Pylons Reference Documentation

Release 1.1

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CONTENTS

CHAPTER

ONE

GETTING STARTED

This section is intended to get Pylons up and running as fast as possible and provide a quick overview of the project. Links are provided throughout to encourage exploration of the various aspects of Pylons.

1.1 Requirements

- **Python 2 series above and including 2.4 (Python 3 or later not supported at** this time)

1.2 Installing

To avoid conflicts with system-installed Python libraries, Pylons comes with a boot-strap Python script that sets up a "virtual" Python environment. Pylons will then be installed under the virtual environment.

By the Way

virtualenv is a useful tool to create isolated Python environments. In addition to isolating packages from possible system conflicts, it makes it easy to install Python libraries using *easy_install* without dumping lots of packages into the system-wide Python.

The other great benefit is that no root access is required since all modules are kept under the desired directory. This makes it easy to setup a working Pylons install on shared hosting providers and other systems where system-wide access is unavailable.

---

1. Download the go-pylons.py script.
2. Run the script and specify a directory for the virtual environment to be created under:

```
$ python go-pylons.py mydevenv
```

Tip

The two steps can be combined on unix systems with curl using the following short-cut:

```
$ curl http://pylonshq.com/download/1.0/go-pylons.py | python - mydevenv
```

To isolate further from additional system-wide Python libraries, run with the –no-site-packages option:

```
$ python go-pylons.py --no-site-packages mydevenv
```

How it Works

The `go-pylons.py` script is little more than a basic *virtualenv* bootstrap script, that then does `easy_install Pylons==1.0`. You could do the equivilant steps by manually fetching the `virtualenv.py` script and then installing Pylons like so:

```
curl -O http://bitbucket.org/ianb/virtualenv/raw/8dd7663d9811/virtualenv.py
python virtualenv.py mydevenv
mydevenv/bin/easy_install Pylons==1.0
```

This will leave a functional virtualenv and Pylons installation.

Activate the virtual environment (scripts may also be run by specifying the full path to the mydevenv/bin dir):

```
$ source mydevenv/bin/activate
```

Or on Window to activate:

```
> mydevenv\Scripts\activate.bat
```

Note: If you get an error such as:

```
ImportError: No module named _md5
```

during the install. It is likely that your Python installation is missing standard libraries needed to run Pylons. Debian and other systems using debian packages most frequently encounter this, make sure to install the `python-dev` packages and `python-hashlib` packages.

1.2.1 Working Directly From the Source Code

Mercurial must be installed to retrieve the latest development source for Pylons. Mercurial packages are also available for Windows, MacOSX, and other OS's.

Check out the latest code:

```
$ hg clone http://bitbucket.org/bbangert/pylons/
```

To tell setuptools to use the version in the `Pylons` directory:

```
$ cd pylons
$ python setup.py develop
```

The active version of Pylons is now the copy in this directory, and changes made there will be reflected for Pylons apps running.

1.3 Creating a Pylons Project

Create a new project named `helloworld` with the following command:

```
$ paster create -t pylons helloworld
```

Note: Windows users must configure their `PATH` as described in *Windows Notes*, otherwise they must specify the full path to the `paster` command (including the virtual environment bin directory).

Running this will prompt for two choices:

1. which templating engine to use
2. whether to include *SQLAlchemy* support

Hit enter at each prompt to accept the defaults (Mako templating, no *SQLAlchemy*).

Here is the created directory structure with links to more information:

- **helloworld**
  - MANIFEST.in
  - README.txt
  - development.ini - *Runtime Configuration*
  - docs
  - ez_setup.py
  - helloworld (See the nested *helloworld directory*)
  - helloworld.egg-info
  - setup.cfg
  - setup.py - *Application Setup*
  - test.ini

The nested `helloworld directory` looks like this:

- **helloworld**
  - __init__.py
  - **config**
    - environment.py - *Environment*
    - middleware.py - *Middleware*
    - routing.py - *URL Configuration*
  - controllers - *Controllers*
  - **lib**
    - app_globals.py - *app_globals*
    - base.py
    - helpers.py - *Helpers*
  - model - *Models*
  - public
  - templates - *Templates*
  - tests - *Unit and functional testing*
  - websetup.py - *Runtime Configuration*

1.4 Running the application

Run the web application:

```
$ cd helloworld
$ paster serve --reload development.ini
```

The command loads the project's server configuration file in `development.ini` and serves the Pylons application.

Note: The `--reload` option ensures that the server is automatically reloaded if changes are made to Python files or the `development.ini` config file. This is very useful during development. To stop the server press **Ctrl+c** or the platform's equivalent.

The paster serve command can be run anywhere, as long as the development.ini path is properly specified. Generally during development it's run in the root directory of the project.

Visiting http://127.0.0.1:5000/ when the server is running will show the welcome page.

1.5 Hello World

To create the basic hello world application, first create a *controller* in the project to handle requests:

```
$ paster controller hello
```

Open the `helloworld/controllers/hello.py` module that was created. The default controller will return just the string 'Hello World':

```
import logging

from pylons import request, response, session, tmpl_context as c, url
from pylons.controllers.util import abort, redirect

from helloworld.lib.base import BaseController, render

log = logging.getLogger(__name__)

class HelloController(BaseController):

    def index(self):
        # Return a rendered template
        #return render('/hello.mako')
        # or, Return a response
        return 'Hello World'
```

At the top of the module, some commonly used objects are imported automatically.

Navigate to http://127.0.0.1:5000/hello/index where there should be a short text string saying "Hello World" (start up the app if needed):

Tip

URL Configuration explains how URL's get mapped to controllers and their methods.

Add a template to render some of the information that's in the *environ*.

First, create a `hello.mako` file in the `templates` directory with the following contents:

```
Hello World, the environ variable looks like: <br />

${request.environ}
```

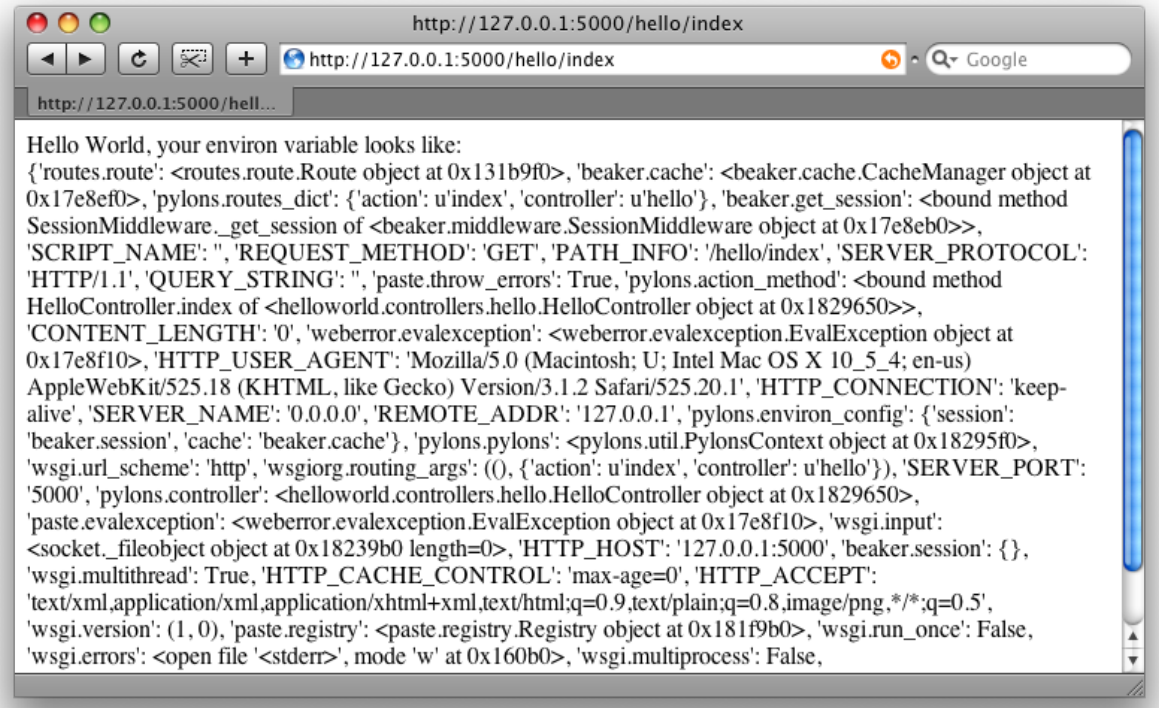
The *request* variable in templates is used to get information about the current request. *Template globals* lists all the variables Pylons makes available for use in templates.

Next, update the `controllers/hello.py` module so that the index method is as follows:

```
class HelloController(BaseController):

    def index(self):
        return render('/hello.mako')
```

Refreshing the page in the browser will now look similar to this:


http://127.0.0.1:5000/hello/index
http://127.0.0.1:5000/hello/index
Google
http://127.0.0.1:5000/hell...
Hello World, your environ variable looks like:
{'routes.route': <routes.route.Route object at 0x131b9f0>, 'beaker.cache': <beaker.cache.CacheManager object at 0x17e8ef0>, 'pylons.routes_dict': {'action': u'index', 'controller': u'hello'}, 'beaker.get_session': <bound method SessionMiddleware._get_session of <beaker.middleware.SessionMiddleware object at 0x17e8eb0>>, 'SCRIPT_NAME': '', 'REQUEST_METHOD': 'GET', 'PATH_INFO': '/hello/index', 'SERVER_PROTOCOL': 'HTTP/1.1', 'QUERY_STRING': '', 'paste.throw_errors': True, 'pylons.action_method': <bound method HelloController.index of <helloworld.controllers.hello.HelloController object at 0x1829650>>, 'CONTENT_LENGTH': '0', 'weberror.evalexception': <weberror.evalexception.EvalException object at 0x17e8f10>, 'HTTP_USER_AGENT': 'Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_4; en-us) AppleWebKit/525.18 (KHTML, like Gecko) Version/3.1.2 Safari/525.20.1', 'HTTP_CONNECTION': 'keep-alive', 'SERVER_NAME': '0.0.0.0', 'REMOTE_ADDR': '127.0.0.1', 'pylons.environ_config': {'session': 'beaker.session', 'cache': 'beaker.cache'}, 'pylons.pylons': <pylons.util.PylonsContext object at 0x18295f0>, 'wsgi.url_scheme': 'http', 'wsgiorg.routing_args': ((), {'action': u'index', 'controller': u'hello'}), 'SERVER_PORT': '5000', 'pylons.controller': <helloworld.controllers.hello.HelloController object at 0x1829650>, 'paste.evalexception': <weberror.evalexception.EvalException object at 0x17e8f10>, 'wsgi.input': <socket._fileobject object at 0x18239b0 length=0>, 'HTTP_HOST': '127.0.0.1:5000', 'beaker.session': {}, 'wsgi.multithread': True, 'HTTP_CACHE_CONTROL': 'max-age=0', 'HTTP_ACCEPT': 'text/xml,application/xml,application/xhtml+xml,text/html;q=0.9,text/plain;q=0.8,image/png,*/*;q=0.5', 'wsgi.version': (1, 0), 'paste.registry': <paste.registry.Registry object at 0x181f9b0>, 'wsgi.run_once': False, 'wsgi.errors': <open file '<stderr>', mode 'w' at 0x160b0>, 'wsgi.multiprocess': False,

CHAPTER

TWO

CONCEPTS OF PYLONS

Understanding the basic concepts of Pylons, the flow of a request and response through the stack and how Pylons operates makes it easier to customize when needed, in addition to clearing up misunderstandings about why things behave the way they do.

This section acts as a basic introduction to the concept of a *WSGI* application, and *WSGI Middleware* in addition to showing how Pylons utilizes them to assemble a complete working web framework.

To follow along with the explanations below, create a project following the *Getting Started* Guide.

2.1 The 'Why' of a Pylons Project

A new Pylons project works a little differently than in many other web frameworks. Rather than loading the framework, which then finds a new projects code and runs it, Pylons creates a Python package that does the opposite. That is, when its run, it imports objects from Pylons, assembles the WSGI Application and stack, and returns it.

If desired, a new project could be completely cleared of the Pylons imports and run any arbitrary WSGI application instead. This is done for a greater degree of freedom and flexibility in building a web application that works the way the developer needs it to.

By default, the project is configured to use standard components that most developers will need, such as sessions, template engines, caching, high level request and response objects, and an *ORM*. By having it all setup in the project (rather than hidden away in 'framework' code), the developer is free to tweak and customize as needed.

In this manner, Pylons has setup a project with its *opinion* of what may be needed by the developer, but the developer is free to use the tools needed to accomplish the projects goals. Pylons offers an unprecedented level of customization by exposing its functionality through the project while still maintaining a remarkable amount of simplicity by retaining a single standard interface between core components (*WSGI*).

2.2 WSGI Applications

WSGI is a basic specification known as **PEP 333**, that describes a method for interacting with a HTTP server. This involves a way to get access to HTTP headers from the request, and how set HTTP headers and return content on the way back out.

A 'Hello World' WSGI Application:

```
def simple_app(environ, start_response):
    start_response('200 OK', [('Content-type', 'text/html')])
    return ['<html><body>Hello World</body></html>']
```

This WSGI application does nothing but set a 200 status code for the response, set the HTTP 'Content-type' header, and return some HTML.

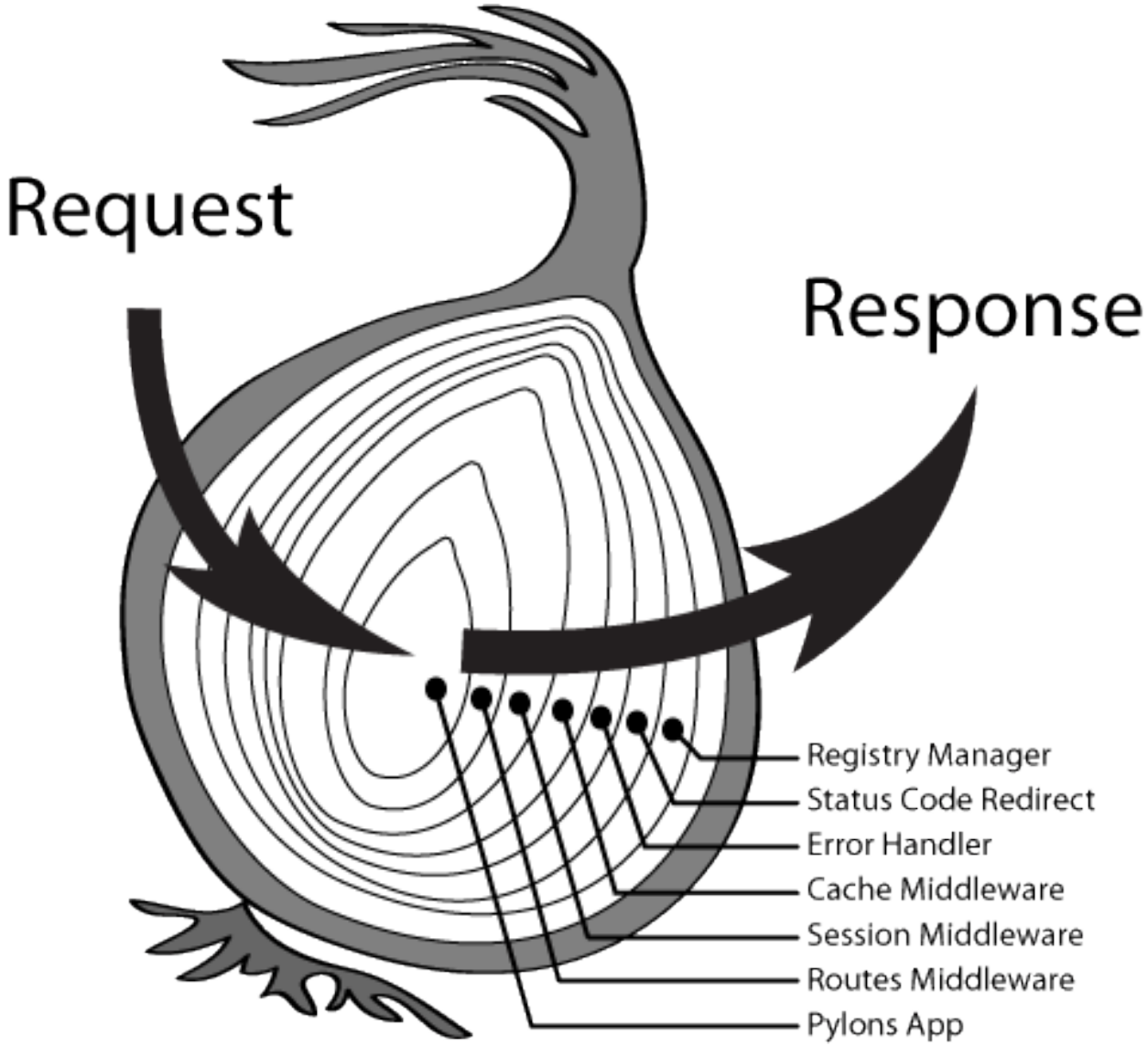
The WSGI specification lays out a set of keys that will be set in the environ dict.

The WSGI interface, that is, this method of calling a function (or method of a class) with two arguments, and handling a response as shown above, is used throughout Pylons as a standard interface for passing control to the next component.

Inside a new project's `config/middleware.py`, the *make_app* function is responsible for creating a WSGI application, wrapping it in WSGI middleware (explained below) and returning it so that it may handle requests from a HTTP server.

2.3 WSGI Middleware

Within `config/middleware.py` a Pylons application is wrapped in successive layers which add functionality. The process of wrapping the Pylons application in middleware results in a structure conceptually similar to the layers in an onion.



Once the middleware has been used to wrap the Pylons application, the make_app function returns the completed app with the following structure (outermost layer listed first):

```
Registry Manager
    Status Code Redirect
        Error Handler
            Cache Middleware
                Session Middleware
                    Routes Middleware
                        Pylons App (WSGI Application)
```

WSGI middleware is used extensively in Pylons to add functionality to the base WSGI application. In Pylons, the 'base' WSGI Application is the `PylonsApp`. It's responsible for looking in the *environ* dict that was passed in (from the Routes Middleware).

To see how this functionality is created, consider a small class that looks at the *HTTP_REFERER* header to see if it's Google:

```
class GoogleRefMiddleware(object):
    def __init__(self, app):
        self.app = app

    def __call__(self, environ, start_response):
        environ['google'] = False
        if 'HTTP_REFERER' in environ:
            if environ['HTTP_REFERER'].startswith('http://google.com'):
                environ['google'] = True
        return self.app(environ, start_response)
```

This is considered WSGI Middleware as it still can be called and returns like a WSGI Application, however, it's adding something to environ, and then calls a WSGI Application that it is initialized with. That's how the layers are built up in the *WSGI Stack* that is configured for a new Pylons project.

Some of the layers, like the Session, Routes, and Cache middleware, only add objects to the *environ* dict, or add HTTP headers to the response (the Session middleware for example adds the session cookie header). Others, such as the Status Code Redirect, and the Error Handler may fully intercept the request entirely, and change how it's responded to.

2.4 Controller Dispatch

When the request passes down the middleware, the incoming URL gets parsed in the RoutesMiddleware, and if it matches a URL (See *URL Configuration*), the information about the controller that should be called is put into the *environ* dict for use by `PylonsApp`.

The `PylonsApp` then attempts to find a controller in the `controllers` directory that matches the name of the controller, and searches for a class inside it by a similar scheme (controller name + 'Controller', ie, HelloController). Upon finding a controller, its then called like any other WSGI application using the same WSGI interface that `PylonsApp` was called with. New in version 1.0: Controller name can also be a dotted path to the module / callable that should be imported and called. For example, to use a controller named 'Foo' that is in the 'bar.controllers' package, the controller name would be *bar.controllers:Foo*. This is why the BaseController that resides in a project's `lib/base.py` module inherits from `WSGIController` and has a *__call__* method that takes the *environ* and *start_response*. The `WSGIController` locates a method in the class that corresponds to the *action* that Routes found, calls it, and returns the response completing the request.

2.5 Paster

Running the **paster** command all by itself will show the sets of commands it accepts:

```
$ paster
Usage: paster [paster_options] COMMAND [command_options]

Options:
  --version          show program's version number and exit
  --plugin=PLUGINS   Add a plugin to the list of commands (plugins are Egg
                     specs; will also require() the Egg)
  -h, --help         Show this help message

Commands:
  create          Create the file layout for a Python distribution
  grep            Search project for symbol
```

```
  help            Display help
  make-config     Install a package and create a fresh config file/directory
  points          Show information about entry points
  post            Run a request for the described application
  request         Run a request for the described application
  serve           Serve the described application
  setup-app       Setup an application, given a config file

pylons:
  controller      Create a Controller and accompanying functional test
  restcontroller  Create a REST Controller and accompanying functional test
  shell           Open an interactive shell with the Pylons app loaded
```

If **paster** is run inside of a Pylons project, this should be the output that will be printed. The last section, *pylons* will be absent if it is not run inside a Pylons project. This is due to a dynamic plugin system the **paster** script uses, to determine what sets of commands should be made available.

Inside a Pylons project, there is a directory ending in *.egg-info*, that has a `paster_plugins.txt` file in it. This file is looked for and read by the **paster** script, to determine what other packages should be searched dynamically for commands. Pylons makes several commands available for use in a Pylons project, as shown above.

2.6 Loading the Application

Running (and thus loading) an application is done using the **paster** command:

```
$ paster serve development.ini
```

This instructs the paster script to go into a 'serve' mode. It will attempt to load both a server and a WSGI application that should be served, by parsing the configuration file specified. It looks for a *[server]* block to determine what server to use, and an *[app]* block for what WSGI application should be used.

The basic egg block in the `development.ini` for a *helloworld* project:

```
[app:main]
use = egg:helloworld
```

That will tell paster that it should load the helloworld *egg* to locate a WSGI application. A new Pylons application includes a line in the `setup.py` that indicates what function should be called to make the WSGI application:

```
entry_points="""
[paste.app_factory]
main = helloworld.config.middleware:make_app

[paste.app_install]
main = pylons.util:PylonsInstaller
""",
```

Here, the *make_app* function is specified as the *main* WSGI application that Paste (the package that **paster** comes from) should use.

The *make_app* function from the project is then called, and the server (by default, a HTTP server) runs the WSGI application.

CHAPTER

THREE

CONTROLLERS

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In the *MVC* paradigm the *controller* interprets the inputs, commanding the model and/or the view to change as appropriate. Under Pylons, this concept is extended slightly in that a Pylons controller is not directly interpreting the client's request, but is acting to determine the appropriate way to assemble data from the model, and render it with the correct template.

The controller interprets requests from the user and calls portions of the model and view as necessary to fulfill the request. So when the user clicks a Web link or submits an HTML form, the controller itself doesn't output anything or perform any real processing. It takes the request and determines which model components to invoke and which formatting to apply to the resulting data.

Pylons uses a class, where the superclass provides the *WSGI* interface and the subclass implements the application-specific controller logic.

The Pylons WSGI Controller handles incoming web requests that are dispatched from the Pylons WSGI application `PylonsApp`.

These requests result in a new instance of the `WSGIController` being created, which is then called with the dict options from the Routes match. The standard WSGI response is then returned with start_response called as per the WSGI spec.

Since Pylons controllers are actually called with the WSGI interface, normal WSGI applications can also be Pylons 'controllers'.

3.1 Standard Controllers

Standard Controllers intended for subclassing by web developers

3.1.1 Keeping methods private

The default route maps any controller and action, so you will likely want to prevent some controller methods from being callable from a URL.

Pylons uses the default Python convention of private methods beginning with _. To hide a method `edit_generic` in this class, just changing its name to begin with _ will be sufficient:

```
class UserController(BaseController):
    def index(self):
        return "This is the index."

    def _edit_generic(self):
        """I can't be called from the web!"""
        return True
```

3.1.2 Special methods

Special controller methods you may define:

__before__ This method is called before your action is, and should be used for setting up variables/objects, restricting access to other actions, or other tasks which should be executed before the action is called.

__after__ This method is called after the action is, unless an unexpected exception was raised. Subclasses of `HTTPException` (such as those raised by `redirect_to` and `abort`) are expected; e.g. `__after__` will be called on redirects.

3.1.3 Adding Controllers dynamically

It is possible for an application to add controllers without restarting the application. This requires telling Routes to re-scan the controllers directory.

New controllers may be added from the command line with the paster command (recommended as that also creates the test harness file), or any other means of creating the controller file.

For Routes to become aware of new controllers present in the controller directory, an internal flag is toggled to indicate that Routes should rescan the directory:

```
from routes import request_config

mapper = request_config().mapper
mapper._created_regs = False
```

On the next request, Routes will rescan the controllers directory and those routes that use the `:controller` dynamic part of the path will be able to match the new controller.

3.1.4 Customizing the Controller Name

By default, Pylons looks for a controller named 'Something'Controller. This naming scheme can be overridden by supplying an optional module-level variable called `__controller__` to indicate the desired controller class:

```
import logging

from pylons import request, response, session, tmpl_context as c
from pylons.controllers.util import abort, redirect_to

from helloworld.lib.base import BaseController, render

log = logging.getLogger(__name__)

__controller__ = 'Hello'

class Hello(BaseController):

    def index(self):
        # Return a rendered template
        #return render('/hello.mako')
        # or, return a string
        return 'Hello World'
```

3.1.5 Attaching WSGI apps

Note: This recipe assumes a basic level of familiarity with the WSGI Specification (PEP 333)

WSGI runs deep through Pylons, and is present in many parts of the architecture. Since Pylons controllers are actually called with the WSGI interface, normal WSGI applications can also be Pylons 'controllers'.

Optionally, if a full WSGI app should be mounted and handle the remainder of the URL, Routes can automatically move the right part of the URL into the `SCRIPT_NAME`, so that the WSGI application can properly handle its `PATH_INFO` part.

This recipe will demonstrate adding a basic WSGI app as a Pylons controller.

Create a new controller file in your Pylons project directory:

```
$ paster controller wsgiapp
```

This sets up the basic imports that you may want available when using other WSGI applications.

Edit your controller so it looks like this:

```
import logging

from YOURPROJ.lib.base import *

log = logging.getLogger(__name__)

def WsgiappController(environ, start_response):
    start_response('200 OK', [('Content-type', 'text/plain')])
    return ["Hello World"]
```

When hooking up other WSGI applications, they will expect the part of the URL that was used to get to this controller to have been moved into `SCRIPT_NAME`. `Routes` can properly adjust the environ if a map route for this controller is added to the `config/routing.py` file:

```
# CUSTOM ROUTES HERE

# Map the WSGI application
map.connect('wsgiapp/{path_info:.*}', controller='wsgiapp')
```

By specifying the `path_info` dynamic path, Routes will put everything leading up to the `path_info` in the `SCRIPT_NAME` and the rest will go in the `PATH_INFO`.

3.2 Using the WSGI Controller to provide a WSGI service

3.2.1 The Pylons WSGI Controller

Pylons' own WSGI Controller follows the WSGI spec for calling and return values

The Pylons WSGI Controller handles incoming web requests that are dispatched from `PylonsApp`. These requests result in a new instance of the `WSGIController` being created, which is then called with the dict options from the Routes match. The standard WSGI response is then returned with `start_response()` called as per the WSGI spec.

3.2.2 WSGIController methods

Special `WSGIController` methods you may define:

__before__ This method will be run before your action is, and should be used for setting up variables/objects, restricting access to other actions, or other tasks which should be executed before the action is called.

__after__ Method to run after the action is run. This method will *always* be run after your method, even if it raises an Exception or redirects.

Each action to be called is inspected with `_inspect_call()` so that it is only passed the arguments in the Routes match dict that it asks for. The arguments passed into the action can be customized by overriding the `_get_method_args()` function which is expected to return a dict.

In the event that an action is not found to handle the request, the Controller will raise an "Action Not Found" error if in debug mode, otherwise a `404 Not Found` error will be returned.

3.3 Using the REST Controller with a RESTful API

3.3.1 Using the paster restcontroller template

```
$ paster restcontroller --help
```

Create a REST Controller and accompanying functional test

The RestController command will create a REST-based Controller file for use with the `resource()` REST-based dispatching. This template includes the methods that `resource()` dispatches to in addition to doc strings for clarification on when the methods will be called.

The first argument should be the singular form of the REST resource. The second argument is the plural form of the word. If its a nested controller, put the directory information in front as shown in the second example below.

Example usage:

```
$ paster restcontroller comment comments
Creating yourproj/yourproj/controllers/comments.py
Creating yourproj/yourproj/tests/functional/test_comments.py
```

If you'd like to have controllers underneath a directory, just include the path as the controller name and the necessary directories will be created for you:

```
$ paster restcontroller admin/trackback admin/trackbacks
Creating yourproj/controllers/admin
Creating yourproj/yourproj/controllers/admin/trackbacks.py
Creating yourproj/yourproj/tests/functional/test_admin_trackbacks.py
```

3.3.2 An Atom-Style REST Controller for Users

```
# From http://pylonshq.com/pasties/503
import logging

from formencode.api import Invalid
from pylons import url
from simplejson import dumps

from restmarks.lib.base import *

log = logging.getLogger(__name__)

class UsersController(BaseController):
    """REST Controller styled on the Atom Publishing Protocol"""
    # To properly map this controller, ensure your
    # config/routing.py file has a resource setup:
    #     map.resource('user', 'users')

    def index(self, format='html'):
        """GET /users: All items in the collection.<br>
            @param format the format passed from the URI.
```

```
        """
        #url('users')
        users = model.User.select()
        if format == 'json':
            data = []
            for user in users:
                d = user._state['original'].data
                del d['password']
                d['link'] = url('user', id=user.name)
                data.append(d)
            response.headers['content-type'] = 'text/javascript'
            return dumps(data)
        else:
            c.users = users
            return render('/users/index_user.mako')

    def create(self):
        """POST /users: Create a new item."""
        # url('users')
        user = model.User.get_by(name=request.params['name'])
        if user:
            # The client tried to create a user that already exists
            abort(409, '409 Conflict',
                  headers=[('location', url('user', id=user.name))])
        else:
            try:
                # Validate the data that was sent to us
                params = model.forms.UserForm.to_python(request.params)
            except Invalid, e:
                # Something didn't validate correctly
                abort(400, '400 Bad Request -- %s' % e)
            user = model.User(**params)
            model.objectstore.flush()
            response.headers['location'] = url('user', id=user.name)
            response.status_code = 201
            c.user_name = user.name
            return render('/users/created_user.mako')

    def new(self, format='html'):
        """GET /users/new: Form to create a new item.
            @param format the format passed from the URI.
        """
        # url('new_user')
        return render('/users/new_user.mako')

    def update(self, id):
        """PUT /users/id: Update an existing item.
            @param id the id (name) of the user to be updated
        """
        # Forms posted to this method should contain a hidden field:
        #    <input type="hidden" name="_method" value="PUT" />
        # Or using helpers:
        #    h.form(url('user', id=ID),
        #           method='put')
        # url('user', id=ID)
        old_name = id
        new_name = request.params['name']
        user = model.User.get_by(name=id)
```

```
        if user:
            if (old_name != new_name) and model.User.get_by(name=new_name):
                abort(409, '409 Conflict')
            else:
                params = model.forms.UserForm.to_python(request.params)
                user.name = params['name']
                user.full_name = params['full_name']
                user.email = params['email']
                user.password = params['password']
                model.objectstore.flush()
                if user.name != old_name:
                    abort(301, '301 Moved Permanently',
                          [('Location', url('users', id=user.name))])
                else:
                    return

    def delete(self, id):
        """DELETE /users/id: Delete an existing item.
            @param id the id (name) of the user to be updated
        """
        # Forms posted to this method should contain a hidden field:
        #    <input type="hidden" name="_method" value="DELETE" />
        # Or using helpers:
        #    h.form(url('user', id=ID),
        #           method='delete')
        # url('user', id=ID)
        user = model.User.get_by(name=id)
        user.delete()
        model.objectstore.flush()
        return

    def show(self, id, format='html'):
        """GET /users/id: Show a specific item.
            @param id the id (name) of the user to be updated.
            @param format the format of the URI requested.
        """
        # url('user', id=ID)
        user = model.User.get_by(name=id)
        if user:
            if format=='json':
                data = user._state['original'].data
                del data['password']
                data['link'] = url('user', id=user.name)
                response.headers['content-type'] = 'text/javascript'
                return dumps(data)
            else:
                c.data = user
                return render('/users/show_user.mako')
        else:
            abort(404, '404 Not Found')

    def edit(self, id, format='html'):
        """GET /users/id;edit: Form to edit an existing item.
            @param id the id (name) of the user to be updated.
            @param format the format of the URI requested.
        """
        # url('edit_user', id=ID)
        user = model.User.get_by(name=id)
```

```
        if not user:
            abort(404, '404 Not Found')
        # Get the form values from the table
        c.values = model.forms.UserForm.from_python(user.__dict__)
        return render('/users/edit_user.mako')
```

3.4 Using the XML-RPC Controller for XML-RPC requests

In order to deploy this controller you will need at least a passing familiarity with XML-RPC itself. We will first review the basics of XML-RPC and then describe the workings of the `Pylons XMLRPCController`. Finally, we will show an example of how to use the controller to implement a simple web service.

After you've read this document, you may be interested in reading the companion document: "A blog publishing web service in XML-RPC" which takes the subject further, covering details of the MetaWeblog API (a popular XML-RPC service) and demonstrating how to construct some basic service methods to act as the core of a MetaWeblog blog publishing service.

3.4.1 A brief introduction to XML-RPC

XML-RPC is a specification that describes a Remote Procedure Call (RPC) interface by which an application can use the Internet to execute a specified procedure call on a remote XML-RPC server. The name of the procedure to be called and any required parameter values are "marshalled" into XML. The XML forms the body of a POST request which is despatched via HTTP to the XML-RPC server. At the server, the procedure is executed, the returned value(s) is/are marshalled into XML and despatched back to the application. XML-RPC is designed to be as simple as possible, while allowing complex data structures to be transmitted, processed and returned.

3.4.2 XML-RPC Controller that speaks WSGI

Pylons uses Python's xmlrpclib library to provide a specialised `XMLRPCController` class that gives you the full range of these XML-RPC Introspection facilities for use in your service methods and provides the foundation for constructing a set of specialised service methods that provide a useful web service — such as a blog publishing interface.

This controller handles XML-RPC responses and complies with the XML-RPC Specification as well as the XML-RPC Introspection specification.

As part of its basic functionality an XML-RPC server provides three standard introspection procedures or "service methods" as they are called. The Pylons `XMLRPCController` class provides these standard service methods ready-made for you:

- `system.listMethods()` Returns a list of XML-RPC methods for this XML-RPC resource
- `system.methodSignature()` Returns an array of arrays for the valid signatures for a method. The first value of each array is the return value of the method. The result is an array to indicate multiple signatures a method may be capable of.
- `system.methodHelp()` Returns the documentation for a method

By default, methods with names containing a dot are translated to use an underscore. For example, the `system.methodHelp` is handled by the method `system_methodHelp()`.

Methods in the XML-RPC controller will be called with the method given in the XML-RPC body. Methods may be annotated with a signature attribute to declare the valid arguments and return types.

For example:

```
class MyXML(XMLRPCController):
    def userstatus(self):
        return 'basic string'
    userstatus.signature = [['string']]

    def userinfo(self, username, age=None):
        user = LookUpUser(username)
        result = {'username': user.name}
        if age and age > 10:
            result['age'] = age
        return result
    userinfo.signature = [['struct', 'string'],
                          ['struct', 'string', 'int']]
```

Since XML-RPC methods can take different sets of data, each set of valid arguments is its own list. The first value in the list is the type of the return argument. The rest of the arguments are the types of the data that must be passed in.

In the last method in the example above, since the method can optionally take an integer value, both sets of valid parameter lists should be provided.

Valid types that can be checked in the signature and their corresponding Python types:

XMLRPC	Python
string	str
array	list
boolean	bool
int	int
double	float
struct	dict
dateTime.iso8601	xmlrpclib.DateTime
base64	xmlrpclib.Binary

Note, requiring a signature is optional.

Also note that a convenient fault handler function is provided.

```
def xmlrpc_fault(code, message):
    """Convenience method to return a Pylons response XMLRPC Fault"""
```

(The XML-RPC Home page and the XML-RPC HOW-TO both provide further detail on the XML-RPC specification.)

3.4.3 A simple XML-RPC service

This simple service `test.battingOrder` accepts a positive integer < 51 as the parameter `posn` and returns a string containing the name of the US state occupying that ranking in the order of ratifying the constitution / joining the union.

```
import xmlrpclib

from pylons import request
from pylons.controllers import XMLRPCController

states = ['Delaware', 'Pennsylvania', 'New Jersey', 'Georgia',
          'Connecticut', 'Massachusetts', 'Maryland', 'South Carolina',
```

```
          'New Hampshire', 'Virginia', 'New York', 'North Carolina',
          'Rhode Island', 'Vermont', 'Kentucky', 'Tennessee', 'Ohio',
          'Louisiana', 'Indiana', 'Mississippi', 'Illinois', 'Alabama',
          'Maine', 'Missouri', 'Arkansas', 'Michigan', 'Florida', 'Texas',
          'Iowa', 'Wisconsin', 'California', 'Minnesota', 'Oregon',
          'Kansas', 'West Virginia', 'Nevada', 'Nebraska', 'Colorado',
          'North Dakota', 'South Dakota', 'Montana', 'Washington', 'Idaho',
          'Wyoming', 'Utah', 'Oklahoma', 'New Mexico', 'Arizona', 'Alaska',
          'Hawaii']

class RpctestController(XMLRPCController):

    def test_battingOrder(self, posn):
        """This docstring becomes the content of the
        returned value for system.methodHelp called with
        the parameter "test.battingOrder"). The method
        signature will be appended below ...
        """
        # XML-RPC checks agreement for arity and parameter datatype, so
        # by the time we get called, we know we have an int.
        if posn > 0 and posn < 51:
            return states[posn-1]
        else:
            # Technically, the param value is correct: it is an int.
            # Raising an error is inappropriate, so instead we
            # return a facetious message as a string.
            return 'Out of cheese error.'
    test_battingOrder.signature = [['string', 'int']]
```

3.4.4 Testing the service

For developers using OS X, there's an XML/RPC client that is an extremely useful diagnostic tool when developing XML-RPC (it's free ... but not entirely bug-free). Or, you can just use the Python interpreter:

```
>>> from pprint import pprint
>>> import xmlrpclib
>>> srvr = xmlrpclib.Server("http://example.com/rpctest/")
>>> pprint(srvr.system.listMethods())
['system.listMethods',
 'system.methodHelp',
 'system.methodSignature',
 'test.battingOrder']
>>> print srvr.system.methodHelp('test.battingOrder')
This docstring becomes the content of the
returned value for system.methodHelp called with
the parameter "test.battingOrder"). The method
signature will be appended below ...

Method signature: [['string', 'int']]
>>> pprint(srvr.system.methodSignature('test.battingOrder'))
[['string', 'int']]
>>> pprint(srvr.test.battingOrder(12))
'North Carolina'
```

To debug XML-RPC servers from Python, create the client object using the optional verbose=1 parameter. You can then use the client as normal and watch as the XML-RPC request and response is displayed in the console.

CHAPTER

FOUR

VIEWS

THE FIRST PYLON OF HARMHABÎ AT KARNAK.[1]

In the MVC paradigm the *view* manages the presentation of the model.

The view is the interface the user sees and interacts with. For Web applications, this has historically been an HTML interface. HTML remains the dominant interface for Web apps but new view options are rapidly appearing.

These include Macromedia Flash, JSON and views expressed in alternate markup languages like XHTML, XML/XSL, WML, and Web services. It is becoming increasingly common for web apps to provide specialised views in the form of a REST API that allows programmatic read/write access to the data model.

More complex APIs are quite readily implemented via SOAP services, yet another type of view on to the data model.

The growing adoption of RDF, the graph-based representation scheme that underpins the Semantic Web, brings a perspective that is strongly weighted towards machine-readability.

Handling all of these interfaces in an application is becoming increasingly challenging. One big advantage of MVC is that it makes it easier to create these interfaces and develop a web app that supports many different views and thereby provides a broad range of services.

Typically, no significant processing occurs in the view; it serves only as a means of outputting data and allowing the user (or the application) to act on that data, irrespective of whether it is an online store or an employee list.

4.1 Templates

Template rendering engines are a popular choice for handling the task of view presentation.

To return a processed template, it must be rendered and returned by the controller:

```
from helloworld.lib.base import BaseController, render

class HelloController(BaseController):
    def sample(self):
        return render('/sample.mako')
```

Using the default Mako template engine, this will cause Mako to look in the `helloworld/templates` directory (assuming the project is called 'helloworld') for a template filed called `sample.mako`.

The `render()` function used here is actually an alias defined in your projects' `base.py` for Pylons' `render_mako()` function.

4.1.1 Directly-supported template engines

Pylons provides pre-configured options for using the Mako, Genshi and Jinja2 template rendering engines. They are setup automatically during the creation of a new Pylons project, or can be added later manually.

4.2 Passing Variables to Templates

To pass objects to templates, the standard Pylons method is to attach them to the *tmpl_context* (aliased as *c* in controllers and templates, by default) object in the *Controllers*:

```
import logging

from pylons import request, response, session, tmpl_context as c, url
```

```
from pylons.controllers.util import abort, redirect

from helloworld.lib.base import BaseController, render

log = logging.getLogger(__name__)

class HelloController(BaseController):

    def index(self):
        c.name = "Fred Smith"
        return render('/sample.mako')
```

Using the variable in the template:

```
Hi there ${c.name}!
```

4.2.1 Strict vs Attribute-Safe tmpl_context objects

The *tmpl_context* object is created at the beginning of every request, and by default is an instance of the `AttribSafeContextObj` class, which is an Attribute-Safe object. This means that accessing attributes on it that do **not** exist will return an empty string **instead** of raising an `AttributeError` error.

This can be convenient for use in templates since it can act as a default:

```
Hi there ${c.name}
```

That will work when *c.name* has not been set, and is a bit shorter than what would be needed with the strict `ContextObj` context object.

Switching to the strict version of the *tmpl_context* object can be done in the `config/environment.py` by adding (after the config.init_app):

```
config['pylons.strict_c'] = True
```

4.3 Default Template Variables

By default, all templates have a set of variables present in them to make it easier to get to common objects. The full list of available names present in the templates global scope:

- *c* – Template context object (Alias for *tmpl_context*)
- *tmpl_context* – Template context object
- `config` – Pylons `PylonsConfig` object (acts as a dict)
- *g* – Project application globals object (Alias for *app_globals*)
- *app_globals* – Project application globals object
- *h* – Project helpers module reference
- `request` – Pylons `Request` object for this request
- `response` – Pylons `Response` object for this request
- `session` – Pylons session object (unless Sessions are removed)
- `translator` – Gettext translator object configured for current locale

- `ungettext()` – Unicode capable version of gettext's ngettext function (handles plural translations)
- `_()` – Unicode capable gettext translate function
- `N_()` – gettext no-op function to mark a string for translation, but doesn't actually translate
- `url` – An instance of the `routes.util.URLGenerator` configured for this request.

4.4 Configuring Template Engines

A new Pylons project comes with the template engine setup inside the projects' `config/environment.py` file. This section creates the Mako template lookup object and attaches it to the *app_globals* object, for use by the template rendering function.

```
# these imports are at the top
from mako.lookup import TemplateLookup
from pylons.error import handle_mako_error

# this section is inside the load_environment function
# Create the Mako TemplateLookup, with the default auto-escaping
config['pylons.app_globals'].mako_lookup = TemplateLookup(
    directories=paths['templates'],
    error_handler=handle_mako_error,
    module_directory=os.path.join(app_conf['cache_dir'], 'templates'),
    input_encoding='utf-8', default_filters=['escape'],
    imports=['from webhelpers.html import escape'])
```

4.4.1 Using Multiple Template Engines

Since template engines are configured in the `config/environment.py` section, then used by render functions, it's trivial to setup additional template engines, or even differently configured versions of a single template engine. However, custom render functions will frequently be needed to utilize the additional template engine objects.

Example of additional Mako template loader for a different templates directory for admins, which falls back to the normal templates directory:

```
# Add the additional path for the admin template
paths = dict(root=root,
             controllers=os.path.join(root, 'controllers'),
             static_files=os.path.join(root, 'public'),
             templates=[os.path.join(root, 'templates')],
             admintemplates=[os.path.join(root, 'admintemplates'),
                             os.path.join(root, 'templates')])

config['pylons.app_globals'].mako_admin_lookup = TemplateLookup(
    directories=paths['admin_templates'],
    error_handler=handle_mako_error,
    module_directory=os.path.join(app_conf['cache_dir'], 'admintemplates'),
    input_encoding='utf-8', default_filters=['escape'],
    imports=['from webhelpers.html import escape'])
```

That adds the additional template lookup instance, next a *custom render function* is needed that utilizes it:

```
from pylons.templating import cached_template, pylons_globals
```

```
def render_mako_admin(template_name, extra_vars=None, cache_key=None,
                      cache_type=None, cache_expire=None):
    # Create a render callable for the cache function
    def render_template():
        # Pull in extra vars if needed
        globs = extra_vars or {}

        # Second, get the globals
        globs.update(pylons_globals())

        # Grab a template reference
        template = globs['app_globals'].mako_admin_lookup.get_template(template_name)

        return template.render(**globs)

    return cached_template(template_name, render_template, cache_key=cache_key,
                           cache_type=cache_type, cache_expire=cache_expire)
```

The only change from the `render_mako()` function that comes with Pylons is to use the *mako_admin_lookup* rather than the *mako_lookup* that is used by default.

4.5 Custom `render()` functions

Writing custom render functions can be used to access specific features in a template engine, such as Genshi, that go beyond the default `render_genshi()` functionality or to add support for additional template engines.

Two helper functions for use with the render function are provided to make it easier to include the common Pylons globals that are useful in a template in addition to enabling easy use of cache capabilities. The `pylons_globals()` and `cached_template()` functions can be used if desired.

Generally, the custom render function should reside in the project's `lib/` directory, probably in `base.py`.

Here's a sample Genshi render function as it would look in a project's `lib/base.py` that doesn't fully render the result to a string, and rather than use `c` assumes that a dict is passed in to be used in the templates global namespace. It also returns a Genshi stream instead the rendered string.

```
from pylons.templating import pylons_globals

def render(template_name, tmpl_vars):
    # First, get the globals
    globs = pylons_globals()

    # Update the passed in vars with the globals
    tmpl_vars.update(globs)

    # Grab a template reference
    template = globs['app_globals'].genshi_loader.load(template_name)

    # Render the template
    return template.generate(**tmpl_vars)
```

Using the `pylons_globals()` function also makes it easy to get to the *app_globals* object which is where the template engine was attached in `config/environment.py`. Changed in version 0.9.7: Prior to 0.9.7, all templating was handled through a layer called 'Buffet'. This layer frequently made customization of the template engine difficult as any customization required additional plugin modules being installed. Pylons 0.9.7 now deprecates use of the Buffet plug-in layer.

See Also:

pylons.templating - Pylons templating API

4.6 Templating with Mako

4.6.1 Introduction

The template library deals with the *view*, presenting the model. It generates (X)HTML code, CSS and Javascript that is sent to the browser. *(In the examples for this section, the project root is ''myapp''.)*

Static vs. dynamic

Templates to generate dynamic web content are stored in *myapp/templates*, static files are stored in *myapp/public*.

Both are served from the server root, **if there is a name conflict the static files will be served in preference**

4.6.2 Making a template hierarchy

Create a base template

In *myapp/templates* create a file named *base.mako* and edit it to appear as follows:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
  <head>
    ${self.head_tags()}
  </head>
  <body>
    ${self.body()}
  </body>
</html>
```

A base template such as the very basic one above can be used for all pages rendered by Mako. This is useful for giving a consistent look to the application.

- Expressions wrapped in *${...}* are evaluated by Mako and returned as text
- *${* and *}* may span several lines but the closing brace should not be on a line by itself (or Mako throws an error)
- Functions that are part of the *self* namespace are defined in the Mako templates

Create child templates

Create another file in *myapp/templates* called *my_action.mako* and edit it to appear as follows:

```
<%inherit file="/base.mako" />

<%def name="head_tags()">
  <!-- add some head tags here -->
</%def>
```

```
<h1>My Controller</h1>

<p>Lorem ipsum dolor ...</p>
```

This file define the functions called by *base.mako*.

- The *inherit* tag specifies a parent file to pass program flow to
- Mako defines functions with *<%def name="function_name()">...</%def>*, the contents of the tag are returned
- Anything left after the Mako tags are parsed out is automatically put into the *body()* function

A consistent feel to an application can be more readily achieved if all application pages refer back to single file (in this case *base.mako*)..

Check that it works

In the controller action, use the following as a *return()* value,

```
return render('/my_action.mako')
```

Now run the action, usually by visiting something like `http://localhost:5000/my_controller/my_action` in a browser. Selecting 'View Source' in the browser should reveal the following output:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
  <head>
  <!-- add some head tags here -->
  </head>
  <body>

<h1>My Controller</h1>

<p>Lorem ipsum dolor ...</p>

  </body>
</html>
```

See Also:

The Mako documentation Reasonably straightforward to follow

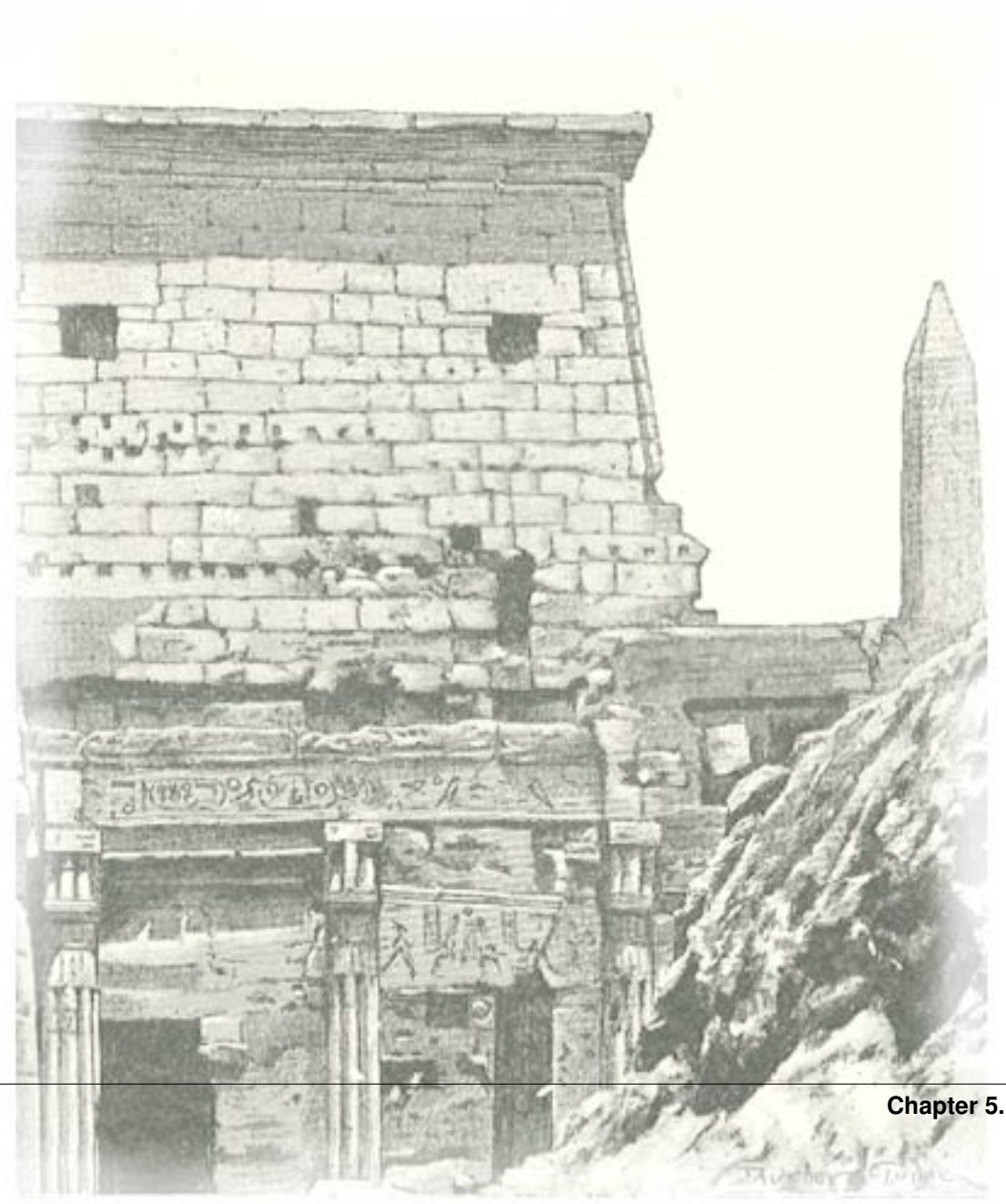
See the *Internationalization and Localization* Provides more help on making your application more worldly.

CHAPTER

FIVE

MODELS

5.1 About the model



In the MVC paradigm the *model* manages the behavior and data of the application domain, responds to requests for information about its state and responds to instructions to change state.

The model represents enterprise data and business rules. It is where most of the processing takes place when using the MVC design pattern. Databases are in the remit of the model, as are component objects such as *EJBs* and *ColdFusion Components*.

The data returned by the model is display-neutral, i.e. the model applies no formatting. A single model can provide data for any number of display interfaces. This reduces code duplication as model code is written only once and is then reused by all of the views.

Because the model returns data without applying any formatting, the same components can be used with any interface. For example, most data is typically formatted with HTML but it could also be formatted with Macromedia Flash or WAP.

The model also isolates and handles state management and data persistence. For example, a Flash site or a wireless application can both rely on the same session-based shopping cart and e-commerce processes.

Because the model is self-contained and separate from the controller and the view, changing the data layer or business rules is less painful. If it proves necessary to switch databases, e.g. from MySQL to Oracle, or change a data source from an RDBMS to LDAP, the only required task is that of altering the model. If the view is written correctly, it won't care at all whether a list of users came from a database or an LDAP server.

This freedom arises from the way that the three parts of an MVC-based application act as *black boxes*, the inner workings of each one are hidden from, and are independent of, the other two. The approach promotes well-defined interfaces and self-contained components.

Note: *adapted from an Oct 2002 TechRepublic article by by Brian Kotek: "MVC design pattern brings about better organization and code reuse"* - http://articles.techrepublic.com.com/5100-10878_11-1049862.html

---

5.2 Model Basics

Pylons provides a `model` package to put your database code in but does not offer a database engine or API. Instead there are several third-party APIs to choose from.

The recommended and most commonly-adopted approach used in Pylons applications is to use SQLAlchemy with the declarative configuration style and develop with a relational database (Postgres, MySQL, etc).

This is the documented and recommended approach for creating a Pylons project with a SQL database.

5.2.1 Install SQLAlchemy

We'll assume you've already installed Pylons and have the *easy_install* command. At the command line, run:

```
easy_install SQLAlchemy
```

Next you'll have to install a database engine and its Python bindings. If you don't know which one to choose, SQLite is a good one to start with. It's small and easy to install, and Python 2.5 includes bindings for it. Installing the database engine is beyond the scope of this article, but here are the Python bindings you'll need for the most popular engines:

```
easy_install pysqlite # If you use SQLite and Python 2.4 (not needed for Python 2.5)
easy_install MySQL-python # If you use MySQL
easy_install psycopg2 # If you use PostgreSQL
```

See the Python Package Index (formerly the Cheeseshop) for other database drivers.

Tip: Checking Your Version

To see which version of SQLAlchemy you have, go to a Python shell and look at `sqlalchemy.__version__`:

```
>>> import sqlalchemy
>>> sqlalchemy.__version__
0.5.8
```

5.2.2 Create a Pylons Project with SQLAlchemy

When creating a Pylons project, one of the questions asked as part of the project creation dialogue is whether the project should be configured with SQLAlchemy. Before continuing, ensure that the project was created with this option, if it's missing the `model/meta.py` file, then the project should be re-created with this option.

Tip: The project doesn't need to be deleted to add this option, just re-run the *paster* command in the project's parent directory and answer "yes" to the SQLAlchemy prompt. The files will then be added and existing files will present a prompt on whether to replace them or leave the current file.

5.2.3 Configure SQLAlchemy

When your Pylons application runs, it needs to know which database to connect to. Normally you put this information in *development.ini* and activate the model in *environment.py*: put the following in *development.ini* in the *[app:main]* section, depending on your database,

For SQLite

```
sqlalchemy.url = sqlite:///%(here)s/mydatabasefilename.sqlite
```

Where *mydatabasefilename.db* is the path to your SQLite database file. "%(here)s" represents the directory containing the development.ini file. If you're using an absolute path, use four slashes after the colon: "sqlite:////var/lib/myapp/database.sqlite". Don't use a relative path (three slashes) because the current directory could be anything. The example has three slashes because the value of "%(here)s" always starts with a slash (or the platform equivalent; e.g., "C:\foo" on Windows).

For MySQL

```
sqlalchemy.url = mysql://username:password@host:port/database
sqlalchemy.pool_recycle = 3600
```

Enter your username, password, host (localhost if it is on your machine), port number (usually 3306) and the name of your database. The second line is an example of setting engine options.

It's important to set "pool_recycle" for MySQL to prevent "MySQL server has gone away" errors. This is because MySQL automatically closes idle database connections without informing the application. Setting the connection lifetime to 3600 seconds (1 hour) ensures that the connections will be expired and recreated before MySQL notices they're idle.

Don't be tempted to use the ".echo" option to enable SQL logging because it may cause duplicate log output. Instead see the Logging section below to integrate MySQL logging into Paste's logging system.

For PostgreSQL

```
sqlalchemy.url = postgres://username:password@host:port/database
```

Enter your username, password, host (localhost if it is on your machine), port number (usually 5432) and the name of your database.

5.3 Organizing

When you answer "yes" to the SQLAlchemy question when creating a Pylons project, it configures a simple default model. The model consists of two files: `model/__init__.py` and `model/meta.py`.

5.3.1 model/__init__.py

The file `model/__init__.py` contains the table definitions, the ORM classes and an `init_model()` function. This `init_model()` function must be called at application startup. In the Pylons default project template this call is made in the `load_environment()` function (in the file `config/environment.py`).

5.3.2 model/meta.py

`model/meta.py` is merely a container for a few housekeeping objects required by SQLAlchemy such as `Session`, `metadata` and `engine` to avoid import issues. In the context of the default Pylons application, only the `Session` object is instantiated.

The objects are optional in the context of other applications that do not make use of them and so if you answer "no" to the SQLAlchemy question when creating a Pylons project, the creation of `model/meta.py` is simply skipped.

It is recommended that, for each model, a new module inside the `model/` directory should be created. This keeps the models tidy when they get larger as more domain specific code is added to each one.

5.4 Creating a Model

SQLAlchemy 0.5 has an optional *Declarative* syntax which offers the convenience of defining the table and the ORM class in one step. This is the recommended usage of SQLAlchemy.

Create a `model/person.py` module:

```
"""Person model"""
from sqlalchemy import Column
from sqlalchemy.types import Integer, String

from myapp.model.meta import Base
```

```
class Person(Base):
    __tablename__ = "person"

    id = Column(Integer, primary_key=True)
    name = Column(String(100))
    email = Column(String(100))

    def __init__(self, name='', email=''):
        self.name = name
        self.email = email

    def __repr__(self):
        return "<Person('%s')" % self.name
```

Note: `Base` is imported from `model/meta.py` to prevent recursive import problems when added to `model/__init__.py` in the next step.

Then for convenience when using the models, import it in `model/__init__.py`:

```
"""The application's model objects"""
from myapp.model.meta import Session, Base

from myapp.model.person import Person

def init_model(engine):
    """Call me before using any of the tables or classes in the model"""
    Session.configure(bind=engine)
```

5.5 Adding a Relation

Here's an example of a `Person` and an `Address` class with a one-to-many relationship on *person.addresses*.

First, add a `model/address.py` module:

```
"""Address model"""
from sqlalchemy import Column, ForeignKey
from sqlalchemy.types import Integer, String
from sqlalchemy.orm import relation, backref

from myapp.model.meta import Base

class Address(Base):
    __tablename__ = "address"

    id = Column(Integer, primary_key=True)
    address = Column(String(100))
    city = Column(String(100))
    state = Column(String(2))
    person_id = Column(Integer, ForeignKey('person.id'))

    person = relation('Person', backref=backref('addresses', order_by=id))

    def __repr__(self):
        return "<Person('%s')" % self.name
```

When models are created using the declarative `Base`, each one is added by name to a mapping. This allows the `relation` option above to locate the model it should be related to based on the text string `'Person'`.

Then add the import to the `model/__init__.py` file:

```
"""The application's model objects"""
from myapp.model.meta import Session, Base

from myapp.model.address import Address
from myapp.model.person import Person

def init_model(engine):
    """Call me before using any of the tables or classes in the model"""
    Session.configure(bind=engine)
```

See Also:

Building a Relation and SQLAlchemy manual

5.6 Creating the Database

To actually create the tables in the database, you call the metadata's *.create_all()* method. You can do this interactively or use *paster*'s application initialization feature. To do this, put the code in `myapp/websetup.py`. After the *load_environment()* call, put:

```
from myapp.model.meta import Base, Session
log.info("Creating tables")
Base.metadata.drop_all(checkfirst=True, bind=Session.bind)
Base.metadata.create_all(bind=Session.bind)
log.info("Successfully setup")
```

Then run the following on the command line:

```
$ paster setup-app development.ini
```

5.7 A brief guide to using model objects in the Controller

In which we: query a model, update a model entity, create a model entity and delete several model entities, all inside a Pylons controller.

To illustrate some typical ways of handling model objects in the Controller, we will draw from the example `PagesController` code of the *QuickWiki Tutorial*.

5.7.1 The `Session`

The SQLAlchemy-provided `Session` object is a crucially important facet when working with models and model object entities.

The SQLAlchemy documentation describes the `Session` thus: "In the most general sense, the Session establishes all conversations with the database and represents a "holding zone" for all the mapped instances which you've loaded or created during its lifespan."

All of the model access that takes place in a Pylons controller is done in the context of a `Session` providing a database connection reference that is created at the start of the processing of each request and destroyed at the end of the processing of the request.

These creation and destruction operations are performed automatically by the `BaseController` instantiated in `MYAPP/lib/base.py` which is in turn subclassed for each standard Pylons controller, ensuring that subclassed controllers can access the database only in a request-specific context which, in turn, protects against data accidentally leaking across requests.

See Also:

SQLAlchemy documentation for the Session object

The net effect of this is that a fully-instantiated `Session` object is available for import and immediate use in the controller for, e.g. querying the model.

5.7.2 Querying the model

The `Session` object provides a `query()` function that, when applied to a class of mapped model object, returns a SQLAlchemy `Query` object that can be passed around and repeatedly consulted.

See Also:

SQLAlchemy documentation for the Query object

Standard usage is illustrated in this code for the `__before__()` function of the QuickWiki `PagesController` in which `self.page_q` is bound to the `Query` object returned by `Session.query(Page)` - where `Page` is the class of mapped model object that will be the subject of the queries.

```
from MYAPP.lib.base import Session
from MYAPP.model import Page

class PagesController(BaseController):

    def __before__(self):
        self.page_q = Session.query(Page)

    # [ ... ]
```

The `Query` object that is bound to `self.page_q` is now specialised to perform queries of the `Page` declarative base entity / mapped model entity.

See Also:

SQLAlchemy documentation for the Querying the database

Here, in the context of a controller's `index()` action, it is used in a very straighforward manner - `self.page_q.all()` - to fuel a list comprehension that returns a list containing the `title` of every `Page` object in the database:

```
def index(self):
    c.titles = [page.title for page in self.page_q.all()]
    return render('/pages/index.mako')
```

and `self.page_q` is used in similarly direct manner for the `show()` action that retrieves a Page with a given value of `title` and then calls the Page's `get_wiki_content()` class method.

```
def show(self, title):
    page = self.page_q.filter_by(title=title).first()
    if page:
        c.content = page.get_wiki_content()
        return render('/pages/show.mako')
    elif wikiwords.match(title):
```

```
        return render('/pages/new.mako')
    abort(404)
```

Note: the `title` argument to the function is bound when the request is dispatched by the Routes map, typically of the form:

```
map.connect('show_page', '/page/show/{title}', controller='page', action='show')
```

The `Query` object has many other features, including filtering on conditions, ordering the results, grouping, etc. These are excellently described in the SQLAlchemy manual. See especially the Data Mapping and Session / Unit of Work chapters.

5.7.3 Creating, updating and deleting model entities

When performing operations that change the state of the database, the recommended approach is for Pylons users to take full advantage of the abstraction provided by the SQLAlchemy ORM and simply treat the retrieved or created model entities as Python objects, make changes to them in a conventional Pythonic way, add them to or delete them from the `Session` "holding zone" and call `Session.commit()` to commit the changes to the database.

The three examples shown below are condensed illustrations of how these operations are typically performed in controller actions.

Creating a model entity

SQLAlchemy's Declarative Base syntax allows model entity classes to act as constructors, accepting keyworded args and values. In this example, a new Page is created with the given title, the created model entity object is then added to the `Session` and then the change is committed.

```
def create(self, title):
    page = Page(title=title)
    Session.add(page)
    Session.commit()
    redirect_to('show_page', title=title)
```

Updating a model entity

Perhaps the most straighforward use - a model entity object is retrieved from the database, a field value is updated and the change committed.

(Note, this example is considerably abbreviated as a controller action - preliminary content checking has been omitted, as has exception handling for the database query.)

```
def save(self, title):
    page = self.page_q.filter_by(title=title).first()
    page.content=escape(request.POST.getone('content'))
    Session.commit()
    redirect_to('show_page', title=title)
```

Deleting a model entity

This example of shows the freedom that the Pylons user has to make repeated changes to the model (in this instance, repeatedly deleting entities from the database) before finally committing those changes by calling `Session.commit()`.

```
def delete(self):
    titles = request.POST.getall('title')
    pages = self.page_q.filter(Page.title.in_(titles))
    for page in pages:
        Session.delete(page)
    Session.commit()
    redirect_to('pages')
```

The Object Relational tutorial in the SQLAlchemy documentation covers a basic SQLAlchemy object-relational mapping scenario in much more detail and the SQL Expression tutorial covers the details of manipulating and marshalling the model entity objects.

5.7.4 Using multiple databases

In order to use multiple databases, in `MYAPP/model/meta.py` create as many instances of `Base` as there are databases to connect to:

```
"""SQLAlchemy Metadata and Session object"""
from sqlalchemy.ext.declarative import declarative_base
from sqlalchemy.orm import scoped_session, sessionmaker

__all__ = ['Base','Base2', 'Session']

# SQLAlchemy session manager. Updated by model.init_model()
Session = scoped_session(sessionmaker())

# The declarative Base
Base = declarative_base()
Base2 = declarative_base()
```

Declare the different database URLs in `development.ini`, appending an integer to the `sqlalchemy` keyword in order to differentiate between them.

```
sqlalchemy.url = sqlite:///%(here)s/database_one.sqlite
sqlalchemy.echo = true
sqlalchemy2.url = sqlite:///%(here)s/database_two.sqlite
sqlalchemy2.echo = false
```

In `MYAPP/config/environment.py`, pick up those db URL declarations by using the different keywords (in this example: *sqlalchemy* and *sqlalchemy2*). Create the engines and call `model.init_model()`, passing through both engines as parameters.

```
# Setup the SQLAlchemy database engine
# Engine 0
engine = engine_from_config(config, 'sqlalchemy.')
engine2 = engine_from_config(config, 'sqlalchemy2.')
model.init_model(engine, engine2)
```

Bind the engines appropriately to the `Base`-specific metadata in `MYAPP/model/__init__.py` - note `init_model()` is expecting both engines to be supplied as formal parameters.

```
def init_model(engine, engine2):
    meta.Base.metadata.bind = engine
    meta.Base2.metadata.bind = engine2
```

Then import `Base` and/or `Base2`

```
from MYAPP.model.meta import Base, Base2
```

and use as required, e.g.

```
class Author(Base2):
    __tablename__ = 'authors'
    id = Column(Integer, primary_key=True)
    keywords = relation("Keyword", secondary=keywords)
```

5.7.5 Avoiding the "circular imports" problem of model interdependency

Closely-interdependent models can sometimes cause "circular import" problems, where importing one model file causes a dependent model file to be imported, which then cause the first model file to be imported, and so on round and round in circles.

In order to break the circle, define the model entities as globals in `MYAPP/model/meta.py`

```
"""The application's model objects"""
import sqlalchemy as sa
from MYAPP.model import meta
from sqlalchemy.orm import scoped_session, sessionmaker

def init_model(engine):
    """Call me before using any of the tables or classes in the model"""
    meta.Base.metadata.bind = engine

    import MYAPP.model.user
    User = MYAPP.model.user.User
    global User

    import MYAPP.model.newsletter
    Newsletter = MYAPP.model.newsletter.Newsletter
    global Newsletter

    import MYAPP.model.submission
    Submission = MYAPP.model.submission.Submission
    global Submission
```

5.7.6 Testing the Models

Normal model usage works fine in model tests, however to use the metadata you must specify an engine connection for it. To have your tables created for every unit test in your project, use a `test_models.py` such as:

```
from myapp.tests import *
from myapp import model
from myapp.model import meta

class TestModels(TestController):
```

```
    def setUp(self):
        meta.Session.remove()
        meta.Base.metadata.create_all(meta.engine)

    def test_index(self):
        # test your models
        pass
```

Note: Notice that the tests inherit from TestController. This is to ensure that the application is setup so that the models will work.

"nosetests –with-pylons=/path/to/test.ini ..." is another way to ensure that your model is properly initialized before the tests are run. This can be used when running non-controller tests.

5.8 Logging

SQLAlchemy has several loggers that chat about the various aspects of its operation. To log all SQL statements executed along with their parameter values, put the following in `development.ini`:

```
[logger_sqlalchemy]
level = INFO
handlers =
qualname = sqlalchemy.engine
```

Then modify the "[loggers]" section to enable your new logger:

```
[loggers]
keys = root, myapp, sqlalchemy
```

To log the results along with the SQL statements, set the level to DEBUG. This can cause a lot of output! To stop logging the SQL, set the level to WARN or ERROR.

SQLAlchemy has several other loggers you can configure in the same way. "sqlalchemy.pool" level INFO tells when connections are checked out from the engine's connection pool and when they're returned. "sqlalchemy.orm" and buddies log various ORM operations. See "Configuring Logging" in the SQLAlchemy manual.

5.9 About SQLAlchemy

SQLAlchemy is by far the most common approach for Pylons databases. It provides a connection pool, a SQL statement builder, an object-relational mapper (ORM), and transaction support. SQLAlchemy works with several database engines (MySQL, PostgreSQL, SQLite, Oracle, Firebird, MS-SQL, Access via ODBC, etc) and understands the peculiar SQL dialect of each, making it possible to port a program from one engine to another by simply changing the connection string. Although its API is still changing gradually, SQLAlchemy is well tested, widely deployed, has excellent documentation, and its mailing list is quick with answers.

SQLAlchemy lets you work at three different levels, and you can even use multiple levels in the same program:

- The object-relational mapper (ORM) lets you interact with the database using your own object classes rather than writing SQL code.

- The SQL expression language has many methods to create customized SQL statements, and the result cursor is more friendly than DBAPI's.
- The low-level execute methods accept literal SQL strings if you find something the SQL builder can't do, such as adding a column to an existing table or modifying the column's type. If they return results, you still get the benefit of SQLAlchemy's result cursor.

The first two levels are *database neutral*, meaning they hide the differences between the databases' SQL dialects. Changing to a different database is merely a matter of supplying a new connection URL. Of course there are limits to this, but SQLAlchemy is 90% easier than rewriting all your SQL queries.

The SQLAlchemy manual should be your next stop for questions not covered here. It's very well written and thorough.

5.9.1 SQLAlchemy add-ons

Most of these provide a higher-level ORM, either by combining the table definition and ORM class definition into one step, or supporting an "active record" style of access.

Please take the time to learn how to do things "the regular way" before using these shortcuts in a production application.

Understanding what these add-ons do behind the scenes will help if you have to troubleshoot a database error or work around a limitation in the add-on later.

SQLSoup, an extension to SQLAlchemy, provides a quick way to generate ORM classes based on existing database tables.

If you're familiar with ActiveRecord, used in Ruby on Rails, then you may want to use the Elixir layer on top of SQLAlchemy. This approach is less common since the introduction of the declarative extension, but has other features the declarative does not.

CHAPTER

SIX

ADVANCED MODELS

Pylons works well with many different types of databases, in addition to other database object-relational mappers.

6.1 Advanced SQLAlchemy

6.1.1 Alternative SQLAlchemy Styles

In addition to the declarative style, SQLAlchemy has a default more verbose and explicit approach.

Definitions using the default SQLAlchemy approach

Here is a sample `model/__init__.py` with a "persons" table, based on the default SQLAlchemy approach:

```
"""The application's model objects"""
import sqlalchemy as sa
from sqlalchemy import orm

from myapp.model import meta

def init_model(engine):
    meta.Session.configure(bind=engine)
    meta.engine = engine


t_persons = sa.Table("persons", meta.metadata,
    sa.Column("id", sa.types.Integer, primary_key=True),
    sa.Column("name", sa.types.String(100), primary_key=True),
    sa.Column("email", sa.types.String(100)),
    )

class Person(object):
    pass

orm.mapper(Person, t_persons)
```

This model has one table, "persons", assigned to the variable `t_persons`. `Person` is an ORM class which is bound to the table via the mapper.

Relation example

Here's an example of a *Person* and an *Address* class with a many:many relationship on *people.my_addresses*. See Relational Databases for People in a Hurry and the **'SQLAlchemy manual'_** for details.

```
t_people = sa.Table('people', meta.metadata,
    sa.Column('id', sa.types.Integer, primary_key=True),
    sa.Column('name', sa.types.String(100)),
    sa.Column('email', sa.types.String(100)),
    )

t_addresses_people = sa.Table('addresses_people', meta.metadata,
    sa.Column('id', sa.types.Integer, primary_key=True),
    sa.Column('person_id', sa.types.Integer, sa.ForeignKey('people.id')),
    sa.Column('address_id', sa.types.Integer, sa.ForeignKey('addresses.id')),
    )

t_addresses = sa.Table('addresses', meta.metadata,
    sa.Column('id', sa.types.Integer, primary_key=True),
    sa.Column('address', sa.types.String(100)),
    )

class Person(object):
    pass

class Address(object):
    pass

orm.mapper(Address, t_addresses)
orm.mapper(Person, t_people, properties = {
    'my_addresses' : orm.relation(Address, secondary = t_addresses_people),
    })
```

Definitions using "reflection" of an existing database table

If the table already exists, SQLAlchemy can read the column definitions directly from the database. This is called *reflecting* the table.

The advantage of this approach is that it allows you to dispense with the task of specifying the column types in Python code.

Reflecting existing database tables must be done inside `init_model()` because to perform the reflection, a live database engine is required and this is not available when the module is imported. A live database engine is bound explicitly in the `init_model()` function and so enables reflection.

(An *engine* is a SQLAlchemy object that knows how to connect to a particular database.)

Here's the second example with reflection:

```
"""The application's model objects"""
import sqlalchemy as sa
from sqlalchemy import orm

from myapp.model import meta

def init_model(engine):
    """Call me before using any of the tables or classes in the model"""
    # Reflected tables must be defined and mapped here
```

```
    global t_persons
    t_persons = sa.Table("persons", meta.metadata, autoload=True,
                         autoload_with=engine)
    orm.mapper(Person, t_persons)

    meta.Session.configure(bind=engine)
    meta.engine = engine


t_persons = None

class Person(object):
    pass
```

Note how `t_persons` and the `orm.mapper()` call moved into `init_model()`, while the `Person` class didn't have to. Also note the `global t_persons` statement. This tells Python that `t_persons` is a global variable outside the function. `global` is required when assigning to a global variable inside a function. It's not required if you're merely modifying a mutable object in place, which is why `meta` doesn't have to be declared global.

Using the model standalone

You now have everything necessary to use the model in a standalone script such as a cron job, or to test it interactively. You just need to create a SQLAlchemy engine and connect it to the model. This example uses a database "test.sqlite" in the current directory:

```
% python
Python 2.5.1 (r251:54863, Oct 5 2007, 13:36:32)
[GCC 4.1.3 20070929 (prerelease) (Ubuntu 4.1.2-16ubuntu2)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import sqlalchemy as sa
>>> engine = sa.create_engine("sqlite:///test.sqlite")
>>> from myapp import model
>>> model.init_model(engine)
```

Now you can use the tables, classes, and Session as described in the **'SQLAlchemy manual'**_. For example:

```
#!/usr/bin/env python
import sqlalchemy as sa
import tmpapp.model as model
import tmpapp.model.meta as meta

DB_URL = "sqlite:///test.sqlite"

engine = sa.create_engine(DB_URL)
model.init_model(engine)

# Create all tables, overwriting them if they exist.
if hasattr(model, "_Base"):
    # SQLAlchemy 0.5 Declarative syntax
    model._Base.metadata.drop_all(bind=engine, checkfirst=True)
    model._Base.metadata.create_all(bind=engine)
else:
    # SQLAlchemy 0.4 and 0.5 syntax without Declarative
    meta.metadata.drop_all(bind=engine, checkfirst=True)
    meta.metadataa.create_all(bind=engine)
```

```
# Create two records and insert them into the database using the ORM.
a = model.Person()
a.name = "Aaa"
a.email = "aaa@example.com"
meta.Session.add(a)

b = model.Person()
b.name = "Bbb"
b.email = "bbb@example.com"
meta.Session.add(b)

meta.Session.commit()

# Display all records in the persons table.
print "Database data:"
for p in meta.Session.query(model.Person):
    print "id:", p.id
    print "name:", p.name
    print "email:", p.email
    print
```

6.1.2 Talking to Multiple Databases at Once

Some applications need to connect to multiple databases (engines). Some always bind certain tables to the same engines (e.g., a general database and a logging database); this is called "horizontal partitioning". Other applications have several databases with the same structure, and choose one or another depending on the current request. A blogging app with a separate database for each blog, for instance. A few large applications store different records from the same logical table in different databases to prevent the database size from getting too large; this is called "vertical partitioning" or "sharding". The pattern above can accommodate any of these schemes with a few minor changes.

First, you can define multiple engines in your config file like this:

```
sqlalchemy.default.url = "mysql://..."
sqlalchemy.default.pool_recycle = 3600
sqlalchemy.log.url = "sqlite://..."
```

This defines two engines, "default" and "log", each with its own set of options. Now you have to instantiate every engine you want to use.

```
default_engine = engine_from_config(config, 'sqlalchemy.default.')
log_engine = engine_from_config(config, 'sqlalchemy.log.')
init_model(default_engine, log_engine)
```

Of course you'll have to modify *init_model()* to accept both arguments and create two engines.

To bind different tables to different databases, but always with a particular table going to the same engine, use the *binds* argument to *sessionmaker* rather than *bind*:

```
binds = {"table1": engine1, "table2": engine2}
Session = scoped_session(sessionmaker(binds=binds))
```

To choose the bindings on a per-request basis, skip the sessionmaker bind(s) argument, and instead put this in your base controller's *__call__* method before the superclass call, or directly in a specific action method:

```
meta.Session.configure(bind=meta.engine)
```

binds= works the same way here too.

Multiple Application Instances

If you're running multiple instances of the _same_ Pylons application in the same WSGI process (e.g., with Paste HTTPServer's "composite" application), you may run into concurrency issues. The problem is that `Session` is thread local but not application-instance local. We're not sure how much this is really an issue if `Session.remove()` is properly called in the base controller, but just in case it becomes an issue, here are possible remedies:

1. Attach the engine(s) to `pylons.g` (aka. `config["pylons.g"]`) rather than to the *meta* module. The globals object is not shared between application instances.
2. Add a scoping function. This prevents the application instances from sharing the same session objects. Add the following function to your model, and pass it as the second argument to *scoped_session*:

```
def pylons_scope():
    import thread
    from pylons import config
    return "Pylons|%s|%s" % (thread.get_ident(), config._current_obj())

Session = scoped_session(sessionmaker(), pylons_scope)
```

If you're affected by this, or think you might be, please bring it up on the pylons-discuss mailing list. We need feedback from actual users in this situation to verify that our advice is correct.

6.2 Non-SQLAlchemy libraries

Most of these expose only the object-relational mapper; their SQL builder and connection pool are not meant to be used directly.

Storm

Geniusql

6.2.1 DB-API

All the SQL libraries above are built on top of Python's DB-API, which provides a common low-level interface for interacting with several database engines: MySQL, PostgreSQL, SQLite, Oracle, Firebird, MS-SQL, Access via ODBC, etc. Most programmers do not use DB-API directly because its API is low-level and repetitive and does not provide a connection pool. There's no "DB-API package" to install because it's an abstract interface rather than software. Instead, install the Python package for the particular engine you're interested in. Python's Database Topic Guide describes the DB-API and lists the package required for each engine. The sqlite3 package for SQLite is included in Python 2.5.

6.3 Object Databases

Object databases store Python dicts, lists, and classes in pickles, allowing you to access hierarchical data using normal Python statements rather than having to map them to tables, relations, and a foreign language (SQL).

ZODB

Durus [1]

[1] Durus is not thread safe, so you should use its server mode if your application writes to the database. Do not share connections between threads. ZODB is thread safe, so it may be a more convenient alternative.

6.4 Popular No-SQL Databases

Pylons can also work with other database systems, such as the following:

Schevo uses Durus to combine some features of relational and object databases. It is written in Python.

CouchDb is a document-based database. It features a Python API.

The Datastore database in Google App Engine.

CHAPTER

SEVEN

CONFIGURATION

Pylons comes with two main ways to configure an application:

- The configuration file (*Runtime Configuration*)
- The application's `config` directory

The files in the `config` directory change certain aspects of how the application behaves. Any options that the webmaster should be able to change during deployment should be specified in a configuration file.

Tip: A good indicator of whether an option should be set in the `config` directory code vs. the configuration file is whether or not the option is necessary for the functioning of the application. If the application won't function without the setting, it belongs in the appropriate `config/` directory file. If the option should be changed depending on deployment, it belongs in the *Runtime Configuration*.

The applications `config/` directory includes:

- `config/environment.py` described in *Environment*
- `config/middleware.py` described in *Middleware*
- `config/deployment.ini_tmpl` described in *Production Configuration Files*
- `config/routing.py` described in *URL Configuration*

Each of these files allows developers to change key aspects of how the application behaves.

7.1 Runtime Configuration

When a new project is created a sample configuration file called `development.ini` is automatically produced as one of the project files. This default configuration file contains sensible options for development use, for example when developing a Pylons application it is very useful to be able to see a debug report every time an error occurs. The `development.ini` file includes options to enable debug mode so these errors are shown.

Since the configuration file is used to determine which application is run, multiple configuration files can be used to easily toggle sets of options. Typically a developer might have a `development.ini` configuration file for testing and a `production.ini` file produced by the **paster make-config** command for testing the command produces sensible production output. A `test.ini` configuration is also included in the project for test-specific options.

To specify a configuration file to use when running the application, change the last part of the **paster serve** to include the desired config file:

```
$ paster serve production.ini
```

See Also:

Configuration file format **and options** are described in great detail in the Paste Deploy documentation.

7.1.1 Getting Information From Configuration Files

All information from the configuration file is available in the `pylons.config` object. `pylons.config` also contains application configuration as defined in the project's `config.environment` module.

```
from pylons import config
```

`pylons.config` behaves like a dictionary. For example, if the configuration file has an entry under the `[app:main]` block:

```
cache_dir = %(here)s/data
```

That can then be read in the projects code:

```
from pylons import config
cache_dir = config['cache.dir']
```

Or the current debug status like this:

```
debug = config['debug']
```

Evaluating Non-string Data in Configuration Files

By default, all the values in the configuration file are considered strings. To make it easier to handle boolean values, the Paste library comes with a function that will convert `true` and `false` to proper Python boolean values:

```
from paste.deploy.converters import asbool

debug = asbool(config['debug'])
```

This is used already in the default projects' *Middleware* to toggle middleware that should only be used in development mode (with `debug`) set to true.

7.1.2 Production Configuration Files

To change the defaults of the configuration INI file that should be used when deploying the application, edit the `config/deployment.ini_tmpl` file. This is the file that will be used as a template during deployment, so that the person handling deployment has a starting point of the minimum options the application needs set.

One of the most important options set in the deployment ini is the `debug = true` setting. The email options should be setup so that errors can be e-mailed to the appropriate developers or webmaster in the event of an application error.

Generating the Production Configuration

To generate the production.ini file from the projects' `config/deployment.ini_tmpl` it must first be installed either as an *egg* or under development mode. Assuming the name of the Pylons application is `helloworld`, run:

```
$ paster make-config helloworld production.ini
```

Note: This command will also work from inside the project when its being developed.

It is the responsibility of the developer to ensure that a sensible set of default configuration values exist when the webmaster uses the `paster make-config` command.

Warning: **Always** make sure that the `debug` is set to `false` when deploying a Pylons application.

7.2 Environment

The `config/environment.py` module sets up the basic Pylons environment variables needed to run the application. Objects that should be setup once for the entire application should either be setup here, or in the `lib/app_globals __init__()` method.

It also calls the *URL Configuration* function to setup how the URL's will be matched up to *Controllers*, creates the *app_globals* object, configures which module will be referred to as *h*, and is where the template engine is setup.

When using SQLAlchemy it's recommended that the SQLAlchemy engine be setup in this module. The default SQLAlchemy configuration that Pylons comes with creates the engine here which is then used in `model/__init__.py`.

7.3 URL Configuration

A Python library called Routes handles mapping URLs to controllers and their methods, or their *action* as Routes refers to them. By default, Pylons sets up the following *route*s (found in `config/routing.py`):

```
map.connect('/{controller}/{action}')
map.connect('/{controller}/{action}/{id}')
```

Changed in version 0.9.7: Prior to Routes 1.9, all map.connect statements required variable parts to begin with a `:` like `map.connect(':controller/:action')`. This syntax is now optional, and the new `{}` syntax is recommended. Any part of the path inside the curly braces is a variable (a *variable part*) that will match any text in the URL for that 'part'. A 'part' of the URL is the text between two forward slashes. Every part of the URL must be present for the *route* to match, otherwise a 404 will be returned.

The routes above are translated by the Routes library into regular expressions for high performance URL matching. By default, all the variable parts (except for the special case of `{controller}`) become a matching regular expression of `[^/]+` to match anything except for a forward slash. This can be changed easily, for example to have the `{id}` only match digits:

```
map.connect('/{controller}/{action}/{id:\d+}')
```

If the desired regular expression includes the `{}`, then it should be specified separately for the variable part. To limit the `{id}` to only match at least 2-4 digits:

```
map.connect('/{controller}/{action}/{id}',  requirements=dict(id='\d{2,4}'))
```

The controller and action can also be specified as keyword arguments so that they don't need to be included in the URL:

```
# Archives by 2 digit year -> /archives/08
map.connect('/archives/{year:\d\d}', controller='articles',  action='archives')
```

Any variable part, or keyword argument in the `map.connect` statement will be available for use in the action used. For the route above, which resolves to the *articles* controller:

```
class ArticlesController(BaseController):

    def archives(self, year):
        ...
```

The part of the URL that matched as the year is available by name in the function argument.

Note: Routes also includes the ability to attempt to 'minimize' the URL. This behavior is generally not intuitive, and starting in Pylons 0.9.7 is turned off by default with the `map.minimization=False` setting.

The default mapping can match to any controller and any of their actions which means the following URLs will match:

```
/hello/index        >>    controller: hello, action: index
/entry/view/4       >>    controller: entry, action: view, id:4
/comment/edit/2     >>    controller: comment, action: edit, id:2
```

This simple scheme can be suitable for even large applications when complex URL's aren't needed.

Controllers can be organized into directories as well. For example, if the admins should have a separate `comments` controller:

```
$ paster controller admin/comments
```

Will create the `admin` directory along with the appropriate `comments` controller under it. To get to the comments controller:

```
/admin/comments/index     >>    controller: admin/comments, action: index
```

Note: The `{controller}` match is special, in that it doesn't always stop at the next forward slash (`/`). As the example above demonstrates, it is able to match controllers nested under a directory should they exist.

7.3.1 Adding a route to match /

The controller and action can be specified directly in the `map.connect()` statement, as well as the raw URL to be matched:

```
map.connect('/', controller='main', action='index')
```

results in `/` being handled by the `index` method of the `main` controller.

Note: By default, projects' static files (in the `public/` directory) are served in preference to controllers. New Pylons projects include a welcome page (`public/index.html`) that shows up at the `/` url. You'll want to remove this file before mapping a route there.

7.3.2 Generating URLs

URLs are generated via the callable `routes.util.URLGenerator` object. Pylons provides an instance of this special object at `pylons.url`. It accepts keyword arguments indicating the desired controller, action and additional variables defined in a route.

```
# generates /content/view/2
url(controller='content', action='view', id=2)
```

To generate the URL of the matched route of the current request, call `routes.util.URLGenerator.current()`:

```
# Generates /content/view/3 during a request for /content/view/3
url.current()
```

`routes.util.URLGenerator.current()` also accepts the same arguments as *url()*. This uses Routes memory to generate a small change to the current URL without the need to specify all the relevant arguments:

```
# Generates /content/view/2 during a request for /content/view/3
url.current(id=2)
```

See Also:

Routes manual Full details and source code.

7.4 Middleware

A projects WSGI stack should be setup in the `config/middleware.py` module. Ideally this file should import middleware it needs, and set it up in the *make_app* function.

The default stack that is setup for a Pylons application is described in detail in *WSGI Middleware*.

Default middleware stack:

```
# The Pylons WSGI app
app = PylonsApp()

# Routing/Session/Cache Middleware
app = RoutesMiddleware(app, config['routes.map'])
app = SessionMiddleware(app, config)
app = CacheMiddleware(app, config)

# CUSTOM MIDDLEWARE HERE (filtered by error handling middlewares)

if asbool(full_stack):
    # Handle Python exceptions
    app = ErrorHandler(app, global_conf, **config['pylons.errorware'])

    # Display error documents for 401, 403, 404 status codes (and
    # 500 when debug is disabled)
    if asbool(config['debug']):
        app = StatusCodeRedirect(app)
    else:
        app = StatusCodeRedirect(app, [400, 401, 403, 404, 500])

# Establish the Registry for this application
app = RegistryManager(app)
```

```
if asbool(static_files):
    # Serve static files
    static_app = StaticURLParser(config['pylons.paths']['static_files'])
    app = Cascade([static_app, app])

return app
```

Since each piece of middleware wraps the one before it, the stack needs to be assembled in reverse order from the order in which its called. That is, the very last middleware that wraps the WSGI Application, is the very first that will be called by the server.

The last piece of middleware in the stack, called Cascade, is used to serve static content files during development. For top performance, consider disabling the Cascade middleware via setting the `static_files = false` in the configuration file. Then have the webserver or a *CDN* serve static files.

Warning: When unsure about whether or not to change the middleware, **don't**. The order of the middleware is important to the proper functioning of a Pylons application, and shouldn't be altered unless needed.

7.4.1 Adding custom middleware

Custom middleware should be included in the `config/middleware.py` at comment marker:

```
# CUSTOM MIDDLEWARE HERE (filtered by error handling middlewares)
```

For example, to add a middleware component named *MyMiddleware*, include it in `config/middleware.py`:

```
# The Pylons WSGI app
app = PylonsApp()

# Routing/Session/Cache Middleware
app = RoutesMiddleware(app, config['routes.map'])
app = SessionMiddleware(app, config)
app = CacheMiddleware(app, config)

# CUSTOM MIDDLEWARE HERE (filtered by error handling middlewares)
app = MyMiddleware(app)
```

The app object is simply passed as a parameter to the *MyMiddleware* middleware which in turn should return a wrapped WSGI application.

Care should be taken when deciding in which layer to place custom middleware. In most cases middleware should be placed before the Pylons WSGI application and its supporting Routes/Session/Cache middlewares, however if the middleware should run *after* the CacheMiddleware:

```
# Routing/Session/Cache Middleware
app = RoutesMiddleware(app, config['routes.map'])
app = SessionMiddleware(app, config)

# MyMiddleware can only see the cache object, nothing *above* here
app = MyMiddleware(app)

app = CacheMiddleware(app, config)
```

7.4.2 What is full_stack?

In the Pylons ini file {`development.ini` or `production.ini`} this block determines if the flag full_stack is set to true or false:

```
[app:main]
use = egg:app_name
full_stack = true
```

The full_stack flag determines if the ErrorHandler and StatusCodeRedirect is included as a layer in the middleware wrapping process. The only condition in which this option would be set to *false* is if multiple Pylons applications are running and will be wrapped in the appropriate middleware elsewhere.

7.5 Application Setup

There are two kinds of 'Application Setup' that are occasionally referenced with regards to a project using Pylons.

- Setting up a new application
- Configuring project information and package dependencies

7.5.1 Setting Up a New Application

To make it easier to setup a new instance of a project, such as setting up the basic database schema, populating necessary defaults, etc. a setup script can be created.

In a Pylons project, the setup script to be run is located in the projects' `websetup.py` file. The default script loads the projects configuration to make it easier to write application setup steps:

```
import logging

from helloworld.config.environment import load_environment

log = logging.getLogger(__name__)

def setup_app(command, conf, vars):
    """Place any commands to setup helloworld here"""
    load_environment(conf.global_conf, conf.local_conf)
```

Note: If the project was configured during creation to use SQLAlchemy this file will include some commands to setup the database connection to make it easier to setup database tables.

To run the setup script using the development configuration:

```
$ paster setup-app development.ini
```

7.5.2 Configuring the Package

A newly created project with Pylons is a standard Python package. As a Python package, it has a `setup.py` file that records meta-information about the package. Most of the options in it are fairly self-explanatory, the most important being the 'install_requires' option:

```
install_requires=[
    "Pylons>=0.9.7",
],
```

These lines indicate what packages are required for the proper functioning of the application, and should be updated as needed. To re-parse the `setup.py` line for new dependencies:

```
$ python setup.py develop
```

In addition to updating the packages as needed so that the dependency requirements are made, this command will ensure that this package is active in the system (without requiring the traditional **python setup.py install**).

See Also:

Declaring Dependencies

CHAPTER

EIGHT

LOGGING

8.1 Logging messages

As of Pylons 0.9.6, Pylons controllers (created via `paster controller/restcontroller`) and `websetup.py` create their own Logger objects via Python's logging module.

For example, in the helloworld project's hello controller (`helloworld/controllers/hello.py`):

```
import logging

from pylons import request, response, session, tmpl_context as c, url
from pylons.controllers.util import abort, redirect

log = logging.getLogger(__name__)

class HelloController(BaseController):

    def index(self):
        ...
```

Python's special `__name__` variable refers to the current module's fully qualified name; in this case, `helloworld.controllers.hello`.

To log messages, simply use methods available on that Logger object:

```
import logging

from pylons import request, response, session, tmpl_context as c, url
from pylons.controllers.util import abort, redirect

log = logging.getLogger(__name__)

class HelloController(BaseController):

    def index(self):
        content_type = 'text/plain'
        content = 'Hello World!'

        log.debug('Returning: %s (content-type: %s)', content, content_type)
        response.content_type = content_type
        return content
```

Which will result in the following printed to the console, on stderr:

```
16:20:20,440 DEBUG [helloworld.controllers.hello] Returning: Hello World!
                   (content-type: text/plain)
```

8.2 Basic Logging configuration

As of Pylons 0.9.6, the default ini files include a basic configuration for the logging module. Paste ini files use the Python standard ConfigParser format; the same format used for the Python logging module's Configuration file format.

`paster`, when loading an application via the `paster serve`, `shell` or `setup-app` commands, calls the logging.fileConfig function on that specified ini file if it contains a 'loggers' entry. `logging.fileConfig` reads the logging configuration from a `ConfigParser` file.

Logging configuration is provided in both the default `development.ini` and the production ini file (created via `paster make-config <package_name> <ini_file>`). The production ini's logging setup is a little simpler than the `development.ini`'s, and is as follows:

```
# Logging configuration
[loggers]
keys = root

[handlers]
keys = console

[formatters]
keys = generic

[logger_root]
level = INFO
handlers = console

[handler_console]
class = StreamHandler
args = (sys.stderr,)
level = NOTSET
formatter = generic

[formatter_generic]
format = %(asctime)s %(levelname)-5.5s [%(name)s] [%(threadName)s] %(message)s
```

One root Logger is created that logs only messages at a level above or equal to the `INFO` level to stderr, with the following format:

```
2007-08-17 15:04:08,704 INFO [helloworld.controllers.hello] Loading resource, id: 86
```

For those familiar with the `logging.basicConfig` function, this configuration is equivalent to the code:

```
logging.basicConfig(level=logging.INFO,
format='%(asctime)s %(levelname)-5.5s [%(name)s] %(message)s')
```

The default `development.ini`'s logging section has a couple of differences: it uses a less verbose timestamp, and defaults your application's log messages to the `DEBUG` level (described in the next section).

Pylons and many other libraries (such as Beaker, SQLAlchemy, Paste) log a number of messages for debugging purposes. Switching the root Logger level to `DEBUG` reveals them:

```
[logger_root]
#level = INFO
level = DEBUG
handlers = console
```

8.3 Filtering log messages

Often there's too much log output to sift through, such as when switching the root Logger's level to `DEBUG`.

An example: you're diagnosing database connection issues in your application and only want to see SQLAlchemy's `DEBUG` messages in relation to database connection pooling. You can leave the root Logger's level at the less verbose `INFO` level and set that particular SQLAlchemy Logger to `DEBUG` on its own, apart from the root Logger:

```
[logger_sqlalchemy.pool]
level = DEBUG
handlers =
qualname = sqlalchemy.pool
```

then add it to the list of Loggers:

```
[loggers]
keys = root, sqlalchemy.pool
```

No Handlers need to be configured for this Logger as by default non root Loggers will propagate their log records up to their parent Logger's Handlers. The root Logger is the top level parent of all Loggers.

This technique is used in the default `development.ini`. The root Logger's level is set to `INFO`, whereas the application's log level is set to `DEBUG`:

```
# Logging configuration
[loggers]
keys = root, helloworld
```

```
[logger_helloworld]
level = DEBUG
handlers =
qualname = helloworld
```

All of the child Loggers of the helloworld Logger will inherit the `DEBUG` level unless they're explicitly set differently. Meaning the `helloworld.controllers.hello`, `helloworld.websetup` (and all your app's modules') Loggers by default have an effective level of `DEBUG` too.

For more advanced filtering, the logging module provides a Filter object; however it cannot be used directly from the configuration file.

8.4 Advanced Configuration

To capture log output to a separate file, use a FileHandler (or a RotatingFileHandler):

```
[handler_accesslog]
class = FileHandler
args = ('access.log','a')
level = INFO
formatter = generic
```

Before it's recognized, it needs to be added to the list of Handlers:

```
[handlers]
keys = console, accesslog
```

and finally utilized by a Logger.

```
[logger_root]
level = INFO
handlers = console, accesslog
```

These final 3 lines of configuration directs all of the root Logger's output to the access.log as well as the console; we'll want to disable this for the next section.

8.5 Request logging with Paste's TransLogger

Paste provides the TransLogger middleware for logging requests using the Apache Combined Log Format. TransLogger combined with a FileHandler can be used to create an `access.log` file similar to Apache's.

Like any standard middleware with a Paste entry point, TransLogger can be configured to wrap your application in the `[app:main]` section of the ini file:

```
filter-with = translogger

[filter:translogger]
use = egg:Paste#translogger
setup_console_handler = False
```

This is equivalent to wrapping your app in a TransLogger instance via the bottom of your project's `config/middleware.py` file:

```
from paste.translogger import TransLogger
app = TransLogger(app, setup_console_handler=False)
return app
```

TransLogger will automatically setup a logging Handler to the console when called with no arguments, so it 'just works' in environments that don't configure logging. Since we've configured our own logging Handlers, we need to disable that option via `setup_console_handler = False`.

With the filter in place, TransLogger's Logger (named the 'wsgi' Logger) will propagate its log messages to the parent Logger (the root Logger), sending its output to the console when we request a page:

```
00:50:53,694 INFO [helloworld.controllers.hello] Returning: Hello World!
                  (content-type: text/plain)
00:50:53,695 INFO [wsgi] 192.168.1.111 - - [11/Aug/2007:20:09:33 -0700] "GET /hello
HTTP/1.1" 404 - "-"
"Mozilla/5.0 (Macintosh; U; Intel Mac OS X; en-US; rv:1.8.1.6) Gecko/20070725
Firefox/2.0.0.6"
```

To direct TransLogger to the `access.log` FileHandler defined above, we need to add that FileHandler to the wsgi Logger's list of Handlers:

```
# Logging configuration
[loggers]
keys = root, wsgi
```

```
[logger_wsgi]
level = INFO
```

```
handlers = handler_accesslog
qualname = wsgi
propagate = 0
```

As mentioned above, non-root Loggers by default propagate their log Records to the root Logger's Handlers (currently the console Handler). Setting `propagate` to 0 (false) here disables this; so the `wsgi` Logger directs its records only to the `accesslog` Handler.

Finally, there's no need to use the `generic` Formatter with TransLogger as TransLogger itself provides all the information we need. We'll use a Formatter that passes-through the log messages as is:

```
[formatters]
keys = generic, accesslog
```

```
[formatter_accesslog]
format = %(message)s
```

Then wire this new `accesslog` Formatter into the FileHandler:

```
[handler_accesslog]
class = FileHandler
args = ('access.log','a')
level = INFO
formatter = accesslog
```

8.6 Logging to wsgi.errors

Pylons provides a custom logging Handler class, pylons.log.WSGIErrorsHandler, for logging output to `environ['wsgi.errors']`: the WSGI server's error stream (see the WSGI Spefification, PEP 333 for more information). `wsgi.errors` can be useful to log to in certain situations, such as when deployed under Apache mod_wsgi/mod_python, where the `wsgi.errors` stream is the Apache error log.

To configure logging of only `ERROR` (and `CRITICAL`) messages to `wsgi.errors`, add the following to the ini file:

```
[handlers]
keys = console, wsgierrors
```

```
[handler_wsgierrors]
class = pylons.log.WSGIErrorsHandler
args = ()
level = ERROR
format = generic
```

then add the new Handler name to the list of Handlers used by the root Logger:

```
[logger_root]
level = INFO
handlers = console, wsgierrors
```

Warning: `WSGIErrorsHandler` does not receive log messages created during application startup. This is due to the `wsgi.errors` stream only being available through the `environ` dictionary; which isn't available until a request is made.

8.6.1 Lumberjacking with log4j's Chainsaw

Java's `log4j` project provides the Java GUI application Chainsaw for viewing and managing log messages. Among its features are the ability to filter log messages on the fly, and customizable color highlighting of log messages.

We can configure Python's logging module to output to a format parsable by Chainsaw, `log4j`'s XMLLayout format.

To do so, we first need to install the Python XMLLayout package:

```
$ easy_install XMLLayout
```

It provides a log Formatter that generates `XMLLayout` XML. It also provides `RawSocketHandler`; like the logging module's `SocketHandler`, it sends log messages across the network, but does not pickle them.

The following is an example configuration for sending `XMLLayout` log messages across the network to Chainsaw, if it were listening on *localhost* port *4448*:

```
[handlers]
keys = console, chainsaw

[formatters]
keys = generic, xmllayout

[logger_root]
level = INFO
handlers = console, chainsaw
```

```
[handler_chainsaw]
class = xmllayout.RawSocketHandler
args = ('localhost', 4448)
level = NOTSET
formatter = xmllayout
```

```
[formatter_xmllayout]
class = xmllayout.XMLLayout
```

This configures any log messages handled by the root Logger to also be sent to Chainsaw. The default `development.ini` configures the root Logger to the `INFO` level, however in the case of using Chainsaw, it is preferable to configure the root Logger to `NOTSET` so *all* log messages are sent to Chainsaw. Instead, we can restrict the console handler to the `INFO` level:

```
[logger_root]
level = NOTSET
handlers = console

[handler_console]
class = StreamHandler
args = (sys.stderr,)
level = INFO
formatter = generic
```

Chainsaw can be downloaded from its home page, but can also be launched directly from a Java-enabled browser via the link: Chainsaw web start.

It can be configured from the GUI, but it also supports reading its configuration from a `log4j.xml` file.

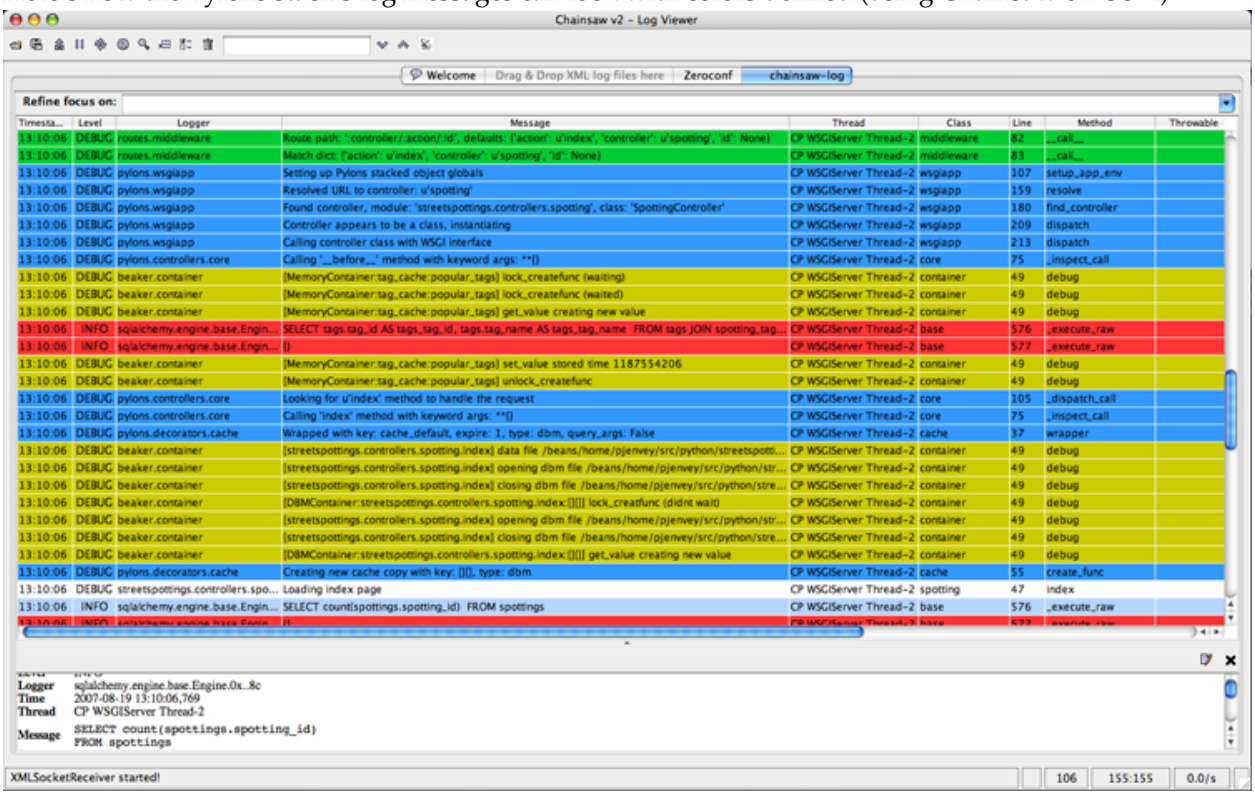
The following `log4j.xml` file configures Chainsaw to listen on port *4448* for `XMLLayout` style log messages. It also hides Chainsaw's own logging messages under the `WARN` level, so only your app's log mes-

sages are displayed:

```
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE configuration>
<configuration xmlns="http://logging.apache.org/">

<plugin name="XMLSocketReceiver" class="org.apache.log4j.net.XMLSocketReceiver">
    <param name="decoder" value="org.apache.log4j.xml.XMLDecoder"/>
    <param name="port" value="4448"/>
</plugin>

<logger name="org.apache.log4j">
    <level value="warn"/>
</logger>

<root>
    <level value="debug"/>
</root>

</configuration>
```

Chainsaw will prompt for a configuration file upon startup. The configuration can also be loaded later by clicking *File/Load Log4J File...*. You should see an XMLSocketReceiver instance loaded in Chainsaw's Receiver list, configured at port *4448*, ready to receive log messages.

Here's how the Pylons stack's log messages can look with colors defined (using Chainsaw on OS X):



8.6.2 Alternate Logging Configuration style

Pylons' default ini files include a basic configuration for Python's logging module. Its format matches the standard Python `logging` module's config file format . If a more concise format is preferred, here is Max

Ischenko's demonstration of an alternative style to setup logging.

The following function is called at the application start up (e.g. Global ctor):

```
def setup_logging():
    logfile = config['logfile']
    if logfile == 'STDOUT': # special value, used for unit testing
        logging.basicConfig(stream=sys.stdout, level=logging.DEBUG,
               #format='%(name)s %(levelname)s %(message)s',
               #format='%(asctime)s,%(msecs)d %(levelname)s %(message)s',
               format='%(asctime)s,%(msecs)d %(name)s %(levelname)s %(message)s',
               datefmt='%H:%M:%S')
    else:
        logdir = os.path.dirname(os.path.abspath(logfile))
        if not os.path.exists(logdir):
            os.makedirs(logdir)
        logging.basicConfig(filename=logfile, mode='at+',
             level=logging.DEBUG,
             format='%(asctime)s,%(msecs)d %(name)s %(levelname)s %(message)s',
             datefmt='%Y-%b-%d %H:%M:%S')
    setup_thirdparty_logging()
```

The setup_thirdparty_logging function searches through the certain keys of the application `.ini` file which specify logging level for a particular logger (module).

```
def setup_thirdparty_logging():
    for key in config:
        if not key.endswith('logging'):
            continue
        value = config.get(key)
        key = key.rstrip('.logging')
        loglevel = logging.getLevelName(value)
        log.info('Set %s logging for %s', logging.getLevelName(loglevel), key)
        logging.getLogger(key).setLevel(loglevel)
```

Relevant section of the .ini file (example):

```
sqlalchemy.logging = WARNING
sqlalchemy.orm.unitofwork.logging = INFO
sqlalchemy.engine.logging = DEBUG
sqlalchemy.orm.logging = INFO
routes.logging = WARNING
```

This means that routes logger (and all sub-loggers such as routes.mapper) only passes through messages of at least WARNING level; sqlalachemy defaults to WARNING level but some loggers are configured with more verbose level to aid debugging.

CHAPTER

NINE

HELPERS

Helpers are functions intended for usage in templates, to assist with common HTML and text manipulation, higher level constructs like a HTML tag builder (that safely escapes variables), and advanced functionality like Pagination of data sets.

The majority of the helpers available in Pylons are provided by the `webhelpers` package. Some of these helpers are also used in controllers to prepare data for use in the template by other helpers, such as the `secure_form_tag()` function which has a corresponding `authenticate_form()`.

To make individual helpers available for use in templates under *h*, the appropriate functions need to be imported in `lib/helpers.py`. All the functions available in this file are then available under *h* just like any other module reference.

By customizing the `lib/helpers.py` module you can quickly add custom functions and classes for use in your templates.

Helper functions are organized into modules by theme. All HTML generators are under the `webhelpers_html` package, except for a few third-party modules which are directly under `webhelpers`. The webhelpers modules are separately documented, see `webhelpers`.

9.1 Pagination

Note: The *paginate* module is not compatible to the deprecated *pagination* module that was provided with former versions of the Webhelpers package.

9.1.1 Purpose of a paginator

When you display large amounts of data like a result from an SQL query then usually you cannot display all the results on a single page. It would simply be too much. So you divide the data into smaller chunks. This is what a paginator does. It shows one page of chunk of data at a time. Imagine you are providing a company phonebook through the web and let the user search the entries. Assume the search result contains 23 entries. You may decide to display no more than 10 entries per page. The first page contains entries 1-10, the second 11-20 and the third 21-23. And you also show a navigational element like `Page 1 of 3: [1] 2 3` that allows the user to switch between the available pages.

9.1.2 The Page class

The webhelpers package provides a *paginate* module that can be used for this purpose. It can create pages from simple Python lists as well as SQLAlchemy queries and SQLAlchemy select objects. The module provides a Page object that represents a single page of items from a larger result set. Such a Page mainly behaves like a list of items on that page. Let's take the above example of 23 items spread across 3 pages:

```
# Create a list of items from 1 to 23
>>> items = range(1,24)

# Import the paginate module
>>> import webhelpers.paginate

# Create a Page object from the 'items' for the second page
>>> page2 = webhelpers.paginate.Page(items, page=2, items_per_page=10)

# The Page object can be printed (__repr__) to show details on the page
>>> page2

    Page:
    Collection type:  <type 'list'>
    (Current) page:   2
    First item:       11
    Last item:        20
    First page:       1
    Last page:        3
    Previous page:    1
    Next page:        3
    Items per page:   10
    Number of items:  23
    Number of pages:  3

# Show the items on this page
>>> list(page2)

    [11, 12, 13, 14, 15, 16, 17, 18, 19, 20]

# Print the items in a for loop
>>> for i in page2: print "This is entry", i

    This is entry 11
    This is entry 12
    This is entry 13
    This is entry 14
    This is entry 15
    This is entry 16
    This is entry 17
    This is entry 18
    This is entry 19
    This is entry 20
```

There are further parameters to invoking a Page object. Please see webhelpers.paginate.Page

---

Note: Page numbers and item numbers start from 1. If you are accessing the items on the page by their index please note that the first item is item[1] instead of item[0].

9.1.3 Switching between pages using a *pager*

The user needs a way to get to another page. This is usually done with a list of links like `Page 3 of 41 - 1 2 [3] 4 5 .. 41`. Such a list can be created by the Page's `pager()` method. Take the above example again:

```
>>> page2.pager()

    <a class="pager_link" href="/content?page=1">1</a>
    <span class="pager_curpage">2</span>
    <a class="pager_link" href="/content?page=3">3</a>
```

Without the HTML tags it looks like `1 [2] 3`. The links point to a URL where the respective page is found. And the current page (2) is highlighted.

The appearance of a pager can be customized. By default the format string is `~2~` which means it shows adjacent pages from the current page with a maximal radius of 2. In a larger set this would look like `1 .. 34 35 [36] 37 38 .. 176`. The radius of 2 means that two pages before and after the current page 36 are shown.

Several special variables can be used in the format string. See `pager()` for a complete list. Some examples for a pager of 20 pages while being on page 10 currently:

```
>>> page.pager()

    1 .. 8 9 [10] 11 12 .. 20

>>> page.pager('~4~')

    1 .. 6 7 8 9 [10] 11 12 13 14 .. 20

>>> page.pager('Page $page of $page_count - ~3~')

    Page 10 of 20 - 1 .. 7 8 9 [10] 11 12 13 .. 20

>>> page.pager('$link_previous $link_next ~2~')

    < > 1 .. 8 9 [10] 11 12 .. 20

>>> page.pager('Items $first_item - $last_item / ~2~')

    Items 91 - 100 / 1 .. 8 9 [10] 11 12 .. 20
```

9.1.4 Paging over an SQLAlchemy query

If the data to page over comes from a database via SQLAlchemy then the `paginate` module can access a `query` object directly. This is useful when using ORM-mapped models. Example:

```
>>> employee_query = Session.query(Employee)
>>> page2 = webhelpers.paginate.Page(
        employee_query,
        page=2,
        items_per_page=10)
>>> for employee in page2: print employee.first_name

    John
    Jack
    Joseph
```

```
    Kay
    Lars
    Lynn
    Pamela
    Sandra
    Thomas
    Tim
```

The *paginate* module is smart enough to only query the database for the objects that are needed on this page. E.g. if a page consists of the items 11-20 then SQLAlchemy will be asked to fetch exactly that 10 rows through *LIMIT* and *OFFSET* in the actual SQL query. So you must not load the complete result set into memory and pass that. Instead always pass a *query* when creating a *Page*.

9.1.5 Paging over an SQLAlchemy select

SQLAlchemy also allows to run arbitrary SELECTs on database tables. This is useful for non-ORM queries. *paginate* can use such select objects, too. Example:

```
>>> selection = sqlalchemy.select([Employee.c.first_name])
>>> page2 = webhelpers.paginate.Page(
        selection,
        page=2,
        items_per_page=10,
        sqlalchemy_session=model.Session)
>>> for first_name in page2: print first_name

    John
    Jack
    Joseph
    Kay
    Lars
    Lynn
    Pamela
    Sandra
    Thomas
    Tim
```

The only difference to using SQLAlchemy *query* objects is that you need to pass an SQLAlchemy *session* via the `sqlalchemy_session` parameter. A bare `select` does not have a database connection assigned. But the session has.

9.1.6 Usage in a Pylons controller and template

A simple example to begin with.

Controller:

```
def list(self):
    c.employees = webhelpers.paginate.Page(
        model.Session.query(model.Employee),
        page = int(request.params['page']),
        items_per_page = 5)
    return render('/employees/list.mako')
```

Template:

```
${c.employees.pager('Page $page: $link_previous $link_next ~4~')}
<ul>
% for employee in c.employees:
    <li>${employee.first_name} ${employee.last_name}</li>
% endfor
</ul>
```

The *pager()* creates links to the previous URL and just sets the *page* parameter appropriately. That's why you need to pass the requested page number (`request.params['page']`) when you create a *Page*.

9.1.7 Partial updates with AJAX

Updating a page partially is easy. All it takes is a little Javascript that - instead of loading the complete page - updates just the part of the page containing the paginated items. The `pager()` method accepts an `onclick` parameter for that purpose. This value is added as an `onclick` parameter to the A-HREF tags. So the `href` parameter points to a URL that loads the complete page while the `onclick` parameter provides Javascript that loads a partial page. An example (using the jQuery Javascript library for simplification) may help explain that.

Controller:

```
def list(self):
    c.employees = webhelpers.paginate.Page(
        model.Session.query(model.Employee),
        page = int(request.params['page']),
        items_per_page = 5)
    if 'partial' in request.params:
        # Render the partial page
        return render('/employees/list-partial.mako')
    else:
        # Render the full page
        return render('/employees/list-full.mako')
```

Template `list-full.mako`:

```
<html>
    <head>
        ${webhelpers.html.tags.javascript_link('/public/jQuery.js')}
    </head>
    <body>
        <div id="page-area">
            <%include file="list-partial.mako"/>
        </div>
    </body>
</html>
```

Template `list-partial.mako`:

```
${c.employees.pager(
    'Page $page: $link_previous $link_next ~4~',
    onclick="$('#my-page-area').load('%s'); return false;")}
<ul>
% for employee in c.employees:
    <li>${employee.first_name} ${employee.last_name}</li>
% endfor
</ul>
```

To avoid code duplication in the template the full template includes the partial template. If a partial page load is requested then just the `list-partial.mako` gets rendered. And if a full page load is requested then the `list-full.mako` is rendered which in turn includes the `list-partial.mako`.

The `%s` variable in the `onclick` string gets replaced with a URL pointing to the respective page with a `partial=1` added (the name of the parameter can be customized through the `partial_param` parameter). Example:

- `href` parameter points to `/employees/list?page=3`
- `onclick` parameter contains Javascript loading `/employees/list?page=3&partial=1`

jQuery's syntax to load a URL into a certain DOM object (e.g. a DIV) is simply:

```
$('#some-id').load('/the/url')
```

The advantage of this technique is that it degrades gracefully. If the user does not have Javascript enabled then a full page is loaded. And if Javascript works then a partial load is done through the `onclick` action.

9.2 Secure Form Tag Helpers

For prevention of Cross-site request forgery (CSRF) attacks.

Generates form tags that include client-specific authorization tokens to be verified by the destined web app.

Authorization tokens are stored in the client's session. The web app can then verify the request's submitted authorization token with the value in the client's session.

This ensures the request came from the originating page. See the wikipedia entry for Cross-site request forgery for more information.

Pylons provides an `authenticate_form` decorator that does this verification on the behalf of controllers.

These helpers depend on Pylons' `session` object. Most of them can be easily ported to another framework by changing the API calls.

The helpers are implemented in such a way that it should be easy for developers to create their own helpers if using helpers for AJAX calls.

`authentication_token()` returns the current authentication token, creating one and storing it in the session if it doesn't already exist.

`auth_token_hidden_field()` creates a hidden field containing the authentication token.

`secure_form()` is `form()` plus `auth_token_hidden_field()`.

CHAPTER

TEN

FORMS

10.1 The basics

When a user submits a form on a website the data is submitted to the URL specified in the *action* attribute of the <*form*> tag. The data can be submitted either via HTTP *GET* or *POST* as specified by the *method* attribute of the <*form*> tag. If your form doesn't specify an *action*, then it's submitted to the current URL, generally you'll want to specify an *action*. When a file upload field such as <*input type="file" name="file" /*> is present, then the HTML <*form*> tag must also specify *enctype="multipart/form-data"* and *method* must be *POST*.

10.2 Getting Started

Add two actions that looks like this:

```
# in the controller

def form(self):
    return render('/form.mako')

def email(self):
    return 'Your email is: %s' % request.params['email']
```

Add a new template called *form.mako* in the *templates* directory that contains the following:

```
<form name="test" method="GET" action="/hello/email">
Email Address: <input type="text" name="email" />
<input type="submit" name="submit" value="Submit" />
</form>
```

If the server is still running (see the *Getting Started Guide*) you can visit http://localhost:5000/hello/form and you will see the form. Try entering the email address *test@example.com* and clicking Submit. The URL should change to `http://localhost:5000/hello/email?email=test%40example.com` and you should see the text *Your email is test@example.com*.

In Pylons all form variables can be accessed from the `request.params` object which behaves like a dictionary. The keys are the names of the fields in the form and the value is a string with all the characters entity decoded. For example note how the @ character was converted by the browser to *%40* in the URL and was converted back ready for use in `request.params`.

Note: *request* and *response* are objects from the *WebOb* library. Full documentation on their attributes and methods is here.

If you have two fields with the same name in the form then using the dictionary interface will return the first string. You can get all the strings returned as a list by using the *.getall()* method. If you only expect one value and want to enforce this you should use *.getone()* which raises an error if more than one value with the same name is submitted.

By default if a field is submitted without a value, the dictionary interface returns an empty string. This means that using *.get(key, default)* on *request.params* will only return a default if the value was not present in the form.

10.2.1 POST vs GET and the Re-Submitted Data Problem

If you change the *form.mako* template so that the method is *POST* and you re-run the example you will see the same message is displayed as before. However, the URL displayed in the browser is simply http://localhost:5000/hello/email without the query string. The data is sent in the body of the request instead of the URL, but Pylons makes it available in the same way as for GET requests through the use of *request.params*.

Note: If you are writing forms that contain password fields you should usually use POST to prevent the password being visible to anyone who might be looking at the user's screen.

When writing form-based applications you will occasionally find users will press refresh immediately after submitting a form. This has the effect of repeating whatever actions were performed the first time the form was submitted but often the user will expect that the current page be shown again. If your form was submitted with a POST, most browsers will display a message to the user asking them if they wish to re-submit the data, this will not happen with a GET so POST is preferable to GET in those circumstances.

Of course, the best way to solve this issue is to structure your code differently so:

```
# in the controller

def form(self):
    return render('/form.mako')

def email(self):
    # Code to perform some action based on the form data
    # ...
    redirect(url(controller='home', action='result'))

def result(self):
    return 'Your data was successfully submitted'
```

In this case once the form is submitted the data is saved and an HTTP redirect occurs so that the browser redirects to http://localhost:5000/hello/result. If the user then refreshes the page, it simply redisplays the message rather than re-performing the action.

10.3 Using the Helpers

Creating forms can also be done using WebHelpers, which comes with Pylons. Here is the same form created in the previous section but this time using the helpers:

```
${h.form(h.url(action='email'), method='get')}
Email Address: ${h.text('email')}
```

```
${h.submit('Submit')}
${h.end_form()}
```

Before doing this you'll have to import the helpers you want to use into your project's *lib/helpers.py* file; then they'll be available under Pylons' `h` global. Most projects will want to import at least these:

```
from webhelpers.html import escape, HTML, literal, url_escape
from webhelpers.html.tags import *
```

There are many other helpers for text formatting, container objects, statistics, and for dividing large query results into pages. See the `WebHelpers documentation` to choose the helpers you'll need.

10.4 File Uploads

File upload fields are created by using the *file* input field type. The *file_field* helper provides a shortcut for creating these form fields:

```
${h.file_field('myfile')}
```

The HTML form must have its *enctype* attribute set to *multipart/form-data* to enable the browser to upload the file. The *form* helper's *multipart* keyword argument provides a shortcut for setting the appropriate *enctype* value:

```
${h.form(h.url(action='upload'), multipart=True)}
Upload file: ${h.file_field('myfile')} <br />
File description: ${h.text_field('description')} <br />
${h.submit('Submit')}
${h.end_form()}
```

When a file upload has succeeded, the *request.POST* (or *request.params*) *MultiDict* will contain a *cgi.FieldStorage* object as the value of the field.

FieldStorage objects have three important attributes for file uploads:

filename The name of file uploaded as it appeared on the uploader's filesystem.

file A file(-like) object from which the file's data can be read: A python *tempfile* or a *StringIO* object.

value The content of the uploaded file, eagerly read directly from the file object.

The easiest way to gain access to the file's data is via the *value* attribute: it returns the entire contents of the file as a string:

```
def upload(self):
    myfile = request.POST['myfile']
    return 'Successfully uploaded: %s, size: %i, description: %s' % \
        (myfile.filename, len(myfile.value), request.POST['description'])
```

However reading the entire contents of the file into memory is undesirable, especially for large file uploads. A common means of handling file uploads is to store the file somewhere on the filesystem. The *FieldStorage* typically reads the file onto filesystem, however to a non permanent location, via a python *tempfile* object (though for very small uploads it stores the file in a *StringIO* object instead).

Python *tempfiles* are secure file objects that are automatically destroyed when they are closed (including an implicit close when the object is garbage collected). One of their security features is that their path cannot be determined: a simple *os.rename* from the *tempfile's* path isn't possible. Alternatively, *shutil.copyfileobj* can perform an efficient copy of the file's data to a permanent location:

```
permanent_store = '/uploads/'

class Uploader(BaseController):
    def upload(self):
        myfile = request.POST['myfile']
        permanent_file = open(os.path.join(permanent_store,
                                   myfile.filename.lstrip(os.sep)),
                                   'w')

    shutil.copyfileobj(myfile.file, permanent_file)
    myfile.file.close()
    permanent_file.close()

    return 'Successfully uploaded: %s, description: %s' % \
        (myfile.filename, request.POST['description'])
```

Warning: The previous basic example allows any file uploader to overwrite any file in the *permanent_store* directory that your web application has permissions to.

Also note the use of *myfile.filename.lstrip(os.sep)* here: without it, *os.path.join* is unsafe. *os.path.join* won't join absolute paths (beginning with *os.sep*), i.e. *os.path.join('/uploads/', '/uploaded_file.txt') == '/uploaded_file.txt'*. Always check user submitted data to be used with *os.path.join*.

10.5 Validating user input with FormEncode

10.5.1 Validation the Quick Way

At the moment you could enter any value into the form and it would be displayed in the message, even if it wasn't a valid email address. In most cases this isn't acceptable since the user's input needs validating. The recommended tool for validating forms in Pylons is FormEncode.

For each form you create you also create a validation schema. In our case this is fairly easy:

```
import formencode

class EmailForm(formencode.Schema):
    allow_extra_fields = True
    filter_extra_fields = True
    email = formencode.validators.Email(not_empty=True)
```

Note: We usually recommend keeping form schemas together so that you have a single place you can go to update them. It's also convenient for inheritance since you can make new form schemas that build on existing ones. If you put your forms in a *models/form.py* file, you can easily use them throughout your controllers as *model.form.EmailForm* in the case shown.

Our form actually has two fields, an email text field and a submit button. If extra fields are submitted FormEncode's default behavior is to consider the form invalid so we specify *allow_extra_fields = True*. Since we don't want to use the values of the extra fields we also specify *filter_extra_fields = True*. The final line specifies that the email field should be validated with an *Email()* validator. In creating the validator we also specify *not_empty=True* so that the email field will require input.

Pylons comes with an easy to use *validate* decorator, if you wish to use it import it in your *lib/base.py* like this:

```
# other imports

from pylons.decorators import validate
```

Using it in your controller is pretty straight-forward:

```
# in the controller

def form(self):
    return render('/form.mako')

@validate(schema=EmailForm(), form='form')
def email(self):
    return 'Your email is: %s' % self.form_result.get('email')
```

Validation only occurs on POST requests so we need to alter our form definition so that the method is a POST:

```
${h.form(h.url(action='email'), method='post')}
```

If validation is successful, the valid result dict will be saved as *self.form_result* so it can be used in the action. Otherwise, the action will be re-run as if it was a GET request to the controller action specified in *form*, and the output will be filled by FormEncode's htmlfill to fill in the form field errors. For simple cases this is really handy because it also avoids having to write code in your templates to display error messages if they are present.

This does exactly the same thing as the example above but works with the original form definition and in fact will work with any HTML form regardless of how it is generated because the validate decorator uses *formencode.htmlfill* to find HTML fields and replace them with the values were originally submitted.

Note: Python 2.3 doesn't support decorators so rather than using the *@validate()* syntax you need to put *email = validate(schema=EmailForm(), form='form')(email)* after the email function's declaration.

10.5.2 Validation the Long Way

The *validate* decorator covers up a bit of work, and depending on your needs it's possible you could need direct access to FormEncode abilities it smoothes over.

Here's the longer way to use the *EmailForm* schema:

```
# in the controller

def email(self):
    schema = EmailForm()
    try:
        form_result = schema.to_python(request.params)
    except formencode.validators.Invalid, error:
        return 'Invalid: %s' % error
    else:
        return 'Your email is: %s' % form_result.get('email')
```

If the values entered are valid, the schema's *to_python()* method returns a dictionary of the validated and coerced *form_result*. This means that you can guarantee that the *form_result* dictionary contains values that are valid and correct Python objects for the data types desired.

In this case the email address is a string so *request.params['email']* happens to be the same as *form_result['email']*. If our form contained a field for age in years and we had used a *formen-*

code.validators.Int() validator, the value in *form_result* for the age would also be the correct type; in this case a Python integer.

FormEncode comes with a useful set of validators but you can also easily create your own. If you do create your own validators you will find it very useful that all FormEncode schemas' *.to_python()* methods take a second argument named *state*. This means you can pass the Pylons *c* object into your validators so that you can set any variables that your validators need in order to validate a particular field as an attribute of the *c* object. It can then be passed as the *c* object to the schema as follows:

```
c.domain = 'example.com'
form_result = schema.to_python(request.params, c)
```

The schema passes *c* to each validator in turn so that you can do things like this:

```
class SimpleEmail(formencode.validators.Email):
    def _to_python(self, value, c):
        if not value.endswith(c.domain):
            raise formencode.validators.Invalid(
                'Email addresses must end in: %s' % \
                    c.domain, value, c)
        return formencode.validators.Email._to_python(self, value, c)
```

For this to work, make sure to change the *EmailForm* schema you've defined to use the new *SimpleEmail* validator. In other words,

```
email = formencode.validators.Email(not_empty=True)
# becomes:
email = SimpleEmail(not_empty=True)
```

In reality the invalid error message we get if we don't enter a valid email address isn't very useful. We really want to be able to redisplay the form with the value entered and the error message produced. Replace the line:

```
return 'Invalid: %s' % error
```

with the lines:

```
c.form_result = error.value
c.form_errors = error.error_dict or {}
return render('/form.mako')
```

Now we will need to make some tweaks to *form.mako*. Make it look like this:

```
${h.form(h.url(action='email'), method='get')}

% if c.form_errors:
<h2>Please correct the errors</h2>
% else:
<h2>Enter Email Address</h2>
% endif

% if c.form_errors:
Email Address: ${h.text_field('email', value=c.form_result['email'] or '')}
<p>${c.form_errors['email']}</p>
% else:
Email Address: ${h.text_field('email')}
% endif

${h.submit('Submit')}
${h.end_form()}
```

Now when the form is invalid the *form.mako* template is re-rendered with the error messages.

10.6 Other Form Tools

If you are going to be creating a lot of forms you may wish to consider using FormBuild to help create your forms. To use it you create a custom Form object and use that object to build all your forms. You can then use the API to modify all aspects of the generation and use of all forms built with your custom Form by modifying its definition without any need to change the form templates.

Here is an one example of how you might use it in a controller to handle a form submission:

```
# in the controller

def form(self):
    results, errors, response = formbuild.handle(
        schema=Schema(), # Your FormEncode schema for the form
                         # to be validated
        template='form.mako', # The template containg the code
                              # that builds your form
        form=Form # The FormBuild Form definition you wish to use
    )
    if response:
        # The form validation failed so re-display
        # the form with the auto-generted response
        # containing submitted values and errors or
        # do something with the errors
        return response
    else:
        # The form validated, do something useful with results.
        ...
```

Full documentation of all features is available in the FormBuild manual which you should read before looking at Using FormBuild in Pylons

Looking forward it is likely Pylons will soon be able to use the TurboGears widgets system which will probably become the recommended way to build forms in Pylons.

CHAPTER

ELEVEN

INTERNATIONALIZATION AND LOCALIZATION

11.1 Introduction

Internationalization and localization are means of adapting software for non-native environments, especially for other nations and cultures.

Parts of an application which might need to be localized might include:

- Language
- Date/time format
- Formatting of numbers e.g. decimal points, positioning of separators, character used as separator
- Time zones (UTC in internationalized environments)
- Currency
- Weights and measures

The distinction between internationalization and localization is subtle but important. Internationalization is the adaptation of products for potential use virtually everywhere, while localization is the addition of special features for use in a specific locale.

For example, in terms of language used in software, internationalization is the process of marking up all strings that might need to be translated whilst localization is the process of producing translations for a particular locale.

Pylons provides built-in support to enable you to internationalize language but leaves you to handle any other aspects of internationalization which might be appropriate to your application.

Note: Internationalization is often abbreviated as I18N (or i18n or I18n) where the number 18 refers to the number of letters omitted. Localization is often abbreviated L10n or l10n in the same manner. These abbreviations also avoid picking one spelling (internationalisation vs. internationalization, etc.) over the other.

In order to represent characters from multiple languages, you will need to utilize Unicode. This document assumes you have read the *unicode*.

By now you should have a good idea of what Unicode is, how to use it in Python and which areas of you application need to pay specific attention to decoding and encoding Unicode data.

This final section will look at the issue of making your application work with multiple languages.

Pylons uses the Python gettext module for internationalization. It is based off the GNU gettext API.

11.2 Getting Started

Everywhere in your code where you want strings to be available in different languages you wrap them in the `_()` function. There are also a number of other translation functions which are documented in the API reference at http://pylonshq.com/docs/module-pylons.i18n.translation.html

---

Note: The `_()` function is a reference to the `ugettext()` function. `_()` is a convention for marking text to be translated and saves on keystrokes. `ugettext()` is the Unicode version of `gettext()`; it returns unicode strings.

In our example we want the string `'Hello'` to appear in three different languages: English, French and Spanish. We also want to display the word `'Hello'` in the default language. We'll then go on to use some plural words too.

Lets call our project `translate_demo`:

```
$ paster create -t pylons translate_demo
```

Now lets add a friendly controller that says hello:

```
$ cd translate_demo
$ paster controller hello
```

Edit `controllers/hello.py` to make use of the `_()` function everywhere where the string `Hello` appears:

```
import logging

from pylons.i18n import get_lang, set_lang

from translate_demo.lib.base import *

log = logging.getLogger(__name__)

class HelloController(BaseController):

    def index(self):
        response.write('Default: %s<br />' % _('Hello'))
        for lang in ['fr','en','es']:
            set_lang(lang)
        response.write("%s: %s<br />" % (get_lang(), _('Hello')))
```

When writing wrapping strings in the gettext functions, it is important not to piece sentences together manually; certain languages might need to invert the grammars. Don't do this:

```
# BAD!
msg = _("He told her ")
msg += _("not to go outside.")
```

but this is perfectly acceptable:

```
# GOOD
msg = _("He told her not to go outside")
```

The controller has now been internationalized, but it will raise a `LanguageError` until we have setup the alternative language catalogs.

GNU gettext use three types of files in the translation framework.

11.2.1 POT (Portable Object Template) files

The first step in the localization process. A program is used to search through your project's source code and pick out every string passed to one of the translation functions, such as `_()`. This list is put together in a specially-formatted template file that will form the basis of all translations. This is the `.pot` file.

11.2.2 PO (Portable Object) files

The second step in the localization process. Using the POT file as a template, the list of messages are translated and saved as a `.po` file.

11.2.3 MO (Machine Object) files

The final step in the localization process. The PO file is run through a program that turns it into an optimized machine-readable binary file, which is the `.mo` file. Compiling the translations to machine code makes the localized program much faster in retrieving the translations while it is running.

GNU gettext provides a suite of command line programs for extracting messages from source code and working with the associated gettext catalogs. The Babel project provides pure Python alternative versions of these tools. Unlike the GNU gettext tool *xgettext*, Babel supports extracting translatable strings from Python templating languages (currently Mako and Genshi).

11.3 Using Babel

To use Babel, you must first install it via easy_install. Run the command:

```
$ easy_install Babel
```

Pylons (as of 0.9.6) includes some sane defaults for Babel's distutils commands in the setup.cfg file.

It also includes an extraction method mapping in the setup.py file. It is commented out by default, to avoid distutils warning about it being an unrecognized option when Babel is not installed. These lines should be uncommented before proceeding with the rest of this walk through:

```
message_extractors = {'translate_demo': [
        ('**.py', 'python', None),
        ('templates/**.mako', 'mako', None),
        ('public/**', 'ignore', None)]},
```

We'll use Babel to extract messages to a `.pot` file in your project's `i18n` directory. First, the directory needs to be created. Don't forget to add it to your revision control system if one is in use:

```
$ cd translate_demo
$ mkdir translate_demo/i18n
$ svn add translate_demo/i18n
```

Next we can extract all messages from the project with the following command:

```
$ python setup.py extract_messages
running extract_messages
extracting messages from translate_demo/__init__.py
extracting messages from translate_demo/websetup.py
...
extracting messages from translate_demo/tests/functional/test_hello.py
writing PO template file to translate_demo/i18n/translate_demo.pot
```

This will create a `.pot` file in the `i18n` directory that looks something like this:

```
# Translations template for translate_demo.
# Copyright (C) 2007 ORGANIZATION
# This file is distributed under the same license as the translate_demo project.
# FIRST AUTHOR <EMAIL@ADDRESS>, 2007.
#
#, fuzzy
msgid ""
msgstr ""
"Project-Id-Version: translate_demo 0.0.0\n"
"Report-Msgid-Bugs-To: EMAIL@ADDRESS\n"
"POT-Creation-Date: 2007-08-02 18:01-0700\n"
"PO-Revision-Date: YEAR-MO-DA HO:MI+ZONE\n"
"Last-Translator: FULL NAME <EMAIL@ADDRESS>\n"
"Language-Team: LANGUAGE <LL@li.org>\n"
"MIME-Version: 1.0\n"
"Content-Type: text/plain; charset=utf-8\n"
"Content-Transfer-Encoding: 8bit\n"
"Generated-By: Babel 0.9dev-r215\n"

#: translate_demo/controllers/hello.py:10 translate_demo/controllers/hello.py:13
msgid "Hello"
msgstr ""
```

The `.pot` details that appear here can be customized via the `extract_messages` configuration in your project's `setup.cfg` (See the Babel Command-Line Interface Documentation for all configuration options).

Next, we'll initialize a catalog (`.po` file) for the Spanish language:

```
$ python setup.py init_catalog -l es
running init_catalog
creating catalog 'translate_demo/i18n/es/LC_MESSAGES/translate_demo.po' based on
'translate_demo/i18n/translate_demo.pot'
```

Then we can edit the last line of the new Spanish `.po` file to add a translation of `"Hello"`:

```
msgid "Hello"
msgstr "¡Hola!"
```

Finally, to utilize these translations in our application, we need to compile the `.po` file to a `.mo` file:

```
$ python setup.py compile_catalog
running compile_catalog
1 of 1 messages (100%) translated in 'translate_demo/i18n/es/LC_MESSAGES/translate_demo.po'
```

```
compiling catalog 'translate_demo/i18n/es/LC_MESSAGES/translate_demo.po' to
'translate_demo/i18n/es/LC_MESSAGES/translate_demo.mo'
```

We can also use the `update_catalog` command to merge new messages from the `.pot` to the `.po` files. For example, if we later added the following line of code to the end of HelloController's index method:

```
response.write('Goodbye: %s' % _('Goodbye'))
```

We'd then need to re-extract the messages from the project, then run the `update_catalog` command:

```
$ python setup.py extract_messages
running extract_messages
extracting messages from translate_demo/__init__.py
extracting messages from translate_demo/websetup.py
...
extracting messages from translate_demo/tests/functional/test_hello.py
writing PO template file to translate_demo/i18n/translate_demo.pot
$ python setup.py update_catalog
running update_catalog
updating catalog 'translate_demo/i18n/es/LC_MESSAGES/translate_demo.po' based on
'translate_demo/i18n/translate_demo.pot'
```

We'd then edit our catalog to add a translation for "Goodbye", and recompile the `.po` file as we did above.

For more information, see the Babel documentation and the GNU Gettext Manual.

11.4 Back To Work

Next we'll need to repeat the process of creating a `.mo` file for the `en` and `fr` locales:

```
$ python setup.py init_catalog -l en
running init_catalog
creating catalog 'translate_demo/i18n/en/LC_MESSAGES/translate_demo.po' based on
'translate_demo/i18n/translate_demo.pot'
$ python setup.py init_catalog -l fr
running init_catalog
creating catalog 'translate_demo/i18n/fr/LC_MESSAGES/translate_demo.po' based on
'translate_demo/i18n/translate_demo.pot'
```

Modify the last line of the `fr` catalog to look like this:

```
#: translate_demo/controllers/hello.py:10 translate_demo/controllers/hello.py:13
msgid "Hello"
msgstr "Bonjour"
```

Since our original messages are already in English, the `en` catalog can stay blank; gettext will fallback to the original.

Once you've edited these new `.po` files and compiled them to `.mo` files, you'll end up with an `i18n` directory containing:

```
i18n/translate_demo.pot
i18n/en/LC_MESSAGES/translate_demo.po
i18n/en/LC_MESSAGES/translate_demo.mo
i18n/es/LC_MESSAGES/translate_demo.po
i18n/es/LC_MESSAGES/translate_demo.mo
i18n/fr/LC_MESSAGES/translate_demo.po
i18n/fr/LC_MESSAGES/translate_demo.mo
```

11.5 Testing the Application

Start the server with the following command:

```
$ paster serve --reload development.ini
```

Test your controller by visiting http://localhost:5000/hello. You should see the following output:

```
Default: Hello
fr: Bonjour
en: Hello
es: ¡Hola!
```

You can now set the language used in a controller on the fly.

For example this could be used to allow a user to set which language they wanted your application to work in. You could save the value to the session object:

```
session['lang'] = 'en'
session.save()
```

then on each controller call the language to be used could be read from the session and set in your controller's `__before__()` method so that the pages remained in the same language that was previously set:

```
def __before__(self):
    if 'lang' in session:
        set_lang(session['lang'])
```

Pylons also supports defining the default language to be used in the configuration file. Set a `lang` variable to the desired default language in your `development.ini` file, and Pylons will automatically call `set_lang` with that language at the beginning of every request.

E.g. to set the default language to Spanish, you would add `lang = es` to your `development.ini`:

```
[app:main]
use = egg:translate_demo
lang = es
```

If you are running the server with the `--reload` option the server will automatically restart if you change the `development.ini` file. Otherwise restart the server manually and the output would this time be as follows:

```
Default: ¡Hola!
fr: Bonjour
en: Hello
es: ¡Hola!
```

11.6 Fallback Languages

If your code calls `_()` with a string that doesn't exist at all in your language catalog, the string passed to `_()` is returned instead.

Modify the last line of the hello controller to look like this:

```
response.write("%s %s, %s" % (_('Hello'), _('World'), _('Hi!')))
```

Warning: Of course, in real life breaking up sentences in this way is very dangerous because some grammars might require the order of the words to be different.

If you run the example again the output will be:

```
Default: ¡Hola!
fr: Bonjour World!
en: Hello World!
es: ¡Hola! World!
```

This is because we never provided a translation for the string `'World!'` so the string itself is used.

Pylons also provides a mechanism for fallback languages, so that you can specify other languages to be used if the word is omitted from the main language's catalog.

In this example we choose `fr` as the main language but `es` as a fallback:

```
import logging

from pylons.i18n import set_lang

from translate_demo.lib.base import *

log = logging.getLogger(__name__)

class HelloController(BaseController):

    def index(self):
        set_lang(['fr', 'es'])
        return "%s %s, %s" % (_('Hello'), _('World'), _('Hi!'))
```

If `Hello` is in the `fr .mo` file as `Bonjour`, `World` is only in `es` as `Mundo` and none of the catalogs contain `Hi!`, you'll get the multilingual message: `Bonjour Mundo, Hi!`. This is a combination of the French, Spanish and original (English in this case, as defined in our source code) words.

You can also add fallback languages after calling `set_lang` via the `pylons.i18n.add_fallback` function. Translations will be tested in the order you add them.

Note: Fallbacks are reset after calling `set_lang(lang)` – that is, fallbacks are associated with the currently selected language.

One case where using fallbacks in this way is particularly useful is when you wish to display content based on the languages requested by the browser in the `HTTP_ACCEPT_LANGUAGE` header. Typically the browser may submit a number of languages so it is useful to be add fallbacks in the order specified by the browser so that you always try to display words in the language of preference and search the other languages in order if a translation cannot be found. The languages defined in the `HTTP_ACCEPT_LANGUAGE` header are available in Pylons as `request.languages` and can be used like this:

```
for lang in request.languages:
    add_fallback(lang)
```

11.7 Translations Within Templates

You can also use the `_()` function within templates in exactly the same way you do in code. For example, in a Mako template:

```
${_('Hello')}
```

would produce the string `'Hello'` in the language you had set.

Babel currently supports extracting gettext messages from Mako and Genshi templates. The Mako extractor also provides support for translator comments. Babel can be extended to extract messages from other sources via a custom extraction method plugin.

Pylons (as of 0.9.6) automatically configures a Babel extraction mapping for your Python source code and Mako templates. This is defined in your project's setup.py file:

```
message_extractors = {'translate_demo': [
        ('**.py', 'python', None),
        ('templates/**.mako', 'mako', None),
        ('public/**', 'ignore', None)]},
```

For a project using Genshi instead of Mako, the Mako line might be replaced with:

```
('templates/**.html, 'genshi', None),
```

See Babel's documentation on Message Extraction for more information.

11.8 Lazy Translations

Occasionally you might come across a situation when you need to translate a string when it is accessed, not when the `_()` or other functions are called.

Consider this example:

```
import logging

from pylons.i18n import get_lang, set_lang

from translate_demo.lib.base import *

log = logging.getLogger(__name__)

text = _('Hello')

class HelloController(BaseController):

    def index(self):
        response.write('Default: %s<br />' % _('Hello'))
        for lang in ['fr','en','es']:
            set_lang(lang)
        response.write("%s: %s<br />" % (get_lang(), _('Hello')))
        response.write('Text: %s<br />' % text)
```

If we run this we get the following output:

```
Default: Hello
['fr']: Bonjour
['en']: Good morning
['es']: Hola
Text: Hello
```

This is because the function `_('Hello')` just after the imports is called when the default language is `en` so the variable `text` gets the value of the English translation even though when the string was used the

default language was Spanish.

The rule of thumb in these situations is to try to avoid using the translation functions in situations where they are not executed on each request. For situations where this isn't possible, perhaps because you are working with legacy code or with a library which doesn't support internationalization, you need to use lazy translations.

If we modify the above example so that the import statements and assignment to `text` look like this:

```
from pylons.i18n import get_lang, lazy_gettext, set_lang

from helloworld.lib.base import *

log = logging.getLogger(__name__)

text = lazy_gettext('Hello')
```

then we get the output we expected:

```
Default: Hello
['fr']: Bonjour
['en']: Good morning
['es']: Hola
Text: Hola
```

There are lazy versions of all the standard Pylons translation functions.

There is one drawback to be aware of when using the lazy translation functions: they are not actually strings. This means that if our example had used the following code it would have failed with an error `cannot concatenate 'str' and 'LazyString' objects`:

```
response.write('Text: ' + text + '<br />')
```

For this reason you should only use the lazy translations where absolutely necessary and should always ensure they are converted to strings by calling `str()` or `repr()` before they are used in operations with real strings.

11.9 Producing a Python Egg

Finally you can produce an egg of your project which includes the translation files like this:

```
$ python setup.py bdist_egg
```

The `setup.py` automatically includes the `.mo` language catalogs your application needs so that your application can be distributed as an egg. This is done with the following line in your `setup.py` file:

```
package_data={'translate_demo': ['i18n/*/LC_MESSAGES/*.mo']},
```

11.10 Plural Forms

Pylons also provides the `ungettext()` function. It's designed for internationalizing plural words, and can be used as follows:

```
ungettext('There is %(num)d file here', 'There are %(num)d files here',
          n) % {'num': n}
```

Plural forms have a different type of entry in `.pot/.po` files, as described in The Format of PO Files in GNU Gettext's Manual:

```
#: translate_demo/controllers/hello.py:12
#, python-format
msgid "There is %(num)d file here"
msgid_plural "There are %(num)d files here"
msgstr[0] ""
msgstr[1] ""
```

One thing to keep in mind is that other languages don't have the same plural forms as English. While English only has 2 plural forms, singular and plural, Slovenian has 4! That means that you *must* use ugettext for proper pluralization. Specifically, the following will not work:

```
# BAD!
if n == 1:
    msg = _("There was no dog.")
else:
    msg = _("There were no dogs.")
```

11.11 Summary

This document only covers the basics of internationalizing and localizing a web application.

GNU Gettext is an extensive library, and the GNU Gettext Manual is highly recommended for more information.

Babel also provides support for interfacing to the CLDR (Common Locale Data Repository), providing access to various locale display names, localized number and date formatting, etc.

You should also be able to internationalize and then localize your application using Pylons' support for GNU gettext.

11.12 Further Reading

http://en.wikipedia.org/wiki/Internationalization

Please feel free to report any mistakes to the Pylons mailing list or to the author. Any corrections or clarifications would be gratefully received.

Note: This is a work in progress. We hope the internationalization, localization and Unicode support in Pylons is now robust and flexible but we would appreciate hearing about any issues we have. Just drop a line to the pylons-discuss mailing list on Google Groups.

11.13 babel.core – Babel core classes

11.13.1 Module Contents

11.14 babel.localedata — Babel locale data

11.15 babel.dates – Babel date classes

11.15.1 Module Contents

11.16 babel.numbers – Babel number classes

11.16.1 Module Contents

CHAPTER

TWELVE

SESSIONS

12.1 Sessions

Pylons includes a session object: a session is a server-side, semi-permanent storage for data associated with a client.

The session object is provided by the Beaker library which also provides caching functionality as described in *Caching*.

12.2 The Session Object

The Pylons session object is available at `pylons.session`. Controller modules created via **paster controller/restcontroller** import the session object by default.

The basic session API is simple, it implements a dict-like interface with a few additional methods. The following is an example of using the session to store a token identifying if a client is logged in.

```
class LoginController(BaseController):

    def authenicate(self):
        name = request.POST['name']
        password = request.POST['password']
        user = Session.query(User).filter_by(name=name,
                                             password=password).first()
        if user:
            msg = 'Successfully logged in as %s' % name
            location = url('index')
            session['logged_in'] = True
            session.save()
        else:
            msg = 'Invalid username/password'
            location = url('login')
        flash(msg)
        redirect(location)

    def logout(self):
        # Clear all values in the session associated with the client
        session.clear()
        session.save()
```

Subsequent requests can then determine if a client is logged in or not by checking the session:

```
if not session.get('logged_in'):
    flash('Please login')
    redirect(url('login'))
```

The session object acts lazily: it does not load the session data (from disk or whichever back-end is used) until the data is first accessed. This lazyness is facilitated via an intermediary `beaker.session.SessionObject` that wraps the actual `beaker.session.Session` object. Furthermore the session will not write changes to its backend without an explicit call to its `beaker.session.Session.save()` method (unless configured with the `auto` option).

Session data is generally serialized for storage via the Python `pickle` module, so anything stored in the session must be pickleable.

The lightweight SessionObject wrapper is created by the: `beaker.middleware.SessionMiddleware` WSGI middleware. SessionMiddleware stores the wrapper in the WSGI environ where Pylons sets a reference to it from pylons.session.

Sessions are associated with a client via a client-side cookie. The WSGI middleware is also responsible for sending said cookie to the client.

12.3 Configuring the Session

The basic session defaults are:

- File based sessions (session data is stored on disk)
- Session cookies have no expiration date (cookies expire at the end of the browser session)
- Session cookie domain/path matches the current host/path

Pylons projects by default sets the following couple of session options via their .ini files. All Beaker specific session options in the ini file are prefixed with *beaker.session*:

```
cache_dir = %(here)s/data
beaker.session.key = foo
beaker.session.secret = somesecret
```

`cache_dir` acts a base directory for both session and cache storage. Session data is stored in this location under a `sessions/` sub-directory.

`session.key` is the name attribute of the cookie sent to the browser. This defaults to your project's name.

`session.secret` is the secret token used to hash the cookie data sent to the client. This should be a secret, ideally randomly generated value on production environments. **paster make-config** will generate a random secret for you when creating a production ini file.

12.3.1 Other Session Options

Some other commonly used session options are:

- `type` The type of the back-end for storing session data. Beaker supports many different backends, see Beaker Configuration Documentation for the choices. Defaults to 'file'.
- `cookie_domain` The domain name to use for the session Cookie. For example, when using sub-domains, set this to the parent domain name so that the cookie is valid for all sub-domains.

To enable pure Cookie-based Sessions and force the cookie domain to be valid for all sub-domains of 'example.com', add the following to your Pylons ini file:

```
beaker.session.type = cookie
beaker.session.cookie_domain = .example.com
```

See the Beaker Configuration Documentation for an exhaustive list of Session options.

12.4 Storing SQLAlchemy mapped objects in Beaker sessions

Mapped objects from SQLAlchemy can be serialized into the beaker session, but care must be taken when retrieving these objects back from the beaker session. They will not be associated with the SQLAlchemy Unit-of-Work Session, however these objects can be reconciled via the SQLAlchemy Session's `merge` method, as follows:

```
    address = DBSession.query(Address).get(id)
    session[id] = address
    ...
    address = session.get(id)
    address = DBSession.merge(address)
```

12.5 Custom and caching middleware

Care should be taken when deciding in which layer to place custom middleware. In most cases middleware should be placed between the Pylons WSGI application instantiation and the Routes middleware; however, if the middleware should run *before* the session object or routing is handled:

```
# Routing/Session Middleware
app = RoutesMiddleware(app, config['routes.map'])
app = SessionMiddleware(app, config)

# MyMiddleware can only see the cache object, nothing *above* here
app = MyMiddleware(app)

app = CacheMiddleware(app, config)
```

Some of the Pylons middleware layers such as the `Session`, `Routes`, and `Cache` middleware, only add objects to the *environ* dict, or add HTTP headers to the response (the Session middleware for example adds the session cookie header). Others, such as the `Status Code Redirect`, and the `Error Handler` may fully intercept the request entirely, and change how its responded to.

12.6 Using *Session* in Internationalization

How to set the language used in a controller on the fly.

For example this could be used to allow a user to set which language they wanted your application to work in. Save the value to the session object:

```
session['lang'] = 'en'
session.save()
```

then on each controller call the language to be used could be read from the session and set in the controller's `__before__()` method so that the pages remained in the same language that was previously set:

```
def __before__(self):
    if 'lang' in session:
        set_lang(session['lang'])
```

12.7 Using *Session* in Secure Forms

Authorization tokens are stored in the client's session. The web app can then verify the request's submitted authorization token with the value in the client's session.

This ensures the request came from the originating page. See the wikipedia entry for Cross-site request forgery for more information.

Pylons provides an `authenticate_form` decorator that does this verification on the behalf of controllers.

These helpers depend on Pylons' `session` object. Most of them can be easily ported to another framework by changing the API calls.

12.8 Hacking the session for no cookies

(From a paste #441 baked by Ben Bangert)

Set the session to not use cookies in the dev.ini file

```
beaker.session.use_cookies = False
```

with this as the *mode d'emploi* in the controller action

```
from beaker.session import Session as BeakerSession

# Get the actual session object through the global proxy
real_session = session._get_current_obj()

# Duplicate the session init options to avoid screwing up other sessions in
# other threads
params = real_session.__dict__['_params']

# Now set the id param used to make a session to our session maker,
# if id is None, a new id will be made automatically
params['id'] = find_id_func()
real_session.__dict__['_sess'] = BeakerSession({}, **params)

# Now we can use the session as usual
session['fred'] = 42
session.save()

# At the end, we need to see if the session was used and handle its id
if session.is_new:
    # do something with session.id to make sure its around next time
    pass
```

12.9 Using middleware (Beaker) with a composite app

How to allow called WSGI apps to share a common session management utility.

(From a paste #616 baked by Mark Luffel)

```
# Here's an example of configuring multiple apps to use a common
# middleware filter
# The [app:home] section is a standard pylons app
# The ''/servicebroker'' and ''/proxy'' apps both want to be able
# to use the same session management

[server:main]
use = egg:Paste#http
host = 0.0.0.0
port = 5000

[filter-app:main]
use = egg:Beaker#beaker_session
next = sessioned
beaker.session.key = my_project_key
beaker.session.secret = i_wear_two_layers_of_socks

[composite:sessioned]
use = egg:Paste#urlmap
/ = home
/servicebroker = servicebroker
/proxy = cross_domain_proxy

[app:servicebroker]
use = egg:Appcelerator#service_broker

[app:cross_domain_proxy]
use = egg:Appcelerator#cross_domain_proxy

[app:home]
use = egg:my_project
full_stack = true
cache_dir = %(here)s/data
```

CHAPTER

THIRTEEN

CACHING

Inevitably, there will be occasions during applications development or deployment when some task is revealed to be taking a significant amount of time to complete. When this occurs, the best way to speed things up is with *caching*.

Caching is enabled in Pylons using Beaker, the same package that provides session handling. Beaker supports a variety of caching backends: in-memory, database, Google Datastore, filesystem, and memcached. Additional extensions are available that support Tokyo Cabinet, Redis, Dynomite, and Ringo. Back-ends can be added with Beaker's extension system.

See Also:

Beaker Extension Add-ons

13.1 Types of Caching

Pylons offers a variety of caching options depending on the granularity of caching desired. Fine-grained caching down to specific sub-sections of a template, arbitrary Python functions, all the way up to entire controller actions and browser-side full-page caching are available.

Available caching options (ordered by granularity, least to most specific):

- **Browser-side** - HTTP/1.1 supports the *ETag* caching system that allows the browser to use its own cache instead of requiring regeneration of the entire page. ETag-based caching avoids repeated generation of content but if the browser has never seen the page before, the page will still be generated. Therefore using ETag caching in conjunction with one of the other types of caching listed here will achieve optimal throughput and avoid unnecessary calls on resource-intensive operations.
- **Controller Actions** - A Pylons controller action can have its entire result cached, including response headers if desired.
- **Templates** - The results of an entire rendered template can be cached using the `3 cache keyword arguments to the render calls`. These render commands can also be used inside templates.
- **Arbitrary Functions** - Any function can be independently cached using Beaker's cache decorators. This allows fine-grained caching of just the parts of the code that can be cached.
- **Template Fragments** - Built-in caching options are available for both Mako and Myghty template engines. They allow fine-grained caching of only certain sections of the template. This is also sometimes called fragment caching since individual fragments of a page can be cached.

13.2 Namespaces and Keys

Beaker is used for caching arbitrary Python functions, template results, and in Mako for caching individual <*def*> blocks. Browser-side caching does *not* utilize Beaker.

The two primary concepts to bear in mind when caching with Beaker are:

1. Caches have a *namespace*, this is to organize a cache such that variations of the same thing being cached are associated under a single place.
2. Variations of something being cached, are *keys* which are under that namespace.

For example, if we want to cache a function, the function name along with a unique name for it would be considered the *namespace*. The arguments it takes to differentiate the output to cache, are the *keys*.

An example of caching with the `cache_region()` decorator:

```
@cache_region('short_term', 'search_func')
def get_results(search_param):
    # do something to retrieve data
    data = get_data(search_param)
    return data

results = get_results('gophers')
```

In this example, the namespace will be the function name + module + 'search_func'. Since a single module might have multiple methods of the same name you wish to cache, the `cache_region()` decorator takes another argument in addition to the region to use, which is added to the namespace.

The key in this example is the *search_param* value. For each value of it, a separate result will be cached.

See Also:

Stephen Pierzchala's Caching for Performance (stephen@pierzchala.com) Beaker Caching Docs

13.3 Configuring

Beaker's cache options can be easily configured in the project's INI file. Beaker's configuration documentation explains how to setup the most common options.

The cache options specified will be used in the absence of more specific keyword arguments to individual cache functions. Functions that support *Cache Regions* will use the settings for that region.

13.3.1 Cache Regions

Cache regions are named groupings of related options. For example, in many web applications, there might be a few cache strategies used in a company, with short-term cached objects ending up in Memcached, and longer-term cached objects stored in the filesystem or a database.

Using cache regions makes it easy to declare the cache strategies in one place, then use them throughout the application by referencing the cache strategy name.

Cache regions should be setup in the `development.ini` file, but can also be configured and passed directly into the *CacheManager* instance that is created in the `lib/app_globals.py` file.

Example INI section for two cache regions (put these under your *[app:main]* section):

```
beaker.cache.regions = short_term, long_term
beaker.cache.short_term.type = ext:memcached
beaker.cache.short_term.url = 127.0.0.1:11211
beaker.cache.short_term.expire = 3600

beaker.cache.long_term.type = ext:database
beaker.cache.long_term.url = mysql://dbuser:dbpass@127.0.0.1/cache_db
beaker.cache.long_term.expire = 86400
```

This sets up two cache regions, *short_term* and *long_term*.

13.4 Browser-Side

Browser-side caching can utilize one of several methods. The entire page can have cache headers associated with it to indicate to the browser that it should be cached. Or, using the ETag Cache header, a page can have more fine-grained caching rules applied.

13.4.1 Cache Headers

Cache headers may be set directly on the `Response` object by setting the headers directly using the `headers()` property, or by using the cache header helpers.

To ensure pages aren't accidentally cached in dynamic web applications, Pylons default behavior sets the *Pragma* and *Cache-Control* headers to *no-cache*. Before setting cache headers, these default values should be cleared.

Clearing the default *no-cache* response headers:

```
class SampleController(BaseController):
    def index(self):
        # Clear the default cache headers
        del response.headers['Cache-Control']
        del response.headers['Pragma']

        return render('/index.html)
```

Using the response cache helpers:

```
# Set an action response to expires in 30 seconds
class SampleController(BaseController):
    def index(self):
        # Clear the default cache headers
        del response.headers['Cache-Control']
        del response.headers['Pragma']

        response.cache_expires(seconds=30)
        return render('/index.html')

# Set the cache-control to private with a max-age of 30 seconds
class SampleController(BaseController):
    def index(self):
        # Clear the default cache headers
        del response.headers['Cache-Control']
        del response.headers['Pragma']
```

```
        response.cache_control = {'max-age': 30, 'public': True}
        return render('/index.html')
```

All of the values that can be passed to the *cache_control* property dict, also may be passed into the *cache_expires* function call. It's recommended that you use the *cache_expires* helper as it also sets the Last-Modified and Expires headers to the second interval as well.

See Also:

Cache Control Header RFC

13.4.2 E-Tag Caching

Caching via ETag involves sending the browser an ETag header so that it knows to save and possibly use a cached copy of the page from its own cache, instead of requesting the application to send a fresh copy.

Because the ETag cache relies on sending headers to the browser, it works in a slightly different manner to the other caching mechanisms.

The `etag_cache()` function will set the proper HTTP headers if the browser doesn't yet have a copy of the page. Otherwise, a 304 HTTP Exception will be thrown that is then caught by Paste middleware and turned into a proper 304 response to the browser. This will cause the browser to use its own locally-cached copy.

ETag-based caching requires a single key which is sent in the ETag HTTP header back to the browser. The RFC specification for HTTP headers indicates that an ETag header merely needs to be a string. This value of this string does not need to be unique for every URL as the browser itself determines whether to use its own copy, this decision is based on the URL and the ETag key.

```
def my_action(self):
    etag_cache('somekey')
    return render('/show.myt', cache_expire=3600)
```

Or to change other aspects of the response:

```
def my_action(self):
    etag_cache('somekey')
    response.headers['content-type'] = 'text/plain'
    return render('/show.myt')
```

The frequency with which an ETag cache key is changed will depend on the web application and the developer's assessment of how often the browser should be prompted to fetch a fresh copy of the page.

13.5 Controller Actions

The `beaker_cache()` decorator is for caching the results of a complete controller action.

Example:

```
from pylons.decorators.cache import beaker_cache

class SampleController(BaseController):

    # Cache this controller action forever (until the cache dir is
    # cleaned)
    @beaker_cache()
    def home(self):
```

```
        c.data = expensive_call()
        return render('/home.myt')

    # Cache this controller action by its GET args for 10 mins to memory
    @beaker_cache(expire=600, type='memory', query_args=True)
    def show(self, id):
        c.data = expensive_call(id)
        return render('/show.myt')
```

By default the decorator uses a composite of all of the decorated function's arguments as the cache key. It can alternatively use a composite of the *request.GET* query args as the cache key when the *query_args* option is enabled.

The cache key can be further customized via the *key* argument.

Warning: By default, the `beaker_cache()` decorator will cache the entire response object. This means the headers that were generated during the action will be cached as well. This can be disabled by providing *cache_response = False* to the decorator.

13.6 Templates

All `render` commands have caching functionality built in. To use it, merely add the appropriate cache keyword to the render call.

```
class SampleController(BaseController):
    def index(self):
        # Cache the template for 10 mins
        return render('/index.html', cache_expire=600)

    def show(self, id):
        # Cache this version of the template for 3 mins
        return render('/show.html', cache_key=id, cache_expire=180)

    def feed(self):
        # Cache for 20 mins to memory
        return render('/feed.html', cache_type='memory', cache_expire=1200)

    def home(self, user):
        # Cache this version of a page forever (until the cache dir
        # is cleaned)
        return render('/home.html', cache_key=user, cache_expire='never')
```

Note: At the moment, these functions do not support the use of cache region pre-defined argument sets.

13.7 Arbitrary Functions

Any Python function that returns a pickle-able result can be cached using Beaker. The recommended way to cache functions is to use the `cache_region()` decorator. This decorator requires the *Cache Regions* to be configured.

Using the `cache_region()` decorator:

```
@cache_region('short_term', 'search_func')
def get_results(search_param):
    # do something to retrieve data
    data = get_data(search_param)
    return data

results = get_results('gophers')
```

See Also:

Beaker Caching Documentation

13.7.1 Invalidating

A cached function can be manually invalidated by using the `region_invalidate()` function.

Example:

```
region_invalidate(get_results, None, 'search_func', search_param)
```

13.8 Fragments

Individual template files, and <*def*> blocks within them can be independently cached. Since the caching system utilizes Beaker, any available Beaker back-ends are present in Mako as well.

Example:

```
<%def name="mycomp" cached="True" cache_timeout="30" cache_type="memory">
    other text
</%def>
```

See Also:

Mako Caching Documentation

CHAPTER

FOURTEEN

UNIT AND FUNCTIONAL TESTING

14.1 Unit Testing with `webtest`

Pylons provides powerful unit testing capabilities for your web application utilizing webtest to emulate requests to your web application. You can then ensure that the response was handled appropriately and that the controller set things up properly.

To run the test suite for your web application, Pylons utilizes the nose test runner/discovery package. Running `nosetests` in your project directory will run all the tests you create in the tests directory. If you don't have nose installed on your system, it can be installed via setuptools with:

```
$ easy_install -U nose
```

To avoid conflicts with your development setup, the tests use the *test.ini* configuration file when run. This means **you must configure any databases, etc. in your test.ini file or your tests will not be able to find the database configuration**.

> **Warning:** Nose can trigger errors during its attempt to search for doc tests since it will try and import all your modules one at a time *before* your app was loaded. This will cause files under models/ that rely on your app to be running, to fail.

Pylons 0.9.6.1 and later includes a plugin for nose that loads the app before the doctests scan your modules, allowing models to be doctested. You can use this option from the command line with nose:

```
nosetests --with-pylons=test.ini
```

Or by setting up a *[nosetests]* block in your setup.cfg:

```
[nosetests]
verbose=True
verbosity=2
with-pylons=test.ini
detailed-errors=1
with-doctest=True
```

Then just run:

```
python setup.py nosetests
```

to run the tests.

14.2 Example: Testing a Controller

First let's create a new project and controller for this example:

```
$ paster create -t pylons TestExample
$ cd TestExample
$ paster controller comments
```

You'll see that it creates two files when you create a controller. The stub controller, and a test for it under `testexample/tests/functional/`.

Modify the `testexample/controllers/comments.py` file so it looks like this:

```
from testexample.lib.base import *

class CommentsController(BaseController):

    def index(self):
        return 'Basic output'

    def sess(self):
        session['name'] = 'Joe Smith'
        session.save()
        return 'Saved a session'
```

Then write a basic set of tests to ensure that the controller actions are functioning properly, modify `testexample/tests/functional/test_comments.py` to match the following:

```
from testexample.tests import *

class TestCommentsController(TestController):
    def test_index(self):
        response = self.app.get(url(controller='/comments'))
        assert 'Basic output' in response

    def test_sess(self):
        response = self.app.get(url(controller='/comments', action='sess'))
        assert response.session['name'] == 'Joe Smith'
        assert 'Saved a session' in response
```

Run `nosetests` in your main project directory and you should see them all pass:

```
..
----------------------------------------------------------------------
Ran 2 tests in 2.999s

OK
```

Unfortunately, a plain assert does not provide detailed information about the results of an assertion should it fail, unless you specify it a second argument. For example, add the following test to the `test_sess` function:

```
assert response.session.has_key('address') == True
```

When you run `nosetests` you will get the following, not-very-helpful result:

```
.F
======================================================================
FAIL: test_sess (testexample.tests.functional.test_comments.TestCommentsController)
----------------------------------------------------------------------
```

```
Traceback (most recent call last):
File "~/TestExample/testexample/tests/functional/test_comments.py", line 12, in test_sess
assert response.session.has_key('address') == True
AssertionError:


----------------------------------------------------------------------
Ran 2 tests in 1.417s

FAILED (failures=1)
```

You can augment this result by doing the following:

```
assert response.session.has_key('address') == True, "address not found in session"
```

Which results in:

```
.F
======================================================================
FAIL: test_sess (testexample.tests.functional.test_comments.TestCommentsController)
----------------------------------------------------------------------
Traceback (most recent call last):
File "~/TestExample/testexample/tests/functional/test_comments.py", line 12, in test_sess
assert response.session.has_key('address') == True
AssertionError: address not found in session


----------------------------------------------------------------------
Ran 2 tests in 1.417s

FAILED (failures=1)
```

But detailing every assert statement could be time consuming. Our TestController subclasses the standard Python `unittest.TestCase` class, so we can use utilize its helper methods, such as `assertEqual`, that can automatically provide a more detailed AssertionError. The new test line looks like this:

```
self.assertEqual(response.session.has_key('address'), True)
```

Which provides the more useful failure message:

```
.F
======================================================================
FAIL: test_sess (testexample.tests.functional.test_comments.TestCommentsController)
----------------------------------------------------------------------
Traceback (most recent call last):
File "~/TestExample/testexample/tests/functional/test_comments.py", line 12, in test_sess
self.assertEqual(response.session.has_key('address'), True)
AssertionError: False != True
```

14.3 Testing Pylons Objects

Pylons will provide several additional attributes for the `webtest` `webtest.TestResponse` object that let you access various objects that were created during the web request:

`config` The configured Pylons applications.

`session` Session object

req Request object

tmpl_context Object containing variables passed to templates

app_globals Globals object

To use them, merely access the attributes of the response *after* you've used a get/post command:

```
response = app.get('/some/url')
assert response.session['var'] == 4
assert 'REQUEST_METHOD' in response.req.environ
```

Note: The `response` object already has a TestRequest object assigned to it, therefore Pylons assigns its `request` object to the response as `req`.

14.3.1 Accessing Special Globals

Sometimes, you might wish to modify or check a global Pylons variable such as *app_globals* before running the rest of your unit tests. The non-request specific variables are available from a special URL that will respond only in unit testing situations.

For example, to get the *app_globals* object without sending a request to your actual applications:

```
response = app.get('/_test_vars')
app_globals = response.app_globals
```

14.4 Testing Your Own Objects

WebTest's fixture testing allows you to designate your own objects that you'd like to access in your tests. This powerful functionality makes it easy to test the value of objects that are normally only retained for the duration of a single request.

Before making objects available for testing, its useful to know when your application is being tested. WebTest will provide an environ variable called `paste.testing` that you can test for the presence and truth of so that your application only populates the testing objects when it has to.

Populating the `webtest` response object with your objects is done by adding them to the environ dict under the key `paste.testing_variables`. Pylons creates this dict before calling your application, so testing for its existence and adding new values to it is recommended. All variables assigned to the `paste.testing_variables` dict will be available on the response object with the key being the attribute name.

Note: WebTest is an extracted stand-alone version of a Paste component called paste.fixture. For backwards compatibility, WebTest continues to honor the `paste.testing_variables` key in the environ.

Example:

```
# testexample/lib/base.py

from pylons import request
from pylons.controllers import WSGIController
from pylons.templating import render_mako as render

class BaseController(WSGIController):
```

```
    def __call__(self, environ, start_response):
        # Create a custom email object
        email = MyCustomEmailObj()
        email.name = 'Fred Smith'
        if 'paste.testing_variables' in request.environ:
            request.environ['paste.testing_variables']['email'] = email
        return WSGIController.__call__(self, environ, start_response)


# testexample/tests/functional/test_controller.py
from testexample.tests import *

class TestCommentsController(TestController):
    def test_index(self):
        response = self.app.get(url(controller='/'))
        assert response.email.name == 'Fred Smith'
```

See Also:

WebTest Documentation Documentation covering webtest and its usage

WebTest Module docs Module API reference for methods available for use when testing the application

14.5 Unit Testing

XXX: Describe unit testing an applications models, libraries

14.6 Functional Testing

XXX: Describe functional/integrated testing, WebTest

CHAPTER

FIFTEEN

ERRORS, TROUBLESHOOTING, AND DEBUGGING

When a web application has an error in production, a few different options for handling it are available. Pylons comes with error handlers to allow the following options:

- E-mail the traceback as HTML to the administrators
- Show the *Interactive Debugging* interface to the developer
- Programmatically handle the error in another controller
- Display a plain error on the web page

Some of these options can be combined by enabling or disabling the appropriate middleware.

15.1 Error Middleware

In a new Pylons project, the error handling middleware is configured in the projects `config/middleware.py`:

```
# Excerpt of applicable section

if asbool(full_stack):
    # Handle Python exceptions
    app = ErrorHandler(app, global_conf, **config['pylons.errorware'])

    # Display error documents for 401, 403, 404 status codes (and
    # 500 when debug is disabled)
    if asbool(config['debug']):
        app = StatusCodeRedirect(app)
    else:
        app = StatusCodeRedirect(app, [400, 401, 403, 404, 500])
```

The first middleware configured, `ErrorHandler()`, actually configures one of two `WebError` middlewares depending on whether the project is in `debug` mode or not. If it is in `debug` mode, then the *Interactive Debugging* is enabled, otherwise, the *e-mail error handling* will be used.

The second middleware configured is the `StatusCodeRedirect` middleware. This middleware watches the request, and if the application returns a response containing one of the status code's listed, it will call back into the application to the error controller, and use that output instead.

None of these are required for a Pylons project to run, and commenting them all out results in the plain text of the error to display on the web page.

Warning: If no middleware at all is used, the error will appear on the screen in its entirety, *including full traceback output*.

15.1.1 Recommended Configurations

- For plain-text output or errors and non-200 status codes, comment out the `StatusCodeRedirect`. Tracebacks will be e-mailed to you in production, and the *Interactive Debugging* will be used during development.
- For programmatic error and non-200 status code handling, keep the stack as-is.
- To *not* have tracebacks e-mailed, remove only the `ErrorHandler()` middleware. This will also disable *Interactive Debugging* however. To retain *Interactive Debugging* but disable traceback e-mails:

```
    if asbool(config['debug']):
        app = ErrorHandler(app, global_conf, **config['pylons.errorware'])
```

Note: To only capture specific non-200 status codes, the `StatusCodeRedirect` middleware can be passed a list of the codes that it should intercept and redirect to the error controller. When in non-debug mode, it captures the 400-404, and 500 status codes. Altering the list will capture more or less types of requests as desired.

15.1.2 Avoiding Displaying Tracebacks

When disabling the `ErrorHandler()` middleware, a replacement middleware should be created and used that captures exceptions and changes them into a normal WSGI response, otherwise the raw traceback error will be displayed on the browser.

An example middleware that just captures exceptions and changes them to a 500 error:

```
from webob import Request, Response

class EatExceptions(object):
    def __init__(self, app):
        self.app = app

    def __call__(self, environ, start_response):
        req = Request(environ)
        try:
            response = req.get_response(self.app)
        except:
            response = Response()
            response.status_int = 500
            response.body = 'An error has occured'
        return response(environ, start_response)
```

Replacing the `ErrorHandler` with this middleware will cause tracebacks to not be displayed to the user.

15.2 Interactive Debugging

Things break, and when they do, quickly pinpointing what went wrong and why makes a huge difference. By default, Pylons uses a customized version of Ian Bicking's EvalException middleware that also includes

full Mako/Myghty Traceback information.

15.2.1 The Debugging Screen

The debugging screen has three tabs at the top:

`Traceback` Provides the raw exception trace with the interactive debugger

`Extra Data` Displays CGI, WSGI variables at the time of the exception, in addition to configuration information

`Template` Human friendly traceback for Mako or Myghty templates

Since Mako and Myghty compile their templates to Python modules, it can be difficult to accurately figure out what line of the template resulted in the error. The *Template* tab provides the full Mako or Myghty traceback which contains accurate line numbers for your templates, and where the error originated from. If your exception was triggered before a template was rendered, no Template information will be available in this section.

15.2.2 Example: Exploring the Traceback

Using the interactive debugger can also be useful to gain a deeper insight into objects present only during the web request like the `session` and `request` objects.

To trigger an error so that we can explore what's happening just raise an exception inside an action you're curious about. In this example, we'll raise an error in the action that's used to display the page you're reading this on. Here's what the docs controller looks like:

```
class DocsController(BaseController):
    def view(self, url):
        if request.path_info.endswith('docs'):
            redirect(url('/docs/'))
        return render('/docs/' + url)
```

Since we want to explore the `session` and `request`, we'll need to bind them first. Here's what our action now looks like with the binding and raising an exception:

```
def view(self, url):
    raise "hi"
    if request.path_info.endswith('docs'):
        redirect(url('/docs/'))
    return render('/docs/' + url)
```

Here's what exploring the Traceback from the above example looks like (Excerpt of the relevant portion):

15.3 E-mailing Errors

You can make various of changes to how the debugging works. For example if you disable the `debug` variable in the config file Pylons will email you an error report instead of displaying it as long as you provide your email address at the top of the config file:

```
error_email_from = you@example.com
```

This is very useful for a production site. Emails are sent via SMTP so you need to specify a valid SMTP server too.

15.4 Programmatically Handling Errors

By default, the `StatusCodeRedirect` will redirect any response with the designated status codes back into the application again. This will result in the `error` controller in the Pylons project being called. This is why there is a default route in `config/routing.py` of:

```
map.connect('/error/{action}', controller='error')
map.connect('/error/{action}/{id}', controller='error')
```

The error controller allows a project to theme the error message appropriately by changing it to render a template, or redirect as desired.

15.4.1 Original Request Information

The original request and response that resulted in the error controller being called is available inside the error controller as:

```
# Original request
request.environ['pylons.original_request']

# Original response
request.environ['pylons.original_response']
```

If an `HTTPException` was thrown in the controller (the `abort()` function throws these), the original object is available as:

```
request.environ['pylons.controller.exception']
```

This allows access to the error message on the exception object.

CHAPTER

SIXTEEN

UPGRADING

16.1 1.0 -> 1.0.1

No changes are necessary, however to take advantage of MarkupSafe's faster HTML escaping, the default filter in `environment.py` that Mako is configured with should be changed from:

```
from webhelpers.html import escape
```

To:: from markupsafe import escape

MarkupSafe utilizes a C extension where available for faster escaping which can help on larger pages with substantial variable substitutions.

16.2 0.9.7 -> 1.0

Upgrading your project is slightly different depending on which versions you're upgrading from and to. It's recommended that upgrades be done in minor revision steps, as deprecation warnings are added between revisions to help in the upgrade process.

For any project prior to 0.9.7, you should first follow the applicable docs to upgrade to 0.9.7 before proceeding.

To upgrade to 1.0, first upgrade your project to 0.10. This is a Pylons release that is fully backwards-compatible with 0.9.7. However under 0.10 a variety of warnings will be issued about the various things that need to be changed before upgrading to 1.0.

Tip: Since Pylons 0.10 is only out as a beta at this point, upgrade using the actual URL, for example:

```
$ easy_install -U http://pylonshq.com/download/0.10/Pylons-0.10.tar.gz
```

Beyond the warnings issued, you should also read the following list and ensure these changes have been applied.

Pylons changes from 0.9.7 to 1.0:

- The config object created in `environment.py` is now passed around explicitly. There are also some other minor updates as follows.

  Update config/environment.py to initialize and return the config:

```
# Add to the imports:
from pylons.configuration import PylonsConfig

# Add under 'def load_environment':
config = PylonsConfig()

# Replace the make_map / app globals line with
config['routes.map'] = make_map(config)
config['pylons.app_globals'] = app_globals.Globals(config)

# Optionally, if removing the CacheMiddleware and using the
# cache in the new 1.0 style, add under the previous lines:
import pylons
pylons.cache._push_object(config['pylons.app_globals'].cache)


# Add at the end of the load_environment function:
return config
```

Update config/middleware.py to use the returned *config*:

```
# modify the load_environment call:
config = load_environment(global_conf, app_conf)

# update the middleware calls

# The Pylons WSGI app
app = PylonsApp(config=config)

# Routing/Session/Cache Middleware
app = RoutesMiddleware(app, config['routes.map'])
app = SessionMiddleware(app, config)

# CUSTOM MIDDLEWARE HERE (filtered by error handling middlewares)

# Add right before 'return app':
app.config = config
```

Note: The CacheMiddleware is no longer setup by default through middleware, its now setup under *app_globals* inside its instantiation in `lib/app_globals.py`.

Update config/routing.py to accept the *config*:

```
# Replace the def line with
def make_map(config):
```

Update lib/app_globals.py to accept the *config*:

```
# Replace the __init__ line with
def __init__(self, config):

# Optionally, if you decided to remove the CacheMiddleware
# Add these imports
from beaker.cache import CacheManager
from beaker.util import parse_cache_config_options

# and add this line in __init__:
self.cache = CacheManager(**parse_cache_config_options(config))
```

Update tests/__init__.py as needed:

```
from unittest import TestCase

from paste.deploy import loadapp
from paste.script.appinstall import SetupCommand
from pylons import url
from routes.util import URLGenerator
from webtest import TestApp

import pylons.test

__all__ = ['environ', 'url', 'TestController']

# Invoke websetup with the current config file
SetupCommand('setup-app').run([pylons.test.pylonsapp.config['__file__']])

environ = {}

class TestController(TestCase):

    def __init__(self, *args, **kwargs):
        wsgiapp = pylons.test.pylonsapp
        config = wsgiapp.config
        self.app = TestApp(wsgiapp)
        url._push_object(URLGenerator(config['routes.map'], environ))
        TestCase.__init__(self, *args, **kwargs)
```

Note: Change the use of `url_for` in your tests to use `url`, which is imported from `tests/__init__.py` in your unit tests.

Finally, update websetup.py to avoid the duplicate app creation that previously could occur during the unit tests:

```
# Add to the imports
import pylons.test

# Add under the 'def setup_app':

# Don't reload the app if it was loaded under the testing environment
if not pylons.test.pylonsapp:
    load_environment(conf.global_conf, conf.local_conf)
```

- Change all instances of `redirect_to(...)` -> `redirect(url(...))`

  `redirect_to` processed arguments in a slightly 'magical' manner in that some of them went to the `url_for` while sometimes... not. `redirect()` issues a redirect and nothing more, so to generate a url, the `url` instance should be used (import: `from pylons import url`).

- Ensure that all use of `g` is switched to using the new name, *app_globals*

- Change all instances of `url_for` to `url`.

  Note that `url` does not retain the current route memory like `url_for` did by default. To get a route generated using the current route, call `url.current`.

  For example:

```
# Rather than url_for() for the current route
url.current()
```

`url` can be imported from `pylons`.

- Change `config` import statement if needed

  Previously, the config object could be imported as if it was a module:

```
import pylons.config
```

  The config object is now an object in `pylons/__init__.py` so the import needs to be changed to:

```
from pylons import config
```

- Routes is now explicit by default

  This won't affect those already using `url` as it ignores route memory. This change does mean that some routes which relied on a default controller of 'content' and a default action of 'index' will not work.

  To restore the old behavior, in `config/routing.py`, set the mapper to explicit:

```
map.explicit = True
```

- By default, the *tmpl_context* (a.k.a 'c'), is no longer a `AttribSafeContextObj`. This means accessing attributes that don't exist will raise an `AttributeError`.

  To use the attribute-safe *tmpl_context*, add this line to the `config/environment.py`:

```
config['pylons.strict_tmpl_context'] = False
```

CHAPTER

SEVENTEEN

PACKAGING AND DEPLOYMENT OVERVIEW

TODO: some of this is redundant to the (more current) *Configuration* doc – should be consolidated and cross-referenced

This document describes how a developer can take advantage of Pylons' application setup functionality to allow webmasters to easily set up their application.

Installation refers to the process of downloading and installing the application with *easy_install* whereas setup refers to the process of setting up an instance of an installed application so it is ready to be deployed.

For example, a wiki application might need to create database tables to use. The webmaster would only install the wiki `.egg` file once using *easy_install* but might want to run 5 wikis on the site so would setup the wiki 5 times, each time specifying a different database to use so that 5 wikis can run from the same code, but store their data in different databases.

17.1 Egg Files

Before you can understand how a user configures an application you have to understand how Pylons applications are distributed. All Pylons applications are distributed in `.egg` format. An egg is simply a Python executable package that has been put together into a single file.

You create an egg from your project by going into the project root directory and running the command:

```
$ python setup.py bdist_egg
```

If everything goes smoothly a `.egg` file with the correct name and version number appears in a newly created `dist` directory.

When a webmaster wants to install a Pylons application he will do so by downloading the egg and then installing it.

17.2 Installing as a Non-root User

It's quite possible when using shared hosting accounts that you do not have root access to install packages. In this case you can install *setuptools* based packages like Pylons and Pylons web applications in your home directory using a *virtualenv* setup. This way you can install all the packages you want to use without super-user access.

17.3 Understanding the Setup Process

Say you have written a Pylons wiki application called `wiki`. When a webmaster wants to install your wiki application he will run the following command to generate a config file:

```
$ paster make-config wiki wiki_production.ini
```

He will then edit the config file for his production environment with the settings he wants and then run this command to setup the application:

```
$ paster setup-app wiki_production.ini
```

Finally he might choose to deploy the wiki application through the paste server like this (although he could have chosen CGI/FastCGI/SCGI etc):

```
$ paster serve wiki_production.ini
```

The idea is that an application only needs to be installed once but if necessary can be set up multiple times, each with a different configuration.

All Pylons applications are installed in the same way, so you as the developer need to know how the above commands work.

17.3.1 Make Config

The `paster make-config` command looks for the file `deployment.ini_tmpl` and uses it as a basis for generating a new `.ini` file.

Using our new wiki example again, the `wiki/config/deployment.ini_tmpl` file contains the text:

```
[DEFAULT]
debug = true
email_to = you@yourdomain.com
smtp_server = localhost
error_email_from = paste@localhost

[server:main]
use = egg:Paste#http
host = 0.0.0.0
port = 5000

[app:main]
use = egg:wiki
full_stack = true
static_files = true
cache_dir = %(here)s/data
beaker.session.key = wiki
beaker.session.secret = ${app_instance_secret}
app_instance_uuid = ${app_instance_uuid}

# If you'd like to fine-tune the individual locations of the cache data dirs
# for the Cache data, or the Session saves, un-comment the desired settings
# here:
#beaker.cache.data_dir = %(here)s/data/cache
#beaker.session.data_dir = %(here)s/data/sessions

# WARNING: *THE LINE BELOW MUST BE UNCOMMENTED ON A PRODUCTION ENVIRONMENT*
# Debug mode will enable the interactive debugging tool, allowing ANYONE to
```

```
# execute malicious code after an exception is raised.
set debug = false


# Logging configuration
[loggers]
keys = root

[handlers]
keys = console

[formatters]
keys = generic

[logger_root]
level = INFO
handlers = console

[handler_console]
class = StreamHandler
args = (sys.stderr,)
level = NOTSET
formatter = generic

[formatter_generic]
format = %(asctime)s %(levelname)-5.5s [%(name)s] [%(threadName)s] %(message)s
```

When the command `paster make-config wiki wiki_production.ini` is run, the contents of this file are produced so you should tweak this file to provide sensible default configuration for production deployment of your app.

17.3.2 Setup App

The `paster setup-app` command references the newly created `.ini` file and calls the function `wiki.websetup.setup_app()` to set up the application. If your application needs to be set up before it can be used, you should edit the `websetup.py` file.

Here's an example which just prints the location of the cache directory via Python's logging facilities:

```
"""Setup the helloworld application"""
import logging

from pylons import config
from helloworld.config.environment import load_environment

log = logging.getLogger(__name__)

def setup_app(command, conf, vars):
    """Place any commands to setup helloworld here"""
    load_environment(conf.global_conf, conf.local_conf)
    log.info("Using cache dirctory %s" % config['cache.dir'])
```

For a more useful example, say your application needs a database set up and loaded with initial data. The user will specify the location of the database to use by editing the config file before running the `paster setup-app` command. The `setup_app()` function will then be able to load the configuration and act on it in the function body. This way, the `setup_app()` function can be used to initialize the database when `paster setup-app` is run. Using the optional *SQLAlchemy* project template support when creating a

Pylons project will set all of this up for you in a basic way. The *quickwiki_tutorial* illustrates an example of this configuration.

17.4 Deploying the Application

Once the application is setup it is ready to be deployed. There are lots of ways of deploying an application, one of which is to use the `paster serve` command which takes the configuration file that has already been used to setup the application and serves it on a local HTTP server for production use:

```
$ paster serve wiki_production.ini
```

More information on Paste deployment options is available on the Paste website at http://pythonpaste.org. See *Running Pylons Apps with Other Web Servers* for alternative Pylons deployment scenarios.

17.5 Advanced Usage

So far everything we have done has happened through the `paste.script.appinstall.Installer` class which looks for the `deployment.ini_tmpl` and `websetup.py` file and behaves accordingly.

If you need more control over how your application is installed you can use your own installer class. Create a file, for example `wiki/installer.py` and code your new installer class in the file by deriving it from the existing one:

```
from paste.script.appinstall import Installer
class MyInstaller(Installer):
    pass
```

You then override the functionality as necessary (have a look at the source code for `Installer` as a basis. You then change your application's `setup.py` file so that the `paste.app_install` entry point `main` points to your new installer:

```
entry_points="""
...
[paste.app_install]
main=wiki.installer:MyInstaller
...
""",
```

Depending on how you code your `MyInstaller` class you may not even need your `websetup.py` or `deployment.ini_tmpl` as you might have decided to create the `.ini` file and setup the application in an entirely different way.

CHAPTER

EIGHTEEN

RUNNING PYLONS APPS WITH OTHER WEB SERVERS

This document assumes that you have already installed a Pylons web application, and *Runtime Configuration* for it. Pylons applications use PasteDeploy to start up your Pylons WSGI application, and can use the flup package to provide a Fast-CGI, SCGI, or AJP connection to it.

18.1 Using Fast-CGI

Fast-CGI is a gateway to connect web severs like Apache and lighttpd to a CGI-style application. Out of the box, Pylons applications can run with Fast-CGI in either a threaded or forking mode. (Threaded is the recommended choice)

Setting a Pylons application to use Fast-CGI is very easy, and merely requires you to change the config line like so:

```
# default
[server:main]
use = egg:Paste#http

# Use Fastcgi threaded
[server:main]
use = egg:PasteScript#flup_fcgi_thread
host = 0.0.0.0
port = 6500
```

Note that you will need to install the flup package, which can be installed via easy_install:

```
$ easy_install -U flup
```

The options in the config file are passed onto flup. The two common ways to run Fast CGI is either using a socket to listen for requests, or listening on a port/host which allows a webserver to send your requests to web applications on a different machine.

To configure for a socket, your `server:main` section should look like this:

```
[server:main]
use = egg:PasteScript#flup_fcgi_thread
socket = /location/to/app.socket
```

If you want to listen on a host/port, the configuration cited in the first example will do the trick.

18.2 Apache Configuration

For this example, we will assume you're using Apache 2, though Apache 1 configuration will be very similar. First, make sure that you have the Apache mod_fastcgi module installed in your Apache.

There will most likely be a section where you declare your FastCGI servers, and whether they're external:

```
<IfModule mod_fastcgi.c>
FastCgiIpcDir /tmp
FastCgiExternalServer /some/path/to/app/myapp.fcgi -host some.host.com:6200
</IfModule>
```

In our example we'll assume you're going to run a Pylons web application listening on a host/port. Changing `-host` to `-socket` will let you use a Pylons web application listening on a socket.

The filename you give in the second option does not need to physically exist on the webserver, URIs that Apache resolve to this filename will be handled by the FastCGI application.

The other important line to ensure that your Apache webserver has is to indicate that fcgi scripts should be handled with Fast-CGI:

```
AddHandler fastcgi-script .fcgi
```

Finally, to configure your website to use the Fast CGI application you will need to indicate the script to be used:

```
<VirtualHost *:80>
    ServerAdmin george@monkey.com
    ServerName monkey.com
    ServerAlias www.monkey.com
    DocumentRoot /some/path/to/app

    ScriptAliasMatch ^(/.*)$ /some/path/to/app/myapp.fcgi$1
</VirtualHost>
```

Other useful directives should be added as needed, for example, the ErrorLog directive, etc. This configuration will result in all requests being sent to your FastCGI application.

18.3 PrefixMiddleware

`PrefixMiddleware` provides a way to manually override the root prefix (`SCRIPT_NAME`) of your application for certain situations.

When running an application under a prefix (such as '`/james`') in FastCGI/apache, the `SCRIPT_NAME` environment variable is automatically set to to the appropriate value: '`/james`'. Pylons' URL generators such as `url` always take the `SCRIPT_NAME` value into account.

One situation where `PrefixMiddleware` is required is when an application is accessed via a reverse proxy with a prefix. The application is accessed through the reverse proxy via the the URL prefix '`/james`', whereas the reverse proxy forwards those requests to the application at the prefix '`/`'.

The reverse proxy, being an entirely separate web server, has no way of specifying the `SCRIPT_NAME` variable; it must be manually set by a `PrefixMiddleware` instance. Without setting `SCRIPT_NAME`, `url` will generate URLs such as: '`/purchase_orders/1`', when it should be generating: '`/james/purchase_orders/1`'.

To filter your application through a `PrefixMiddleware` instance, add the following to the '`[app:main]`' section of your .ini file:

```
filter-with = proxy-prefix

[filter:proxy-prefix]
use = egg:PasteDeploy#prefix
prefix = /james
```

The name `proxy-prefix` simply acts as an identifier of the filter section; feel free to rename it.

These .ini settings are equivalent to adding the following to the end of your application's `config/middleware.py`, right before the `return app` line:

```
# This app is served behind a proxy via the following prefix (SCRIPT_NAME)
app = PrefixMiddleware(app, global_conf, prefix='/james')
```

This requires the additional import line:

```
from paste.deploy.config import PrefixMiddleware
```

Whereas the modification to `config/middleware.py` will setup an instance of `PrefixMiddleware` under every environment (.ini).

18.4 Using Java Web Servers with Jython

See *Deploying to Java Web servers*.

CHAPTER

NINETEEN

DOCUMENTING YOUR APPLICATION

TODO: this needs to be rewritten – Pudge is effectively dead

While the information in this document should be correct, it may not be entirely complete... Pudge is somewhat unruly to work with at this time, and you may need to experiment to find a working combination of package versions. In particular, it has been noted that an older version of Kid, like 0.9.1, may be required. You might also need to install {{RuleDispatch}} if you get errors related to {{FormEncode}} when attempting to build documentation.

Apologies for this suboptimal situation. Considerations are being taken to fix Pudge or supplant it for future versions of Pylons.

19.1 Introduction

Pylons comes with support for automatic documentation generation tools like Pudge.

Automatic documentation generation allows you to write your main documentation in the docs directory of your project as well as throughout the code itself using docstrings.

When you run a simple command all the documentation is built into sophisticated HTML.

19.2 Tutorial

First create a project as described in *Getting Started*.

You will notice a docs directory within your main project directory. This is where you should write your main documentation.

There is already an `index.txt` file in `docs` so you can already generate documentation. First we'll install Pudge and buildutils. By default, Pylons sets an option to use Pygments for syntax-highlighting of code in your documentation, so you'll need to install it too (unless you wish to remove the option from `setup.cfg`):

```
$ easy_install pudge buildutils
$ easy_install Pygments
```

then run the following command from your project's main directory where the `setup.py` file is:

```
$ python setup.py pudge
```

Note: The `pudge` command is currently disabled by default. Run the following command first to enable it:

..code-block:: bash

    $ python setup.py addcommand -p buildutils.pudge_command

Thanks to Yannick Gingras for the tip.

Pudge will produce output similar to the following to tell you what it is doing and show you any problems:

```
running pudge
generating documentation
copying: pudge\template\pythonpaste.org\rst.css -> do/docs/html\rst.css
copying: pudge\template\base\pudge.css -> do/docs/html\pudge.css
copying: pudge\template\pythonpaste.org\layout.css -> do/docs/html\layout.css
rendering: pudge\template\pythonpaste.org\site.css.kid -> site.css
colorizing: do/docs/html\do/__init__.py.html
colorizing: do/docs/html\do/tests/__init__.py.html
colorizing: do/docs/html\do/i18n/__init__.py.html
colorizing: do/docs/html\do/lib/__init__.py.html
colorizing: do/docs/html\do/controllers/__init__.py.html
colorizing: do/docs/html\do/model.py.html
```

Once finished you will notice a `docs/html` directory. The `index.html` is the main file which was generated from `docs/index.txt`.

19.3 Learning ReStructuredText

Python programs typically use a rather odd format for documentation called reStructuredText. It is designed so that the text file used to generate the HTML is as readable as possible but as a result can be a bit confusing for beginners.

Read the reStructuredText tutorial which is part of the docutils project.

Once you have mastered reStructuredText you can write documentation until your heart's content.

19.4 Using Docstrings

Docstrings are one of Python's most useful features if used properly. They are described in detail in the Python documentation but basically allow you to document any module, class, method or function, in fact just about anything. Users can then access this documentation interactively.

Try this:

```
>>> import pylons
>>> help(pylons)
...
```

As you can see if you tried it you get detailed information about the pylons module including the information in the docstring.

Docstrings are also extracted by Pudge so you can describe how to use all the controllers, actions and modules that make up your application. Pudge will extract that information and turn it into useful API documentation automatically.

Try clicking the `Modules` link in the HTML documentation you generated earlier or look at the Pylons source code for some examples of how to use docstrings.

19.5 Using doctest

The final useful thing about docstrings is that you can use the `doctest` module with them. `doctest` again is described in the Python documentation but it looks through your docstrings for things that look like Python code written at a Python prompt. Consider this example:

```
>>> a = 2
>>> b = 3
>>> a + b
5
```

If `doctest` was run on this file it would have found the example above and executed it. If when the expression `a + b` is executed the result was not `5`, `doctest` would raise an Exception.

This is a very handy way of checking that the examples in your documentation are actually correct.

To run `doctest` on a module use:

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

The `if __name__ == "__main__":` part ensures that your module won't be tested if it is just imported, only if it is run from the command line

To run `doctest` on a file use:

```
import doctest
doctest.testfile("docs/index.txt")
```

You might consider incorporating this functionality in your `tests/test.py` file to improve the testing of your application.

19.6 Summary

So if you write your documentation in reStructuredText, in the `docs` directory and in your code's docstrings, liberally scattered with example code, Pylons provides a very useful and powerful system for you.

If you want to find out more information have a look at the Pudge documentation or try tinkering with your project's `setup.cfg` file which contains the Pudge settings.

CHAPTER

TWENTY

DISTRIBUTING YOUR APPLICATION

TODO: this assumes helloworld tutorial context that is no longer present, and could be consolidated with packaging info in *Packaging and Deployment Overview*

As mentioned earlier eggs are a convenient format for packaging applications. You can create an egg for your project like this:

```
$ cd helloworld
$ python setup.py bdist_egg
```

Your egg will be in the `dist` directory and will be called `helloworld-0.0.0dev-py2.4.egg`.

You can change options in `setup.py` to change information about your project. For example change version to `version="0.1.0",` and run `python setup.py bdist_egg` again to produce a new egg with an updated version number.

You can then register your application with the Python Package Index (PyPI) with the following command:

```
$ python setup.py register
```

Note: You should not do this unless you actually want to register a package!

If users want to install your software and have installed *easy_install* they can install your new egg as follows:

```
$ easy_install helloworld==0.1.0
```

This will retrieve the package from PyPI and install it. Alternatively you can install the egg locally:

```
$ easy_install -f C:\path\with\the\egg\files\in helloworld==0.1.0
```

In order to use the egg in a website you need to use Paste. You have already used Paste to create your Pylons template and to run a test server to test the tutorial application.

Paste is a set of tools available at http://pythonpaste.org for providing a uniform way in which all compatible Python web frameworks can work together. To run a paste application such as any Pylons application you need to create a Paste configuration file. The idea is that the your paste configuration file will contain all the configuration for all the different Paste applications you run. A configuration file suitable for development is in the `helloworld/development.ini` file of the tutorial but the idea is that the person using your egg will add relevant configuration options to their own Paste configuration file so that your egg behaves they way they want. See the section below for more on this configuration.

Paste configuration files can be run in many different ways, from CGI scripts, as standalone servers, with FastCGI, SCGI, mod_python and more. This flexibility means that your Pylons application can be run in virtually any environment and also take advantage of the speed benefits that the deployment option offers.

See Also:

Running Pylons Apps with Other Web Servers

20.1 Running Your Application

In order to run your application your users will need to install it as described above but then generate a config file and setup your application before deploying it. This is described in *Runtime Configuration* and *Packaging and Deployment Overview*.

CHAPTER

TWENTYONE

PYTHON 2.3 INSTALLATION INSTRUCTIONS

21.1 Advice of end of support for Python 2.3

Warning: **END OF SUPPORT FOR PYTHON 2.3** This is the **LAST** version to support Python 2.3 **BEGIN UPGRADING OR DIE**

21.2 Preparation

First, please note that Python 2.3 users on Windows will need to install subprocess.exe before beginning the installation (whereas Python 2.4 users on Windows do not). All windows users also should read the section *Windows Notes* after installation. Users of Ubuntu/debian will also likely need to install the python-dev package.

21.3 System-wide Install

To install Pylons so it can be used by everyone (you'll need root access).

If you already have easy install:

```
$ easy_install Pylons==0.9.7
```

Note: On rare occasions, the python.org Cheeseshop goes down. It is still possible to install Pylons and its dependencies however by specifying our local package directory for installation with:

```
$ easy_install -f http://pylonshq.com/download/ Pylons==0.9.7
```

Which will use the packages necessary for the latest release. If you're using an older version of Pylons, you can get the packages that went with it by specifying the version desired:

```
$ easy_install -f http://pylonshq.com/download/0.9.7/ Pylons==0.9.7
```

Otherwise:

1. Download the easy install setup file from http://peak.telecommunity.com/dist/ez_setup.py

2. Run:

```
$ python ez_setup.py Pylons==0.9.7
```

Warning: **END OF SUPPORT FOR PYTHON 2.3** This is the **LAST** version to support Python 2.3 **BEGIN UPGRADING OR DIE**

CHAPTER

TWENTYTWO

WINDOWS NOTES

Python scripts installed as part of the Pylons install process will be put in the `Scripts` directory of your Python installation, typically in `C:\Python24\Scripts`. By default on Windows, this directory is not in your `PATH`; this can cause the following error message when running a command such as `paster` from the command prompt:

```
C:\Documents and Settings\James>paster
'paster' is not recognized as an internal or external command,
operable program or batch file.
```

To run the scripts installed with Pylons either the full path must be specified:

```
C:\Documents and Settings\James>C:\Python24\Scripts\paster
Usage: C:\Python24\Scripts\paster-script.py COMMAND
usage: paster-script.py [paster_options] COMMAND [command_options]

options:
  --version          show program's version number and exit
  --plugin=PLUGINS   Add a plugin to the list of commands (plugins are Egg
                     specs; will also require() the Egg)
  -h, --help         Show this help message

... etc ...
```

or (the preferable solution) the `Scripts` directory must be added to the `PATH` as described below.

22.1 For Win2K or WinXP

1. From the desktop or Start Menu, right click My Computer and click Properties.
2. In the System Properties window, click on the Advanced tab.
3. In the Advanced section, click the Environment Variables button.
4. Finally, in the Environment Variables window, highlight the path variable in the Systems Variable section and click edit. Add or modify the path lines with the paths you wish the computer to access. Each different directory is separated with a semicolon as shown below:

```
C:\Program Files;C:\WINDOWS;C:\WINDOWS\System32
```

1. Add the path to your scripts directory:

```
C:\Program Files;C:\WINDOWS;C:\WINDOWS\System32;C:\Python24\Scripts
```

See Finally below.

22.2 For Windows 95, 98 and ME

Edit `autoexec.bat`, and add the following line to the end of the file:

```
set PATH=%PATH%;C:\Python24\Scripts
```

See Finally below.

22.3 Finally

Restarting your computer may be required to enable the change to the `PATH`. Then commands may be entered from any location:

```
C:\Documents and Settings\James>paster
Usage: C:\Python24\Scripts\paster-script.py COMMAND
usage: paster-script.py [paster_options] COMMAND [command_options]

options:
  --version          show program's version number and exit
  --plugin=PLUGINS   Add a plugin to the list of commands (plugins are Egg
                     specs; will also require() the Egg)
  -h, --help         Show this help message

... etc ...
```

All documentation assumes the `PATH` is setup correctly as described above.

CHAPTER

TWENTYTHREE

PYLONS ON JYTHON

Pylons supports Jython as of v0.9.7.

23.1 Installation

The installation process is the same as CPython, as described in *Getting Started*. At least Jython 2.5b2 is required.

23.2 Deploying to Java Web servers

The Java platform defines the Servlet API for creating web applications. The modjy library included with Jython provides a gateway between Java Servlets and WSGI applications.

The snakefight tool can create a WAR file from a Pylons application (and modjy) that's suitable for deployment to the various Servlet containers (such as Apache Tomcat or Sun's Glassfish).

23.2.1 Creating .wars with snakefight

First, install snakefight:

```
$ easy_install snakefight
```

This adds an additional command to distutils: **bdist_war**.

Pylons applications are loaded from Paste, via its `paste.app_factory` entry point and a Paste style configuration file. **bdist_war** knows how to setup Paste apps for deployment when specified the *`--paste-config`* option:

```
$ paster make-config MyApp production.ini
$ jython setup.py bdist_war --paste-config production.ini
```

As with any distutils command the preferred options can instead be added to the `setup.cfg` in the root directory of the project:

```
[bdist_war]
paste-config = production.ini
```

Then we can simply run:

```
$ jython setup.py bdist_war
```

bdist_war creates a `.war` with the following:

- Jython's `jar` files in `WEB-INF/lib`
- Jython's stdlib in `WEB-INF/lib-python`
- Your application's required eggs in `WEB-INF/lib-python`

With the *`--paste-config`* option, it also:

- Creates a simple loader for the application/config
- Generates a `web.xml` deployment descriptor configuring modjy to load the application with the simple loader

For further information/usages, see snakefight's documentation.

CHAPTER

TWENTYFOUR

SECURITY POLICY FOR BUGS

24.1 Receiving Security Updates

The Pylons team have set up a mailing list at wsgi-security-announce@googlegroups.com to which any security vulnerabilities that affect Pylons will be announced. Anyone wishing to be notified of vulnerabilities in Pylons should subscribe to this list. Security announcements will only be made once a solution to the problem has been discovered.

24.2 Reporting Security Issues

Please report security issues by email to both the lead developers of Pylons at the following addresses:

ben@groovie.org

security@3aims.com

Please DO NOT announce the vulnerability to any mailing lists or on the ticket system because we would not want any malicious person to be aware of the problem before a solution is available.

In the event of a confirmed vulnerability in Pylons itself, we will take the following actions:

- Acknowledge to the reporter that we've received the report and that a fix is forthcoming. We'll give a rough timeline and ask the reporter to keep the issue confidential until we announce it.
- Halt all other development as long as is needed to develop a fix, including patches against the current release.
- Publicly announce the vulnerability and the fix as soon as it is available to the WSGI security list at wsgi-security-announce@googlegroups.com.

This will probably mean a new release of Pylons, but in some cases it may simply be the release of documentation explaining how to avoid the vulnerability.

In the event of a confirmed vulnerability in one of the components that Pylons uses, we will take the following actions:

- Acknowledge to the reporter that we've received the report and ask the reporter to keep the issue confidential until we announce it.
- Contact the developer or maintainer of the package containing the vulnerability.
- If the developer or maintainer fails to release a new version in a reasonable time-scale and the vulnerability is serious we will either create documentation explaining how to avoid the problem or as a last resort, create a patched version.

- Publicly announce the vulnerability and the fix as soon as it is available to the WSGI security list at wsgi-security-announce@googlegroups.com.

24.3 Minimising Risk

- Only use official production versions of Pylons released publicly on the Python Package Index.
- Only use stable releases of third party software not development, alpha, beta or release candidate code.
- Do not assume that related software is of the same quality as Pylons itself, even if Pylons users frequently make use of it.
- Subscribe to the wsgi-security-announce@googlegroups.com mailing list to be informed of security issues and their solutions.

CHAPTER

TWENTYFIVE

WSGI SUPPORT

The Web Server Gateway Interface defined in PEP 333 is a standard interface between web servers and Python web applications or frameworks, to promote web application portability across a variety of web servers.

Pylons supports the Web Server Gateway Interface (or WSGI for short, pronounced "wizgy") throughout its stack. This is important for developers because it means that as well coming with all the features you would expect of a modern web framework, Pylons is also extremely flexible. With the WSGI it is possible to change any part of the Pylons stack to add new functionality or modify a request or a response without having to take apart the whole framework.

25.1 Paste and WSGI

Most of Pylons' WSGI capability comes from its close integration with Paste. Paste provides all the tools and middleware necessary to deploy WSGI applications. It can be thought of as a low-level WSGI framework designed for other web frameworks to build upon. Pylons is an example of a framework which makes full use of the possibilities of Paste.

If you want to, you can get the WSGI application object from your Pylons configuration file like this:

```
from paste.deploy import loadapp
wsgi_app = loadapp('config:/path/to/config.ini')
```

You can then serve the file using a WSGI server. Here is an example using the WSGI Reference Implementation included with Python 2.5:

```
from paste.deploy import loadapp
wsgi_app = loadapp('config:/path/to/config.ini')

from wsgiref import simple_server
httpd = simple_server.WSGIServer(('',8000), simple_server.WSGIRequestHandler)
httpd.set_app(wsgi_app)
httpd.serve_forever()
```

The `paster serve` command you will be used to using during the development of Pylons projects combines these two steps of creating a WSGI app from the config file and serving the resulting file to give the illusion that it is serving the config file directly.

Because the resulting Pylons application is a WSGI application it means you can do the same things with it that you can do with any WSGI application. For example add a middleware chain to it or serve it via FastCGI/SCGI/CGI/mod_python/AJP or standalone.

You can also configure extra WSGI middleware, applications and more directly using the configuration file. The various options are described in the Paste Deploy Documentation so we won't repeat them here.

25.2 Using a WSGI Application as a Pylons 0.9 Controller

In Pylons 0.9 controllers are derived from `pylons.controllers.WSGIController` and are also valid WSGI applications. Unless your controller is derived from the legacy `pylons.controllers.Controller` class it is also assumed to be a WSGI application. This means that you don't actually need to use a Pylons controller class in your controller, any WSGI application will work as long as you give it the same name.

For example, if you added a `hello` controller by executing `paster controller hello`, you could modify it to look like this:

```
def HelloController(environ, start_response):
    start_response('200 OK', [('Content-Type','text/html')])
    return ['Hello World!']
```

or use `yield` statements like this:

```
def HelloController(environ, start_response):
    start_response('200 OK', [('Content-Type','text/html')])
    yield 'Hello '
    yield 'World!'
```

or use the standard Pylons `Response` object which is a valid WSGI response which takes care of calling `start_response()` for you:

```
def HelloController(environ, start_response):
    return Response('Hello World!')
```

and you could use the `render()` and `render_response()` objects exactly like you would in a normal controller action.

As well as writing your WSGI application as a function you could write it as a class:

```
class HelloController:

    def __call__(self, environ, start_response):
        start_response('200 OK', [('Content-Type','text/html')])
        return ['Hello World!']
```

All the standard Pylons middleware defined in `config/middleware.py` is still available.

25.3 Running a WSGI Application From Within a Controller

There may be occasions where you don't want to replace your entire controller with a WSGI application but simply want to run a WSGI application from with a controller action. If your project was called `test` and you had a WSGI application called `wsgi_app` you could even do this:

```
from test.lib.base import *

def wsgi_app(environ, start_response):
    start_response('200 OK',[('Content-type','text/html')])
    return ['<html>\n<body>\nHello World!\n</body>\n</html>']
```

```
class HelloController(BaseController):
    def index(self):
        return wsgi_app(request.environ, self.start_response)
```

25.4 Configuring Middleware Within a Pylons Application

A Pylons application middleware stack is directly exposed in the project's `config/middleware.py` file. This means that you can add and remove pieces from the stack as you choose.

Warning: If you remove any of the default middleware you are likely to find that various parts of Pylons stop working!

As an example, if you wanted to add middleware that added a new key to the environ dictionary you might do this:

```
# YOUR MIDDLEWARE
# Put your own middleware here, so that any problems are caught by the error
# handling middleware underneath

class KeyAdder:
def __init__(self, app, key, value):
    self.app = app
    if '.' not in key:
        raise Exception("WSGI environ keys must contain a '.' character")
    self.key = key
    self.value = value

def __call__(self, environ, start_response):
    environ[self.key] = self.value
    return self.app(environ, start_response)

app = KeyAdder(app, 'test.hello', 'Hello World')
```

Then in your controller you could write:

```
return Response(request.environ['test.hello'])
```

and you would see your `Hello World!` message.

Of course, this isn't a particularly useful thing to do. Middleware classes can do one of four things or a combination of them:

- Change the environ dictionary
- Change the status
- Change the HTTP headers
- Change the response body of the application

With the ability to do these things as a middleware you can create authentication code, error handling middleware and more but the great thing about WSGI is that someone probably already has so you can consult the wsgi.org middleware list or have a look at the Paste project and reuse an exisiting piece of middleware.

25.5 The Cascade

Towards the end of the middleware stack in your project's `config/middleware.py` file you will find a special piece of middleware called the cascade:

```
app = Cascade([static_app, javascripts_app, app])
```

Passed a list of applications, `Cascade` will try each of them in turn. If one returns a 404 status code then the next application is tried until one of the applications returns a code other than `404` in which case its response is returned. If all applications fail, then the last application's failure response is used.

The three WSGI applications in the cascade serve files from your project's `public` directory first then if nothing matches, the WebHelpers module JavaScripts are searched and finally if no JavaScripts are found your Pylons app is tried. This is why the `public/index.html` file is served before your controller is executed and why you can put `/javascripts/` into your HTML and the files will be found.

You are free to change the order of the cascade or add extra WSGI applications to it before `app` so that other locations are checked before your Pylons application is executed.

25.6 Useful Resources

Whilst other frameworks have put WSGI adapters at the end of their stacks so that their applications can be served by WSGI servers, we hope you can see how fully Pylons embraces WSGI throughout its design to be the most flexible and extensible of the main Python web frameworks.

To find out more about the Web Server Gateway Interface you might find the following resources useful:

- PEP 333
- The WSGI website at wsgi.org
- XML.com articles: Introducing WSGI - Pythons Secret Web Weapon.html Part 1 Part 2

CHAPTER

TWENTYSIX

ADVANCED PYLONS

26.1 WSGI, CLI scripts

26.1.1 Working with `wsgiwrappers.WSGIRequest`

Pylons uses a specialised *WSGIRequest* class that is accessible via the `paste.wsgiwrappers` module.

The `wsgiwrappers.WSGIRequest` object represents a WSGI request that has a more programmer-friendly interface. This interface does not expose every detail of the WSGI environment *(why?)* and does not attempt to express anything beyond what is available in the environment dictionary.

The only state maintained in this object is the desired `charset`, an associated errors handler and a `decode_param_names` option.

> *Unicode notes*
>
> When `charset` is set, the incoming parameter values will be automatically coerced to unicode objects of the charset encoding.
>
> When unicode is expected, `charset` will be overridden by the the value of the charset parameter set in the Content-Type header, if one was specified by the client.
>
> The incoming parameter names are not decoded to unicode unless the decode_param_names option is enabled.

The class variable `defaults` specifies default values for charset, errors, and language. These default values can be overridden for the current request via the registry *(what's a registry?)*.

The language default value is considered the fallback during i18n translations to ensure in odd cases that mixed languages don't occur should the language file contain the string but not another language in the accepted languages list. The language value only applies when getting a list of accepted languages from the HTTP Accept header.

This behavior is duplicated from Aquarium, and may seem strange but is very useful. Normally, everything in the code is in "en-us". However, the "en-us" translation catalog is usually empty. If the user requests ["en-us", "zh-cn"] and a translation isn't found for a string in "en-us", you don't want gettext to fallback to "zh-cn". You want it to just use the string itself. Hence, if a string isn't found in the language catalog, the string in the source code will be used.

All other state is kept in the environment dictionary; this is essential for interoperability.

You are free to subclass this object.

26.1.2 Attributes

GET

A dictionary-like object representing the QUERY_STRING parameters. Always present, possibly empty.

If the same key is present in the query string multiple times, a list of its values can be retrieved from the `MultiDict` via the :meth:`getall` method.

Returns a `MultiDict` container or, when charset is set, a `UnicodeMultiDict`.

POST

A dictionary-like object representing the `POST` body.

Most values are encoded strings, or unicode strings when charset is set. There may also be FieldStorage objects representing file uploads. If this is not a POST request, or the body is not encoded fields (e.g., an XMLRPC request) then this will be empty.

This will consume wsgi.input when first accessed if applicable, but the raw version will be put in environ['paste.parsed_formvars'].

Returns a MultiDict container or a UnicodeMultiDict when charset is set.

cookies

A dictionary of cookies, keyed by cookie name.

Just a plain dictionary, may be empty but not None.

defaults

```
{'errors': 'replace',
 'decode_param_names': False,
 'charset': None,
 'language': 'en-us'}
```

host

The host name, as provided in `HTTP_HOST` with a fall-back to `SERVER_NAME`

is_xhr

Returns a boolean if `X-Requested-With` is present and is a `XMLHttpRequest`

languages

Returns a (possibly empty) list of preferred languages, most preferred first.

params

A dictionary-like object of keys from `POST`, `GET`, `URL` dicts

Return a key value from the parameters, they are checked in the following order: POST, GET, URL

26.1.3 Additional methods supported:

getlist(key)

Returns a list of all the values by that key, collected from POST, GET, URL dicts

Returns a `MultiDict` container or a `UnicodeMultiDict` when `charset` is set.

urlvars

Return any variables matched in the URL (e.g. wsgiorg.routing_args).

26.1.4 Methods

__init__(self, environ)

determine_browser_charset(self)

Determine the encoding as specified by the browser via the Content-Type's `charset parameter`, if one is set

match_accept(self, mimetypes)

Return a list of specified mime-types that the browser's HTTP Accept header allows in the order provided.

26.2 Adding commands to Paster

26.2.1 Paster command

The command line will be `paster my-command arg1 arg2` if the current directory is the application egg, or `paster --plugin=MyPylonsApp my-command arg1 arg2` otherwise. In the latter case, `MyPylonsApp` must have been installed via `easy_install` or `python setup.py develop`.

Make a package directory for your commands:

```
$ mkdir myapp/commands
$ touch myapp/commands/__init__.py
```

Create a module `myapp/commands/my_command.py` like this:

```
from paste.script.command import Command

class MyCommand(Command):
        # Parser configuration
        summary = "--NO SUMMARY--"
```

```
        usage = "--NO USAGE--"
        group_name = "myapp"
        parser = Command.standard_parser(verbose=False)

        def command(self):
                import pprint
                print "Hello, app script world!"
                print
                print "My options are:"
                print "    ", pprint.pformat(vars(self.options))
                print "My args are:"
                print "    ", pprint.pformat(self.args)
                print
                print "My parser help is:"
                print
                print self.parser.format_help()
```

Note: The class _must_ define `.command`, `.parser`, and `.summary`

Modify the `entry_points` argument in `setup.py` to contain:

```
[paste.paster_command]
my-command = myapp.commands.my_command:MyCommand
```

Run `python setup.py develop` or `easy_install .` to update the entry points in the egg in sys.path.

Now you should be able to run:

```
$ paster --plugin=MyApp my-command arg1 arg2
Hello, MyApp script world!

My options are:
         {'interactive': False, 'overwrite': False, 'quiet': 0, 'verbose': 0}
My args are:
         ['arg1', 'arg2']

My parser help is:

Usage: /usr/local/bin/paster my-command [options] --NO USAGE--
--NO SUMMARY--

Options:
  -h, --help  show this help message and exit

$ paster --plugin=MyApp --help
Usage: paster [paster_options] COMMAND [command_options]

...
myapp:
  my-command      --NO SUMMARY--

pylons:
  controller      Create a Controller and accompanying functional test
  restcontroller  Create a REST Controller and accompanying functional test
  shell           Open an interactive shell with the Pylons app loaded
```

26.2.2 Required class attributes

In addition to the `.command` method, the class should define `.parser` and `.summary`.

26.2.3 Command-line options

`Command.standard_parser()` returns a Python `OptionParser`. Calling `parser.add_option` enables the developer to add as many options as desired. Inside the `.command` method, the user's options are available under `self.options`, and any additional arguments are in `self.args`.

There are several other class attributes that affect the parser; see them defined in `paste.script.command:Command`. The most useful attributes are `.usage`, `.description`, `.min_args`, and `.max_args`. `.usage` is the part of the usage string _after_ the command name. The `.standard_parser()` method has several optional arguments to add standardized options; some of these got added to my parser although I don't see how.

See the `paster shell` command, `pylons.commands:ShellCommand`, for an example of using command-line options and loading the `.ini file` and model.

Also see "paster setup-app" where it is defined in `paste.script.appinstall.SetupCommand`. This is evident from the entry point in PasteScript (`PasteScript-VERSION.egg/EGG_INFO/entry_points.txt`). It is a complex example of reading a config file and delegating to another entry point.

The code for calling `myapp.websetup:setup_config` is in `paste.script.appinstall`.

The `Command` class also has several convenience methods to handle console prompts, enable logging, verify directories exist and that files have expected content, insert text into a file, run a shell command, add files to Subversion, parse "var=value" arguments, add variables to an .ini file.

26.2.4 Using paster to access a Pylons app

Paster provides `request` and `post` commands for running requests on an application. These commands will be run in the full configuration context of a normal application. Useful for cron jobs, the error handler will also be in place and you can get email reports of failed requests.

Because arguments all just go in `QUERY_STRING`, `request.GET` and `request.PARAMS` won't look like you expect. But you can parse them with something like:

```
parser = optparse.OptionParser()
parser.add_option(etc)

args = [item[0] for item in
        cgi.parse_qsl(request.environ['QUERY_STRING'])]

options, args = parser.parse_args(args)
```

paster request / post

Usage: paster request / post [options] CONFIG_FILE URL [OPTIONS/ARGUMENTS]

Run a request for the described application

This command makes an artifical request to a web application that uses a `paste.deploy` configuration file for the server and application. Use 'paster request config.ini /url' to request `/url`.

Use 'paster post config.ini /url < data' to do a POST with the given request body.

If the URL is relative (i.e. doesn't begin with /) it is interpreted as relative to /.command/.

The variable `environ['paste.command_request']` will be set to True in the request, so your application can distinguish these calls from normal requests.

Note that you can pass options besides the options listed here; any unknown options will be passed to the application in `environ['QUERY_STRING']`.

```
Options:
  -h, --help            show this help message and exit
  -v, --verbose
  -q, --quiet
  -n NAME, --app-name=NAME
                        Load the named application (default main)
  --config-var=NAME:VALUE
                        Variable to make available in the config for %()s
                        substitution (you can use this option multiple times)
  --header=NAME:VALUE   Header to add to request (you can use this option
                        multiple times)
  --display-headers     Display headers before the response body
```

Future development

A Pylons controller that handled some of this would probably be quite useful. Probably even nicer with additions to the current template, so that `/.command/` all gets routed to a single controller that uses actions for the various sub-commands, and can provide a useful response to `/.command/?-h`, etc.

26.3 Creating Paste templates

26.3.1 Introduction

Python Paste is an extremely powerful package that isn't just about WSGI middleware. The related document *Using Entry Points to Write Plugins* demonstrates how to use entry_points to create simple plugins. This document describes how to write just such a plugin for use Paste's project template creation facility and how to add a command to Paste's `paster` script.

The example task is to create a template for an imaginary content management system. The template is going to produce a project directory structure for a Python package, so we need to be able to specify a package name.

26.3.2 Creating The Directory Structure and Templates

The directory structure for the new project needs to look like this:

```
- default_project
    - +package+
        - __init__.py
        - static
            - layout
            - region
            - renderer
        - service
            - layout
                - __init__.py
```

```
            - region
                - __init__.py
            - renderer
                - __init__.py
    - setup.py_tmpl
    - setup.cfg_tmpl
    - development.ini_tmpl
    - README.txt_tmpl
    - ez_setup.py
```

Of course, the actual project's directory structure might look very different. In fact the `paster create` command can even be used to generate directory structures which *aren't* project templates — although this wasn't what it was designed for.

When the `paster create` command is run, any directories with `+package+` in their name will have that portion of the name replaced by a simplified package name and likewise any directories with `+egg+` in their name will have that portion replaced by the name of the egg directory, although we don't make use of that feature in this example.

All of the files with `_tmpl` at the end of their filenames are treated as templates and will have the variables they contain replaced automatically. All other files will remain unchanged.

Note: The small templating language used with `paster create` in files ending in `_tmpl` is described in detail in the Paste util module documentation

---

When specifying a package name it can include capitalisation and _ characters but it should be borne in mind that the actual name of the package will be the *lowercase* package name with the _ characters removed. If the package name contains an _, the egg name will contain a _ character so occasionally the `+egg+` name is different to the `+package+` name.

To avoid difficulty always recommend to users that they stick with package names that contain no _ characters so that the names remain unique when made lowercase.

26.3.3 Implementing the Code

Now that the directory structure has been defined, the next step is to implement the commands that will convert this to a ready-to-run project. The template creation commands are implemented by a class derived from `paste.script.templates.Template`. This is how our example appears:

```
from paste.script.templates import Template, var

vars = [
    var('version', 'Version (like 0.1)'),
    var('description', 'One-line description of the package'),
    var('long_description', 'Multi-line description (in reST)'),
    var('keywords', 'Space-separated keywords/tags'),
    var('author', 'Author name'),
    var('author_email', 'Author email'),
    var('url', 'URL of homepage'),
    var('license_name', 'License name'),
    var('zip_safe', 'True/False: if the package can be distributed as a .zip file',
        default=False),
]

class ArtProjectTemplate(Template):
    _template_dir = 'templates/default_project'
```

```
    summary = 'Art project template'
    vars = vars
```

The `vars` arguments can all be set at run time and will be available to be used as (in this instance) Cheetah template variables in the files which end `_tmpl`. For example the `setup.py_tmpl` file for the `default_project` might look like this:

```
from setuptools import setup, find_packages

version = ${repr(version)|"0.0"}

setup(name=${repr(project)},
    version=version,
    description="${description|nothing}",
    long_description="""\
    ${long_description|nothing}""",
    classifiers=[],
    keywords=${repr(keywords)|empty},
    author=${repr(author)|empty},
    author_email=${repr(author_email)|empty},
    url=${repr(url)|empty},
    license=${repr(license_name)|empty},
    packages=find_packages(exclude=['ez_setup']),
    include_package_data=True,
    zip_safe=${repr(bool(zip_safe))|False},
    install_requires=[
      # Extra requirements go here #
    ],
    entry_points="""
        [paste.app_factory]
        main=${package}:make_app
    """,
)
```

Note how the variables specified in `vars` earlier are used to generate the actual `setup.py` file.

In order to use the new templates they must be hooked up to the `paster create` command by means of an entry point. In the `setup.py` file of the project (in which created the project template is going to be stored) we need to add the following:

```
entry_points="""
    [paste.paster_create_template]
    art_project=art.entry.template:ArtProjectTemplate
""",
```

We also need to add `PasteScript>=1.3` to the `install_requires` line.

```
install_requires=["PasteScript>=1.3"],
```

We just need to install the entry points now by running:

```
python setup.py develop
```

We should now be able to see a list of available templates with this command:

```
$ paster create --list-templates
```

Note: Windows users will need to add their Python scripts directory to their path or enter the full version of the command, similar to this:

```
C:\Python24\Scripts\paster.exe create --list-templates
```

You should see the following:

```
Available templates:
art_project:              Art project template
basic_package:            A basic setuptools-enabled package
```

There may be other projects too.

26.3.4 Troubleshooting

If the Art entries don't show up, check whether it is possible to import the `template.py` file because any errors are simply ignored by the paster create command rather than output as a warning.

If the code is correct, the issue might be that the entry points data hasn't been updated. Examine the Python `site-packages` directory and delete the `Art.egg-link` files, any `Art*.egg` files or directories and remove any entries for art from `easy_install.pth` (replacing `Art` with the name chosen for the project of course). Then re-run `python setup.py develop` to install the correct information.

If problems are still evident, then running the following code will print out a list of all entry points. It might help track the problem down:

```
import pkg_resources
    for x in pkg_resources.iter_group_name(None, None):
        print x
```

26.3.5 Using the Template

Now that the entry point is working, a new project can be created:

```
$ paster create --template=art TestProject
```

Paster will ask lots of questions based on the variables set up in `vars` earlier. Pressing `return` will cause the default to be used. The final result is a nice project template ready for people to start coding with.

26.3.6 Implementing Pylons Templates

If the development context is subject to a frequent need to create lots of Pylons projects, each with a slightly different setup from the standard Pylons defaults then it is probably desirable to create a customised Pylons template to use when generating projects. This can be done in exactly the way described in this document.

First, set up a new Python package, perhaps called something like `CustomPylons` (obviously, don't use the Pylons name because Pylons itself is already using it). Then check out the Pylons source code and copy the pylons/templates/default_project directory into the new project as a starting point. The next stage is to add the custom `vars` and `Template` class and set up the entry points in the `CustomPylons` `setup.py` file.

After those tasks have been completed, it is then possible to create customised templates (ultimately based on the Pylons one) by using the `CustomPylons` package.

26.4 Using Entry Points to Write Plugins

26.4.1 Introduction

An entry point is a Python object in a project's code that is identified by a string in the project's `setup.py` file. The entry point is referenced by a group and a name so that the object may be discoverabe. This means that another application can search for all the installed software that has an entry point with a particular group name, and then access the Python object associated with that name.

This is extremely useful because it means it is possible to write plugins for an appropriately-designed application that can be loaded at run time. This document describes just such an application.

It is important to understand that entry points are a feature of the new Python eggs package format and are *not* a standard feature of Python. To learn about eggs, their benefits, how to install them and how to set them up, see:

- Python Eggs
- Easy Install
- Setuptools

If reading the above documentation is inconvenient, suffice it to say that eggs are created via a similar `setup.py` file to the one used by Python's own distutils module — except that eggs have some powerful extra features such as entry points and the ability to specify module dependencies and have them automatically installed by `easy_install` when the application itself is installed.

For those developers unfamiliar with `distutils`: it is the standard mechanism by which Python packages should be distributed. To use it, add a `setup.py` file to the desired project, insert the required metadata and specify the important files. The `setup.py` file can be used to issue various commands which create distributions of the pacakge in various formats for users to install.

26.4.2 Creating Plugins

This document describes how to use entry points to create a plugin mechansim which allows new types of content to be added to a content management system but we are going to start by looking at the plugin.

Say the standard way the CMS creates a plugin is with the `make_plugin()` function. In order for a plugin to be a plugin it must therefore have the function which takes the same arguments as the `make_plugin()` function and returns a plugin. We are going to add some image plugins to the CMS so we setup a project with the following directory structure:

```
+ image_plugins
  + __init__.py
+ setup.py
```

The `image_plugins/__init__.py` file looks like this:

```
def make_jpeg_image_plugin():
    return "This would return the JPEG image plugin"

def make_png_image_plugin():
    return "This would return the PNG image plugin"
```

We have now defined our plugins so we need to define our entry points. First lets write a basic `setup.py` for the project:

```
from setuptools import setup, find_packages

setup(
    name='ImagePlugins',
    version="1.0",
    description="Image plugins for the imaginary CMS 1.0 project",
    author="James Gardner",
    packages=find_packages(),
    include_package_data=True,
)
```

When using `setuptools` we can specify the `find_packages()` function and `include_package_data=True` rather than having to manually list all the modules and package data like we had to do in the old `distutils` `setup.py`.

Because the plugin is designed to work with the (imaginary) CMS 1.0 package, we need to specify that the plugin requires the CMS to be installed too and so we add this line to the `setup()` function:

```
install_requires=["CMS>=1.0"],
```

Now when the plugins are installed, CMS 1.0 or above will be installed automatically if it is not already present.

There are lots of other arguments such as `author_email` or `url` which you can add to the `setup.py` function too.

We are interested in adding the entry points. We need to decide on a group name for the entry points. It is traditional to use the name of the package using the entry point, separated by a `.` character and then use a name that describes what the entry point does. For our example `cms.plugin` might be an appropriate name for the entry point. Since the `image_plugin` module contains two plugins we will need two entries. Add the following to the `setup.py` function:

```
entry_points="""
    [cms.plugin]
    jpg_image=image_plugin:make_jpeg_image_plugin
    png_image=image_plugin:make_jpeg_image_plugin
""",
```

Group names are specified in square brackets, plugin names are specified in the format `name=module.import.path:object_within_the_module`. The object doesn't have to be a function and can have any valid Python name. The module import path doesn't have to be a top level component as it is in this example and the name of the entry point doesn't have to be the same as the name of the object it is pointing to.

The developer can add as many entries as desired in each group as long as the names are different and the same holds for adding groups. It is also possible to specify the entry points as a Python dictionary rather than a string if that approach is preferred.

There are two more things we need to do to complete the plugin. The first is to include an `ez_setup` module so that if the user installing the plugin doesn't have `setuptools` installed, it will be installed for them. We do this by adding the follwoing to the very top of the `setup.py` file before the import:

```
from ez_setup import use_setuptools
use_setuptools()
```

We also need to download the `ez_setup.py` file into our project directory at the same level as `setup.py`.

Note: If you keep your project in SVN there is a trick you can use with the 'SVN:externals to keep the `ez_setup.py` file up to date.

Finally in order for the CMS to find the plugins we need to install them. We can do this with:

```
$ python setup.py install
```

as usual or, since we might go on to develop the plugins further we can install them using a special development mode which sets up the paths to run the plugins from the source rather than installing them to Python's `site-packages` directory:

```
$ python setup.py develop
```

Both commands will download and install `setuptools` if you don't already have it installed.

26.4.3 Using Plugins

Now that the plugin is written we need to write the code in the CMS package to load it. Luckily this is even easier.

There are actually lots of ways of discovering plugins. For example: by distribution name and version requirement (such as `ImagePlugins>=1.0`) or by the entry point group and name (eg `jpg_image`). For this example we are choosing the latter, here is a simple script for loading the plugins:

```
from pkg_resources import iter_entry_points
for object in iter_entry_points(group='cms.plugin', name=None):
    print object()

from pkg_resources import iter_entry_points
available_methods = []
for method_handler in iter_entry_points(group='authkit.method', name=None):
    available_methods.append(method_handler.load())
```

Executing this short script, will result in the following output:

```
This would return the JPEG image plugin
This would return the PNG image plugin
```

The `iter_entry_points()` function has looped though all the objects in the `cms.plugin` group and returned the function they were associated with. The application then called the function that the enrty point was pointing to.

We hope that we have demonstrated the power of entry points for building extensible code and developers are encouraged to read the pkg_resources module documentation to learn about some more features of the eggs format.

CHAPTER

TWENTYSEVEN

PYLONS EXECUTION ANALYSIS

By Mike Orr and Alfredo Deza

This chapter shows how Pylons calls your application, and how Pylons interacts with Paste, Routes, Mako, and its other dependencies. We'll create a simple application and then analyze the Python code executed starting from the moment we run the "paster serve" command.

Abbreviations: **$APP** is your top-level application directory. **$SP** is the site-packages directory where Pylons is installed. **$BIN** is the location of `paster` and other executables. $SP paths are shown in pip style ($SP/pylons) rather than easy_install style ($SP/Pylons-VERSION.egg/pylons).

27.1 The sample application

1. Create an application called "Analysis" with a controller called "main":

```
$ paster create -t pylons Analysis
$ cd Analysis
$ paster controller main
```

   Press Enter at all question prompts.

2. Edit **analysis/controllers/main.py** to look like this:

```
from analysis.lib.base import BaseController

class MainController(BaseController):

    def index(self):
        return '<h1>Welcome to the Analysis Demo</h1>Here is a <a href="/page2">link</a>.'

    def page2(self):
        return 'Thank you for using the Analysis Demo. <a href="/">Home</a>'
```

   There are two shortcuts here which you would not use in a normal application. One, we're returning incomplete HTML documents. Two, we've hardcoded the URLs to make the analysis easier to follow, rather than using the `url` object.

3. Now edit **analysis/config/routing.py**. Add these lines after "CUSTOM ROUTES HERE" (line 21):

```
map.connect("home", "/", controller="main", action="index")
map.connect("page2", "/page2", controller="main", action="page2")
```

4. Delete the file **analysis/public/index.html**.

5. Now run the server. (Press ctrl-C to quit it.)

```
$ paster serve development.ini
Starting server in PID 7341.
serving on http://127.0.0.1:5000
```

27.2 Pylons' dependencies

Pylons 1.0 has the following direct and indirect dependencies, which will be found in your site-packages directory ($SP):

- Beaker 1.5.4
- decorator 3.2.0
- FormEncode 1.2.2
- Mako 0.3.4
- MarkupSafe 0.9.3
- Nose 0.11.4
- Paste 1.7.3.1
- PasteDeploy 1.3.3
- PasteScript 1.7.3
- Routes 1.12.3
- simplejson 2.0.9 (if Python < 2.6)
- Tempita 0.4
- WebError 0.10.2
- WebHelpers 1.2
- WebOb 0.9.8
- Webtest 1.2.1

These are the current versions as of August 29, 2010. Your installation may have slightly newer or older versions.

27.3 The analysis

27.3.1 Startup (PasteScript)

When you run `paster serve development.ini`, it runs the "$BIN/paster" program. This is a platform-specific stub created by `pip` or `easy_install`. It does this:

```
__requires__ = 'PasteScript==1.7.3'
import sys
from pkg_resources import load_entry_point

sys.exit(
   load_entry_point('PasteScript==1.7.3', 'console_scripts', 'paster')()
)
```

This says to load a Python object "paster" located in an egg "PasteScript", version 1.7.3, under the entry point group `[console_scripts]`.

To explain what this means we have to get into Setuptools. Setuptools is Python's de facto package manager, and was installed as part of your virtualenv or Pylons installation. (If you're using Distribute 0.6, an alternative package manager, it works the same way.) `load_entry_point` is a function that looks up a Python object via entry point and returns it.

So what's an entry point? It's an alias for a Python object. Here's the entry point itself:

```
[console_scripts]
paster=paste.script.command:run
```

This is from $SP/PasteScript-VERSION.egg-info/entry_points.txt. (If you used easy_install rather than pip, the path would be slightly different: $APP/PasteScript-VERSION.egg/EGG-INFO/entry_points.txt.)

"console_scripts" is the entry point group. "paster" is the entry point. The right side of the value tells which module to import (`paste.script.command`) and which object in it to return (the `run` function). (To create an entry point, define it in your package's setup.py. Pip or easy_install will create the egg_info metadata from that. If you modify a package's entry points, you must reinstall the package to update the egg_info.)

The most common use case for entry points is for plugins. So Nose for instance defines an entry point group by which it will look for plugins. Any other package can provide plugins for Nose by defining entry points in that group. Paster uses plugins extensively, as we'll soon see.

So to make a long story short, "paster serve" calls this `run` function. I inserted print statements into `paste.script.command` to figure out what it does. Here's a simplified description:

1. The `run()` function parses the command-line options into a subcommand `"serve"` with arguments `["development.ini"]`.
2. It calls `get_commands()`, which loads Paster commands from plugins located at various entry points. (You can add custom commands with the "–plugin" command-line argument.) Paste's standard commands are listed in the same entry_points.txt file we saw above:

```
    [paste.global_paster_command]
    serve=paste.script.serve:ServeCommand [Config]
    #... other commands like "make-config", "setup-app", etc ...
```

3. It calls `invoke()`, which essentially does `paste.script.serve.ServeCommand(["development.ini"]).run`. This in turn calls `ServeCommand.command()`, which handles daemonizing and other top-level stuff. Since our command line is short, there's no top-level stuff to do. It creates 'server' and 'app' objects based on the configuration file, and calls `server(app)`.

27.3.2 Loading the server and the application (PasteDeploy)

This all happens during step 3 of the application startup. We need to find and instantiate the WSGI application and server based on the configuration file. The application is our Analysis application. The server is Paste's built-in multithreaded HTTP server. A simplified version of the code is:

```
# Inside paste.script.serve module, ServeCommand.command() method.
from paste.deploy.loadwsgi import loadapp, loadserver
server = self.loadserver(server_spec, name=server_name,
                                 relative_to=base, global_conf=vars)
app = self.loadapp(app_spec, name=app_name,
                   relative_to=base, global_conf=vars)
```

`loadserver()` and `loadapp()` are defined in module `paste.deploy.loadwsgi`. The code here is complex, so we'll just look at its general behavior. Both functions see the "config:" URI and read our config file. Since there is no server name or app name they both default to "main". Therefore loadserver() looks for a "[server:main]" section in the config file, and loadapp()' looks for "[app:main]". Here's what they find in "development.ini":

```
[server:main]
use = egg:Paste#http
host = 127.0.0.1
port = 5000

[app:main]
use = egg:Analysis
full_stack = true
static_files = true
...
```

The "use =" line in each section tells which object to load. The other lines are configuration parameters for that object, or for plugins that object is expected to load. We can also put custom parameters in [app:main] for our application to read directly.

Server loading

1. `loadserver()`'s args are `uri="config:development.ini", name=None, relative_to="$APP"`.
2. A "config:" URI means to read a config file.
3. A server name was not specified so it defaults to "main". So loadserver() looks for a section "[server:main]". The "server" part comes from the loadwsgi._Server.config_prefixes class attribute in $SP/paste/deploy/loadwsgi.py).
4. "use = egg:Paste#http" says to load an egg called "Paste".
5. loadwsgi._Server.egg_protocols lists two protocols it supports: "server_factory" and "server_runner".
6. "paste.server_runner" is an entry point group in the "Paste" egg, and it has an entry point "http". The relevant lines in $SP/Paste*.egg_info/entry_points.txt are:

```
    [paste.server_runner]
    http = paste.httpserver:server_runner
```

7. There's a server_runner() function in the paste.httpserver module ($SP/paste/httpserver.py).

We'll stop here for a moment and look at how the application is loaded.

Application loading

1. loadapp() looks for a section "[app:main]" in the config file. The "app" part comes from the loadwsgi._App.config_prefixes class attribute (in $SP/paste/deploy/loadwsgi.py).
2. "use = egg:Analysis" says to find an egg called "Analysis".
3. loadwsgi._App.egg_protocols lists "paste.app_factory" as one of the protocols it supports.
4. "paste.app_factory" is also an entry point group in the egg, as seen in $APP/Analysis.egg-info/entry_points.txt:

```
    [paste.app_factory]
    main = analysis.config.middleware:make_app
```

5. The line "main = analysis.config.middleware:make_app" means to look for a `make_app()` object in the `analysis` package. This is a function imported from `analysis.config.middleware` ($APP/analysis/config/middleware.py).

27.3.3 Instantiating the application (Analysis)

Here's a closer look at our application's `make_app` function:

```
# In $APP/analysis/config/middleware.py
def make_app(global_conf, full_stack=True, static_files=True, **app_conf):
    config = load_environment(global_conf, app_conf)
    app = PylonsApp(config=config)
    app = SomeMiddleware(app, ...)    # Repeated for several middlewares.
    app.config = config
    return app
```

This sets up the Pylons environment (next subsection), creates the application object (following subsection), wraps it in several layers of middleware (listed in "Anatomy of a Request" below), and returns the complete application object.

The [DEFAULT] section of the config file is passed as dict `global_conf`. The [app:main] section is passed as keyword arguments into dict `app_conf`.

`full_stack` defaults to True because we're running the application standalone. If we were embedding this application as a WSGI component of some larger application, we'd set `full_stack` to False to disable some of the middleware.

`static_files=True` means to serve static files from our public directory ($APP/analysis/public). Advanced users can arrange for Apache to serve the static files itself, and put "static_files = false" in their configuration file to gain a bit of efficiency.

load_environment & pylons.config

Before we begin, remember that `pylons.config`, `pylons.app_globals`, `pylons.request`, `pylons.response`, `pylons.session`, `pylons.url`, and `pylons.cache` are special globals that change value depending on the current request. The objects are proxies which maintain a thread-local stack of real values. Pylons pushes the actual values onto them at the beginning of a request, and pops them off at the end. (Some of them it also pushes at other times so they can be used outside of requests.) The proxies delegate attribute access and key access to the topmost actual object on the stack. (You can also call `myproxy._current_obj()` to get the actual object itself.) The proxy code is in `paste.registry.StackedObjectProxy`, so these are called "StackedObjectProxies", or "SOPs" for short.

The first thing `analysis.config.middleware.make_app()` does is call `analysis.config.environment.load_environment()`:

```
def load_environment(global_conf, app_conf):
    config = PylonsConfig()
    root = os.path.dirname(os.path.dirname(os.path.abspath(__file__)))
    paths = dict(root=root,
                 controllers=os.path.join(root, 'controllers'),
                 static_files=os.path.join(root, 'public'),
                 templates=[os.path.join(root, 'templates')])
```

```
    # Initialize config with the basic options
    config.init_app(global_conf, app_conf, package='analysis',
                    paths=paths)
    config['routes.map'] = make_map(config)
    config['pylons.app_globals'] = app_globals.Globals(config)
    config['pylons.h'] = analysis.lib.helpers

    # Setup cache object as early as possible
    import pylons
    pylons.cache._push_object(config['pylons.app_globals'].cache)

    # Create the Mako TemplateLookup, with the default auto-escaping
    config['pylons.app_globals'].mako_lookup = TemplateLookup(
        directories=paths['templates'],
        error_handler=handle_mako_error,
        module_directory=os.path.join(app_conf['cache_dir'], 'templates'),
        input_encoding='utf-8', default_filters=['escape'],
        imports=['from webhelpers.html import escape'])

    # CONFIGURATION OPTIONS HERE (note: all config options will override
    # any Pylons config options)

    return config
```

`config` is the Pylons configuration object, which will later be pushed onto `pylons.config`. It's an instance of `pylons.configuration.PylonsConfig`, a dict subclass. `config.init_app()` initializes the dict's keys. It sets the keys to a merger of app_conf and global_conf (with app_conf overriding). It also adds "app_conf" and "global_conf" keys so you can access the original app_conf and global_conf if desired. It also adds several Pylons-specific keys.

`config["routes.map"]` is the Routes map defined in `analysis.config.routing.make_map()`.

`config["pylons.app_globals"]` is the application's globals object, which will later be pushed onto `pylons.app_globals`. It's an instance of `analysis.lib.app_globals.Globals`.

`config["pylons.h"]` is the helpers module, `analysis.lib.helpers`. Pylons will assign it to `h` in the templates' namespace.

The "cache" lines push `pylons.app_globals.cache` onto `pylons.cache` for backward compatibility. This gives a preview of how StackedObjectProxies work.

The Mako stanza creates a TemplateLookup, which `render()` will use to find templates. The object is put on `app_globals`.

If you've used older versions of Pylons, you'll notice a couple differences in 1.0. The `config` object is created as a local variable and returned, and it's passed explicitly to the route map factory and globals factory. Previous versions pushed it onto `pylons.config` immediately and used it from there. This was changed to make it easier to nest Pylons applications inside other Pylons applications.

The other difference is that Buffet is gone, and along with it the `template_engine` argument and template config options. Pylons 1.0 gets out of the business of initializing template engines. You use one of the standard render functions such as `render_mako` or write your own, and define any attributes in `app_globals` that your render function depends on.

PylonsApp

The second line of `make_app()` creates a Pylons application object based on your configuration. Again the `config` object is passed around explicitly, unlike older versions of Pylons. A Pylons application is an in-

stance of `pylons.wsgiapp.PylonsApp` instance. (Older versions of Pylons had a `PylonsBaseWSGIApp` superclass, but that has been merged into `PylonsApp`.)

Middleware

`make_app()` then wraps the application (the `app` variable) in several layers of middleware. Each middleware provides an optional add-on service.

Middleware	Service	Effect if disabled
RoutesMiddleware	Use Routes to manage URLs.	Routes and `pylons.url` won't work.
SessionMiddleware	HTTP sessions using Beaker, with flexible persistence backends (disk, memached, database).	`pylons.session` won't work.
ErrorHandler	Display interactive traceback if an exception occurs. In production mode, email the traceback to the site admin.	Paste will catch exceptions and convert them to Internal Server Error.
StatusCodeRedirect	If an HTTP error occurs, make a subrequest to display a fancy styled HTML error page.	If an HTTP error occurs, display a plain white HTML page with the error message.
RegistryManager	Handles the special globals (`pylons.request`, etc).	The special globals won't work. There are other ways to access the objects without going through the special globals.
StaticURLParser	Serve the static files in the application's public directory.	The static files won't be found. Presumably you've configured Apache to serve them directly.
Cascade	Call several sub-middlewares in order, and use the first one that doesn't return "404 Not Found". Used in conjunction with StaticURLParser.	No cascading through alternative apps.

At the end of the function, `app.config` is set to the `config` object, so that any part of the application can access the config without going through the special global.

27.3.4 Anatomy of a request

Let's say you're running the demo and click the "link" link on the home page. The browser sends a request for "http://localhost:5000/page2". In my Firefox the HTTP request headers are:

```
GET /page2
Host: 127.0.0.1:5000
User-Agent: Mozilla/5.0 ...
Accept: text/html,...
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7*;q=0.7
Keep-Alive: 300
Connection: keep-alive
```

```
Referer: http://127.0.0.1/5000/
Cache-Control   max-age=0
```

The response is:

```
HTTP/1.x 200 OK
Server: PasteWSGIServer/0.5 Python/2.6.4
Date: Sun, 06 Dec 2009 14:06:05 GMT
Content-Type: text/html; charset=utf-8
Pragma:  no-cache
Cache-Control:   no-cache
Content-Length:  59

Thank you for using the Analysis Demo.  <a href="/">Home</a>
```

Here's the processing sequence:

1. `server(app)` is still running, called by `ServeCommand.command()` in $SP/paste/script/serve.py.
2. `server` is actually `paste.httpserver.server_runner()` in $SP/paste/httpserver. The only keyword args are 'host' and 'port' extracted from the config file. `server_runner` de-stringifies the arguments and calls `serve(wsgi_app, **kwargs)` (same module).
3. `serve()`'s 'use_threadpool' arg defaults to True, so it creates a `WSGIThreadPoolServer` instance called (`server`) with the following inheritance:

```
        SocketServer.BaseServer     # In SocketServer.py in Python stdlib.
        BaseHTTPServer.HTTPServer  # In BaseHTTPServer.py in Python stdlib.
        paste.httpserver.SecureHTTPServer  # Adds SSL (HTTPS).
        paste.httpserver.WSGIServerBase    # Adds WSGI.
        paste.httpserver.WSGIThreadPoolServer
            multiple inheritance: ThreadPoolMixIn <= ThreadPool

    Note that SecureHTTPServer overrides the implementation of Python's
    SocketServer.TCPServer
```

4. It calls `server.serve_forever()`, implemented by the `ThreadPoolMixIn` superclass. This calls `self.handle_request()` in a loop until `self.running` becomes false. That initiates this call stack:

```
    # In paste.httpserver.serve(), calling 'server.serve_forever()'
    ThreadPoolMixIn.serve_forever()  # Defined in paste.httpserver.
    -> TCPServer.handle_request()    # Called for every request.
    -> WSGIServerBase.get_request()
    -> SecureHTTPServer.get_request()
    -> self.socket.accept()          # Defined in stdlib socket module.
```

   `self.socket.accept()` blocks, waiting for the next request.

5. The request arrives and `self.socket.accept()` returns a new socket for the connection. `TCPServer.handle_request()` continues. It calls `ThreadPoolMixIn.process_request()`, which puts the request in a thread queue:

```
    self.thread_pooladd.add_task(
        lambda: self.process_request_in_thread(request, client_address))
        # 'request' is the connection socket.
```

   The thread pool is defined in the `ThreadPool` class. It spawns a number of threads which each wait on the queue for a callable to run. In this case the callable will be a complete Web transaction

including sending the HTML page to the client. Each thread will repeatedly process transactions from the queue until they receive a sentinel value ordering them to die.

The main thread goes back to listening for other requests, so we're no longer interested in it.

6. **Thread #2** pulls the lambda out of the queue and calls it:

```
lambda
-> ThreadPoolMixIn.process_request_in_thread()
-> BaseServer.finish_request()
-> self.RequestHandlerClass(request, client_address, self)  # Instantiates this.
   The class instantiated is paste.httpserver.WSGIHandler; i.e., the 'handler' variable in serve
```

7. The newly-created request handler takes over:

```
SocketServer.BaseRequestHandler.__init__(request, client_address, server)
-> WSGIHandler.handle()
-> BaseHTTPRequestHandler.handle()  # In stdlib BaseHTTPServer.py
   Handles requests in a loop until self.close_connection is true.  (For HTTP keepalive?)
-> WSGIHandler.handle_one_request()
   Reads the command from the socket.  The command is
   "GET /page2 HTTP/1.1" plus the HTTP headers above.
   BaseHTTPRequestHandler.parse_request() parses this into attributes
   .command, .path, .request_version, and .headers.
-> WSGIHandlerMixin.wsgi_execute().
-> WSGIHandlerMixin.wsgi_setup()
   Creates the .wsgi_environ dict.
```

The WSGI environment dict is described in PEP 333, the WSGI specification. It contains various keys specifying the URL to fetch, query parameters, server info, etc. All keys required by the CGI specification are present, as are other keys specific to WSGI or to paricular middleware. The application will calculate a response based on the dict. The application is wrapped in layers of middleware – nested function calls – which modify the dict on the way in and modify the response on the way out.

8. The request handler, still in `WSGIHandlerMixin.wsgi_execute()`, calls the application thus:

```
result = self.server.wsgi_application(self.wsgi_environ,
                                      self.wsgi_start_response)
```

`wsgi_start_response` is a callable mandated by the WSGI spec. The application will call it to specify the HTTP headers. The return value is an iteration of strings, which when concatenated form the HTML document to send to the browser. Other MIME types are handled analagously.

9. The application, as we remember, was returned by `analysis.config.middleware.make_app()`. It's wrapped in several layers of middleware, so calling it will execute the middleware in reverse order of how they're listed in $APP/analysis/config/middleware.py and $SP/pylons/wsgiapp.py:

    - `Cascade` (defined in $SP/paste/cascade.py) lists a series of applications which will be tried in order (Skipped if static_files is set to False):

        (a) `StaticURLParser` (defined in $SP/paste/urlparser) looks for a file URL under $APP/analysis/public that matches the URL. The demo has no static files.

        (b) If that fails the cascader tries your application. But first there are other middleware to go through...

    - `RegistryManager` (defined in $SP/paste/registry.py) makes Pylons special globals both thread-local and middleware-local. This includes **app_globals**, **cache**, **request**, **response**, **session**, **tmpl_context**, **url**, and any other `StackedObjectProxy` listed in $SP/pylons/__init__.py. (**h** is a module so it doesn't need a proxy.)

- `StatusCodeRedirect` (defined in $SP/pylons/middleware.py) intercepts any HTTP error status returned by the application (e.g., "Page Not Found", "Internal Server Error") and sends another request to the application to get the appropriate error page to display instead. (Skipped if `full_stack` argument was false.)
- `ErrorHandler` (defined in $SP/pylons/middleware.py) sends an interactive traceback to the browser if the app raises an exception, if "debug" is true in the config file. Otherwise it attempts to email the traceback to the site administrator, and substitutes a generic Internal Server Error for the response. (Skipped if `full_stack` argument was false.
- User-defined middleware goes here.
- `SessionMiddleware` (wsgiapp.py) adds Beaker session support (the `pylons.session` object). (Skipped if the WSGI environment has a key 'session' – it doesn't in this demo.)
- `RoutesMiddleware` (wsgiapp.py) compares the request URI against the routing rules in $APP/analysis/config/routing.py and sets 'wsgi.routing_args' to the routing match dict (useful) and 'routes.route' to the Route (probably not useful). Pylons 1.0 apps have a `singleton=False` argument that suppresses initializing the deprecated `url_for()` function. Routes now puts a URL generator in the WSGI environment, which Pylons aliases to `pylons.url`.
- The innermost middleware calls the PylonsApp instance it was initialized with.

Note: CacheMiddleware is no longer used in Pylons 1.0. Instead, `app_globals` creates the cache as an attribute, and a line in environment.py aliases `pylons.cache` to it.

10. Surprise! PylonsApp is itself middleware. Its .__call__() method does:

```
self.setup_app_env(environ, start_response)
controller = self.resolve(environ, start_response)
response = self.dispatch(controller, environ, start_response)
return response
```

`.setup_app_env()` registers all those special globals.

`.resolve()` calculates the controller class based on the route chosen by the RoutesMiddleware, and returns the controller class.

`.dispatch` instantiates the controller class and calls in the WSGI manner. If the controller does not exist (`.resolve()` returned None), raise an Exception that tells you what controller did not have any content.

This method also handles the special URL "/_test_vars", which is enabled if the application is running under a Nose test. This URL initializes Pylons' special globals, for tests that have to access them before making a regular request.

11. `analysis.controllers.main.MainController` does not have a `.\_\_call\_\_()` method, so control falls to its parent, `analysis.lib.base.BaseController`. This trivially calls the grandparent, `pylons.controllers.WSGIController`. It calls the action method `MainController.page2()`. The action method may have any number of positional arguments as long as they correspond to variables in the routing match dict. (GET/POST variables are in the **request.params** dict.) If the method has a `\*\*kwargs` argument, all other match variables are put there. Any variables passed to the action method are also put on the **tmpl_context** object as attributes. If an action method name starts with "_", it's private and HTTPNotFound is raised.
12. If the controller has .__before__() and/or .__after__() methods, they are called before and after the action, respectively. These can perform authorization, lock OS resources, etc. These methods can have

arguments in the same manner as the action method. However, if the code is used by all controllers, most Pylons programmers prefer to it in the base controller's `.\_\_call\_\_` method instead.

13. The action method returns a string, unicode, Response object, or is a generator of strings. In this trivial case it returns a string. A typical Pylons action would set some *tmpl_context* attributes and 'return render('/some/template.html")' . In either case the global *response* object's body would be set to the string.

14. `WSGIController.\_\_call\_\_()` continues, converting the Response object to an appropriate WSGI return value. (First it calls the start_response callback to specify the HTTP headers, then it returns an iteration of strings. The Response object converts unicode to utf-8 encoded strings, or whatever encoding you've specified in the config file.)

15. The stack of middleware calls unwinds, each modifying the return value and headers if it desires.

16. The server receives the final return value. (We're way back in `paste.httpserver.WSGIHandlerMixin.wsgi_execute()` now.) The outermost middleware has called back to `server.start_response()`, which has saved the status and HTTP headers in `.wsgi_curr_headers`. `.wsgi_execute()` then iterates the application's return value, calling `.wsgi_write_chunk(chunk)` for each encoded string yielded. `.wsgi_write_chunk(")` formats the status and HTTP headers and sends them on the socket if they haven't been sent yet, then sends the chunk. The convoluted header behavior here is mandated by the WSGI spec.

17. Control returns to `BaseHTTPRequestHandler.handle()`. `.close_connection` is true so this method returns. The call stack continues unwinding all the way to `paste.httpserver.ThreadPoolMixIn.process_request_in_thread()`. This tries to finish the request first and then close it unless it finds errors in it to end raising an Exception.

18. The request lambda finishes and control returns to `ThreadPool.worker_thread_callback()`. It waits for another request in the thread queue. If the next item in the queue is the shutdown sentinel value, thread #2 dies.

Thus endeth our request's long journey, and this analysis is finished too.

CHAPTER

TWENTYEIGHT

PYLONS MODULES

28.1 `pylons.commands` – Command line functions

Paster Commands, for use with paster in your project

The following commands are made available via paster utilizing setuptools points discovery. These can be used from the command line when the directory is the Pylons project.

Commands available:

`controller` Create a Controller and accompanying functional test

`restcontroller` Create a REST Controller and accompanying functional test

`shell` Open an interactive shell with the Pylons app loaded

Example usage:

```
~/sample$ paster controller account
Creating /Users/ben/sample/sample/controllers/account.py
Creating /Users/ben/sample/sample/tests/functional/test_account.py
~/sample$
```

How it Works

paster is a command line script (from the PasteScript package) that allows the creation of context sensitive commands. **paster** looks in the current directory for a `.egg-info` directory, then loads the `paster_plugins.txt` file.

Using setuptools entry points, **paster** looks for functions registered with setuptools as `paste.paster_command()`. These are defined in the entry_points block in each packages `setup.py` module.

This same system is used when running **paster create** to determine what templates are available when creating new projects.

28.1.1 Module Contents

class `pylons.commands.`**`ControllerCommand`**(*name*)

Create a Controller and accompanying functional test

The Controller command will create the standard controller template file and associated functional test to speed creation of controllers.

Example usage:

```
yourproj% paster controller comments
Creating yourproj/yourproj/controllers/comments.py
Creating yourproj/yourproj/tests/functional/test_comments.py
```

If you'd like to have controllers underneath a directory, just include the path as the controller name and the necessary directories will be created for you:

```
yourproj% paster controller admin/trackback
Creating yourproj/controllers/admin
Creating yourproj/yourproj/controllers/admin/trackback.py
Creating yourproj/yourproj/tests/functional/test_admin_trackback.py
```

class pylons.commands.**RestControllerCommand**(*name*)
Create a REST Controller and accompanying functional test

The RestController command will create a REST-based Controller file for use with the `resource()` REST-based dispatching. This template includes the methods that `resource()` dispatches to in addition to doc strings for clarification on when the methods will be called.

The first argument should be the singular form of the REST resource. The second argument is the plural form of the word. If its a nested controller, put the directory information in front as shown in the second example below.

Example usage:

```
yourproj% paster restcontroller comment comments
Creating yourproj/yourproj/controllers/comments.py
Creating yourproj/yourproj/tests/functional/test_comments.py
```

If you'd like to have controllers underneath a directory, just include the path as the controller name and the necessary directories will be created for you:

```
yourproj% paster restcontroller admin/tracback admin/trackbacks
Creating yourproj/controllers/admin
Creating yourproj/yourproj/controllers/admin/trackbacks.py
Creating yourproj/yourproj/tests/functional/test_admin_trackbacks.py
```

class pylons.commands.**ShellCommand**(*name*)
Open an interactive shell with the Pylons app loaded

The optional CONFIG_FILE argument specifies the config file to use for the interactive shell. CONFIG_FILE defaults to 'development.ini'.

This allows you to test your mapper, models, and simulate web requests using `paste.fixture`.

Example:

```
$ paster shell my-development.ini
```

28.2 pylons.configuration – Configuration object and defaults setup

Configuration object and defaults setup

The PylonsConfig object is initialized in pylons projects inside the `config/environment.py` module. Importing the `config` object from module causes the PylonsConfig object to be created, and setup in app-safe manner so that multiple apps being setup avoid conflicts.

After importing `config`, the project should then call `init_app()` with the appropriate options to setup the configuration. In the config data passed with `init_app()`, various defaults are set use with Paste and Routes.

28.2.1 Module Contents

class `pylons.configuration.`**PylonsConfig**
Pylons configuration object

The Pylons configuration object is a per-application instance object that retains the information regarding the global and app conf's as well as per-application instance specific data such as the mapper, and the paths for this instance.

The config object is available in your application as the Pylons global `pylons.config`. For example:

```
from pylons import config

template_paths = config['pylons.paths']['templates']
```

There's several useful keys of the config object most people will be interested in:

pylons.paths A dict of absolute paths that were defined in the applications `config/environment.py` module.

pylons.environ_config Dict of environ keys for where in the environ to pickup various objects for registering with Pylons. If these are present then PylonsApp will use them from environ rather than using default middleware from Beaker. Valid keys are: `session, cache`

pylons.strict_tmpl_context Whether or not the `tmpl_context` object should throw an attribute error when access is attempted to an attribute that doesn't exist. Defaults to True.

pylons.tmpl_context_attach_args Whethor or not Routes variables should automatically be attached to the tmpl_context object when specified in a controllers method.

pylons.request_options A dict of Content-Type related default settings for new instances of `Request`. May contain the values `charset` and `errors` and `decode_param_names`. Overrides the Pylons default values specified by the `request_defaults` dict.

pylons.response_options A dict of Content-Type related default settings for new instances of `Response`. May contain the values `content_type`, `charset` and `errors`. Overrides the Pylons default values specified by the `response_defaults` dict.

routes.map Mapper object used for Routing. Yes, it is possible to add routes after your application has started running.

init_app(*global_conf*, *app_conf*, *package=None*, *paths=None*)
Initialize configuration for the application

global_conf Several options are expected to be set for a Pylons web application. They will be loaded from the global_config which has the main Paste options. If `debug` is not enabled as a global config option, the following option *must* be set:

- error_to - The email address to send the debug error to

The optional config options in this case are:

- smtp_server - The SMTP server to use, defaults to 'localhost'
- error_log - A logfile to write the error to
- error_subject_prefix - The prefix of the error email subject

- from_address - Whom the error email should be from

app_conf Defaults supplied via the [app:main] section from the Paste config file. `load_config` only cares about whether a 'prefix' option is set, if so it will update Routes to ensure URL's take that into account.

package The name of the application package, to be stored in the app_conf.

Changed in version 1.0: `template_engine` option is no longer supported.

28.3 `pylons.controllers` – Controllers

This module makes available the `WSGIController` and `XMLRPCController` for easier importing.

28.4 `pylons.controllers.core` – WSGIController Class

The core WSGIController

28.4.1 Module Contents

class `pylons.controllers.core.`**WSGIController**
WSGI Controller that follows WSGI spec for calling and return values

The Pylons WSGI Controller handles incoming web requests that are dispatched from the PylonsBaseWSGIApp. These requests result in a new instance of the WSGIController being created, which is then called with the dict options from the Routes match. The standard WSGI response is then returned with start_response called as per the WSGI spec.

Special WSGIController methods you may define:

__before__ This method is called before your action is, and should be used for setting up variables/objects, restricting access to other actions, or other tasks which should be executed before the action is called.

__after__ This method is called after the action is, unless an unexpected exception was raised. Subclasses of `HTTPException` (such as those raised by `redirect_to` and `abort`) are expected; e.g. `__after__` will be called on redirects.

Each action to be called is inspected with `_inspect_call()` so that it is only passed the arguments in the Routes match dict that it asks for. The arguments passed into the action can be customized by overriding the `_get_method_args()` function which is expected to return a dict.

In the event that an action is not found to handle the request, the Controller will raise an "Action Not Found" error if in debug mode, otherwise a `404 Not Found` error will be returned.

_perform_call(*func*, *args*)
Hide the traceback for everything above this method

_inspect_call(*func*)
Calls a function with arguments from `_get_method_args()`

Given a function, inspect_call will inspect the function args and call it with no further keyword args than it asked for.

If the function has been decorated, it is assumed that the decorator preserved the function signature.

_get_method_args()
Retrieve the method arguments to use with inspect call

By default, this uses Routes to retrieve the arguments, override this method to customize the arguments your controller actions are called with.

This method should return a dict.

_dispatch_call()
Handles dispatching the request to the function using Routes

__call__(*environ*, *start_response*)
The main call handler that is called to return a response

28.5 pylons.controllers.util – Controller Utility functions

Utility functions and classes available for use by Controllers

Pylons subclasses the WebOb webob.Request and webob.Response classes to provide backwards compatible functions for earlier versions of Pylons as well as add a few helper functions to assist with signed cookies.

For reference use, refer to the Request and Response below.

Functions available:

abort(), forward(), etag_cache(), mimetype() and redirect()

28.5.1 Module Contents

class pylons.controllers.util.**Request**(*environ*, *charset=None*, *unicode_errors=None*, *decode_param_names=None*, ***kw*)
Bases: webob.request.BaseRequest

WebOb Request subclass

The WebOb webob.Request has no charset, or other defaults. This subclass adds defaults, along with several methods for backwards compatibility with paste.wsgiwrappers.WSGIRequest.

determine_browser_charset()
Legacy method to return the webob.Request.accept_charset

languages

match_accept(*mimetypes*)

signed_cookie(*name*, *secret*)
Extract a signed cookie of name from the request

The cookie is expected to have been created with Response.signed_cookie, and the secret should be the same as the one used to sign it.

Any failure in the signature of the data will result in None being returned.

class pylons.controllers.util.**Response**(*body=None*, *status=None*, *headerlist=None*, *app_iter=None*, *content_type=None*, *conditional_response=None*, ***kw*)
Bases: webob.response.Response

WebOb Response subclass

The WebOb Response has no default content type, or error defaults. This subclass adds defaults, along with several methods for backwards compatibility with paste.wsgiwrappers.WSGIResponse.

content
The body of the response, as a `str`. This will read in the entire app_iter if necessary.

determine_charset()

get_content()

has_header(*header*)

signed_cookie(*name*, *data*, *secret=None*, ***kwargs*)
Save a signed cookie with `secret` signature

Saves a signed cookie of the pickled data. All other keyword arguments that `WebOb.set_cookie` accepts are usable and passed to the WebOb set_cookie method after creating the signed cookie value.

wsgi_response()

pylons.controllers.util.**abort**(*status_code=None*, *detail=''*, *headers=None*, *comment=None*)
Aborts the request immediately by returning an HTTP exception

In the event that the status_code is a 300 series error, the detail attribute will be used as the Location header should one not be specified in the headers attribute.

pylons.controllers.util.**etag_cache**(*key=None*)
Use the HTTP Entity Tag cache for Browser side caching

If a "If-None-Match" header is found, and equivilant to `key`, then a `304` HTTP message will be returned with the ETag to tell the browser that it should use its current cache of the page.

Otherwise, the ETag header will be added to the response headers.

Suggested use is within a Controller Action like so:

```
import pylons

class YourController(BaseController):
    def index(self):
        etag_cache(key=1)
        return render('/splash.mako')
```

Note: This works because etag_cache will raise an HTTPNotModified exception if the ETag received matches the key provided.

---

pylons.controllers.util.**forward**(*wsgi_app*)
Forward the request to a WSGI application. Returns its response.

```
return forward(FileApp('filename'))
```

pylons.controllers.util.**redirect**(*url*, *code=302*)
Raises a redirect exception to the specified URL

Optionally, a code variable may be passed with the status code of the redirect, ie:

```
redirect(url(controller='home', action='index'), code=303)
```

28.6 pylons.controllers.xmlrpc – XMLRPCController Class

The base WSGI XMLRPCController

28.6.1 Module Contents

class pylons.controllers.xmlrpc.**XMLRPCController**

XML-RPC Controller that speaks WSGI

This controller handles XML-RPC responses and complies with the XML-RPC Specification as well as the XML-RPC Introspection specification.

By default, methods with names containing a dot are translated to use an underscore. For example, the *system.methodHelp* is handled by the method `system_methodHelp()`.

Methods in the XML-RPC controller will be called with the method given in the XMLRPC body. Methods may be annotated with a signature attribute to declare the valid arguments and return types.

For example:

```
class MyXML(XMLRPCController):
    def userstatus(self):
        return 'basic string'
    userstatus.signature = [ ['string'] ]

    def userinfo(self, username, age=None):
        user = LookUpUser(username)
        response = {'username':user.name}
        if age and age > 10:
            response['age'] = age
        return response
    userinfo.signature = [['struct', 'string'],
                          ['struct', 'string', 'int']]
```

Since XML-RPC methods can take different sets of data, each set of valid arguments is its own list. The first value in the list is the type of the return argument. The rest of the arguments are the types of the data that must be passed in.

In the last method in the example above, since the method can optionally take an integer value both sets of valid parameter lists should be provided.

Valid types that can be checked in the signature and their corresponding Python types:

```
'string' - str
'array' - list
'boolean' - bool
'int' - int
'double' - float
'struct' - dict
'dateTime.iso8601' - xmlrpclib.DateTime
'base64' - xmlrpclib.Binary
```

The class variable `allow_none` is passed to xmlrpclib.dumps; enabling it allows translating `None` to XML (an extension to the XML-RPC specification)

Note: Requiring a signature is optional.

__call__(*environ*, *start_response*)
Parse an XMLRPC body for the method, and call it with the appropriate arguments

system_listMethods()
Returns a list of XML-RPC methods for this XML-RPC resource

system_methodSignature(*name*)
Returns an array of array's for the valid signatures for a method.

The first value of each array is the return value of the method. The result is an array to indicate multiple signatures a method may be capable of.

system_methodHelp(*name*)
Returns the documentation for a method

28.7 pylons.decorators – Decorators

Pylons Decorators

Common decorators intended for use in controllers. Additional decorators for use with controllers are in the cache, rest and secure modules.

28.7.1 Module Contents

pylons.decorators.**jsonify**(*func*)
Action decorator that formats output for JSON

Given a function that will return content, this decorator will turn the result into JSON, with a content-type of 'application/json' and output it.

pylons.decorators.**validate**(*schema=None*, *validators=None*, *form=None*, *variable_decode=False*, *dict_char='.'*, *list_char='-'*, *post_only=True*, *state=None*, *on_get=False*, ***htmlfill_kwargs*)
Validate input either for a FormEncode schema, or individual validators

Given a form schema or dict of validators, validate will attempt to validate the schema or validator list.

If validation was successful, the valid result dict will be saved as self.form_result. Otherwise, the action will be re-run as if it was a GET, and the output will be filled by FormEncode's htmlfill to fill in the form field errors.

schema Refers to a FormEncode Schema object to use during validation.

form Method used to display the form, which will be used to get the HTML representation of the form for error filling.

variable_decode Boolean to indicate whether FormEncode's variable decode function should be run on the form input before validation.

dict_char Passed through to FormEncode. Toggles the form field naming scheme used to determine what is used to represent a dict. This option is only applicable when used with variable_decode=True.

list_char Passed through to FormEncode. Toggles the form field naming scheme used to determine what is used to represent a list. This option is only applicable when used with variable_decode=True.

post_only Boolean that indicates whether or not GET (query) variables should be included during validation.

> **Warning:** `post_only` applies to *where* the arguments to be validated come from. It does *not* restrict the form to only working with post, merely only checking POST vars.

state Passed through to FormEncode for use in validators that utilize a state object.

on_get Whether to validate on GET requests. By default only POST requests are validated.

Example:

```
class SomeController(BaseController):

    def create(self, id):
        return render('/myform.mako')

    @validate(schema=model.forms.myshema(), form='create')
    def update(self, id):
        # Do something with self.form_result
        pass
```

28.8 pylons.decorators.cache – Cache Decorators

Caching decorator

28.8.1 Module Contents

pylons.decorators.cache.**beaker_cache**(*key='cache_default', expire='never', type=None, query_args=False, cache_headers=('content-type', 'content-length'), invalidate_on_startup=False, cache_response=True, **b_kwargs*)

Cache decorator utilizing Beaker. Caches action or other function that returns a pickle-able object as a result.

Optional arguments:

key None - No variable key, uses function name as key "cache_default" - Uses all function arguments as the key string - Use kwargs[key] as key list - Use [kwargs[k] for k in list] as key

expire Time in seconds before cache expires, or the string "never". Defaults to "never"

type Type of cache to use: dbm, memory, file, memcached, or None for Beaker's default

query_args Uses the query arguments as the key, defaults to False

cache_headers A tuple of header names indicating response headers that will also be cached.

invalidate_on_startup If True, the cache will be invalidated each time the application starts or is restarted.

cache_response Determines whether the response at the time beaker_cache is used should be cached or not, defaults to True.

> **Note:** When cache_response is set to False, the cache_headers argument is ignored as none of the response is cached.

If cache_enabled is set to False in the .ini file, then cache is disabled globally.

28.9 pylons.decorators.rest – REST-ful Decorators

REST decorators

28.9.1 Module Contents

pylons.decorators.rest.**dispatch_on**(***method_map*)

Dispatches to alternate controller methods based on HTTP method

Multiple keyword arguments should be passed, with the keyword corresponding to the HTTP method to dispatch on (DELETE, POST, GET, etc.) and the value being the function to call. The value should be a string indicating the name of the function to dispatch to.

Example:

```
from pylons.decorators import rest

class SomeController(BaseController):

    @rest.dispatch_on(POST='create_comment')
    def comment(self):
        # Do something with the comment

    def create_comment(self, id):
        # Do something if its a post to comment
```

pylons.decorators.rest.**restrict**(**methods*)

Restricts access to the function depending on HTTP method

Example:

```
from pylons.decorators import rest

class SomeController(BaseController):

    @rest.restrict('GET')
    def comment(self, id):
```

28.10 pylons.decorators.secure – Secure Decorators

Security related decorators

28.10.1 Module Contents

pylons.decorators.secure.**authenticate_form**(*func*)

Decorator for authenticating a form

This decorator uses an authorization token stored in the client's session for prevention of certain Cross-site request forgery (CSRF) attacks (See http://en.wikipedia.org/wiki/Cross-site_request_forgery for more information).

For use with the `webhelpers.html.secure_form` helper functions.

`pylons.decorators.secure.`**`https`**(*url_or_callable=None*)

Decorator to redirect to the SSL version of a page if not currently using HTTPS. Apply this decorator to controller methods (actions).

Takes a url argument: either a string url, or a callable returning a string url. The callable will be called with no arguments when the decorated method is called. The url's scheme will be rewritten to https if necessary.

Non-HTTPS POST requests are aborted (405 response code) by this decorator.

Example:

```
# redirect to HTTPS /pylons
@https('/pylons')
def index(self):
    do_secure()

# redirect to HTTPS /auth/login, delaying the url() call until
# later (as the url object may not be functional when the
# decorator/method are defined)
@https(lambda: url(controller='auth', action='login'))
def login(self):
    do_secure()

# redirect to HTTPS version of myself
@https()
def get(self):
    do_secure()
```

28.11 `pylons.error` – Error handling support

Custom EvalException support

Provides template engine HTML error formatters for the Template tab of EvalException.

28.12 `pylons.i18n.translation` – Translation/Localization functions

Translation/Localization functions.

Provides `gettext` translation functions via an app's `pylons.translator` and get/set_lang for changing the language translated to.

28.12.1 Module Contents

exception `pylons.i18n.translation.`**`LanguageError`**

Exception raised when a problem occurs with changing languages

class `pylons.i18n.translation.`**`LazyString`**(*func*, **args*, ***kwargs*)

Has a number of lazily evaluated functions replicating a string. Just override the eval() method to produce the actual value.

This method copied from TurboGears.

pylons.i18n.translation.**lazify**(*func*)
Decorator to return a lazy-evaluated version of the original

pylons.i18n.translation.**gettext_noop**(*value*)
Mark a string for translation without translating it. Returns value.

Used for global strings, e.g.:

```
foo = N_('Hello')

class Bar:
    def __init__(self):
        self.local_foo = _(foo)

h.set_lang('fr')
assert Bar().local_foo == 'Bonjour'
h.set_lang('es')
assert Bar().local_foo == 'Hola'
assert foo == 'Hello'
```

pylons.i18n.translation.**gettext**(*value*)
Mark a string for translation. Returns the localized string of value.

Mark a string to be localized as follows:

```
gettext('This should be in lots of languages')
```

pylons.i18n.translation.**ugettext**(*value*)
Mark a string for translation. Returns the localized unicode string of value.

Mark a string to be localized as follows:

```
_('This should be in lots of languages')
```

pylons.i18n.translation.**ngettext**(*singular*, *plural*, *n*)
Mark a string for translation. Returns the localized string of the pluralized value.

This does a plural-forms lookup of a message id. `singular` is used as the message id for purposes of lookup in the catalog, while `n` is used to determine which plural form to use. The returned message is a string.

Mark a string to be localized as follows:

```
ngettext('There is %(num)d file here', 'There are %(num)d files here',
         n) % {'num': n}
```

pylons.i18n.translation.**ungettext**(*singular*, *plural*, *n*)
Mark a string for translation. Returns the localized unicode string of the pluralized value.

This does a plural-forms lookup of a message id. `singular` is used as the message id for purposes of lookup in the catalog, while `n` is used to determine which plural form to use. The returned message is a Unicode string.

Mark a string to be localized as follows:

```
ungettext('There is %(num)d file here', 'There are %(num)d files here',
          n) % {'num': n}
```

pylons.i18n.translation.**set_lang**(*lang*, *set_environ=True*, ***kwargs*)
Set the current language used for translations.

`lang` should be a string or a list of strings. If a list of strings, the first language is set as the main and the subsequent languages are added as fallbacks.

pylons.i18n.translation.**get_lang**()
Return the current i18n language used

pylons.i18n.translation.**add_fallback**(*lang*, ***kwargs*)
Add a fallback language from which words not matched in other languages will be translated to.

This fallback will be associated with the currently selected language – that is, resetting the language via set_lang() resets the current fallbacks.

This function can be called multiple times to add multiple fallbacks.

28.13 pylons.log – Logging for WSGI errors

Logging related functionality

This logging Handler logs to `environ['wsgi.errors']` as designated in **PEP 333**.

28.13.1 Module Contents

class pylons.log.**WSGIErrorsHandler**(*cache=False*, **args*, ***kwargs*)
A handler class that writes logging records to *environ['wsgi.errors']*.

This code is derived from CherryPy's `cherrypy._cplogging.WSGIErrorHandler`.

cache Whether the *wsgi.errors* stream is cached (instead of looked up via *pylons.request.environ* per every logged message). Enabling this option is not recommended (particularly for the use case of logging to *wsgi.errors* outside of a request) as the behavior of a cached *wsgi.errors* stream is not strictly defined. In particular, mod_wsgi's *wsgi.errors* will raise an exception when used outside of a request.

emit(*record*)
Emit a record

flush()
Flushes the stream

get_wsgierrors()
Return the wsgi.errors stream

Raises a TypeError when outside of a web request (pylons.request is not setup)

28.14 pylons.middleware – WSGI Middleware

Pylons' WSGI middlewares

28.14.1 Module Contents

class pylons.middleware.**StatusCodeRedirect**(*app*, *errors=(400, 401, 403, 404)*, *path='/error/document'*)
Internally redirects a request based on status code

StatusCodeRedirect watches the response of the app it wraps. If the response is an error code in the errors sequence passed the request will be re-run with the path URL set to the path passed in.

This operation is non-recursive and the output of the second request will be used no matter what it is.

Should an application wish to bypass the error response (ie, to purposely return a 401), set `environ['pylons.status_code_redirect'] = True` in the application.

__init__(*app*, *errors=(400, 401, 403, 404)*, *path='/error/document'*)
Initialize the ErrorRedirect

errors A sequence (list, tuple) of error code integers that should be caught.

path The path to set for the next request down to the application.

`pylons.middleware.`**ErrorHandler**(*app*, *global_conf*, ***errorware*)
ErrorHandler Toggle

If debug is enabled, this function will return the app wrapped in the WebError `EvalException` middleware which displays interactive debugging sessions when a traceback occurs.

Otherwise, the app will be wrapped in the WebError `ErrorMiddleware`, and the `errorware` dict will be passed into it. The `ErrorMiddleware` handles sending an email to the address listed in the .ini file, under `email_to`.

Note:

The `errorware` dictionary is constructed from the settings in the *DEFAULT* section of development.ini. the recognised

- `error_email` = conf.get('email_to')
- `error_log` = conf.get('error_log', None)
- `smtp_server` = conf.get('smtp_server','localhost')
- `error_subject_prefix` = conf.get('error_subject_prefix', 'WebApp Error: ')
- `from_address` = conf.get('from_address', conf.get('error_email_from', 'pylons@yourapp.com'))
- `error_message` = conf.get('error_message', 'An internal server error occurred')

28.14.2 Referenced classes

Pylons middleware uses `WebError` to effect the error-handling. The two classes implicated are:

ErrorMiddleware

`weberror.errormiddleware` `weberror.errormiddleware.ErrorMiddleware`

EvalException

`weberror.evalexception` `weberror.evalexception.EvalException`

28.15 `pylons.templating` – Render functions and helpers

Render functions and helpers

28.15.1 Render functions and helpers

`pylons.templating` includes several basic render functions, `render_mako()`, `render_genshi()` and `render_jinja2()` that render templates from the file-system with the assumption that variables intended for the will be attached to `tmpl_context` (hereafter referred to by its short name of `c` which it is commonly imported as).

The default render functions work with the template language loader object that is setup on the `app_globals` object in the project's `config/environment.py`.

Usage

Generally, one of the render functions will be imported in the controller. Variables intended for the template are attached to the `c` object. The render functions return unicode (they actually return `literal` objects, a subclass of unicode).

Tip

`tmpl_context` (template context) is abbreviated to `c` instead of its full name since it will likely be used extensively and it's much faster to use `c`. Of course, for users that can't tolerate one-letter variables, feel free to not import `tmpl_context` as `c` since both names are available in templates as well.

Example of rendering a template with some variables:

```
from pylons import tmpl_context as c
from pylons.templating import render_mako as render

from sampleproject.lib.base import BaseController

class SampleController(BaseController):

    def index(self):
        c.first_name = "Joe"
        c.last_name = "Smith"
        return render('/some/template.mako')
```

And the accompanying Mako template:

```
Hello ${c.first name}, I see your lastname is ${c.last_name}!
```

Your controller will have additional default imports for commonly used functions.

Template Globals

Templates rendered in Pylons should include the default Pylons globals as the `render_mako()`, `render_genshi()` and `render_jinja2()` functions. The full list of Pylons globals that are included in the template's namespace are:

- *c* – Template context object
- *tmpl_context* – Template context object
- `config` – Pylons `PylonsConfig` object (acts as a dict)
- *app_globals* – Project application globals object
- *h* – Project helpers module reference

- `request` – Pylons `Request` object for this request
- `response` – Pylons `Response` object for this request
- `session` – Pylons session object (unless Sessions are removed)
- `url` – Routes url generator object
- `translator` – Gettext translator object configured for current locale
- `ungettext()` – Unicode capable version of gettext's ngettext function (handles plural translations)
- `_()` – Unicode capable gettext translate function
- `N_()` – gettext no-op function to mark a string for translation, but doesn't actually translate

Configuring the template language

The template engine is created in the projects `config/environment.py` and attached to the `app_globals` (g) instance. Configuration options can be directly passed into the template engine, and are used by the render functions.

> **Warning:** Don't change the variable name on `app_globals` that the template loader is attached to if you want to use the render_* functions that `pylons.templating` comes with. The render_* functions look for the template loader to render the template.

28.15.2 Module Contents

`pylons.templating.`**`pylons_globals`**`()`

Create and return a dictionary of global Pylons variables

Render functions should call this to retrieve a list of global Pylons variables that should be included in the global template namespace if possible.

Pylons variables that are returned in the dictionary: `c`, `h`, `_`, `N_`, config, request, response, translator, ungettext, `url`

If SessionMiddleware is being used, `session` will also be available in the template namespace.

`pylons.templating.`**`cached_template`**`(`*template_name*, *render_func*, *ns_options=()*, *cache_key=None*, *cache_type=None*, *cache_expire=None*, ***kwargs*`)`

Cache and render a template

Cache a template to the namespace `template_name`, along with a specific key if provided.

Basic Options

`template_name` Name of the template, which is used as the template namespace.

`render_func` Function used to generate the template should it no longer be valid or doesn't exist in the cache.

`ns_options` Tuple of strings, that should correspond to keys likely to be in the `kwargs` that should be used to construct the namespace used for the cache. For example, if the template language supports the 'fragment' option, the namespace should include it so that the cached copy for a template is not the same as the fragment version of it.

Caching options (uses Beaker caching middleware)

`cache_key` Key to cache this copy of the template under.

cache_type Valid options are `dbm`, `file`, `memory`, `database`, or `memcached`.

cache_expire Time in seconds to cache this template with this `cache_key` for. Or use 'never' to designate that the cache should never expire.

The minimum key required to trigger caching is `cache_expire='never'` which will cache the template forever seconds with no key.

`pylons.templating.`**render_mako**(*template_name*, *extra_vars=None*, *cache_key=None*, *cache_type=None*, *cache_expire=None*)

Render a template with Mako

Accepts the cache options `cache_key`, `cache_type`, and `cache_expire`.

`pylons.templating.`**render_mako_def**(*template_name*, *def_name*, *cache_key=None*, *cache_type=None*, *cache_expire=None*, ***kwargs*)

Render a def block within a Mako template

Takes the template name, and the name of the def within it to call. If the def takes arguments, they should be passed in as keyword arguments.

Example:

```
# To call the def 'header' within the 'layout.mako' template
# with a title argument
render_mako_def('layout.mako', 'header', title='Testing')
```

Also accepts the cache options `cache_key`, `cache_type`, and `cache_expire`.

`pylons.templating.`**render_genshi**(*template_name*, *extra_vars=None*, *cache_key=None*, *cache_type=None*, *cache_expire=None*, *method='xhtml'*)

Render a template with Genshi

Accepts the cache options `cache_key`, `cache_type`, and `cache_expire` in addition to method which are passed to Genshi's render function.

28.16 `pylons.test` – Test related functionality

Test related functionality

Adds a Pylons plugin to nose that loads the Pylons app *before* scanning for doc tests.

This can be configured in the projects `setup.cfg` under a `[nosetests]` block:

```
[nosetests]
with-pylons=development.ini
```

Alternate ini files may be specified if the app should be loaded using a different configuration.

28.16.1 Module Contents

class `pylons.test.`**PylonsPlugin**

Nose plugin extension

For use with nose to allow a project to be configured before nose proceeds to scan the project for doc tests and unit tests. This prevents modules from being loaded without a configured Pylons environment.

28.17 pylons.util – Paste Template and Pylons utility functions

Paste Template and Pylons utility functions

PylonsTemplate is a Paste Template sub-class that configures the source directory and default plug-ins for a new Pylons project. The minimal template a more minimal template with less additional directories and layout.

28.17.1 Module Contents

class pylons.util.**PylonsContext**
Pylons context object

All the Pylons Stacked Object Proxies are also stored here, for use in generators and async based operation where the globals can't be used.

This object is attached in WSGIController instances as _py_object. For example:

```
class MyController(WSGIController):
    def index(self):
        pyobj = self._py_object
        return "Environ is %s" % pyobj.request.environ
```

class pylons.util.**ContextObj**
The *tmpl_context* object, with strict attribute access (raises an Exception when the attribute does not exist)

class pylons.util.**AttribSafeContextObj**
The *tmpl_context* object, with lax attribute access (returns '' when the attribute does not exist)

28.18 pylons.wsgiapp – PylonsWSGI App Creator

WSGI App Creator

This module is responsible for creating the basic Pylons WSGI application (PylonsApp). It's generally assumed that it will be called by Paste, though any WSGI server could create and call the WSGI app as well.

28.18.1 Module Contents

class pylons.wsgiapp.**PylonsApp**(*config=None*, ***kwargs*)
Pylons WSGI Application

This basic WSGI app is provided should a web developer want to get access to the most basic Pylons web application environment available. By itself, this Pylons web application does little more than dispatch to a controller and setup the context object, the request object, and the globals object.

Additional functionality like sessions, and caching can be setup by altering the environ['pylons.environ_config'] setting to indicate what key the session and cache functionality should come from.

Resolving the URL and dispatching can be customized by sub-classing or "monkey-patching" this class. Subclassing is the preferred approach.

__call__(*environ*, *start_response*)
Setup and handle a web request

PylonsApp splits its functionality into several methods to make it easier to subclass and customize core functionality.

The methods are called in the following order:

1. `setup_app_env()`
2. `load_test_env()` (Only if operating in testing mode)
3. `resolve()`
4. `dispatch()`

The response from `dispatch()` is expected to be an iterable (valid **PEP 333** WSGI response), which is then sent back as the response.

dispatch(*controller*, *environ*, *start_response*)
Dispatches to a controller, will instantiate the controller if necessary.

Override this to change how the controller dispatch is handled.

find_controller(*controller*)
Locates a controller by attempting to import it then grab the SomeController instance from the imported module.

Controller name is assumed to be a module in the controllers directory unless it contains a '.' or ':' which is then assumed to be a dotted path to the module and name of the controller object.

Override this to change how the controller object is found once the URL has been resolved.

load_test_env(*environ*)
Sets up our Paste testing environment

register_globals(*environ*)
Registers globals in the environment, called from `setup_app_env()`

Override this to control how the Pylons API is setup. Note that a custom render function will need to be used if the `pylons.app_globals` global is not available.

resolve(*environ*, *start_response*)
Uses dispatching information found in `environ['wsgiorg.routing_args']` to retrieve a controller name and return the controller instance from the appropriate controller module.

Override this to change how the controller name is found and returned.

setup_app_env(*environ*, *start_response*)
Setup and register all the Pylons objects with the registry

After creating all the global objects for use in the request, `register_globals()` is called to register them in the environment.

CHAPTER

TWENTYNINE

THIRD-PARTY COMPONENTS

29.1 FormEncode

FormEncode is a validation and form generation package. The validation can be used separately from the form generation. The validation works on compound data structures, with all parts being nestable. It is separate from HTTP or any other input mechanism.

These module API docs are divided into section by category.

29.1.1 Core API

formencode.api

These functions are used mostly internally by FormEncode. Core classes for validation.

`formencode.api.`**is_validator**(*obj*)
Returns whether `obj` is a validator object or not.

class `formencode.api.`**Invalid**(*msg*, *value*, *state*, *error_list=None*, *error_dict=None*)
This is raised in response to invalid input. It has several public attributes:

msg: The message, *without* values substituted. For instance, if you want HTML quoting of values, you can apply that.

substituteArgs: The arguments (a dictionary) to go with `msg`.

str(self): The message describing the error, with values substituted.

value: The offending (invalid) value.

state: The state that went with this validator. This is an application-specific object.

error_list: If this was a compound validator that takes a repeating value, and sub-validator(s) had errors, then this is a list of those exceptions. The list will be the same length as the number of values – valid values will have None instead of an exception.

error_dict: Like `error_list`, but for dictionary compound validators.

__init__(*msg*, *value*, *state*, *error_list=None*, *error_dict=None*)

unpack_errors(*encode_variables=False*, *dict_char='.'*, *list_char='-'*)
Returns the error as a simple data structure – lists, dictionaries, and strings.

If `encode_variables` is true, then this will return a flat dictionary, encoded with variable_encode

class formencode.api.**Validator**(**args*, ***kw*)
The base class of most validators. See IValidator for more, and FancyValidator for the more common (and more featureful) class.

Messages

classmethod all_messages()
Return a dictionary of all the messages of this validator, and any subvalidators if present. Keys are message names, values may be a message or list of messages. This is really just intended for documentation purposes, to show someone all the messages that a validator or compound validator (like Schemas) can produce.

@@: Should this produce a more structured set of messages, so that messages could be unpacked into a rendered form to see the placement of all the messages? Well, probably so.

if_missing
alias of NoDefault

classmethod subvalidators()
Return any validators that this validator contains. This is not useful for functional, except to inspect what values are available. Specifically the .all_messages() method uses this to accumulate all possible messages.

class formencode.api.**FancyValidator**(**args*, ***kw*)
FancyValidator is the (abstract) superclass for various validators and converters. A subclass can validate, convert, or do both. There is no formal distinction made here.

Validators have two important external methods:

.to_python(value, state): Attempts to convert the value. If there is a problem, or the value is not valid, an Invalid exception is raised. The argument for this exception is the (potentially HTML-formatted) error message to give the user.

.from_python(value, state): Reverses .to_python().

These two external methods make use of the following four important internal methods that can be overridden. However, none of these *have* to be overridden, only the ones that are appropriate for the validator.

._to_python(value, state): This method converts the source to a Python value. It returns the converted value, or raises an Invalid exception if the conversion cannot be done. The argument to this exception should be the error message. Contrary to .to_python() it is only meant to convert the value, not to fully validate it.

._from_python(value, state): Should undo ._to_python() in some reasonable way, returning a string.

.validate_other(value, state): Validates the source, before ._to_python(), or after ._from_python(). It's usually more convenient to use .validate_python() however.

.validate_python(value, state): Validates a Python value, either the result of ._to_python(), or the input to ._from_python().

You should make sure that all possible validation errors are raised in at least one these four methods, not matter which.

Subclasses can also override the __init__() method if the declarative.Declarative model doesn't work for this.

Validators should have no internal state besides the values given at instantiation. They should be reusable and reentrant.

All subclasses can take the arguments/instance variables:

if_empty: If set, then this value will be returned if the input evaluates to false (empty list, empty string, None, etc), but not the 0 or False objects. This only applies to `.to_python()`.

not_empty: If true, then if an empty value is given raise an error. (Both with `.to_python()` and also `.from_python()` if `.validate_python` is true).

strip: If true and the input is a string, strip it (occurs before empty tests).

if_invalid: If set, then when this validator would raise Invalid during `.to_python()`, instead return this value.

if_invalid_python: If set, when the Python value (converted with `.from_python()`) is invalid, this value will be returned.

accept_python: If True (the default), then `.validate_python()` and `.validate_other()` will not be called when `.from_python()` is used.

These parameters are handled at the level of the external methods `.to_python()` and `.from_python` already; if you overwrite one of the internal methods, you usually don't need to care about them.

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

base64encode (*value*)
Encode a string in base64, stripping whitespace and removing newlines.

if_empty
alias of `NoDefault`

if_invalid
alias of `NoDefault`

if_invalid_python
alias of `NoDefault`

validate_other (*value*, *state=None*)
A validation method that doesn't do anything.

validate_python (*value*, *state=None*)
A validation method that doesn't do anything.

formencode.schema

The FormEncode schema is one of the most important parts of using FormEncode, as it lets you organize validators into parts that can be re-used between schemas. Generally, a single schema will represent an entire form, but may inherit other schemas for re-usable validation parts (ie, maybe multiple forms all requires first and last name).

class `formencode.schema.`**Schema** (**args*, ***kw*)
A schema validates a dictionary of values, applying different validators (be key) to the different values. If allow_extra_fields=True, keys without validators will be allowed; otherwise they will raise Invalid. If filter_extra_fields is set to true, then extra fields are not passed back in the results.

Validators are associated with keys either with a class syntax, or as keyword arguments (class syntax is usually easier). Something like:

```
class MySchema(Schema):
    name = Validators.PlainText()
    phone = Validators.PhoneNumber()
```

These will not be available as actual instance variables, but will be collected in a dictionary. To remove a validator in a subclass that is present in a superclass, set it to None, like:

```
class MySubSchema(MySchema):
    name = None
```

Note that missing fields are handled at the Schema level. Missing fields can have the 'missing' message set to specify the error message, or if that does not exist the *schema* message 'missingValue' is used.

Messages

badDictType: The input must be dict-like (not a `%(type)s`: `%(value)r`)

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

missingValue: Missing value

noneType: The input must be a string (not None)

notExpected: The input field `%(name)s` was not expected.

singleValueExpected: Please provide only one value

class formencode.schema.**SimpleFormValidator**(**args*, ***kw*)
This validator wraps a simple function that validates the form.

The function looks something like this:

```
>>> def validate(form_values, state, validator):
...     if form_values.get('country', 'US') == 'US':
...         if not form_values.get('state'):
...             return dict(state='You must enter a state')
...     if not form_values.get('country'):
...         form_values['country'] = 'US'
```

This tests that the field 'state' must be filled in if the country is US, and defaults that country value to 'US'. The `validator` argument is the SimpleFormValidator instance, which you can use to format messages or keep configuration state in if you like (for simple ad hoc validation you are unlikely to need it).

To create a validator from that function, you would do:

```
>>> from formencode.schema import SimpleFormValidator
>>> validator = SimpleFormValidator(validate)
>>> validator.to_python({'country': 'US', 'state': ''}, None)
Traceback (most recent call last):
    ...
Invalid: state: You must enter a state
>>> sorted(validator.to_python({'state': 'IL'}, None).items())
[('country', 'US'), ('state', 'IL')]
```

The validate function can either return a single error message (that applies to the whole form), a dictionary that applies to the fields, None which means the form is valid, or it can raise Invalid.

Note that you may update the value_dict *in place*, but you cannot return a new value.

Another way to instantiate a validator is like this:

```
>>> @SimpleFormValidator.decorate()
... def MyValidator(value_dict, state):
...     return None # or some more useful validation
```

After this `MyValidator` will be a `SimpleFormValidator` instance (it won't be your function).

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

29.1.2 Validators

Validator/Converters for use with FormEncode.

class `formencode.validators.`**`Bool`**(**args*, ***kw*)
Always Valid, returns True or False based on the value and the existance of the value.

If you want to convert strings like `'true'` to booleans, then use `StringBool`.

Examples:

```
>>> Bool.to_python(0)
False
>>> Bool.to_python(1)
True
>>> Bool.to_python('')
False
>>> Bool.to_python(None)
False
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class `formencode.validators.`**`CIDR`**(**args*, ***kw*)
Formencode validator to check whether a string is in correct CIDR notation (IP address, or IP address plus /mask).

Examples:

```
>>> cidr = CIDR()
>>> cidr.to_python('127.0.0.1')
'127.0.0.1'
>>> cidr.to_python('299.0.0.1')
Traceback (most recent call last):
    ...
Invalid: The octets must be within the range of 0-255 (not '299')
>>> cidr.to_python('192.168.0.1/1')
Traceback (most recent call last):
    ...
Invalid: The network size (bits) must be within the range of 8-32 (not '1')
>>> cidr.to_python('asdf')
```

```
    Traceback (most recent call last):
        ...
    Invalid: Please enter a valid IP address (a.b.c.d) or IP network (a.b.c.d/e)
```

Messages

badFormat: Please enter a valid IP address (a.b.c.d) or IP network (a.b.c.d/e)

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

illegalBits: The network size (bits) must be within the range of 8-32 (not `%(bits)r`)

illegalOctets: The octets must be within the range of 0-255 (not `%(octet)r`)

leadingZeros: The octets must not have leading zeros

noneType: The input must be a string (not None)

class formencode.validators.**CreditCardValidator**(**args*, ***kw*)
Checks that credit card numbers are valid (if not real).

You pass in the name of the field that has the credit card type and the field with the credit card number. The credit card type should be one of "visa", "mastercard", "amex", "dinersclub", "discover", "jcb".

You must check the expiration date yourself (there is no relation between CC number/types and expiration dates).

```
    >>> cc = CreditCardValidator()
    >>> sorted(cc.to_python({'ccType': 'visa', 'ccNumber': '4111111111111111'}).items())
    [('ccNumber', '4111111111111111'), ('ccType', 'visa')]
    >>> cc.to_python({'ccType': 'visa', 'ccNumber': '411111111111111'})
    Traceback (most recent call last):
        ...
    Invalid: ccNumber: You did not enter a valid number of digits
    >>> cc.to_python({'ccType': 'visa', 'ccNumber': '411111111111112'})
    Traceback (most recent call last):
        ...
    Invalid: ccNumber: You did not enter a valid number of digits
    >>> cc().to_python({})
    Traceback (most recent call last):
        ...
    Invalid: The field ccType is missing
```

Messages

badLength: You did not enter a valid number of digits

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalidNumber: That number is not valid

missing_key: The field `%(key)s` is missing

noneType: The input must be a string (not None)

notANumber: Please enter only the number, no other characters

class formencode.validators.**CreditCardExpires**(**args*, ***kw*)
Checks that credit card expiration date is valid relative to the current date.

You pass in the name of the field that has the credit card expiration month and the field with the credit card expiration year.

```
>>> ed = CreditCardExpires()
>>> sorted(ed.to_python({'ccExpiresMonth': '11', 'ccExpiresYear': '2250'}).items())
[('ccExpiresMonth', '11'), ('ccExpiresYear', '2250')]
>>> ed.to_python({'ccExpiresMonth': '10', 'ccExpiresYear': '2005'})
Traceback (most recent call last):
    ...
Invalid: ccExpiresMonth: Invalid Expiration Date<br>
ccExpiresYear: Invalid Expiration Date
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalidNumber: Invalid Expiration Date

noneType: The input must be a string (not None)

notANumber: Please enter numbers only for month and year

class formencode.validators.**CreditCardSecurityCode**(**args*, ***kw*)
Checks that credit card security code has the correct number of digits for the given credit card type.

You pass in the name of the field that has the credit card type and the field with the credit card security code.

```
>>> code = CreditCardSecurityCode()
>>> sorted(code.to_python({'ccType': 'visa', 'ccCode': '111'}).items())
[('ccCode', '111'), ('ccType', 'visa')]
>>> code.to_python({'ccType': 'visa', 'ccCode': '1111'})
Traceback (most recent call last):
    ...
Invalid: ccCode: Invalid credit card security code length
```

Messages

badLength: Invalid credit card security code length

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

notANumber: Please enter numbers only for credit card security code

class formencode.validators.**DateConverter**(**args*, ***kw*)
Validates and converts a string date, like mm/yy, dd/mm/yy, dd-mm-yy, etc. Using `month_style` you can support `'mm/dd/yyyy'` or `'dd/mm/yyyy'`. Only these two general styles are supported.

Accepts English month names, also abbreviated. Returns value as a datetime object (you can get mx.DateTime objects if you use `datetime_module='mxDateTime'`). Two year dates are assumed to be within 1950-2020, with dates from 21-49 being ambiguous and signaling an error.

Use accept_day=False if you just want a month/year (like for a credit card expiration date).

```
>>> d = DateConverter()
>>> d.to_python('12/3/09')
datetime.date(2009, 12, 3)
>>> d.to_python('12/3/2009')
```

```
    datetime.date(2009, 12, 3)
    >>> d.to_python('2/30/04')
    Traceback (most recent call last):
        ...
    Invalid: That month only has 29 days
    >>> d.to_python('13/2/05')
    Traceback (most recent call last):
        ...
    Invalid: Please enter a month from 1 to 12
    >>> d.to_python('1/1/200')
    Traceback (most recent call last):
        ...
    Invalid: Please enter a four-digit year after 1899
```

If you change `month_style` you can get European-style dates:

```
    >>> d = DateConverter(month_style='dd/mm/yyyy')
    >>> date = d.to_python('12/3/09')
    >>> date
    datetime.date(2009, 3, 12)
    >>> d.from_python(date)
    '12/03/2009'
```

Messages

badFormat: Please enter the date in the form `%(format)s`

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

dayRange: That month only has `%(days)i` days

empty: Please enter a value

fourDigitYear: Please enter a four-digit year after 1899

invalidDate: That is not a valid day (`%(exception)s`)

invalidDay: Please enter a valid day

invalidYear: Please enter a number for the year

monthRange: Please enter a month from 1 to 12

noneType: The input must be a string (not None)

unknownMonthName: Unknown month name: `%(month)s`

wrongFormat: Please enter the date in the form `%(format)s`

class `formencode.validators.`**`DateValidator`**(**args*, ***kw*)

Validates that a date is within the given range. Be sure to call DateConverter first if you aren't expecting mxDateTime input.

`earliest_date` and `latest_date` may be functions; if so, they will be called each time before validating.

`after_now` means a time after the current timestamp; note that just a few milliseconds before now is invalid! `today_or_after` is more permissive, and ignores hours and minutes.

Examples:

```
    >>> from datetime import datetime, timedelta
    >>> d = DateValidator(earliest_date=datetime(2003, 1, 1))
    >>> d.to_python(datetime(2004, 1, 1))
```

```
    datetime.datetime(2004, 1, 1, 0, 0)
    >>> d.to_python(datetime(2002, 1, 1))
    Traceback (most recent call last):
        ...
    Invalid: Date must be after Wednesday, 01 January 2003
    >>> d.to_python(datetime(2003, 1, 1))
    datetime.datetime(2003, 1, 1, 0, 0)
    >>> d = DateValidator(after_now=True)
    >>> now = datetime.now()
    >>> d.to_python(now+timedelta(seconds=5)) == now+timedelta(seconds=5)
    True
    >>> d.to_python(now-timedelta(days=1))
    Traceback (most recent call last):
        ...
    Invalid: The date must be sometime in the future
    >>> d.to_python(now+timedelta(days=1)) > now
    True
    >>> d = DateValidator(today_or_after=True)
    >>> d.to_python(now) == now
    True
```

Messages

after: Date must be after `%(date)s`

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

before: Date must be before `%(date)s`

date_format: %%A, %%d %%B %%Y

empty: Please enter a value

future: The date must be sometime in the future

noneType: The input must be a string (not None)

class `formencode.validators.`**`DictConverter`**(**args*, ***kw*)

Converts values based on a dictionary which has values as keys for the resultant values.

If `allowNull` is passed, it will not balk if a false value (e.g., '' or None) is given (it will return None in these cases).

to_python takes keys and gives values, from_python takes values and gives keys.

If you give hideDict=True, then the contents of the dictionary will not show up in error messages.

Examples:

```
    >>> dc = DictConverter({1: 'one', 2: 'two'})
    >>> dc.to_python(1)
    'one'
    >>> dc.from_python('one')
    1
    >>> dc.to_python(3)
    Traceback (most recent call last):
        ....
    Invalid: Enter a value from: 1; 2
    >>> dc2 = dc(hideDict=True)
    >>> dc2.hideDict
    True
    >>> dc2.dict
    {1: 'one', 2: 'two'}
```

```
>>> dc2.to_python(3)
Traceback (most recent call last):
    ....
Invalid: Choose something
>>> dc.from_python('three')
Traceback (most recent call last):
    ....
Invalid: Nothing in my dictionary goes by the value 'three'.  Choose one of: 'one'; 'two'
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

chooseKey: Enter a value from: `%(items)s`

chooseValue: Nothing in my dictionary goes by the value `%(value)s`. Choose one of: `%(items)s`

empty: Please enter a value

keyNotFound: Choose something

noneType: The input must be a string (not None)

valueNotFound: That value is not known

class formencode.validators.**Email**(**args*, ***kw*)
Validate an email address.

If you pass `resolve_domain=True`, then it will try to resolve the domain name to make sure it's valid. This takes longer, of course. You must have the pyDNS modules installed to look up DNS (MX and A) records.

```
>>> e = Email()
>>> e.to_python(' test@foo.com ')
'test@foo.com'
>>> e.to_python('test')
Traceback (most recent call last):
    ...
Invalid: An email address must contain a single @
>>> e.to_python('test@foobar')
Traceback (most recent call last):
    ...
Invalid: The domain portion of the email address is invalid (the portion after the @: foobar)
>>> e.to_python('test@foobar.com.5')
Traceback (most recent call last):
    ...
Invalid: The domain portion of the email address is invalid (the portion after the @: foobar.com
>>> e.to_python('test@foo..bar.com')
Traceback (most recent call last):
    ...
Invalid: The domain portion of the email address is invalid (the portion after the @: foo..bar.c
>>> e.to_python('test@.foo.bar.com')
Traceback (most recent call last):
    ...
Invalid: The domain portion of the email address is invalid (the portion after the @: .foo.bar.c
>>> e.to_python('nobody@xn--m7r7ml7t24h.com')
'nobody@xn--m7r7ml7t24h.com'
>>> e.to_python('o*reilly@test.com')
'o*reilly@test.com'
>>> e = Email(resolve_domain=True)
>>> e.resolve_domain
```

```
    True
    >>> e.to_python('doesnotexist@colorstudy.com')
    'doesnotexist@colorstudy.com'
    >>> e.to_python('test@nyu.edu')
    'test@nyu.edu'
    >>> # NOTE: If you do not have PyDNS installed this example won't work:
    >>> e.to_python('test@thisdomaindoesnotexistithinkforsure.com')
    Traceback (most recent call last):
        ...
    Invalid: The domain of the email address does not exist (the portion after the @: thisdomaindoes
    >>> e.to_python(u'test@google.com')
    u'test@google.com'
    >>> e = Email(not_empty=False)
    >>> e.to_python('')
```

Messages

badDomain: The domain portion of the email address is invalid (the portion after the @: `%(domain)s`)

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

badUsername: The username portion of the email address is invalid (the portion before the @: `%(username)s`)

domainDoesNotExist: The domain of the email address does not exist (the portion after the @: `%(domain)s`)

empty: Please enter an email address

noAt: An email address must contain a single @

noneType: The input must be a string (not None)

socketError: An error occured when trying to connect to the server: `%(error)s`

class formencode.validators.**Empty**(**args*, ***kw*)
Invalid unless the value is empty. Use cleverly, if at all.

Examples:

```
    >>> Empty.to_python(0)
    Traceback (most recent call last):
      ...
    Invalid: You cannot enter a value here
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

notEmpty: You cannot enter a value here

class formencode.validators.**FieldsMatch**(**args*, ***kw*)
Tests that the given fields match, i.e., are identical. Useful for password+confirmation fields. Pass the list of field names in as *field_names*.

```
    >>> f = FieldsMatch('pass', 'conf')
    >>> sorted(f.to_python({'pass': 'xx', 'conf': 'xx'}).items())
    [('conf', 'xx'), ('pass', 'xx')]
    >>> f.to_python({'pass': 'xx', 'conf': 'yy'})
```

```
Traceback (most recent call last):
    ...
Invalid: conf: Fields do not match
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalid: Fields do not match (should be `%(match)s`)

invalidNoMatch: Fields do not match

noneType: The input must be a string (not None)

notDict: Fields should be a dictionary

class `formencode.validators.`**FieldStorageUploadConverter**(**args*, ***kw*)
Handles cgi.FieldStorage instances that are file uploads.

This doesn't do any conversion, but it can detect empty upload fields (which appear like normal fields, but have no filename when no upload was given).

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class `formencode.validators.`**FileUploadKeeper**(**args*, ***kw*)
Takes two inputs (a dictionary with keys `static` and `upload`) and converts them into one value on the Python side (a dictionary with `filename` and `content` keys). The upload takes priority over the static value. The filename may be None if it can't be discovered.

Handles uploads of both text and `cgi.FieldStorage` upload values.

This is basically for use when you have an upload field, and you want to keep the upload around even if the rest of the form submission fails. When converting *back* to the form submission, there may be extra values `'original_filename'` and `'original_content'`, which may want to use in your form to show the user you still have their content around.

To use this, make sure you are using variabledecode, then use something like:

```
<input type="file" name="myfield.upload">
<input type="hidden" name="myfield.static">
```

Then in your scheme:

```
class MyScheme(Scheme):
    myfield = FileUploadKeeper()
```

Note that big file uploads mean big hidden fields, and lots of bytes passed back and forth in the case of an error.

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class formencode.validators.**FormValidator**(**args*, ***kw*)
A FormValidator is something that can be chained with a Schema.

Unlike normal chaining the FormValidator can validate forms that aren't entirely valid.

The important method is .validate(), of course. It gets passed a dictionary of the (processed) values from the form. If you have .validate_partial_form set to True, then it will get the incomplete values as well – check with the "in" operator if the form was able to process any particular field.

Anyway, .validate() should return a string or a dictionary. If a string, it's an error message that applies to the whole form. If not, then it should be a dictionary of fieldName: errorMessage. The special key "form" is the error message for the form as a whole (i.e., a string is equivalent to {"form": string}).

Returns None on no errors.

Messages

badType: The input must be a string (not a %(type)s: %(value)r)

empty: Please enter a value

noneType: The input must be a string (not None)

class formencode.validators.**IndexListConverter**(**args*, ***kw*)
Converts a index (which may be a string like '2') to the value in the given list.

Examples:

```
>>> index = IndexListConverter(['zero', 'one', 'two'])
>>> index.to_python(0)
'zero'
>>> index.from_python('zero')
0
>>> index.to_python('1')
'one'
>>> index.to_python(5)
Traceback (most recent call last):
Invalid: Index out of range
>>> index(not_empty=True).to_python(None)
Traceback (most recent call last):
Invalid: Please enter a value
>>> index.from_python('five')
Traceback (most recent call last):
Invalid: Item 'five' was not found in the list
```

Messages

badType: The input must be a string (not a %(type)s: %(value)r)

empty: Please enter a value

integer: Must be an integer index

noneType: The input must be a string (not None)

notFound: Item %(value)s was not found in the list

outOfRange: Index out of range

class formencode.validators.**Int**(**args*, ***kw*)
Convert a value to an integer.

Example:

```
>>> Int.to_python('10')
10
>>> Int.to_python('ten')
Traceback (most recent call last):
    ...
Invalid: Please enter an integer value
>>> Int(min=5).to_python('6')
6
>>> Int(max=10).to_python('11')
Traceback (most recent call last):
    ...
Invalid: Please enter a number that is 10 or smaller
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

integer: Please enter an integer value

noneType: The input must be a string (not None)

tooHigh: Please enter a number that is `%(max)s` or smaller

tooLow: Please enter a number that is `%(min)s` or greater

class formencode.validators.**IPhoneNumberValidator**

class formencode.validators.**MACAddress**(**args*, ***kw*)
Formencode validator to check whether a string is a correct hardware (MAC) address.

Examples:

```
>>> mac = MACAddress()
>>> mac.to_python('aa:bb:cc:dd:ee:ff')
'aabbccddeeff'
>>> mac.to_python('aa:bb:cc:dd:ee:ff:e')
Traceback (most recent call last):
    ...
Invalid: A MAC address must contain 12 digits and A-F; the value you gave has 13 characters
>>> mac.to_python('aa:bb:cc:dd:ee:fx')
Traceback (most recent call last):
    ...
Invalid: MAC addresses may only contain 0-9 and A-F (and optionally :), not 'x'
>>> MACAddress(add_colons=True).to_python('aabbccddeeff')
'aa:bb:cc:dd:ee:ff'
```

Messages

badCharacter: MAC addresses may only contain 0-9 and A-F (and optionally :), not `%(char)r`

badLength: A MAC address must contain 12 digits and A-F; the value you gave has `%(length)s` characters

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class formencode.validators.**MaxLength**(**args*, ***kw*)
Invalid if the value is longer than *maxLength*. Uses len(), so it can work for strings, lists, or anything with length.

Examples:

```
>>> max5 = MaxLength(5)
>>> max5.to_python('12345')
'12345'
>>> max5.from_python('12345')
'12345'
>>> max5.to_python('123456')
Traceback (most recent call last):
  ...
Invalid: Enter a value less than 5 characters long
>>> max5(accept_python=False).from_python('123456')
Traceback (most recent call last):
  ...
Invalid: Enter a value less than 5 characters long
>>> max5.to_python([1, 2, 3])
[1, 2, 3]
>>> max5.to_python([1, 2, 3, 4, 5, 6])
Traceback (most recent call last):
  ...
Invalid: Enter a value less than 5 characters long
>>> max5.to_python(5)
Traceback (most recent call last):
  ...
Invalid: Invalid value (value with length expected)
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalid: Invalid value (value with length expected)

noneType: The input must be a string (not None)

tooLong: Enter a value less than `%(maxLength)i` characters long

class `formencode.validators.`**MinLength**(**args*, ***kw*)

Invalid if the value is shorter than *minlength*. Uses len(), so it can work for strings, lists, or anything with length. Note that you **must** use `not_empty=True` if you don't want to accept empty values – empty values are not tested for length.

Examples:

```
>>> min5 = MinLength(5)
>>> min5.to_python('12345')
'12345'
>>> min5.from_python('12345')
'12345'
>>> min5.to_python('1234')
Traceback (most recent call last):
  ...
Invalid: Enter a value at least 5 characters long
>>> min5(accept_python=False).from_python('1234')
Traceback (most recent call last):
  ...
Invalid: Enter a value at least 5 characters long
>>> min5.to_python([1, 2, 3, 4, 5])
[1, 2, 3, 4, 5]
>>> min5.to_python([1, 2, 3])
```

```
    Traceback (most recent call last):
      ...
    Invalid: Enter a value at least 5 characters long
    >>> min5.to_python(5)
    Traceback (most recent call last):
      ...
    Invalid: Invalid value (value with length expected)
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalid: Invalid value (value with length expected)

noneType: The input must be a string (not None)

tooShort: Enter a value at least `%(minLength)i` characters long

class `formencode.validators.`**`Number`**(**args*, ***kw*)

Convert a value to a float or integer.

Tries to convert it to an integer if no information is lost.

Example:

```
>>> Number.to_python('10')
10
>>> Number.to_python('10.5')
10.5
>>> Number.to_python('ten')
Traceback (most recent call last):
    ...
Invalid: Please enter a number
>>> Number(min=5).to_python('6.5')
6.5
>>> Number(max=10.5).to_python('11.5')
Traceback (most recent call last):
    ...
Invalid: Please enter a number that is 10.5 or smaller
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

number: Please enter a number

tooHigh: Please enter a number that is `%(max)s` or smaller

tooLow: Please enter a number that is `%(min)s` or greater

class `formencode.validators.`**`NotEmpty`**(**args*, ***kw*)

Invalid if value is empty (empty string, empty list, etc).

Generally for objects that Python considers false, except zero which is not considered invalid.

Examples:

```
>>> ne = NotEmpty(messages=dict(empty='enter something'))
>>> ne.to_python('')
Traceback (most recent call last):
  ...
Invalid: enter something
>>> ne.to_python(0)
0
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class `formencode.validators.`**`OneOf`**(**args*, ***kw*)
Tests that the value is one of the members of a given list.

If `testValueList=True`, then if the input value is a list or tuple, all the members of the sequence will be checked (i.e., the input must be a subset of the allowed values).

Use `hideList=True` to keep the list of valid values out of the error message in exceptions.

Examples:

```
>>> oneof = OneOf([1, 2, 3])
>>> oneof.to_python(1)
1
>>> oneof.to_python(4)
Traceback (most recent call last):
  ...
Invalid: Value must be one of: 1; 2; 3 (not 4)
>>> oneof(testValueList=True).to_python([2, 3, [1, 2, 3]])
[2, 3, [1, 2, 3]]
>>> oneof.to_python([2, 3, [1, 2, 3]])
Traceback (most recent call last):
  ...
Invalid: Value must be one of: 1; 2; 3 (not [2, 3, [1, 2, 3]])
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalid: Invalid value

noneType: The input must be a string (not None)

notIn: Value must be one of: `%(items)s` (not `%(value)r`)

class `formencode.validators.`**`PhoneNumber`**

class `formencode.validators.`**`PlainText`**(**args*, ***kw*)
Test that the field contains only letters, numbers, underscore, and the hyphen. Subclasses Regex.

Examples:

```
>>> PlainText.to_python('_this9_')
'_this9_'
>>> PlainText.from_python('  this  ')
'  this  '
>>> PlainText(accept_python=False).from_python('  this  ')
```

```
    Traceback (most recent call last):
      ...
    Invalid: Enter only letters, numbers, or _ (underscore)
    >>> PlainText(strip=True).to_python('  this  ')
    'this'
    >>> PlainText(strip=True).from_python('  this  ')
    'this'
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalid: Enter only letters, numbers, or _ (underscore)

noneType: The input must be a string (not None)

class `formencode.validators.`**`PostalCode`**

class `formencode.validators.`**`Regex`**`(`*args*, ***kw*`)`
Invalid if the value doesn't match the regular expression *regex*.

The regular expression can be a compiled re object, or a string which will be compiled for you.

Use strip=True if you want to strip the value before validation, and as a form of conversion (often useful).

Examples:

```
    >>> cap = Regex(r'^[A-Z]+$')
    >>> cap.to_python('ABC')
    'ABC'
```

Note that `.from_python()` calls (in general) do not validate the input:

```
    >>> cap.from_python('abc')
    'abc'
    >>> cap(accept_python=False).from_python('abc')
    Traceback (most recent call last):
      ...
    Invalid: The input is not valid
    >>> cap.to_python(1)
    Traceback (most recent call last):
      ...
    Invalid: The input must be a string (not a <type 'int'>: 1)
    >>> Regex(r'^[A-Z]+$', strip=True).to_python('  ABC  ')
    'ABC'
    >>> Regex(r'this', regexOps=('I',)).to_python('THIS')
    'THIS'
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

invalid: The input is not valid

noneType: The input must be a string (not None)

class `formencode.validators.`**`RequireIfMissing`**`(`*args*, ***kw*`)`
Require one field based on another field being present or missing.

This validator is applied to a form, not an individual field (usually using a Schema's `pre_validators` or `chained_validators`) and is available under both names `RequireIfMissing` and `RequireIfPresent`.

If you provide a `missing` value (a string key name) then if that field is missing the field must be entered. This gives you an either/or situation.

If you provide a `present` value (another string key name) then if that field is present, the required field must also be present.

```
>>> from formencode import validators
>>> v = validators.RequireIfPresent('phone_type', present='phone')
>>> v.to_python(dict(phone_type='', phone='510 420  4577'))
Traceback (most recent call last):
    ...
Invalid: You must give a value for phone_type
>>> v.to_python(dict(phone=''))
{'phone': ''}
```

Note that if you have a validator on the optionally-required field, you should probably use `if_missing=None`. This way you won't get an error from the Schema about a missing value. For example:

```
class PhoneInput(Schema):
    phone = PhoneNumber()
    phone_type = String(if_missing=None)
    chained_validators = [RequireIfPresent('phone_type', present='phone')]
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class `formencode.validators.`**Set**(**args*, ***kw*)

This is for when you think you may return multiple values for a certain field.

This way the result will always be a list, even if there's only one result. It's equivalent to ForEach(convert_to_list=True).

If you give `use_set=True`, then it will return an actual `set` object.

```
>>> Set.to_python(None)
[]
>>> Set.to_python('this')
['this']
>>> Set.to_python(('this', 'that'))
['this', 'that']
>>> s = Set(use_set=True)
>>> s.to_python(None)
set([])
>>> s.to_python('this')
set(['this'])
>>> s.to_python(('this',))
set(['this'])
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class formencode.validators.**SignedString**(**args*, ***kw*)

Encodes a string into a signed string, and base64 encodes both the signature string and a random nonce.

It is up to you to provide a secret, and to keep the secret handy and consistent.

Messages

badType: The input must be a string (not a %(type)s: %(value)r)

badsig: Signature is not correct

empty: Please enter a value

malformed: Value does not contain a signature

noneType: The input must be a string (not None)

class formencode.validators.**StateProvince**

class formencode.validators.**String**(**args*, ***kw*)

Converts things to string, but treats empty things as the empty string.

Also takes a *max* and *min* argument, and the string length must fall in that range.

Also you may give an *encoding* argument, which will encode any unicode that is found. Lists and tuples are joined with *list_joiner* (default `', '`) in `from_python`.

```
>>> String(min=2).to_python('a')
Traceback (most recent call last):
    ...
Invalid: Enter a value 2 characters long or more
>>> String(max=10).to_python('xxxxxxxxxxx')
Traceback (most recent call last):
    ...
Invalid: Enter a value not more than 10 characters long
>>> String().from_python(None)
''
>>> String().from_python([])
''
>>> String().to_python(None)
''
>>> String(min=3).to_python(None)
Traceback (most recent call last):
    ...
Invalid: Please enter a value
>>> String(min=1).to_python('')
Traceback (most recent call last):
    ...
Invalid: Please enter a value
```

Messages

badType: The input must be a string (not a %(type)s: %(value)r)

empty: Please enter a value

noneType: The input must be a string (not None)

tooLong: Enter a value not more than %(max)i characters long

tooShort: Enter a value %(min)i characters long or more

class formencode.validators.**StringBool**(**args*, ***kw*)
Converts a string to a boolean.

Values like 'true' and 'false' are considered True and False, respectively; anything in `true_values` is true, anything in `false_values` is false, case-insensitive). The first item of those lists is considered the preferred form.

```
>>> s = StringBool()
>>> s.to_python('yes'), s.to_python('no')
(True, False)
>>> s.to_python(1), s.to_python('N')
(True, False)
>>> s.to_python('ye')
Traceback (most recent call last):
    ...
Invalid: Value should be 'true' or 'false'
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

string: Value should be `%(true)r` or `%(false)r`

class formencode.validators.**StripField**(**args*, ***kw*)
Take a field from a dictionary, removing the key from the dictionary.

`name` is the key. The field value and a new copy of the dictionary with that field removed are returned.

```
>>> StripField('test').to_python({'a': 1, 'test': 2})
(2, {'a': 1})
>>> StripField('test').to_python({})
Traceback (most recent call last):
    ...
Invalid: The name 'test' is missing
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

missing: The name `%(name)s` is missing

noneType: The input must be a string (not None)

class formencode.validators.**TimeConverter**(**args*, ***kw*)
Converts times in the format HH:MM:SSampm to (h, m, s). Seconds are optional.

For ampm, set use_ampm = True. For seconds, use_seconds = True. Use 'optional' for either of these to make them optional.

Examples:

```
>>> tim = TimeConverter()
>>> tim.to_python('8:30')
(8, 30)
>>> tim.to_python('20:30')
(20, 30)
>>> tim.to_python('30:00')
Traceback (most recent call last):
```

```
    ...
Invalid: You must enter an hour in the range 0-23
>>> tim.to_python('13:00pm')
Traceback (most recent call last):
    ...
Invalid: You must enter an hour in the range 1-12
>>> tim.to_python('12:-1')
Traceback (most recent call last):
    ...
Invalid: You must enter a minute in the range 0-59
>>> tim.to_python('12:02pm')
(12, 2)
>>> tim.to_python('12:02am')
(0, 2)
>>> tim.to_python('1:00PM')
(13, 0)
>>> tim.from_python((13, 0))
'13:00:00'
>>> tim2 = tim(use_ampm=True, use_seconds=False)
>>> tim2.from_python((13, 0))
'1:00pm'
>>> tim2.from_python((0, 0))
'12:00am'
>>> tim2.from_python((12, 0))
'12:00pm'
```

Examples with `datetime.time`:

```
>>> v = TimeConverter(use_datetime=True)
>>> a = v.to_python('18:00')
>>> a
datetime.time(18, 0)
>>> b = v.to_python('30:00')
Traceback (most recent call last):
    ...
Invalid: You must enter an hour in the range 0-23
>>> v2 = TimeConverter(prefer_ampm=True, use_datetime=True)
>>> v2.from_python(a)
'6:00:00pm'
>>> v3 = TimeConverter(prefer_ampm=True,
...                    use_seconds=False, use_datetime=True)
>>> a = v3.to_python('18:00')
>>> a
datetime.time(18, 0)
>>> v3.from_python(a)
'6:00pm'
>>> a = v3.to_python('18:00:00')
Traceback (most recent call last):
    ...
Invalid: You may not enter seconds
```

Messages

badHour: You must enter an hour in the range `%(range)s`

badMinute: You must enter a minute in the range 0-59

badNumber: The `%(part)s` value you gave is not a number: `%(number)r`

badSecond: You must enter a second in the range 0-59

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

minutesRequired: You must enter minutes (after a :)

noAMPM: You must indicate AM or PM

noSeconds: You may not enter seconds

noneType: The input must be a string (not None)

secondsRequired: You must enter seconds

tooManyColon: There are too many :'s

class `formencode.validators.`**`UnicodeString`**(***kw*)
Converts things to unicode string, this is a specialization of the String class.

In addition to the String arguments, an encoding argument is also accepted. By default the encoding will be utf-8. You can overwrite this using the encoding parameter. You can also set inputEncoding and outputEncoding differently. An inputEncoding of None means "do not decode", an outputEncoding of None means "do not encode".

All converted strings are returned as Unicode strings.

```
>>> UnicodeString().to_python(None)
u''
>>> UnicodeString().to_python([])
u''
>>> UnicodeString(encoding='utf-7').to_python('Ni Ni Ni')
u'Ni Ni Ni'
```

Messages

badEncoding: Invalid data or incorrect encoding

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

tooLong: Enter a value not more than `%(max)i` characters long

tooShort: Enter a value `%(min)i` characters long or more

class `formencode.validators.`**`URL`**(**args*, ***kw*)
Validate a URL, either http://... or https://. If check_exists is true, then we'll actually make a request for the page.

If add_http is true, then if no scheme is present we'll add http://

```
>>> u = URL(add_http=True)
>>> u.to_python('foo.com')
'http://foo.com'
>>> u.to_python('http://hahaha.ha/bar.html')
'http://hahaha.ha/bar.html'
>>> u.to_python('http://xn--m7r7ml7t24h.com')
'http://xn--m7r7ml7t24h.com'
>>> u.to_python('http://xn--c1aay4a.xn--p1ai')
'http://xn--c1aay4a.xn--p1ai'
>>> u.to_python('http://foo.com/test?bar=baz&fleem=morx')
'http://foo.com/test?bar=baz&fleem=morx'
>>> u.to_python('http://foo.com/login?came_from=http%3A%2F%2Ffoo.com%2Ftest')
```

```
    'http://foo.com/login?came_from=http%3A%2F%2Ffoo.com%2Ftest'
    >>> u.to_python('http://foo.com:8000/test.html')
    'http://foo.com:8000/test.html'
    >>> u.to_python('http://foo.com/something\nelse')
    Traceback (most recent call last):
        ...
    Invalid: That is not a valid URL
    >>> u.to_python('https://test.com')
    'https://test.com'
    >>> u.to_python('http://test')
    Traceback (most recent call last):
        ...
    Invalid: You must provide a full domain name (like test.com)
    >>> u.to_python('http://test..com')
    Traceback (most recent call last):
        ...
    Invalid: That is not a valid URL
    >>> u = URL(add_http=False, check_exists=True)
    >>> u.to_python('http://google.com')
    'http://google.com'
    >>> u.to_python('google.com')
    Traceback (most recent call last):
        ...
    Invalid: You must start your URL with http://, https://, etc
    >>> u.to_python('http://www.formencode.org/does/not/exist/page.html')
    Traceback (most recent call last):
        ...
    Invalid: The server responded that the page could not be found
    >>> u.to_python('http://this.domain.does.not.exist.example.org/test.html')
    ...
    Traceback (most recent call last):
        ...
    Invalid: An error occured when trying to connect to the server: ...
```

If you want to allow addresses without a TLD (e.g., `localhost`) you can do:

```
    >>> URL(require_tld=False).to_python('http://localhost')
    'http://localhost'
```

By default, internationalized domain names (IDNA) in Unicode will be accepted and encoded to ASCII using Punycode (as described in RFC 3490). You may set allow_idna to False to change this behavior:

```
    >>> URL(allow_idna=True).to_python(
    ... u'http://\u0433\u0443\u0433\u043b.\u0440\u0444')
    'http://xn--c1aay4a.xn--p1ai'
    >>> URL(allow_idna=True, add_http=True).to_python(
    ... u'\u0433\u0443\u0433\u043b.\u0440\u0444')
    'http://xn--c1aay4a.xn--p1ai'
    >>> URL(allow_idna=False).to_python(
    ... u'http://\u0433\u0443\u0433\u043b.\u0440\u0444')
    Traceback (most recent call last):
    ...
    Invalid: That is not a valid URL
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

badURL: That is not a valid URL

empty: Please enter a value

httpError: An error occurred when trying to access the URL: `%(error)s`

noScheme: You must start your URL with http://, https://, etc

noTLD: You must provide a full domain name (like `%(domain)s`.com)

noneType: The input must be a string (not None)

notFound: The server responded that the page could not be found

socketError: An error occured when trying to connect to the server: `%(error)s`

status: The server responded with a bad status code (`%(status)s`)

Wrapper Validators

class formencode.validators.**ConfirmType**(**args*, ***kw*)

Confirms that the input/output is of the proper type.

Uses the parameters:

subclass: The class or a tuple of classes; the item must be an instance of the class or a subclass.

type: A type or tuple of types (or classes); the item must be of the exact class or type. Subclasses are not allowed.

Examples:

```
>>> cint = ConfirmType(subclass=int)
>>> cint.to_python(True)
True
>>> cint.to_python('1')
Traceback (most recent call last):
    ...
Invalid: '1' is not a subclass of <type 'int'>
>>> cintfloat = ConfirmType(subclass=(float, int))
>>> cintfloat.to_python(1.0), cintfloat.from_python(1.0)
(1.0, 1.0)
>>> cintfloat.to_python(1), cintfloat.from_python(1)
(1, 1)
>>> cintfloat.to_python(None)
Traceback (most recent call last):
    ...
Invalid: None is not a subclass of one of the types <type 'float'>, <type 'int'>
>>> cint2 = ConfirmType(type=int)
>>> cint2(accept_python=False).from_python(True)
Traceback (most recent call last):
    ...
Invalid: True must be of the type <type 'int'>
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

inSubclass: `%(object)r` is not a subclass of one of the types `%(subclassList)s`

inType: `%(object)r` must be one of the types `%(typeList)s`

noneType: The input must be a string (not None)

subclass: `%(object)r` is not a subclass of `%(subclass)s`

type: `%(object)r` must be of the type `%(type)s`

class `formencode.validators.`**`Wrapper`**`(*args, **kw)`
Used to convert functions to validator/converters.

You can give a simple function for *to_python*, *from_python*, *validate_python* or *validate_other*. If that function raises an exception, the value is considered invalid. Whatever value the function returns is considered the converted value.

Unlike validators, the *state* argument is not used. Functions like *int* can be used here, that take a single argument.

Note that as Wrapper will generate a FancyValidator, empty values (those who pass `FancyValidator.is_empty`) will return `None`. To override this behavior you can use `Wrapper(empty_value=callable)`. For example passing `Wrapper(empty_value=lambda val: val)` will return the value itself when is considered empty.

Examples:

```
>>> def downcase(v):
...     return v.lower()
>>> wrap = Wrapper(to_python=downcase)
>>> wrap.to_python('This')
'this'
>>> wrap.from_python('This')
'This'
>>> wrap.to_python('') is None
True
>>> wrap2 = Wrapper(from_python=downcase, empty_value=lambda val: val)
>>> wrap2.from_python('This')
'this'
>>> wrap2.to_python('')
''
>>> wrap2.from_python(1)
Traceback (most recent call last):
  ...
Invalid: 'int' object has no attribute 'lower'
>>> wrap3 = Wrapper(validate_python=int)
>>> wrap3.to_python('1')
'1'
>>> wrap3.to_python('a')
Traceback (most recent call last):
  ...
Invalid: invalid literal for int()...
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

class `formencode.validators.`**`Constant`**`(*args, **kw)`
This converter converts everything to the same thing.

I.e., you pass in the constant value when initializing, then all values get converted to that constant value.

This is only really useful for funny situations, like:

```
# Any evaluates sub validators in reverse order for to_python
fromEmailValidator = Any(
                        Constant('unknown@localhost'),
                           Email())
```

In this case, the if the email is not valid `'unknown@localhost'` will be used instead. Of course, you could use `if_invalid` instead.

Examples:

```
>>> Constant('X').to_python('y')
'X'
```

Messages

badType: The input must be a string (not a `%(type)s`: `%(value)r`)

empty: Please enter a value

noneType: The input must be a string (not None)

29.1.3 Validator Modifiers

formencode.compound

Validators for applying validations in sequence.

class formencode.compound.**Any**(**args*, ***kw*)

This class is like an 'or' operator for validators. The first validator/converter in the order of evaluation that validates the value will be used.

The order of evaluation differs depending on if you are validating to python or from python as follows:

The validators are evaluated right to left when validating to python.

The validators are evaluated left to right when validating from python.

class formencode.compound.**All**(**args*, ***kw*)

This class is like an 'and' operator for validators. All validators must work, and the results are passed in turn through all validators for conversion in the order of evaluation. All is the same as *Pipe* but operates in the reverse order.

The order of evaluation differs depending on if you are validating to python or from python as follows:

The validators are evaluated right to left when validating to python.

The validators are evaluated left to right when validating from python.

Pipe is more intuitive when predominatenly validating to python.

Examples:

```
>>> from formencode.validators import DictConverter
>>> av = All(validators=[DictConverter({2: 1}), DictConverter({3: 2}), DictConverter({4: 3})])
>>> av.to_python(4)
1
>>> av.from_python(1)
4
```

formencode.foreach

Validator for repeating items.

class formencode.foreach.**ForEach**(**args*, ***kw*)

Use this to apply a validator/converter to each item in a list.

For instance:

```
ForEach(AsInt(), InList([1, 2, 3]))
```

Will take a list of values and try to convert each of them to an integer, and then check if each integer is 1, 2, or 3. Using multiple arguments is equivalent to:

```
ForEach(All(AsInt(), InList([1, 2, 3])))
```

Use convert_to_list=True if you want to force the input to be a list. This will turn non-lists into one-element lists, and None into the empty list. This tries to detect sequences by iterating over them (except strings, which aren't considered sequences).

ForEach will try to convert the entire list, even if errors are encountered. If errors are encountered, they will be collected and a single Invalid exception will be raised at the end (with error_list set).

If the incoming value is a set, then we return a set.

29.1.4 HTML Parsing and Form Filling

formencode.htmlfill

Parser for HTML forms, that fills in defaults and errors. See `render`.

formencode.htmlfill.**render**(*form*, *defaults=None*, *errors=None*, *use_all_keys=False*, *error_formatters=None*, *add_attributes=None*, *auto_insert_errors=True*, *auto_error_formatter=None*, *text_as_default=False*, *checkbox_checked_if_present=False*, *listener=None*, *encoding=None*, *error_class='error'*, *prefix_error=True*, *force_defaults=True*)

Render the `form` (which should be a string) given the `defaults` and `errors`. Defaults are the values that go in the input fields (overwriting any values that are there) and errors are displayed inline in the form (and also effect input classes). Returns the rendered string.

If `auto_insert_errors` is true (the default) then any errors for which `<form:error>` tags can't be found will be put just above the associated input field, or at the top of the form if no field can be found.

If `use_all_keys` is true, if there are any extra fields from defaults or errors that couldn't be used in the form it will be an error.

`error_formatters` is a dictionary of formatter names to one-argument functions that format an error into HTML. Some default formatters are provided if you don't provide this.

`error_class` is the class added to input fields when there is an error for that field.

`add_attributes` is a dictionary of field names to a dictionary of attribute name/values. If the name starts with + then the value will be appended to any existing attribute (e.g., `{'+class': ' important'}`).

`auto_error_formatter` is used to create the HTML that goes above the fields. By default it wraps the error message in a span and adds a `<br>`.

If `text_as_default` is true (default false) then `<input type="unknown">` will be treated as text inputs.

If `checkbox_checked_if_present` is true (default false) then `<input type="checkbox">` will be set to `checked` if any corresponding key is found in the `defaults` dictionary, even a value that evaluates to False (like an empty string). This can be used to support pre-filling of checkboxes that do not have a `value` attribute, since browsers typically will only send the name of the checkbox in the form submission if the checkbox is checked, so simply the presence of the key would mean the box should be checked.

`listener` can be an object that watches fields pass; the only one currently is in `htmlfill_schemabuilder.SchemaBuilder`

`encoding` specifies an encoding to assume when mixing str and unicode text in the template.

`prefix_error` specifies if the HTML created by auto_error_formatter is put before the input control (default) or after the control.

`force_defaults` specifies if a field default is not given in the `defaults` dictionary then the control associated with the field should be set as an unsuccessful control. So checkboxes will be cleared, radio and select controls will have no value selected, and textareas will be emptied. This defaults to `True`, which is appropriate the defaults are the result of a form submission.

`formencode.htmlfill.`**`default_formatter`**(*error*)
Formatter that escapes the error, wraps the error in a span with class `error-message`, and adds a `<br>`

`formencode.htmlfill.`**`none_formatter`**(*error*)
Formatter that does nothing, no escaping HTML, nothin'

`formencode.htmlfill.`**`escape_formatter`**(*error*)
Formatter that escapes HTML, no more.

`formencode.htmlfill.`**`escapenl_formatter`**(*error*)
Formatter that escapes HTML, and translates newlines to `<br>`

class `formencode.htmlfill.`**`FillingParser`**(*defaults*, *errors=None*, *use_all_keys=False*, *error_formatters=None*, *error_class='error'*, *add_attributes=None*, *listener=None*, *auto_error_formatter=None*, *text_as_default=False*, *checkbox_checked_if_present=False*, *encoding=None*, *prefix_error=True*, *force_defaults=True*)
Fills HTML with default values, as in a form.

Examples:

```
>>> defaults = dict(name='Bob Jones',
...                 occupation='Crazy Cultist',
...                 address='14 W. Canal\nNew Guinea',
...                 living='no',
...                 nice_guy=0)
>>> parser = FillingParser(defaults)
>>> parser.feed('''<input type="text" name="name" value="fill">
... <select name="occupation"> <option value="">Default</option>
... <option value="Crazy Cultist">Crazy cultist</option> </select>
... <textarea cols="20" style="width: 100%" name="address">
... An address</textarea>
... <input type="radio" name="living" value="yes">
... <input type="radio" name="living" value="no">
... <input type="checkbox" name="nice_guy" checked="checked">''')
>>> parser.close()
```

```
>>> print parser.text()
<input type="text" name="name" value="Bob Jones">
<select name="occupation">
<option value="">Default</option>
<option value="Crazy Cultist" selected="selected">Crazy cultist</option>
</select>
<textarea cols="20" style="width: 100%" name="address">14 W. Canal
New Guinea</textarea>
<input type="radio" name="living" value="yes">
<input type="radio" name="living" value="no" checked="checked">
<input type="checkbox" name="nice_guy">
```

29.2 weberror – Weberror

29.2.1 weberror.errormiddleware

Error handler middleware

class weberror.errormiddleware.**ErrorMiddleware**(*application*, *global_conf=None*, *debug=<NoDefault>*, *error_email=None*, *error_log=None*, *show_exceptions_in_wsgi_errors=<NoDefault>*, *from_address=None*, *smtp_server=None*, *smtp_username=None*, *smtp_password=None*, *smtp_use_tls=False*, *error_subject_prefix=None*, *error_message=None*, *xmlhttp_key=None*, *reporters=None*)

Error handling middleware

Usage:

```
error_catching_wsgi_app = ErrorMiddleware(wsgi_app)
```

Settings:

debug: If true, then tracebacks will be shown in the browser.

error_email: an email address (or list of addresses) to send exception reports to

error_log: a filename to append tracebacks to

show_exceptions_in_wsgi_errors: If true, then errors will be printed to `wsgi.errors` (frequently a server error log, or stderr).

from_address, smtp_server, error_subject_prefix, smtp_username, smtp_password, smtp_use_t variables to control the emailed exception reports

error_message: When debug mode is off, the error message to show to users.

xmlhttp_key: When this key (default _) is in the request GET variables (not POST!), expect that this is an XMLHttpRequest, and the response should be more minimal; it should not be a complete HTML page.

Environment Configuration:

paste.throw_errors: If this setting in the request environment is true, then this middleware is disabled. This can be useful in a testing situation where you don't want errors to be caught and transformed.

paste.expected_exceptions: When this middleware encounters an exception listed in this environment variable and when the `start_response` has not yet occurred, the exception will be re-raised instead of being caught. This should generally be set by middleware that may (but probably shouldn't be) installed above this middleware, and wants to get certain exceptions. Exceptions raised after `start_response` have been called are always caught since by definition they are no longer expected.

29.2.2 weberror.evalcontext

class weberror.evalcontext.**EvalContext**(*namespace*, *globs*)

Class that represents a interactive interface. It has its own namespace. Use eval_context.exec_expr(expr) to run commands; the output of those commands is returned, as are print statements.

This is essentially what doctest does, and is taken directly from doctest.

29.2.3 weberror.evalexception

Exception-catching middleware that allows interactive debugging.

This middleware catches all unexpected exceptions. A normal traceback, like produced by `weberror.exceptions.errormiddleware.ErrorMiddleware` is given, plus controls to see local variables and evaluate expressions in a local context.

This can only be used in single-process environments, because subsequent requests must go back to the same process that the exception originally occurred in. Threaded or non-concurrent environments both work.

This shouldn't be used in production in any way. That would just be silly.

If calling from an XMLHttpRequest call, if the GET variable _ is given then it will make the response more compact (and less Javascripty), since if you use innerHTML it'll kill your browser. You can look for the header X-Debug-URL in your 500 responses if you want to see the full debuggable traceback. Also, this URL is printed to `wsgi.errors`, so you can open it up in another browser window.

class weberror.evalexception.**EvalException**(*application*, *global_conf=None*, *error_template_filename=None*, *xmlhttp_key=None*, *media_paths=None*, *templating_formatters=None*, *head_html=''*, *footer_html=''*, *reporters=None*, *libraries=None*, ***params*)

Handles capturing an exception and turning it into an interactive exception explorer

media(*req*)

Static path where images and other files live

relay(*req*)

Relay a request to a remote machine for JS proxying

summary(*req*)

Returns a JSON-format summary of all the cached exception reports

view(*req*)

View old exception reports

29.2.4 weberror.formatter

Formatters for the exception data that comes from ExceptionCollector.

class weberror.formatter.**AbstractFormatter**(*show_hidden_frames=False, include_reusable=True, show_extra_data=True, trim_source_paths=(), **kwargs*)

filter_frames(*frames*)
Removes any frames that should be hidden, according to the values of traceback_hide, self.show_hidden_frames, and the hidden status of the final frame.

format_frame_end(*frame*)
Called after each frame ends; may return None to output no text.

format_frame_start(*frame*)
Called before each frame starts; may return None to output no text.

long_item_list(*lst*)
Returns true if the list contains items that are long, and should be more nicely formatted.

pretty_string_repr(*s*)
Formats the string as a triple-quoted string when it contains newlines.

class weberror.formatter.**TextFormatter**(*show_hidden_frames=False, include_reusable=True, show_extra_data=True, trim_source_paths=(), **kwargs*)

class weberror.formatter.**HTMLFormatter**(*show_hidden_frames=False, include_reusable=True, show_extra_data=True, trim_source_paths=(), **kwargs*)

class weberror.formatter.**XMLFormatter**(*show_hidden_frames=False, include_reusable=True, show_extra_data=True, trim_source_paths=(), **kwargs*)

weberror.formatter.**create_text_node**(*doc, elem, text*)

weberror.formatter.**html_quote**(*s*)

weberror.formatter.**format_html**(*exc_data, include_hidden_frames=False, **ops*)

weberror.formatter.**format_text**(*exc_data, **ops*)

weberror.formatter.**format_xml**(*exc_data, **ops*)

weberror.formatter.**str2html**(*src, strip=False, indent_subsequent=0, highlight_inner=False, frame=None, filename=None*)
Convert a string to HTML. Try to be really safe about it, returning a quoted version of the string if nothing else works.

weberror.formatter.**_str2html**(*src, strip=False, indent_subsequent=0, highlight_inner=False, frame=None, filename=None*)

weberror.formatter.**truncate**(*string, limit=1000*)
Truncate the string to the limit number of characters

weberror.formatter.**make_wrappable**(*html, wrap_limit=60, split_on=';?&@!$#-/\\"\''*)

weberror.formatter.**make_pre_wrappable**(*html, wrap_limit=60, split_on=';?&@!$#-/\\"\''*)
Like `make_wrappable()` but intended for text that will go in a `<pre>` block, so wrap on a line-by-line basis.

29.2.5 weberror.reporter

class weberror.reporter.**Reporter**(***conf*)

class weberror.reporter.**EmailReporter**(***conf*)

class weberror.reporter.**LogReporter**(***conf*)

class weberror.reporter.**FileReporter**(***conf*)

class weberror.reporter.**WSGIAppReporter**(*exc_data*)

29.2.6 weberror.collector

An exception collector that finds traceback information plus supplements

class weberror.collector.**ExceptionCollector**(*limit=None*)
Produces a data structure that can be used by formatters to display exception reports.

Magic variables:

If you define one of these variables in your local scope, you can add information to tracebacks that happen in that context. This allows applications to add all sorts of extra information about the context of the error, including URLs, environmental variables, users, hostnames, etc. These are the variables we look for:

__traceback_supplement__: You can define this locally or globally (unlike all the other variables, which must be defined locally).

`__traceback_supplement__` is a tuple of `(factory, arg1, arg2...)`. When there is an exception, `factory(arg1, arg2, ...)` is called, and the resulting object is inspected for supplemental information.

__traceback_info__: This information is added to the traceback, usually fairly literally.

__traceback_hide__: If set and true, this indicates that the frame should be hidden from abbreviated tracebacks. This way you can hide some of the complexity of the larger framework and let the user focus on their own errors.

By setting it to `'before'`, all frames before this one will be thrown away. By setting it to `'after'` then all frames after this will be thrown away until `'reset'` is found. In each case the frame where it is set is included, unless you append `'_and_this'` to the value (e.g., `'before_and_this'`).

Note that formatters will ignore this entirely if the frame that contains the error wouldn't normally be shown according to these rules.

__traceback_reporter__: This should be a reporter object (see the reporter module), or a list/tuple of reporter objects. All reporters found this way will be given the exception, innermost first.

__traceback_decorator__: This object (defined in a local or global scope) will get the result of this function (the CollectedException defined below). It may modify this object in place, or return an entirely new object. This gives the object the ability to manipulate the traceback arbitrarily.

The actually interpretation of these values is largely up to the reporters and formatters.

`collect_exception(*sys.exc_info())` will return an object with several attributes:

frames: A list of frames

exception_formatted: The formatted exception, generally a full traceback

exception_type: The type of the exception, like `ValueError`

exception_value: The string value of the exception, like `'x not in list'`

identification_code: A hash of the exception data meant to identify the general exception, so that it shares this code with other exceptions that derive from the same problem. The code is a hash of all the module names and function names in the traceback, plus exception_type. This should be shown to users so they can refer to the exception later. (@@: should it include a portion that allows identification of the specific instance of the exception as well?)

The list of frames goes innermost first. Each frame has these attributes; some values may be None if they could not be determined.

modname: the name of the module

filename: the filename of the module

lineno: the line of the error

revision: the contents of __version__ or __revision__

name: the function name

supplement: an object created from `__traceback_supplement__`

supplement_exception: a simple traceback of any exception `__traceback_supplement__` created

traceback_info: the str() of any `__traceback_info__` variable found in the local scope (@@: should it str()-ify it or not?)

traceback_hide: the value of any `__traceback_hide__` variable

traceback_log: the value of any `__traceback_log__` variable

`__traceback_supplement__` is thrown away, but a fixed set of attributes are captured; each of these attributes is optional.

object: the name of the object being visited

source_url: the original URL requested

line: the line of source being executed (for interpreters, like ZPT)

column: the column of source being executed

expression: the expression being evaluated (also for interpreters)

warnings: a list of (string) warnings to be displayed

getInfo: a function/method that takes no arguments, and returns a string describing any extra information

extraData: a function/method that takes no arguments, and returns a dictionary. The contents of this dictionary will not be displayed in the context of the traceback, but globally for the exception. Results will be grouped by the keys in the dictionaries (which also serve as titles). The keys can also be tuples of (importance, title); in this case the importance should be `important` (shows up at top), `normal` (shows up somewhere; unspecified), `supplemental` (shows up at bottom), or `extra` (shows up hidden or not at all).

These are used to create an object with attributes of the same names (`getInfo` becomes a string attribute, not a method). `__traceback_supplement__` implementations should be careful to produce values that are relatively static and unlikely to cause further errors in the reporting system – any complex introspection should go in `getInfo()` and should ultimately return a string.

Note that all attributes are optional, and under certain circumstances may be None or may not exist at all – the collector can only do a best effort, but must avoid creating any exceptions itself.

Formatters may want to use `__traceback_hide__` as a hint to hide frames that are part of the 'framework' or underlying system. There are a variety of rules about special values for this variables that formatters should be aware of.

TODO:

More attributes in __traceback_supplement__? Maybe an attribute that gives a list of local variables that should also be collected? Also, attributes that would be explicitly meant for the entire request, not just a single frame. Right now some of the fixed set of attributes (e.g., source_url) are meant for this use, but there's no explicit way for the supplement to indicate new values, e.g., logged-in user, HTTP referrer, environment, etc. Also, the attributes that do exist are Zope/Web oriented.

More information on frames? cgitb, for instance, produces extensive information on local variables. There exists the possibility that getting this information may cause side effects, which can make debugging more difficult; but it also provides fodder for post-mortem debugging. However, the collector is not meant to be configurable, but to capture everything it can and let the formatters be configurable. Maybe this would have to be a configuration value, or maybe it could be indicated by another magical variable (which would probably mean 'show all local variables below this frame')

class `weberror.collector.`**`ExceptionFrame`**(***attrs*)
This represents one frame of the exception. Each frame is a context in the call stack, typically represented by a line number and module name in the traceback.

`get_source_line`(*context=0*)
Return the source of the current line of this frame. You probably want to .strip() it as well, as it is likely to have leading whitespace.

If context is given, then that many lines on either side will also be returned. E.g., context=1 will give 3 lines.

`weberror.collector.`**`collect_exception`**(*t*, *v*, *tb*, *limit=None*)
Collection an exception from `sys.exc_info()`.

Use like:

```
try:
    blah blah
except:
    exc_data = collect_exception(*sys.exc_info())
```

29.3 `webtest` – WebTest

Routines for testing WSGI applications.

Most interesting is app

class `webtest.`**`TestApp`**(*app*, *extra_environ=None*, *relative_to=None*, *use_unicode=True*)
Wraps a WSGI application in a more convenient interface for testing.

`app` may be an application, or a Paste Deploy app URI, like `'config:filename.ini#test'`.

`extra_environ` is a dictionary of values that should go into the environment for each request. These can provide a communication channel with the application.

`relative_to` is a directory, and filenames used for file uploads are calculated relative to this. Also `config:` URIs that aren't absolute.

delete(*url*, *params=''*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*, *content_type=None*)
Do a DELETE request. Very like the `.get()` method.

Returns a `webob.Response` object.

delete_json(*url*, *params=<class 'webtest.app.NoDefault'>*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*)
Do a DELETE request. Very like the `.get()` method. Content-Type is set to `application/json`.

Returns a `webob.Response` object.

do_request(*req*, *status*, *expect_errors*)
Executes the given request (`req`), with the expected `status`. Generally `.get()` and `.post()` are used instead.

To use this:

```
resp = app.do_request(webtest.TestRequest.blank(
    'url', ...args...))
```

Note you can pass any keyword arguments to `TestRequest.blank()`, which will be set on the request. These can be arguments like `content_type`, `accept`, etc.

encode_multipart(*params*, *files*)
Encodes a set of parameters (typically a name/value list) and a set of files (a list of (name, filename, file_body)) into a typical POST body, returning the (content_type, body).

get(*url*, *params=None*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*)
Get the given url (well, actually a path like `'/page.html'`).

params: A query string, or a dictionary that will be encoded into a query string. You may also include a query string on the `url`.

headers: A dictionary of extra headers to send.

extra_environ: A dictionary of environmental variables that should be added to the request.

status: The integer status code you expect (if not 200 or 3xx). If you expect a 404 response, for instance, you must give `status=404` or it will be an error. You can also give a wildcard, like `'3*'` or `'*'`.

expect_errors: If this is not true, then if anything is written to `wsgi.errors` it will be an error. If it is true, then non-200/3xx responses are also okay.

Returns a `webtest.TestResponse` object.

head(*url*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*)
Do a HEAD request. Very like the `.get()` method.

Returns a `webob.Response` object.

options(*url*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*)
Do a OPTIONS request. Very like the `.get()` method.

Returns a `webob.Response` object.

post(*url*, *params=''*, *headers=None*, *extra_environ=None*, *status=None*, *upload_files=None*, *expect_errors=False*, *content_type=None*)
Do a POST request. Very like the `.get()` method. `params` are put in the body of the request.

`upload_files` is for file uploads. It should be a list of `[(fieldname, filename, file_content)]`. You can also use just `[(fieldname, filename)]` and the file content will be read from disk.

For post requests params could be a collections.OrderedDict with Upload fields included in order:

app.post('/myurl', collections.OrderedDict([('textfield1', 'value1'), ('uploadfield', webapp.Upload('filename.txt', 'contents'), ('textfield2', 'value2')])))

Returns a `webob.Response` object.

post_json(*url*, *params=<class 'webtest.app.NoDefault'>*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*)
Do a POST request. Very like the `.get()` method. `params` are dumps to json and put in the body of the request. Content-Type is set to `application/json`.

Returns a `webob.Response` object.

put(*url*, *params=''*, *headers=None*, *extra_environ=None*, *status=None*, *upload_files=None*, *expect_errors=False*, *content_type=None*)
Do a PUT request. Very like the `.post()` method. `params` are put in the body of the request, if params is a tuple, dictionary, list, or iterator it will be urlencoded and placed in the body as with a POST, if it is string it will not be encoded, but placed in the body directly.

Returns a `webob.Response` object.

put_json(*url*, *params=<class 'webtest.app.NoDefault'>*, *headers=None*, *extra_environ=None*, *status=None*, *expect_errors=False*)
Do a PUT request. Very like the `.post()` method. `params` are dumps to json and put in the body of the request. Content-Type is set to `application/json`.

Returns a `webob.Response` object.

request(*url_or_req*, *status=None*, *expect_errors=False*, ***req_params*)
Creates and executes a request. You may either pass in an instantiated `TestRequest` object, or you may pass in a URL and keyword arguments to be passed to `TestRequest.blank()`.

You can use this to run a request without the intermediary functioning of `TestApp.get()` etc. For instance, to test a WebDAV method:

```
resp = app.request('/new-col', method='MKCOL')
```

Note that the request won't have a body unless you specify it, like:

```
resp = app.request('/test.txt', method='PUT', body='test')
```

You can use `POST={args}` to set the request body to the serialized arguments, and simultaneously set the request method to `POST`

reset()
Resets the state of the application; currently just clears saved cookies.

class webtest.**TestResponse**(*body=None*, *status=None*, *headerlist=None*, *app_iter=None*, *content_type=None*, *conditional_response=None*, ***kw*)
Instances of this class are return by `TestApp`

click(*description=None*, *linkid=None*, *href=None*, *anchor=None*, *index=None*, *verbose=False*, *extra_environ=None*)
Click the link as described. Each of `description`, `linkid`, and `url` are *patterns*, meaning that they are either strings (regular expressions), compiled regular expressions (objects with a `search` method), or callables returning true or false.

All the given patterns are ANDed together:

- `description` is a pattern that matches the contents of the anchor (HTML and all – everything between `<a...>` and `</a>`)
- `linkid` is a pattern that matches the `id` attribute of the anchor. It will receive the empty string if no id is given.
- `href` is a pattern that matches the `href` of the anchor; the literal content of that attribute, not the fully qualified attribute.
- `anchor` is a pattern that matches the entire anchor, with its contents.

If more than one link matches, then the `index` link is followed. If `index` is not given and more than one link matches, or if no link matches, then `IndexError` will be raised.

If you give `verbose` then messages will be printed about each link, and why it does or doesn't match. If you use `app.click(verbose=True)` you'll see a list of all the links.

You can use multiple criteria to essentially assert multiple aspects about the link, e.g., where the link's destination is.

clickbutton(*description=None*, *buttonid=None*, *href=None*, *button=None*, *index=None*, *verbose=False*)

Like `.click()`, except looks for link-like buttons. This kind of button should look like `<button onclick="...location.href='url'...">`.

follow(***kw*)

If this request is a redirect, follow that redirect. It is an error if this is not a redirect response. Returns another response object.

form

Returns a single `Form` instance; it is an error if there are multiple forms on the page.

forms

A list of :class:'~webtest.Form's found on the page

forms__get()

Returns a dictionary of `Form` objects. Indexes are both in order (from zero) and by form id (if the form is given an id).

goto(*href*, *method='get'*, ***args*)

Go to the (potentially relative) link `href`, using the given method (`'get'` or `'post'`) and any extra arguments you want to pass to the `app.get()` or `app.post()` methods.

All hostnames and schemes will be ignored.

html

Returns the response as a BeautifulSoup object.

Only works with HTML responses; other content-types raise AttributeError.

json

Return the response as a JSON response. You must have simplejson installed to use this, or be using a Python version with the json module.

The content type must be application/json to use this.

lxml

Returns the response as an lxml object. You must have lxml installed to use this.

If this is an HTML response and you have lxml 2.x installed, then an `lxml.html.HTML` object will be returned; if you have an earlier version of lxml then a `lxml.HTML` object will be returned.

mustcontain(**strings*, ***kw*)
Assert that the response contains all of the strings passed in as arguments.

Equivalent to:

```
assert string in res
```

normal_body
Return the whitespace-normalized body

pyquery
Returns the response as a PyQuery object.

Only works with HTML and XML responses; other content-types raise AttributeError.

showbrowser()
Show this response in a browser window (for debugging purposes, when it's hard to read the HTML).

unicode_normal_body
Return the whitespace-normalized body, as unicode

xml
Returns the response as an ElementTree object.

Only works with XML responses; other content-types raise AttributeError

class webtest.**Form**(*response*, *text*)
This object represents a form that has been found in a page. This has a couple useful attributes:

text: the full HTML of the form.

action: the relative URI of the action.

method: the method (e.g., `'GET'`).

id: the id, or None if not given.

fields: a dictionary of fields, each value is a list of fields by that name. `<input type="radio">` and `<select>` are both represented as single fields with multiple options.

FieldClass
alias of `Field`

get(*name*, *index=None*, *default=<class 'webtest.app.NoDefault'>*)
Get the named/indexed field object, or `default` if no field is found.

lint()
Check that the html is valid:

- each field must have an id
- each field must have a label

select(*name*, *value*, *index=None*)
Like `.set()`, except also confirms the target is a `<select>`.

set(*name*, *value*, *index=None*)
Set the given name, using `index` to disambiguate.

submit(*name=None*, *index=None*, ***args*)
Submits the form. If `name` is given, then also select that button (using `index` to disambiguate)''.

Any extra keyword arguments are passed to the `.get()` or `.post()` method.

Returns a `webtest.TestResponse` object.

submit_fields(*name=None*, *index=None*)
Return a list of `[(name, value), ...]` for the current state of the form.

upload_fields()

Return a list of file field tuples of the form: (field name, file name)

or (field name, file name, file contents).

29.4 webob – Request/Response objects

29.4.1 Request

class webob.**Request**(*environ*, *charset=None*, *unicode_errors=None*, *decode_param_names=None*, ***kw*)
The default request implementation

Parses a variety of `Accept-*` headers.

These headers generally take the form of:

```
value1; q=0.5, value2; q=0
```

Where the `q` parameter is optional. In theory other parameters exists, but this ignores them.

class webob.acceptparse.**Accept**(*header_value*)
Represents a generic `Accept-*` style header.

This object should not be modified. To add items you can use `accept_obj + 'accept_thing'` to get a new object

class webob.acceptparse.**MIMEAccept**(*header_value*)
Represents the `Accept` header, which is a list of mimetypes.

This class knows about mime wildcards, like `image/*`

class webob.byterange.**Range**(*start*, *end*)
Represents the Range header.

Represents the Cache-Control header

class webob.cachecontrol.**CacheControl**(*properties*, *type*)
Represents the Cache-Control header.

By giving a type of `'request'` or `'response'` you can control what attributes are allowed (some Cache-Control values only apply to requests or responses).

Does parsing of ETag-related headers: If-None-Matches, If-Matches

Also If-Range parsing

class webob.etag.**ETagMatcher**(*etags*)

class webob.etag.**IfRange**(*etag*)

29.4.2 Response

class webob.**Response**(*body=None*, *status=None*, *headerlist=None*, *app_iter=None*, *content_type=None*, *conditional_response=None*, ***kw*)
Represents a WSGI response

class webob.byterange.**ContentRange**(*start*, *stop*, *length*)
Represents the Content-Range header

This header is `start-stop/length`, where start-stop and length can be `*` (represented as None in the attributes).

class webob.cachecontrol.**CacheControl**(*properties*, *type*)
Represents the Cache-Control header.

By giving a type of `'request'` or `'response'` you can control what attributes are allowed (some Cache-Control values only apply to requests or responses).

29.4.3 Misc Functions

webob.**html_escape**(*s*)
HTML-escape a string or object

This converts any non-string objects passed into it to strings (actually, using `unicode()`). All values returned are non-unicode strings (using `&#num;` entities for all non-ASCII characters).

None is treated specially, and returns the empty string.

class webob.response.**AppIterRange**(*app_iter*, *start*, *stop*)
Wraps an app_iter, returning just a range of bytes

Gives a multi-value dictionary object (MultiDict) plus several wrappers

class webob.multidict.**MultiDict**(**args*, ***kw*)
An ordered dictionary that can have multiple values for each key. Adds the methods getall, getone, mixed and extend and add to the normal dictionary interface.

class webob.multidict.**NestedMultiDict**(**dicts*)
Wraps several MultiDict objects, treating it as one large MultiDict

class webob.multidict.**NoVars**(*reason=None*)
Represents no variables; used when no variables are applicable.

This is read-only

29.4.4 Descriptors

class webob.descriptors.**environ_getter**

class webob.descriptors.**header_getter**

class webob.descriptors.**converter**

class webob.descriptors.**deprecated_property**
Wraps a descriptor, with a deprecation warning or error

CHAPTER

THIRTY

GLOSSARY

action The class method in a Pylons applications' controller that handles a request.

API Application Programming Interface. The means of communication between a programmer and a software program or operating system.

app_globals The `app_globals` object is created on application instantiation by the `Globals` class in a projects `lib/app_globals.py` module.

This object is created once when the application is loaded by the projects `config/environment.py` module (See *Environment*). It remains persistent during the lifecycle of the web application, and is *not* thread-safe which means that it is best used for global options that should be *read-only*, or as an object to attach db connections or other objects which ensure their own access is thread-safe.

c Commonly used alias for *tmpl_context* to save on the typing when using lots of controller populated variables in templates.

caching The storage of the results of expensive or length computations for later re-use at a point more quickly accessed by the end user.

CDN Content Delivery Networks (CDN's) are generally globally distributed content delivery networks optimized for low latency for static file distribution. They can significantly increase page-load times by ensuring that the static resources on a page are delivered by servers geographically close to the client in addition to lightening the load placed on the application server.

ColdFusion Components CFCs represent an attempt by Macromedia to bring ColdFusion closer to an Object Oriented Programming (OOP) language. ColdFusion is in no way an OOP language, but thanks in part to CFCs, it does boast some of the attributes that make OOP languages so popular.

config The `PylonsConfig` instance for a given application. This can be accessed as `pylons.config` after an Pylons application has been loaded.

controller The 'C' in MVC. The controller is given a request, does the necessary logic to prepare data for display, then renders a template with the data and returns it to the user. See *Controllers*.

easy_install A tool that lets you download, build, install and manage Python packages and their dependencies. easy_install is the end-user facing component of *setuptools*.

Pylons can be installed with `easy_install`, and applications built with Pylons can easily be deployed this way as well.

See Also:

Pylons *Packaging and Deployment Overview*

dotted name string A reference to a Python module by name using a string to identify it, e.g. `pylons.controllers.util`. These strings are evaluated to import the module being referenced without having to import it in the code used. This is generally used to avoid import-time side-effects.

egg Python egg's are bundled Python packages, generally installed by a package called *setuptools*. Unlike normal Python package installs, egg's allow a few additional features, such as package dependencies, and dynamic discovery.

See Also:

The Quick Guide to Python Eggs

EJBs Enterprise JavaBeans (EJB) technology is the server-side component architecture for Java Platform, Enterprise Edition (Java EE). EJB technology enables rapid and simplified development of distributed, transactional, secure and portable applications based on Java technology.

environ environ is a dictionary passed into all *WSGI* application. It generally contains unparsed header information, CGI style variables and other objects inserted by *WSGI Middleware*.

ETag An ETag (entity tag) is an HTTP response header returned by an HTTP/1.1 compliant web server used to determine change in content at a given URL. See http://wikipedia.org/wiki/HTTP_ETag

g Alias used in prior versions of Pylons for *app_globals*.

Google App Engine A cloud computing platform for hosting web applications implemented in Python. Building Pylons applications for App Engine is facilitated by Ian Bicking's appengine-monkey project.

See Also:

What is Google App Engine? - Official Doc

h The helpers reference, `h`, is made available for use inside templates to assist with common rendering tasks. `h` is just a reference to the `lib/helpers.py` module and can be used in the same manner as any other module import.

Model-View-Controller An architectural pattern used in software engineering. In Pylons, the MVC paradigm is extended slightly with a pipeline that may transform and extend the data available to a controller, as well as the Pylons *WSGI* app itself that determines the appropriate Controller to call.

See Also:

MVC at Wikipedia

MVC See *Model-View-Controller*

ORM (Object-Relational Mapper) Maps relational databases such as MySQL, Postgres, Oracle to objects providing a cleaner API. Most ORM's also make it easier to prevent SQL Injection attacks by binding variables, and can handle generating sometimes extensive SQL.

Pylons A Python-based WSGI oriented web framework.

Rails Abbreviated as RoR, Ruby on Rails (also referred to as just Rails) is an open source Web application framework, written in Ruby

request Refers to the current request being processed. Available to import from `pylons` and is available for use in templates by the same name. See `Request`.

response Refers to the response to the current request. Available to import from `pylons` and is available for use in template by the same name. See `Response`.

route Routes determine how the URL's are mapped to the controllers and which URL is generated. See *URL Configuration*

setuptools An extension to the basic distutils, setuptools allows packages to specify package dependencies and have dynamic discovery of other installed Python packages.

See Also:

Building and Distributing Packages with setuptools

SQLAlchemy One of the most popular Python database object-relational mappers (*ORM*). SQLAlchemy is the default ORM recommended in Pylons. SQLAlchemy at the ORM level can look similar to Rails ActiveRecord, but uses the DataMapper pattern for additional flexibility with the ability to map simple to extremely complex databases.

tmpl_context The `tmpl_context` is available in the `pylons` module, and refers to the template context. Objects attached to it are available in the template namespace as either `tmpl_context` or `c` for convenience.

UI User interface. The means of communication between a person and a software program or operating system.

virtualenv A tool to create isolated Python environments, designed to supersede the `workingenv` package and virtual python configurations. In addition to isolating packages from possible system conflicts, virtualenv makes it easy to install Python libraries using *easy_install* without dumping lots of packages into the system-wide Python.

The other great benefit is that no root access is required since all modules are kept under the desired directory. This makes it easy to setup a working Pylons install on shared hosting providers and other systems where system-wide access is unavailable.

`virtualenv` is employed automatically by the `go-pylons.py` script described in *Getting Started*. The Pylons wiki has more information on working with virtualenv.

web server gateway interface A specification for web servers and application servers to communicate with web applications. Also referred to by its initials, as *WSGI*.

WSGI The WSGI Specification, also commonly referred to as PEP 333 and described by **PEP 333**.

WSGI Middleware *WSGI* Middleware refers to the ability of WSGI applications to modify the environ, and/or the content of other WSGI applications by being placed in between the request and the other WSGI application.

See Also:

WSGI Middleware in Concepts of Pylons WSGI Middleware Configuration