})]
>>> calls is a.calls
True
```

Changed in version 0.9.0: Renamed *history* option to *calls*. Renamed *call* option to *iscalled*. Added *callback* option. Added *extended* option.

`aspectlib.test.mock` (*return_value*, *call=False*)

Factory for a decorator that makes the function return a given *return_value*.

Parameters

- **return_value** – Value to return from the wrapper.
- **call** (*bool*) – If `True`, call the decorated function. (default: `False`)

Returns A decorator.

6.3.2 Capture-replay toolkit: `Story` and `Replay`

Elaborate tools for testing difficult code

class `aspectlib.test.Story` (*target*, ***options*)

This a simple yet flexible tool that can do “capture-replay mocking” or “test doubles” ¹. It leverages `aspectlib`'s powerful weaver.

Parameters

- **target** (Same as for `aspectlib.weave`.) – Targets to weave in the *story/replay* transactions.

- **subclasses** (*bool*) – If `True`, subclasses of target are weaved. *Only available for classes*
- **aliases** (*bool*) – If `True`, aliases of target are replaced.
- **lazy** (*bool*) – If `True` only target's `__init__` method is patched, the rest of the methods are patched after `__init__` is called. *Only available for classes.*
- **methods** (*list or regex or string*) – Methods from target to patch. *Only available for classes*

The `Story` allows some testing patterns that are hard to do with other tools:

- **Proxied mocks:** partially mock *objects* and *modules* so they are called normally if the request is unknown.
- **Stubs:** completely mock *objects* and *modules*. Raise errors if the request is unknown.

The `Story` works in two of transactions:

- **The story:** You describe what calls you want to mocked. Initially you don't need to write this. Example:

```
>>> import mymod
>>> with Story(mymod) as story:
...     mymod.func('some arg') == 'some result'
...     mymod.func('bad arg') ** ValueError("can't use this")
```

- **The replay:** You run the code uses the interfaces mocked in the *story*. The `replay` always starts from a *story* instance.

Changed in version 0.9.0: Added in.

replay (***options*)

Parameters

- **proxy** (*bool*) – If `True` then unexpected uses are allowed (will use the real functions) but they are collected for later use. Default: `True`.
- **strict** (*bool*) – If `True` then an `AssertionError` is raised when there were *unexpected calls* or there were *missing calls* (specified in the story but not called). Default: `True`.
- **dump** (*bool*) – If `True` then the *unexpected/missing calls* will be printed (to `sys.stdout`). Default: `True`.

Returns A `aspectlib.test.Replay` object.

Example:

```
>>> import mymod
>>> with Story(mymod) as story:
...     mymod.func('some arg') == 'some result'
...     mymod.func('other arg') == 'other result'
>>> with story.replay(strict=False):
...     print(mymod.func('some arg'))
...     mymod.func('bogus arg')
some result
Got bogus arg in the real code !
STORY/REPLAY DIFF:
--- expected...
+++ actual...
@@ -1,2 +1,2 @@
-mymod.func('other arg') == 'other result' # returns
+mymod.func('bogus arg') == None # returns
mymod.func('some arg') == 'some result' # returns
```

class `aspectlib.test.Replay`(?)

Object implementing the *replay transaction*.

This object should be created by Story's replay method.

diff()

Returns a pretty text representation of the unexpected and missing calls.

Most of the time you don't need to directly use this. This is useful when you run the *replay* in `strict=False` mode and want to do custom assertions.

missing()

Returns a pretty text representation of just the missing calls.

unexpected(_missing=False)

Returns a pretty text representation of just the unexpected calls.

The output should be usable directly in the story (just copy-paste it). Example:

```
>>> import mymod
>>> with Story(mymod) as story:
...     pass
>>> with story.replay(strict=False, dump=False) as replay:
...     mymod.func('some arg')
...     try:
...         mymod.badfunc()
...     except ValueError as exc:
...         print(exc)
Got some arg in the real code !
boom!
>>> print(replay.unexpected())
mymod.badfunc() ** ValueError('boom!') # raises
mymod.func('some arg') == None # returns
```

We can just take the output and paste in the story:

```
>>> import mymod
>>> with Story(mymod) as story:
...     mymod.badfunc() ** ValueError('boom!') # raises
...     mymod.func('some arg') == None # returns
>>> with story.replay():
...     mymod.func('some arg')
...     try:
...         mymod.badfunc()
...     except ValueError as exc:
...         print(exc)
boom!
```

Development

Development is happening on [Github](#).

TODO & Ideas

8.1 Validation

```
class BaseProcessor(object):
    def process_foo(self, data):
        # do some work

    def process_bar(self, data):
        # do some work

class ValidationConcern(aspectlib.Concern):
    @aspectlib.Aspect
    def process_foo(self, data):
        # validate data
        if is_valid_foo(data):
            yield aspectlib.Proceed
        else:
            raise ValidationError()

    @aspectlib.Aspect
    def process_bar(self, data):
        # validate data
        if is_valid_bar(data):
            yield aspectlib.Proceed
        else:
            raise ValidationError()

aspectlib.weave(BaseProcessor, ValidationConcern)

class MyProcessor(BaseProcessor):
    def process_foo(self, data):
        # do some work

    def process_bar(self, data):
        # do some work

# MyProcessor automatically inherits BaseProcessor's ValidationConcern
```

Changelog

9.1 Version 0.9.0

- Changed `aspectlib.test.record`:
 - Renamed *history* option to *calls*.
 - Renamed *call* option to *iscalled*.
 - Added *callback* option.
 - Added *extended* option.
- Changed `aspectlib.weave`:
 - Allow weaving everything in a module.
 - Allow weaving instances of new-style classes.
- Changed `aspectlib.test.Story` class for capture-replay and stub/mock testing.

9.2 Version 0.8.1

- Use simpler import for the `py3support`.

9.3 Version 0.8.0

- Change `aspectlib.debug.log` to use `Aspect` and work as expected with coroutines or generators.
- Fixed `aspectlib.debug.log` to work on Python 3.4.
- Remove the undocumented `aspectlib.Yield` advice. It was only usable when decorating generators.

9.4 Version 0.7.0

- Add support for decorating generators and coroutines in `Aspect`.
- Made `aspectlib` raise better exceptions.

9.5 Version 0.6.1

- Fix checks inside `aspectlib.debug.log` that would inadvertently call `__bool__`/`__nonzero`.

9.6 Version 0.6.0

- Don't include `__getattr__` in `ALL_METHODS` - it's too dangerous dangerous dangerous dangerous dangerous dangerous ... ;)
- Do a more reliable check for old-style classes in `debug.log`
- When weaving a class don't weave attributes that are callable but are not actually routines (functions, methods etc)

9.7 Version 0.5.0

- Changed `aspectlib.debug.log`:
 - Renamed *arguments* to *call_args*.
 - Renamed *arguments_repr* to *call_args_repr*.
 - Added *call* option.
 - Fixed issue with logging from old-style methods (object name was a generic “instance”).
- Fixed issues with weaving some types of builtin methods.
- Allow to apply multiple aspects at the same time.
- Validate string targets before weaving. `aspectlib.weave('mod.invalid name', aspect)` now gives a clear error (*invalid name is not a valid identifier*)
- Various documentation improvements and examples.

9.8 Version 0.4.1

- Remove junk from 0.4.0's source distribution.

9.9 Version 0.4.0

- Changed `aspectlib.weave`:
 - Replaced *only_methods*, *skip_methods*, *skip_magicmethods* options with *methods*.
 - Renamed *on_init* option to *lazy*.
 - Added *aliases* option.
 - Replaced *skip_subclasses* option with *subclasses*.
- Fixed weaving methods from a string target.

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