The Pyramid Web Application Development Framework

Version 1.2.7

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The Pyramid Web Application Development Framework, Version 1.1

by Chris McDonough

ISBN-10: 0615445675

ISBN-13: 978-0615445670

First print publishing: February, 2011

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Print Production

The print version of this book was produced using the Sphinx documentation generation system and the LaTeX typesetting system.

Contacting The Publisher

Please send documentation licensing inquiries, translation inquiries, and other business communications to Agendaless Consulting. Please send software and other technical queries to the Pylons-devel maillist.

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Typographical Conventions

Literals, filenames and function arguments are presented using the following style:

```
argument1
```

Warnings, which represent limitations and need-to-know information related to a topic or concept are presented in the following style:

This is a warning.

Notes, which represent additional information related to a topic or concept are presented in the following style:

This is a note.

We present Python method names using the following style:

```
pyramid.config.Configurator.add_view()
```

We present Python class names, module names, attributes and global variables using the following style:

```
pyramid.config.Configurator.registry
```

References to glossary terms are presented using the following style:

Pylons

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Pylons

References to sections and chapters are presented using the following style:

Traversal

Code and configuration file blocks are presented in the following style:

```
def foo(abc):
    pass
```

When a command that should be typed on one line is too long to fit on a page, the backslash \ is used to indicate that the following printed line should actually be part of the command:

```
c:\bigfntut\tutorial> ..\Scripts\nosetests --cover-package=tutorial \
      --cover-erase --with-coverage
```

A sidebar, which presents a concept tangentially related to content discussed on a page, is rendered like so:

This is a sidebar

Sidebar information.

Welcome to "The Pyramid Web Application Framework". In this introduction, I'll describe the audience for this book, I'll describe the book content, I'll provide some context regarding the genesis of Pyramid, and I'll thank some important people.

I hope you enjoy both this book and the software it documents. I've had a blast writing both.

Audience

This book is aimed primarily at a reader that has the following attributes:

- At least a moderate amount of *Python* experience.
- A familiarity with web protocols such as HTTP and CGI.

If you fit into both of these categories, you're in the direct target audience for this book. But don't worry, even if you have no experience with Python or the web, both are easy to pick up "on the fly".

Python is an *excellent* language in which to write applications; becoming productive in Python is almost mind-blowingly easy. If you already have experience in another language such as Java, Visual Basic, Perl, Ruby, or even C/C++, learning Python will be a snap; it should take you no longer than a couple of days to become modestly productive. If you don't have previous programming experience, it will be slightly harder, and it will take a little longer, but you'd be hard-pressed to find a better "first language."

Web technology familiarity is assumed in various places within the book. For example, the book doesn't try to define common web-related concepts like "URL" or "query string." Likewise, the book describes various interactions in terms of the HTTP protocol, but it does not describe how the HTTP protocol works in detail. Like any good web framework, though, Pyramid shields you from needing to know most of the gory details of web protocols and low-level data structures. As a result, you can usually avoid becoming "blocked" while you read this book even if you don't yet deeply understand web technologies.

Book Content

This book is divided into three major parts:

Narrative Documentation

> This is documentation which describes Pyramid concepts in narrative form, written in a largely conversational tone. Each narrative documentation chapter describes an isolated Pyramid concept. You should be able to get useful information out of the narrative chapters if you read them out-of-order, or when you need only a reminder about a particular topic while you're developing an application.

Tutorials

> Each tutorial builds a sample application or implements a set of concepts with a sample; it then describes the application or concepts in terms of the sample. You should read the tutorials if you want a guided tour of Pyramid.

API Reference

> Comprehensive reference material for every public API exposed by Pyramid. The API documentation is organized alphabetically by module name.

The Genesis of `repoze.bfg`

Before the end of 2010, Pyramid was known as `repoze.bfg`.

I wrote `repoze.bfg` after many years of writing applications using *Zope*. Zope provided me with a lot of mileage: it wasn't until almost a decade of successfully creating applications using it that I decided to write a different web framework. Although `repoze.bfg` takes inspiration from a variety of web frameworks, it owes more of its core design to Zope than any other.

The Repoze "brand" existed before `repoze.bfg` was created. One of the first packages developed as part of the Repoze brand was a package named `repoze.zope2`. This was a package that allowed Zope 2 applications to run under a *WSGI* server without modification. Zope 2 did not have reasonable WSGI support at the time.

During the development of the `repoze.zope2` package, I found that replicating the Zope 2 "publisher" – the machinery that maps URLs to code – was time-consuming and fiddly. Zope 2 had evolved over many years, and emulating all of its edge cases was extremely difficult. I finished the `repoze.zope2`

package, and it emulates the normal Zope 2 publisher pretty well. But during its development, it became clear that Zope 2 had simply begun to exceed my tolerance for complexity, and I began to look around for simpler options.

I considered using the Zope 3 application server machinery, but it turned out that it had become more indirect than the Zope 2 machinery it aimed to replace, which didn't fulfill the goal of simplification. I also considered using Django and Pylons, but neither of those frameworks offer much along the axes of traversal, contextual declarative security, or application extensibility; these were features I had become accustomed to as a Zope developer.

I decided that in the long term, creating a simpler framework that retained features I had become accustomed to when developing Zope applications was a more reasonable idea than continuing to use any Zope publisher or living with the limitations and unfamiliarities of a different framework. The result is what is now Pyramid.

The Genesis of Pyramid

What was `repoze.bfg` has become Pyramid as the result of a coalition built between the *Repoze* and *Pylons* community throughout the year 2010. By merging technology, we're able to reduce duplication of effort, and take advantage of more of each others' technology.

Thanks

This book is dedicated to my grandmother, who gave me my first typewriter (a Royal), and my mother, who bought me my first computer (a VIC-20).

Thanks to the following people for providing expertise, resources, and software. Without the help of these folks, neither this book nor the software which it details would exist: Paul Everitt, Tres Seaver, Andrew Sawyers, Malthe Borch, Carlos de la Guardia, Chris Rossi, Shane Hathaway, Daniel Holth, Wichert Akkerman, Georg Brandl, Blaise Laflamme, Ben Bangert, Casey Duncan, Hugues Laflamme, Mike Orr, John Shipman, Chris Beelby, Patricio Paez, Simon Oram, Nat Hardwick, Ian Bicking, Jim Fulton, Michael Merickel, Tom Moroz of the Open Society Institute, and Todd Koym of Environmental Health Sciences.

Thanks to Guido van Rossum and Tim Peters for Python.

Special thanks to Tricia for putting up with me.

Part I

Narrative Documentation

CHAPTER 1

Pyramid Introduction

Pyramid is a general, open source, Python web application development *framework*. Its primary goal is to make it easier for a Python developer to create web applications.

Frameworks vs. Libraries

A *framework* differs from a *library* in one very important way: library code is always *called* by code that you write, while a framework always *calls* code that you write. Using a set of libraries to create an application is usually easier than using a framework initially, because you can choose to cede control to library code you have not authored very selectively. But when you use a framework, you are required to cede a greater portion of control to code you have not authored: code that resides in the framework itself. You needn't use a framework at all to create a web application using Python. A rich set of libraries already exists for the platform. In practice, however, using a framework to create an application is often more practical than rolling your own via a set of libraries if the framework provides a set of facilities that fits your application requirements.

Pyramid attempts to follow these design and engineering principles:

Simplicity Pyramid takes a *"pay only for what you eat"* approach. You can get results even if you have only a partial understanding of Pyramid. It doesn't force you to use any particular technology to produce an application, and we try to keep the core set of concepts that you need to understand to a minimum.

Minimalism Pyramid tries to solve only the fundamental problems of creating a web application: the mapping of URLs to code, templating, security and serving static assets. We consider these to be the core activities that are common to nearly all web applications.

Documentation Pyramid's minimalism means that it is easier for us to maintain complete and up-to-date documentation. It is our goal that no aspect of Pyramid is undocumented.

Speed Pyramid is designed to provide noticeably fast execution for common tasks such as templating and simple response generation. Although "hardware is cheap", the limits of this approach become painfully evident when one finds him or herself responsible for managing a great many machines.

Reliability Pyramid is developed conservatively and tested exhaustively. Where Pyramid source code is concerned, our motto is: "If it ain't tested, it's broke".

Openness As with Python, the Pyramid software is distributed under a permissive open source license.

1.1 What Makes Pyramid Unique

Understandably, people don't usually want to hear about squishy engineering principles, they want to hear about concrete stuff that solves their problems. With that in mind, what would make someone want to use Pyramid instead of one of the many other web frameworks available today? What makes Pyramid unique?

This is a hard question to answer, because there are lots of excellent choices, and it's actually quite hard to make a wrong choice, particularly in the Python web framework market. But one reasonable answer is this: you can write very small applications in Pyramid without needing to know a lot. "What?", you say, "that can't possibly be a unique feature, lots of other web frameworks let you do that!" Well, you're right. But unlike many other systems, you can also write very large applications in Pyramid if you learn a little more about it. Pyramid will allow you to become productive quickly, and will grow with you; it won't hold you back when your application is small and it won't get in your way when your application becomes large. "Well that's fine," you say, "lots of other frameworks let me write large apps too." Absolutely. But other Python web frameworks don't seamlessly let you do both. They seem to fall into two non-overlapping categories: frameworks for "small apps" and frameworks for "big apps". The "small app" frameworks typically sacrifice "big app" features, and vice versa.

We don't think it's a universally reasonable suggestion to write "small apps" in a "small framework" and "big apps" in a "big framework". You can't really know to what size every application will eventually grow. We don't really want to have to rewrite a previously small application in another framework when it gets "too big". We believe the current binary distinction between frameworks for small and large applications is just false; a well-designed framework should be able to be good at both. Pyramid strives to be that kind of framework.

To this end, Pyramid provides a set of features, that, combined, are unique amongst Python web frameworks. Lots of other frameworks contain some combination of these features; Pyramid of course actually stole many of them from those other frameworks. But Pyramid is the only one that has all of them in one place, documented appropriately, and useful a la carte without necessarily paying for the entire banquet. These are detailed below.

1.1.1 Single-file applications

You can write a Pyramid application that lives entirely in one Python file, not unlike existing Python microframeworks. This is beneficial for one-off prototyping, bug reproduction, and very small applications. These applications are easy to understand because all the information about the application lives in a single place, and you can deploy them without needing to understand much about Python distributions and packaging. Pyramid isn't really marketed as a microframework, but it allows you to do almost everything that frameworks that are marketed as micro offer in very similar ways.

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response


def hello_world(request):
    return Response('Hello %(name)s!' % request.matchdict)

if __name__ == '__main__':
    config = Configurator()
    config.add_route('hello', '/hello/{name}')
    config.add_view(hello_world, route_name='hello')
    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

See also *Creating Your First Pyramid Application*.

1.1.2 Decorator-based configuration

If you like the idea of framework configuration statements living next to the code it configures, so you don't have to constantly switch between files to refer to framework configuration when adding new code, you can use Pyramid decorators to localize the configuration. For example:

```
from pyramid.view import view_config
from pyramid.response import Response

@view_config(route_name='fred')
def fred_view(request):
    return Response('fred')
```

However, unlike some other systems, using decorators for Pyramid configuration does not make your application difficult to extend, test or reuse. The `view_config` decorator, for example, does not actually

change the input or output of the function it decorates, so testing it is a "WYSIWYG" operation; you don't need to understand the framework to test your own code, you just behave as if the decorator is not there. You can also instruct Pyramid to ignore some decorators, or use completely imperative configuration instead of decorators to add views. Pyramid decorators are inert instead of eager: you detect and activate them with a *scan*.

Example: *Adding View Configuration Using the @view_config Decorator*.

1.1.3 URL generation

Pyramid is capable of generating URLs for resources, routes, and static assets. Its URL generation APIs are easy to use and flexible. If you use Pyramid's various APIs for generating URLs, you can change your configuration around arbitrarily without fear of breaking a link on one of your web pages.

Example: *Generating Route URLs*.

1.1.4 Static file serving

Pyramid is perfectly willing to serve static files itself. It won't make you use some external web server to do that. You can even serve more than one set of static files in a single Pyramid web application (e.g. `/static` and `/static2`). You can also, optionally, place your files on an external web server and ask Pyramid to help you generate URLs to those files, so you can use Pyramid's internal fileserving while doing development, and a faster static file server in production without changing any code.

Example: *Serving Static Assets*.

1.1.5 Debug Toolbar

Pyramid's debug toolbar comes activated when you use a Pyramid scaffold to render a project. This toolbar overlays your application in the browser, and allows you access to framework data such as the routes configured, the last renderings performed, the current set of packages installed, SQLAlchemy queries run, logging data, and various other facts. When an exception occurs, you can use its interactive debugger to poke around right in your browser to try to determine the cause of the exception. It's handy.

Example: *The Debug Toolbar*.

1.1.6 Debugging settings

Pyramid has debugging settings that allow you to print Pyramid runtime information to the console when things aren't behaving as you're expecting. For example, you can turn on "debug_notfound", which prints an informative message to the console every time a URL does not match any view. You can turn on "debug_authorization", which lets you know why a view execution was allowed or denied by printing a message to the console. These features are useful for those WTF moments.

There are also a number of `paster` commands that allow you to introspect the configuration of your system: `paster proutes` shows all configured routes for an application in the order they'll be evaluated for matching; `paster pviews` shows all configured views for any given URL. These are also WTF-crushers in some circumstances.

Examples: *Debugging View Authorization Failures* and *Command-Line Pyramid*.

1.1.7 Add-ons

Pyramid has an extensive set of add-ons held to the same quality standards as the Pyramid core itself. Add-ons are packages which provide functionality that the Pyramid core doesn't. Add-on packages already exist which let you easily send email, let you use the Jinja2 templating system, let you use XML-RPC or JSON-RPC, let you integrate with jQuery Mobile, etc.

Examples: http://docs.pylonsproject.org/docs/pyramid.html#pyramid-add-on-documentation

1.1.8 Class-based and function-based views

Pyramid has a structured, unified concept of a *view callable*. View callables can be functions, methods of classes, or even instances. When you add a new view callable, you can choose to make it a function or a method of a class; in either case, Pyramid treats it largely the same way. You can change your mind later, and move code between methods of classes and functions. A collection of similar view callables can be attached to a single class as methods, if that floats your boat, and they can share initialization code as necessary. All kinds of views are easy to understand and use and operate similarly. There is no phony distinction between them; they can be used for the same purposes.

Here's a view callable defined as a function:

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config(route_name='aview')
def aview(request):
    return Response('one')
```

Here's a few views defined as methods of a class instead:

```
from pyramid.response import Response
from pyramid.view import view_config

class AView(object):
    def __init__(self, request):
        self.request = request

    @view_config(route_name='view_one')
    def view_one(request):
        return Response('one')

    @view_config(route_name='view_two')
    def view_two(request):
        return Response('two')
```

See also *@view_config Placement*.

1.1.9 Asset specifications

Asset specifications are strings that contain both a Python package name and a file or directory name, e.g. `MyPackage:static/index.html`. Use of these specifications is omnipresent in Pyramid. An asset specification can refer to a template, a translation directory, or any other package-bound static resource. This makes a system built on Pyramid extensible, because you don't have to rely on globals ("*the* static directory") or lookup schemes ("*the* ordered set of template directories") to address your files. You can move files around as necessary, and include other packages that may not share your system's templates or static files without encountering conflicts.

Because asset specifications are used heavily in Pyramid, we've also provided a way to allow users to override assets. Say you love a system that someone else has created with Pyramid but you just need to change "that one template" to make it all better. No need to fork the application. Just override the asset specification for that template with your own inside a wrapper, and you're good to go.

Examples: *Understanding Asset Specifications* and *Overriding Assets*.

1.1.10 Extensible templating

Pyramid has a structured API that allows for pluggability of "renderers". Templating systems such as Mako, Genshi, Chameleon, and Jinja2 can be treated as renderers. Renderer bindings for all of these templating systems already exist for use in Pyramid. But if you'd rather use another, it's not a big deal. Just copy the code from an existing renderer package, and plug in your favorite templating system. You'll then be able to use that templating system from within Pyramid just as you'd use one of the "built-in" templating systems.

Pyramid does not make you use a single templating system exclusively. You can use multiple templating systems, even in the same project.

Example: *Using Templates Directly*.

1.1.11 Rendered views can return dictionaries

If you use a *renderer*, you don't have to return a special kind of "webby" `Response` object from a view. Instead, you can return a dictionary instead, and Pyramid will take care of converting that dictionary to a Response using a template on your behalf. This makes the view easier to test, because you don't have to parse HTML in your tests; just make an assertion instead that the view returns "the right stuff" in the dictionary it returns. You can write "real" unit tests instead of functionally testing all of your views.

For example, instead of:

```
from pyramid.renderers import render_to_response

def myview(request):
    return render_to_response('myapp:templates/mytemplate.pt', {'a':1},
                              request=request)
```

You can do this:

```
from pyramid.view import view_config

@view_config(renderer='myapp:templates/mytemplate.pt')
def myview(request):
    return {'a':1}
```

When this view callable is called by Pyramid, the `{'a':1}` dictionary will be rendered to a response on your behalf. The string passed as `renderer=` above is an *asset specification*. It is in the form `packagename:directoryname/filename.ext`. In this case, it names the `mytemplate.pt` file in the `templates` directory within the `myapp` Python package. Asset specifications are omnipresent in Pyramid: see *Asset specifications* for more information.

Example: *Renderers*.

1.1.12 Event system

Pyramid emits *events* during its request processing lifecycle. You can subscribe any number of listeners to these events. For example, to be notified of a new request, you can subscribe to the `NewRequest` event. To be notified that a template is about to be rendered, you can subscribe to the `BeforeRender` event, and so forth. Using an event publishing system as a framework notification feature instead of hardcoded hook points tends to make systems based on that framework less brittle.

You can also use Pyramid's event system to send your *own* events. For example, if you'd like to create a system that is itself a framework, and may want to notify subscribers that a document has just been indexed, you can create your own event type (`DocumentIndexed` perhaps) and send the event via Pyramid. Users of this framework can then subscribe to your event like they'd subscribe to the events that are normally sent by Pyramid itself.

Example: *Using Events* and *Event Types*.

1.1.13 Built-in internationalization

Pyramid ships with internationalization-related features in its core: localization, pluralization, and creating message catalogs from source files and templates. Pyramid allows for a plurality of message catalog via the use of translation domains: you can create a system that has its own translations without conflict with other translations in other domains.

Example: *Internationalization and Localization*.

1.1.14 HTTP caching

Pyramid provides an easy way to associate views with HTTP caching policies. You can just tell Pyramid to configure your view with an `http_cache` statement, and it will take care of the rest:

```
@view_config(http_cache=3600) # 60 minutes
def myview(request): ....
```

Pyramid will add appropriate `Cache-Control` and `Expires` headers to responses generated when this view is invoked.

See the `add_view()` method's `http_cache` documentation for more information.

1.1.15 Sessions

Pyramid has built-in HTTP sessioning. This allows you to associate data with otherwise anonymous users between requests. Lots of systems do this. But Pyramid also allows you to plug in your own sessioning system by creating some code that adheres to a documented interface. Currently there is a binding package for the third-party Beaker sessioning system that does exactly this. But if you have a specialized need (perhaps you want to store your session data in MongoDB), you can. You can even switch between implementations without changing your application code.

Example: *Sessions*.

1.1.16 Speed

The Pyramid core is, as far as we can tell, at least marginally faster than any other existing Python web framework. It has been engineered from the ground up for speed. It only does as much work as absolutely necessary when you ask it to get a job done. Extraneous function calls and suboptimal algorithms in its core codepaths are avoided. It is feasible to get, for example, between 3500 and 4000 requests per second from a simple Pyramid view on commodity dual-core laptop hardware and an appropriate WSGI server (mod_wsgi or gunicorn). In any case, performance statistics are largely useless without requirements and goals, but if you need speed, Pyramid will almost certainly never be your application's bottleneck; at least no more than Python will be a bottleneck.

Example: http://blog.curiasolutions.com/the-great-web-framework-shootout/

1.1.17 Exception views

Exceptions happen. Rather than deal with exceptions that might present themselves to a user in production in an ad-hoc way, Pyramid allows you to register an *exception view*. Exception views are like regular Pyramid views, but they're only invoked when an exception "bubbles up" to Pyramid itself. For example, you might register an exception view for the `Exception` exception, which will catch *all* exceptions, and present a pretty "well, this is embarrassing" page. Or you might choose to register an exception view for only specific kinds of application-specific exceptions, such as an exception that happens when a file is not found, or an exception that happens when an action cannot be performed because the user doesn't have permission to do something. In the former case, you can show a pretty "Not Found" page; in the latter case you might show a login form.

Example: *Custom Exception Views*.

1.1.18 No singletons

Pyramid is written in such a way that it requires your application to have exactly zero "singleton" data structures. Or, put another way, Pyramid doesn't require you to construct any "mutable globals". Or put even a different way, an import of a Pyramid application needn't have any "import-time side effects". This is esoteric-sounding, but if you've ever tried to cope with parameterizing a Django "settings.py" file for multiple installations of the same application, or if you've ever needed to monkey-patch some framework fixture so that it behaves properly for your use case, or if you've ever wanted to deploy your system using an asynchronous server, you'll end up appreciating this feature. It just won't be a problem. You can even run multiple copies of a similar but not identically configured Pyramid application within the same Python process. This is good for shared hosting environments, where RAM is at a premium.

1.1.19 View predicates and many views per route

Unlike many other systems, Pyramid allows you to associate more than one view per route. For example, you can create a route with the pattern `/items` and when the route is matched, you can shuffle off the request to one view if the request method is GET, another view if the request method is POST, etc. A system known as "view predicates" allows for this. Request method matching is the very most basic thing you can do with a view predicate. You can also associate views with other request parameters such as the elements in the query string, the Accept header, whether the request is an XHR request or not, and lots of other things. This feature allows you to keep your individual views "clean"; they won't need much conditional logic, so they'll be easier to test.

Example: *View Configuration Parameters*.

1.1.20 Transaction management

Pyramid's *scaffold* system renders projects that include a *transaction management* system, stolen from Zope. When you use this transaction management system, you cease being responsible for committing your data anymore. Instead, Pyramid takes care of committing: it commits at the end of a request or aborts if there's an exception. Why is that a good thing? Having a centralized place for transaction management is a great thing. If, instead of managing your transactions in a centralized place, you sprinkle `session.commit` calls in your application logic itself, you can wind up in a bad place. Wherever you manually commit data to your database, it's likely that some of your other code is going to run *after* your commit. If that code goes on to do other important things after that commit, and an error happens in the later code, you can easily wind up with inconsistent data if you're not extremely careful. Some data will have been written to the database that probably should not have. Having a centralized commit point saves you from needing to think about this; it's great for lazy people who also care about data integrity. Either the request completes successfully, and all changes are committed, or it does not, and all changes are aborted.

Also, Pyramid's transaction management system allows you to synchronize commits between multiple databases, and allows you to do things like conditionally send email if a transaction commits, but otherwise keep quiet.

Example: *SQLAlchemy + URL Dispatch Wiki Tutorial* (note the lack of commit statements anywhere in application code).

1.1.21 Configuration conflict detection

When a system is small, it's reasonably easy to keep it all in your head. But when systems grow large, you may have hundreds or thousands of configuration statements which add a view, add a route, and so forth. Pyramid's configuration system keeps track of your configuration statements, and if you accidentally add two that are identical, or Pyramid can't make sense out of what it would mean to have both statements active at the same time, it will complain loudly at startup time. It's not dumb though: it will automatically resolve conflicting configuration statements on its own if you use the configuration `include()` system: "more local" statements are preferred over "less local" ones. This allows you to intelligently factor large systems into smaller ones.

Example: *Conflict Detection*.

1.1.22 Configuration extensibility

Unlike other systems, Pyramid provides a structured "include" mechanism (see `include()`) that allows you to compose applications from multiple Python packages. All the configuration statements that can be performed in your "main" Pyramid application can also be performed by included packages including the addition of views, routes, subscribers, and even authentication and authorization policies. You can even extend or override an existing application by including another application's configuration in your own, overriding or adding new views and routes to it. This has the potential to allow you to compose a big application out of many other smaller ones. For example, if you want to reuse an existing application that already has a bunch of routes, you can just use the `include` statement with a `route_prefix`; the new application will live within your application at a URL prefix. It's not a big deal, and requires little up-front engineering effort.

For example:

```
from pyramid.config import Configurator

if __name__ == '__main__':
    config = Configurator()
    config.include('pyramid_jinja2')
    config.include('pyramid_exclog')
    config.include('some.other.guys.package', route_prefix='/someotherguy')
```

See also *Including Configuration from External Sources* and *Rules for Building An Extensible Application*

1.1.23 Flexible authentication and authorization

Pyramid includes a flexible, pluggable authentication and authorization system. No matter where your user data is stored, or what scheme you'd like to use to permit your users to access your data, you can use a predefined Pyramid plugpoint to plug in your custom authentication and authorization code. If you want to change these schemes later, you can just change it in one place rather than everywhere in your code. It also ships with prebuilt well-tested authentication and authorization schemes out of the box. But what if you don't want to use Pyramid's built-in system? You don't have to. You can just write your own bespoke security code as you would in any other system.

Example: *Enabling an Authorization Policy*.

1.1.24 Traversal

Traversal is a concept stolen from *Zope*. It allows you to create a tree of resources, each of which can be addressed by one or more URLs. Each of those resources can have one or more *views* associated with it. If your data isn't naturally treelike (or you're unwilling to create a treelike representation of your data), you aren't going to find traversal very useful. However, traversal is absolutely fantastic for sites that need to be arbitrarily extensible: it's a lot easier to add a node to a tree than it is to shoehorn a route into an ordered list of other routes, or to create another entire instance of an application to service a department and glue code to allow disparate apps to share data. It's a great fit for sites that naturally lend themselves to changing departmental hierarchies, such as content management systems and document management systems. Traversal also lends itself well to systems that require very granular security ("Bob can edit *this* document" as opposed to "Bob can edit documents").

Example: *Much Ado About Traversal*.

1.1.25 Tweens

Pyramid has a sort of internal WSGI-middleware-ish pipeline that can be hooked by arbitrary add-ons named "tweens". The debug toolbar is a "tween", and the `pyramid_tm` transaction manager is also. Tweens are more useful than WSGI middleware in some circumstances because they run in the context of Pyramid itself, meaning you have access to templates and other renderers, a "real" request object, and other niceties.

Example: *Registering "Tweens"*.

1.1.26 View response adapters

A lot is made of the aesthetics of what *kinds* of objects you're allowed to return from view callables in various frameworks. In a previous section in this document we showed you that, if you use a *renderer*, you can usually return a dictionary from a view callable instead of a full-on *Response* object. But some frameworks allow you to return strings or tuples from view callables. When frameworks allow for this, code looks slightly prettier, because fewer imports need to be done, and there is less code. For example, compare this:

```
def aview(request):
    return "Hello world!"
```

To this:

```
from pyramid.response import Response

def aview(request):
    return Response("Hello world!")
```

The former is "prettier", right?

Out of the box, if you define the former view callable (the one that simply returns a string) in Pyramid, when it is executed, Pyramid will raise an exception. This is because "explicit is better than implicit", in most cases, and by default, Pyramid wants you to return a *Response* object from a view callable. This is because there's usually a heck of a lot more to a response object than just its body. But if you're the kind of person who values such aesthetics, we have an easy way to allow for this sort of thing:

```
from pyramid.config import Configurator
from pyramid.response import Response

def string_response_adapter(s):
    response = Response(s)
    response.content_type = 'text/html'
    return response

if __name__ == '__main__':
    config = Configurator()
    config.add_response_adapter(string_response_adapter, basestring)
```

Do that once in your Pyramid application at startup. Now you can return strings from any of your view callables, e.g.:

```
def helloview(request):
    return "Hello world!"

def goodbyeview(request):
    return "Goodbye world!"
```

Oh noes! What if you want to indicate a custom content type? And a custom status code? No fear:

```
from pyramid.config import Configurator

def tuple_response_adapter(val):
    status_int, content_type, body = val
    response = Response(body)
    response.content_type = content_type
    response.status_int = status_int
    return response

def string_response_adapter(body):
    response = Response(body)
    response.content_type = 'text/html'
    response.status_int = 200
    return response

if __name__ == '__main__':
    config = Configurator()
    config.add_response_adapter(string_response_adapter, basestring)
    config.add_response_adapter(tuple_response_adapter, tuple)
```

Once this is done, both of these view callables will work:

```
def aview(request):
    return "Hello world!"

def anotherview(request):
    return (403, 'text/plain', "Forbidden")
```

Pyramid defaults to explicit behavior, because it's the most generally useful, but provides hooks that allow you to adapt the framework to localized aesthetic desires.

See also *Changing How Pyramid Treats View Responses*.

1.1.27 "Global" response object

"Constructing these response objects in my view callables is such a chore! And I'm way too lazy to register a response adapter, as per the prior section," you say. Fine. Be that way:

```
def aview(request):
    response = request.response
    response.body = 'Hello world!'
    response.content_type = 'text/plain'
    return response
```

See also *Varying Attributes of Rendered Responses*.

1.1.28 Automating repetitive configuration

Does Pyramid's configurator allow you to do something, but you're a little adventurous and just want it a little less verbose? Or you'd like to offer up some handy configuration feature to other Pyramid users without requiring that we change Pyramid? You can extend Pyramid's *Configurator* with your own directives. For example, let's say you find yourself calling `pyramid.config.Configurator.add_view()` repetitively. Usually you can take the boring away by using existing shortcuts, but let's say that this is a case such a way that no existing shortcut works to take the boring away:

```
from pyramid.config import Configurator

config = Configurator()
config.add_route('xhr_route', '/xhr/{id}')
config.add_view('my.package.GET_view', route_name='xhr_route',
                xhr=True,  permission='view', request_method='GET')
config.add_view('my.package.POST_view', route_name='xhr_route',
                xhr=True, permission='view', request_method='POST')
config.add_view('my.package.HEAD_view', route_name='xhr_route',
                xhr=True, permission='view', request_method='HEAD')
```

Pretty tedious right? You can add a directive to the Pyramid configurator to automate some of the tedium away:

```
from pyramid.config import Configurator

def add_protected_xhr_views(config, module):
    module = config.maybe_dotted(module)
    for method in ('GET', 'POST', 'HEAD'):
```

```
        view = getattr(module, 'xhr_%s_view' % method, None)
        if view is not None:
            config.add_view(view, route_name='xhr_route', xhr=True,
                            permission='view', request_method=method)

config = Configurator()
config.add_directive('add_protected_xhr_views', add_protected_xhr_views)
```

Once that's done, you can call the directive you've just added as a method of the Configurator object:

```
config.add_route('xhr_route', '/xhr/{id}')
config.add_protected_xhr_views('my.package')
```

Your previously repetitive configuration lines have now morphed into one line.

You can share your configuration code with others this way too by packaging it up and calling `add_directive()` from within a function called when another user uses the `include()` method against your code.

See also *Adding Methods to the Configurator via add_directive*.

1.1.29 Testing

Every release of Pyramid has 100% statement coverage via unit and integration tests, as measured by the `coverage` tool available on PyPI. It also has greater than 95% decision/condition coverage as measured by the `instrumental` tool available on PyPI. It is automatically tested by the Jenkins tool on Python 2.5, Python 2.6, Python 2.7, Jython and PyPy after each commit to its GitHub repository. Official Pyramid add-ons are held to a similar testing standard. We still find bugs in Pyramid and its official add-ons, but we've noticed we find a lot more of them while working on other projects that don't have a good testing regime.

Example: http://jenkins.pylonsproject.org/

1.1.30 Support

It's our goal that no Pyramid question go unanswered. Whether you ask a question on IRC, on the Pylons-discuss maillist, or on StackOverflow, you're likely to get a reasonably prompt response. We don't tolerate "support trolls" or other people who seem to get their rocks off by berating fellow users in our various offical support channels. We try to keep it well-lit and new-user-friendly.

Example: Visit irc://freenode.net#pyramid (the `#pyramid` channel on irc.freenode.net in an IRC client) or the pylons-discuss maillist at http://groups.google.com/group/pylons-discuss/ .

1.1.31 Documentation

It's a constant struggle, but we try to maintain a balance between completeness and new-user-friendliness in the official narrative Pyramid documentation (concrete suggestions for improvement are always appreciated, by the way). We also maintain a "cookbook" of recipes, which are usually demonstrations of common integration scenarios, too specific to add to the official narrative docs. In any case, the Pyramid documentation is comprehensive.

Example: The rest of this documentation and the cookbook at http://docs.pylonsproject.org/projects/pyramid_cookbook/dev/ .

1.2 What Is The Pylons Project?

Pyramid is a member of the collection of software published under the Pylons Project. Pylons software is written by a loose-knit community of contributors. The Pylons Project website includes details about how Pyramid relates to the Pylons Project.

1.3 Pyramid and Other Web Frameworks

The first release of Pyramid's predecessor (named `repoze.bfg`) was made in July of 2008. At the end of 2010, we changed the name of `repoze.bfg` to Pyramid. It was merged into the Pylons project as Pyramid in November of that year.

Pyramid was inspired by *Zope*, *Pylons* (version 1.0) and *Django*. As a result, Pyramid borrows several concepts and features from each, combining them into a unique web framework.

Many features of Pyramid trace their origins back to *Zope*. Like Zope applications, Pyramid applications can be easily extended: if you obey certain constraints, the application you produce can be reused, modified, re-integrated, or extended by third-party developers without forking the original application. The concepts of *traversal* and declarative security in Pyramid were pioneered first in Zope.

The Pyramid concept of *URL dispatch* is inspired by the *Routes* system used by *Pylons* version 1.0. Like Pylons version 1.0, Pyramid is mostly policy-free. It makes no assertions about which database you should use, and its built-in templating facilities are included only for convenience. In essence, it only supplies a mechanism to map URLs to *view* code, along with a set of conventions for calling those views. You are free to use third-party components that fit your needs in your applications.

The concept of *view* is used by Pyramid mostly as it would be by Django. Pyramid has a documentation culture more like Django's than like Zope's.

Like *Pylons* version 1.0, but unlike *Zope*, a Pyramid application developer may use completely imperative code to perform common framework configuration tasks such as adding a view or a route. In Zope, *ZCML* is typically required for similar purposes. In *Grok*, a Zope-based web framework, *decorator* objects and class-level declarations are used for this purpose. Out of the box, Pyramid supports imperative and decorator-based configuration; *ZCML* may be used via an add-on package named `pyramid_zcml`.

Also unlike *Zope* and unlike other "full-stack" frameworks such as *Django*, Pyramid makes no assumptions about which persistence mechanisms you should use to build an application. Zope applications are typically reliant on *ZODB*; Pyramid allows you to build *ZODB* applications, but it has no reliance on the ZODB software. Likewise, *Django* tends to assume that you want to store your application's data in a relational database. Pyramid makes no such assumption; it allows you to use a relational database but doesn't encourage or discourage the decision.

Other Python web frameworks advertise themselves as members of a class of web frameworks named model-view-controller frameworks. Insofar as this term has been claimed to represent a class of web frameworks, Pyramid also generally fits into this class.

You Say Pyramid is MVC, But Where's The Controller?

The Pyramid authors believe that the MVC pattern just doesn't really fit the web very well. In a Pyramid application, there is a resource tree, which represents the site structure, and views, which tend to present the data stored in the resource tree and a user-defined "domain model". However, no facility provided *by the framework* actually necessarily maps to the concept of a "controller" or "model". So if you had to give it some acronym, I guess you'd say Pyramid is actually an "RV" framework rather than an "MVC" framework. "MVC", however, is close enough as a general classification moniker for purposes of comparison with other web frameworks.

CHAPTER 2

Installing Pyramid

2.1 Before You Install

You will need Python version 2.5 or better to run Pyramid.

Python Versions

As of this writing, Pyramid has been tested under Python 2.5.5, Python 2.6.6, and Python 2.7.2. Pyramid does not run under any version of Python before 2.5, and does not yet run under Python 3.X.

Pyramid is known to run on all popular UNIX-like systems such as Linux, MacOS X, and FreeBSD as well as on Windows platforms. It is also known to run on Google's App Engine, *PyPy* (1.5 and 1.6), and *Jython* (2.5.2).

Pyramid installation does not require the compilation of any C code, so you need only a Python interpreter that meets the requirements mentioned.

2.1.1 If You Don't Yet Have A Python Interpreter (UNIX)

If your system doesn't have a Python interpreter, and you're on UNIX, you can either install Python using your operating system's package manager *or* you can install Python from source fairly easily on any UNIX system that has development tools.

Package Manager Method

You can use your system's "package manager" to install Python. Every system's package manager is slightly different, but the "flavor" of them is usually the same.

For example, on an Ubuntu Linux system, to use the system package manager to install a Python 2.6 interpreter, use the following command:

```
$ sudo apt-get install python2.6-dev
```

Once these steps are performed, the Python interpreter will usually be invokable via `python2.6` from a shell prompt.

Source Compile Method

It's useful to use a Python interpreter that *isn't* the "system" Python interpreter to develop your software. The authors of Pyramid tend not to use the system Python for development purposes; always a self-compiled one. Compiling Python is usually easy, and often the "system" Python is compiled with options that aren't optimal for web development.

To compile software on your UNIX system, typically you need development tools. Often these can be installed via the package manager. For example, this works to do so on an Ubuntu Linux system:

```
$ sudo apt-get install build-essential
```

On Mac OS X, installing XCode has much the same effect.

Once you've got development tools installed on your system, you can install a Python 2.6 interpreter from *source*, on the same system, using the following commands:

```
[chrism@vitaminf ~]$ cd ~
[chrism@vitaminf ~]$ mkdir tmp
[chrism@vitaminf ~]$ mkdir opt
[chrism@vitaminf ~]$ cd tmp
[chrism@vitaminf tmp]$ wget \
       http://www.python.org/ftp/python/2.6.4/Python-2.6.4.tgz
[chrism@vitaminf tmp]$ tar xvzf Python-2.6.4.tgz
[chrism@vitaminf tmp]$ cd Python-2.6.4
[chrism@vitaminf Python-2.6.4]$ ./configure \
        --prefix=$HOME/opt/Python-2.6.4
[chrism@vitaminf Python-2.6.4]$ make; make install
```

Once these steps are performed, the Python interpreter will be invokable via `$HOME/opt/Python-2.6.4/bin/python` from a shell prompt.

2.1.2 If You Don't Yet Have A Python Interpreter (Windows)

If your Windows system doesn't have a Python interpreter, you'll need to install it by downloading a Python 2.6-series interpreter executable from python.org's download section (the files labeled "Windows Installer"). Once you've downloaded it, double click on the executable and accept the defaults during the installation process. You may also need to download and install the Python for Windows extensions.

 After you install Python on Windows, you may need to add the `C:\Python26` directory to your environment's `Path` in order to make it possible to invoke Python from a command prompt by typing `python`. To do so, right click `My Computer`, select `Properties` –> `Advanced Tab` –> `Environment Variables` and add that directory to the end of the `Path` environment variable.

2.2 Installing Pyramid on a UNIX System

It is best practice to install Pyramid into a "virtual" Python environment in order to obtain isolation from any "system" packages you've got installed in your Python version. This can be done by using the *virtualenv* package. Using a virtualenv will also prevent Pyramid from globally installing versions of packages that are not compatible with your system Python.

To set up a virtualenv in which to install Pyramid, first ensure that *setuptools* is installed. Invoke `import setuptools` within the Python interpreter you'd like to run Pyramid under:

```
[chrism@vitaminf pyramid]$ python
Python 2.6.5 (r265:79063, Apr 29 2010, 00:31:32)
[GCC 4.4.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import setuptools
```

If running `import setuptools` does not raise an `ImportError`, it means that setuptools is already installed into your Python interpreter. If `import setuptools` fails, you will need to install setuptools manually. Note that above we're using a Python 2.6-series interpreter on Mac OS X; your output may differ if you're using a later Python version or a different platform.

If you are using a "system" Python (one installed by your OS distributor or a 3rd-party packager such as Fink or MacPorts), you can usually install the setuptools package by using your system's package manager. If you cannot do this, or if you're using a self-installed version of Python, you will need to install setuptools "by hand". Installing setuptools "by hand" is always a reasonable thing to do, even if your package manager already has a pre-chewed version of setuptools for installation.

To install setuptools by hand, first download ez_setup.py then invoke it using the Python interpreter into which you want to install setuptools.

```
$ python ez_setup.py
```

Once this command is invoked, setuptools should be installed on your system. If the command fails due to permission errors, you may need to be the administrative user on your system to successfully invoke the script. To remediate this, you may need to do:

```
$ sudo python ez_setup.py
```

2.2.1 Installing the `virtualenv` Package

Once you've got setuptools installed, you should install the *virtualenv* package. To install the *virtualenv* package into your setuptools-enabled Python interpreter, use the `easy_install` command.

```
$ easy_install virtualenv
```

This command should succeed, and tell you that the virtualenv package is now installed. If it fails due to permission errors, you may need to install it as your system's administrative user. For example:

```
$ sudo easy_install virtualenv
```

2.2.2 Creating the Virtual Python Environment

Once the *virtualenv* package is installed in your Python, you can then create a virtual environment. To do so, invoke the following:

```
$ virtualenv --no-site-packages env
New python executable in env/bin/python
Installing setuptools.............done.
```

 Using `--no-site-packages` when generating your virtualenv is *very important*. This flag provides the necessary isolation for running the set of packages required by Pyramid. If you do not specify `--no-site-packages`, it's possible that Pyramid will not install properly into the virtualenv, or, even if it does, may not run properly, depending on the packages you've already got installed into your Python's "main" site-packages dir.

 *do not* use `sudo` to run the `virtualenv` script. It's perfectly acceptable (and desirable) to create a virtualenv as a normal user.

You should perform any following commands that mention a "bin" directory from within the `env` virtualenv dir.

2.2.3 Installing Pyramid Into the Virtual Python Environment

After you've got your `env` virtualenv installed, you may install Pyramid itself using the following commands from within the virtualenv (`env`) directory you created in the last step.

```
$ cd env

.. parsed-literal::

$ bin/easy_install "pyramid==\ |release|\ "
```

The `easy_install` command will take longer than the previous ones to complete, as it downloads and installs a number of dependencies.

2.3 Installing Pyramid on a Windows System

1. Install, or find Python 2.6 for your system.

2. Install the Python for Windows extensions. Make sure to pick the right download for Python 2.6 and install it using the same Python installation from the previous step.

3. Install latest *setuptools* distribution into the Python you obtained/installed/found in the step above: download ez_setup.py and run it using the `python` interpreter of your Python 2.6 installation using a command prompt:

   ```
   c:\> c:\Python26\python ez_setup.py
   ```

4. Use that Python's *bin/easy_install* to install *virtualenv*:

```
c:\> c:\Python26\Scripts\easy_install virtualenv
```

5. Use that Python's virtualenv to make a workspace:

```
c:\> c:\Python26\Scripts\virtualenv --no-site-packages env
```

6. Switch to the `env` directory:

```
c:\> cd env
```

7. (Optional) Consider using `Scripts\activate.bat` to make your shell environment wired to use the virtualenv.

8. Use `easy_install` pointed at the "current" index to get Pyramid and its direct dependencies installed:

```
c:\env> Scripts\easy_install ``pyramid==1.2.7``
```

2.4 Installing Pyramid on Google App Engine

Running Pyramid on Google's App Engine documents the steps required to install a Pyramid application on Google App Engine.

2.5 Installing Pyramid on Jython

Pyramid is known to work under *Jython* version 2.5.1. Install *Jython*, and then follow the installation steps for Pyramid on your platform described in one of the sections entitled *Installing Pyramid on a UNIX System* or *Installing Pyramid on a Windows System* above, replacing the `python` command with `jython` as necessary. The steps are exactly the same except you should use the `jython` command name instead of the `python` command name.

One caveat exists to using Pyramid under Jython: the *Chameleon* templating engine does not work on Jython. However, the *Mako* templating system, which is also included with Pyramid, does work under Jython; use it instead.

2.6 What Gets Installed

When you `easy_install` Pyramid, various Zope libraries, various Chameleon libraries, WebOb, Paste, PasteScript, and PasteDeploy libraries are installed.

Additionally, as chronicled in *Creating a Pyramid Project*, scaffolds will be registered, which make it easy to start a new Pyramid project.

CHAPTER 3

Application Configuration

Most people already understand "configuration" as settings that influence the operation of an application. For instance, it's easy to think of the values in a `.ini` file parsed at application startup time as "configuration". However, if you're reasonably open-minded, it's easy to think of *code* as configuration too. Since Pyramid, like most other web application platforms, is a *framework*, it calls into code that you write (as opposed to a *library*, which is code that exists purely for you to call). The act of plugging application code that you've written into Pyramid is also referred to within this documentation as "configuration"; you are configuring Pyramid to call the code that makes up your application.

There are two ways to configure a Pyramid application: *imperative configuration* and *declarative configuration*. Both are described below.

3.1 Imperative Configuration

"Imperative configuration" just means configuration done by Python statements, one after the next. Here's one of the simplest Pyramid applications, configured imperatively:

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response

def hello_world(request):
    return Response('Hello world!')

if __name__ == '__main__':
    config = Configurator()
    config.add_view(hello_world)
    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

We won't talk much about what this application does yet. Just note that the "configuration' statements take place underneath the `if __name__ == '__main__':` stanza in the form of method calls on a *Configurator* object (e.g. `config.add_view(...)`). These statements take place one after the other, and are executed in order, so the full power of Python, including conditionals, can be employed in this mode of configuration.

3.2 Declarative Configuration

It's sometimes painful to have all configuration done by imperative code, because often the code for a single application may live in many files. If the configuration is centralized in one place, you'll need to have at least two files open at once to see the "big picture": the file that represents the configuration, and the file that contains the implementation objects referenced by the configuration. To avoid this, Pyramid allows you to insert *configuration decoration* statements very close to code that is referred to by the declaration itself. For example:

```
1 from pyramid.response import Response
2 from pyramid.view import view_config
3
4 @view_config(name='hello', request_method='GET')
5 def hello(request):
6     return Response('Hello')
```

The mere existence of configuration decoration doesn't cause any configuration registration to be performed. Before it has any effect on the configuration of a Pyramid application, a configuration decoration within application code must be found through a process known as a *scan*.

For example, the `pyramid.view.view_config` decorator in the code example above adds an attribute to the `hello` function, making it available for a *scan* to find it later.

A *scan* of a *module* or a *package* and its subpackages for decorations happens when the `pyramid.config.Configurator.scan()` method is invoked: scanning implies searching for configuration declarations in a package and its subpackages. For example:

Starting A Scan

```
from paste.httpserver import serve
from pyramid.response import Response
from pyramid.view import view_config

@view_config()
def hello(request):
    return Response('Hello')

if __name__ == '__main__':
    from pyramid.config import Configurator
    config = Configurator()
    config.scan()
    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

The scanning machinery imports each module and subpackage in a package or module recursively, looking for special attributes attached to objects defined within a module. These special attributes are typically attached to code via the use of a *decorator*. For example, the `view_config` decorator can be attached to a function or instance method.

Once scanning is invoked, and *configuration decoration* is found by the scanner, a set of calls are made to a *Configurator* on your behalf: these calls replace the need to add imperative configuration statements that don't live near the code being configured.

The combination of *configuration decoration* and the invocation of a *scan* is collectively known as *declarative configuration*.

In the example above, the scanner translates the arguments to `view_config` into a call to the `pyramid.config.Configurator.add_view()` method, effectively:

```
config.add_view(hello)
```

3.3 Summary

There are two ways to configure a Pyramid application: declaratively and imperatively. You can choose the mode you're most comfortable with; both are completely equivalent. Examples in this documentation will use both modes interchangeably.

CHAPTER 4

Creating Your First Pyramid Application

In this chapter, we will walk through the creation of a tiny Pyramid application. After we're finished creating the application, we'll explain in more detail how it works.

4.1 Hello World

Here's one of the very simplest Pyramid applications:

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response


def hello_world(request):
    return Response('Hello %(name)s!' % request.matchdict)

if __name__ == '__main__':
    config = Configurator()
    config.add_route('hello', '/hello/{name}')
    config.add_view(hello_world, route_name='hello')
    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

When this code is inserted into a Python script named `helloworld.py` and executed by a Python interpreter which has the Pyramid software installed, an HTTP server is started on TCP port 8080:

```
$ python helloworld.py
serving on 0.0.0.0:8080 view at http://127.0.0.1:8080
```

When port 8080 is visited by a browser on the URL `/hello/world`, the server will simply serve up the text "Hello world!"

Press `Ctrl-C` to stop the application.

Now that we have a rudimentary understanding of what the application does, let's examine it piece-by-piece.

4.1.1 Imports

The above `helloworld.py` script uses the following set of import statements:

```
1 from paste.httpserver import serve
2 from pyramid.config import Configurator
3 from pyramid.response import Response
```

The script imports the `Configurator` class from the `pyramid.config` module. An instance of the `Configurator` class is later used to configure your Pyramid application.

Like many other Python web frameworks, Pyramid uses the *WSGI* protocol to connect an application and a web server together. The `paste.httpserver` server is used in this example as a WSGI server for convenience, as the `paste` package is a dependency of Pyramid itself.

The script also imports the `pyramid.response.Response` class for later use. An instance of this class will be used to create a web response.

4.1.2 View Callable Declarations

The above script, beneath its set of imports, defines a function named `hello_world`.

```
1 def hello_world(request):
2     return Response('Hello %(name)s!' % request.matchdict)
```

This function doesn't do anything very difficult. The functions accepts a single argument (`request`). The `hello_world` function returns an instance of the `pyramid.response.Response`. The single argument to the class' constructor is value computed from arguments matched from the url route. This value becomes the body of the response.

This function is known as a *view callable*. A view callable accepts a single argument, `request`. It is expected to return a *response* object. A view callable doesn't need to be a function; it can be represented via another type of object, like a class or an instance, but for our purposes here, a function serves us well.

A view callable is always called with a *request* object. A request object is a representation of an HTTP request sent to Pyramid via the active *WSGI* server.

A view callable is required to return a *response* object because a response object has all the information necessary to formulate an actual HTTP response; this object is then converted to text by the *WSGI* server which called Pyramid and it is sent back to the requesting browser. To return a response, each view callable creates an instance of the `Response` class. In the `hello_world` function, a string is passed as the body to the response.

4.1.3 Application Configuration

In the above script, the following code represents the *configuration* of this simple application. The application is configured using the previously defined imports and function definitions, placed within the confines of an `if` statement:

```
1 if __name__ == '__main__':
2     config = Configurator()
3     config.add_route('hello', '/hello/{name}')
4     config.add_view(hello_world, route_name='hello')
5     app = config.make_wsgi_app()
6     serve(app, host='0.0.0.0')
```

Let's break this down piece-by-piece.

4.1.4 Configurator Construction

```
1 if __name__ == '__main__':
2     config = Configurator()
```

The `if __name__ == '__main__':` line in the code sample above represents a Python idiom: the code inside this if clause is not invoked unless the script containing this code is run directly from the operating system command line. For example, if the file named `helloworld.py` contains the entire script body, the code within the `if` statement will only be invoked when `python helloworld.py` is executed from the command line.

Using the `if` clause is necessary – or at least best practice – because code in a Python `.py` file may be eventually imported via the Python `import` statement by another `.py` file. `.py` files that are imported by other `.py` files are referred to as *modules*. By using the `if __name__ == 'main':` idiom, the script above is indicating that it does not want the code within the `if` statement to execute if this module is imported from another; the code within the `if` block should only be run during a direct script execution.

The `config = Configurator()` line above creates an instance of the `Configurator` class. The resulting `config` object represents an API which the script uses to configure this particular Pyramid application. Methods called on the Configurator will cause registrations to be made in an *application registry* associated with the application.

4.1.5 Adding Configuration

```
1     config.add_route('hello', '/hello/{name}')
2     config.add_view(hello_world, route_name='hello')
```

First line above calls the `pyramid.config.Configurator.add_route()` method, which registers a *route* to match any url path that begins with `/hello/` followed by a string.

The second line, `config.add_view(hello_world, route_name='hello')`, registers the `hello_world` function as a *view callable* and makes sure that it will be called when the `hello` route is matched.

4.1.6 WSGI Application Creation

```
1     app = config.make_wsgi_app()
```

After configuring views and ending configuration, the script creates a WSGI *application* via the `pyramid.config.Configurator.make_wsgi_app()` method. A call to `make_wsgi_app` implies that all configuration is finished (meaning all method calls to the configurator which set up views, and various other configuration settings have been performed). The `make_wsgi_app` method returns a *WSGI* application object that can be used by any WSGI server to present an application to a requestor.

WSGI is a protocol that allows servers to talk to Python applications. We don't discuss *WSGI* in any depth within this book, however, you can learn more about it by visiting wsgi.org.

The Pyramid application object, in particular, is an instance of a class representing a Pyramid *router*. It has a reference to the *application registry* which resulted from method calls to the configurator used to configure it. The *router* consults the registry to obey the policy choices made by a single application. These policy choices were informed by method calls to the *Configurator* made earlier; in our case, the only policy choices made were implied by calls to its `add_view` and `add_route` methods.

4.1.7 WSGI Application Serving

```
1     serve(app, host='0.0.0.0')
```

Finally, we actually serve the application to requestors by starting up a WSGI server. We happen to use the `paste.httpserver.serve()` WSGI server runner, passing it the `app` object (a *router*) as the application we wish to serve. We also pass in an argument `host='0.0.0.0'`, meaning "listen on all TCP interfaces." By default, the Paste HTTP server listens only on the `127.0.0.1` interface, which is problematic if you're running the server on a remote system and you wish to access it with a web browser from a local system. We don't specify a TCP port number to listen on; this means we want to use the default TCP port, which is 8080.

When this line is invoked, it causes the server to start listening on TCP port 8080. The server will serve requests forever, or at least until we stop it by killing the process which runs it (usually by pressing `Ctrl-C` in the terminal we used to start it).

4.1.8 Conclusion

Our hello world application is one of the simplest possible Pyramid applications, configured "imperatively". We can see that it's configured imperatively because the full power of Python is available to us as we perform configuration tasks.

4.2 References

For more information about the API of a *Configurator* object, see `Configurator` .

For more information about *view configuration*, see *View Configuration*.

CHAPTER 5

Creating a Pyramid Project

As we saw in *Creating Your First Pyramid Application*, it's possible to create a Pyramid application completely manually. However, it's usually more convenient to use a *scaffold* to generate a basic Pyramid *project*.

A project is a directory that contains at least one Python *package*. You'll use a scaffold to create a project, and you'll create your application logic within a package that lives inside the project. Even if your application is extremely simple, it is useful to place code that drives the application within a package, because: 1) a package is more easily extended with new code and 2) an application that lives inside a package can also be distributed more easily than one which does not live within a package.

Pyramid comes with a variety of scaffolds that you can use to generate a project. Each scaffold makes different configuration assumptions about what type of application you're trying to construct.

These scaffolds are rendered using the *PasteDeploy* `paster create` command.

5.1 Scaffolds Included with Pyramid

The convenience scaffolds included with Pyramid differ from each other on a number of axes:

- the persistence mechanism they offer (no persistence mechanism, *ZODB*, or *SQLAlchemy*).
- the mechanism they use to map URLs to code (*traversal* or *URL dispatch*).
- whether or not the `pyramid_beaker` library is relied upon as the sessioning implementation (as opposed to no sessioning or default sessioning).

The included scaffolds are these:

pyramid_starter URL mapping via *traversal* and no persistence mechanism.

pyramid_zodb URL mapping via *traversal* and persistence via *ZODB*.

pyramid_routesalchemy URL mapping via *URL dispatch* and persistence via *SQLAlchemy*

pyramid_alchemy URL mapping via *traversal* and persistence via *SQLAlchemy*

 At this time, each of these scaffolds uses the *Chameleon* templating system, which is incompatible with Jython. To use scaffolds to build applications which will run on Jython, you can try the `pyramid_jinja2_starter` scaffold which ships as part of the *pyramid_jinja2* package. You can also just use any above scaffold and replace the Chameleon template it includes with a *Mako* analogue.

Rather than use any of the above scaffolds, Pylons 1 users may feel more comfortable installing the *Akhet* development environment, which provides a scaffold named `akhet`. This scaffold configures a Pyramid application in a "Pylons-esque" way, including the use of a *view handler* to map URLs to code (a handler is much like a Pylons "controller").

5.2 Creating the Project

In *Installing Pyramid*, you created a virtual Python environment via the `virtualenv` command. To start a Pyramid *project*, use the `paster` facility installed within the virtualenv. In *Installing Pyramid* we called the virtualenv directory `env`; the following command assumes that our current working directory is that directory. We'll choose the `pyramid_starter` scaffold for this purpose.

On UNIX:

```
$ bin/paster create -t pyramid_starter
```

Or on Windows:

```
$ Scripts\paster.exe create -t pyramid_starter
```

The above command uses the `paster create` command to create a project with the `pyramid_starter` scaffold. To use a different scaffold, such as `pyramid_routesalchemy`, you'd just change the last argument. For example, on UNIX:

```
$ bin/paster create -t pyramid_routesalchemy
```

Or on Windows:

```
$ Scripts\paster.exe create -t pyramid_routesalchemy
```

`paster create` will ask you a single question: the *name* of the project. You should use a string without spaces and with only letters in it. Here's sample output from a run of `paster create` on UNIX for a project we name `MyProject`:

```
$ bin/paster create -t pyramid_starter
Selected and implied templates:
  pyramid#pyramid_starter  pyramid starter project

Enter project name: MyProject
Variables:
  egg:      MyProject
  package:  myproject
  project:  MyProject
Creating template pyramid
Creating directory ./MyProject
# ... more output ...
Running /Users/chrism/projects/pyramid/bin/python setup.py egg_info
```

You can skip the interrogative question about a project name during `paster create` by adding the project name to the command line, e.g. `paster create -t pyramid_starter MyProject`.

You may encounter an error when using `paster create` if a dependent Python package is not installed. This will result in a traceback ending in `pkg_resources.DistributionNotFound: <package name>`. Simply run `bin/easy_install` (or `Script\easy_install.exe` on Windows), with the missing package name from the error message to work around this issue.

As a result of invoking the `paster create` command, a project is created in a directory named `MyProject`. That directory is a *project* directory. The `setup.py` file in that directory can be used to distribute your application, or install your application for deployment or development.

A *PasteDeploy* `.ini` file named `development.ini` will be created in the project directory. You will use this `.ini` file to configure a server, to run your application, and to debug your application. It sports configuration that enables an interactive debugger and settings optimized for development.

Another *PasteDeploy* `.ini` file named `production.ini` will also be created in the project directory. It sports configuration that disables any interactive debugger (to prevent inappropriate access and disclosure), and turns off a number of debugging settings. You can use this file to put your application into production.

The `MyProject` project directory contains an additional subdirectory named `myproject` (note the case difference) representing a Python *package* which holds very simple Pyramid sample code. This is where you'll edit your application's Python code and templates.

5.3 Installing your Newly Created Project for Development

To install a newly created project for development, you should `cd` to the newly created project directory and use the Python interpreter from the *virtualenv* you created during *Installing Pyramid* to invoke the command `python setup.py develop`

The file named `setup.py` will be in the root of the paster-generated project directory. The `python` you're invoking should be the one that lives in the `bin` (or `Scripts` on Windows) directory of your virtual Python environment. Your terminal's current working directory *must* be the newly created project directory.

On UNIX:

```
$ cd MyProject
$ ../bin/python setup.py develop
```

Or on Windows:

```
$ cd MyProject
$ ..\Scripts\python.exe setup.py develop
```

Elided output from a run of this command on UNIX is shown below:

```
$ cd MyProject
$ ../bin/python setup.py develop
...
Finished processing dependencies for MyProject==0.0
```

This will install a *distribution* representing your project into the interpreter's library set so it can be found by `import` statements and by *PasteDeploy* commands such as `paster serve`, `paster pshell`, `paster proutes` and `paster pviews`.

5.4 Running The Tests For Your Application

To run unit tests for your application, you should invoke them using the Python interpreter from the *virtualenv* you created during *Installing Pyramid* (the `python` command that lives in the `bin` directory of your virtualenv).

On UNIX:

```
$ ../bin/python setup.py test -q
```

Or on Windows:

```
$ ..\Scripts\python.exe setup.py test -q
```

Here's sample output from a test run on UNIX:

```
$ ../bin/python setup.py test -q
running test
running egg_info
writing requirements to MyProject.egg-info/requires.txt
writing MyProject.egg-info/PKG-INFO
writing top-level names to MyProject.egg-info/top_level.txt
writing dependency_links to MyProject.egg-info/dependency_links.txt
writing entry points to MyProject.egg-info/entry_points.txt
reading manifest file 'MyProject.egg-info/SOURCES.txt'
writing manifest file 'MyProject.egg-info/SOURCES.txt'
running build_ext
..
----------------------------------------------------------------------
Ran 1 test in 0.108s

OK
```

 The `-q` option is passed to the `setup.py test` command to limit the output to a stream of dots. If you don't pass `-q`, you'll see more verbose test result output (which normally isn't very useful).

The tests themselves are found in the `tests.py` module in your `paster create` -generated project. Within a project generated by the `pyramid_starter` scaffold, a single sample test exists.

5.5 Running The Project Application

Once a project is installed for development, you can run the application it represents using the `paster serve` command against the generated configuration file. In our case, this file is named `development.ini`.

On UNIX:

```
$ ../bin/paster serve development.ini
```

On Windows:

```
$ ..\Scripts\paster.exe serve development.ini
```

Here's sample output from a run of `paster serve` on UNIX:

```
$ ../bin/paster serve development.ini
Starting server in PID 16601.
serving on 0.0.0.0:6543 view at http://127.0.0.1:6543
```

By default, Pyramid applications generated from a scaffold will listen on TCP port 6543. You can shut down a server started this way by pressing `Ctrl-C`.

During development, it's often useful to run `paster serve` using its `--reload` option. When `--reload` is passed to `paster serve`, changes to any Python module your project uses will cause the server to restart. This typically makes development easier, as changes to Python code made within a Pyramid application is not put into effect until the server restarts.

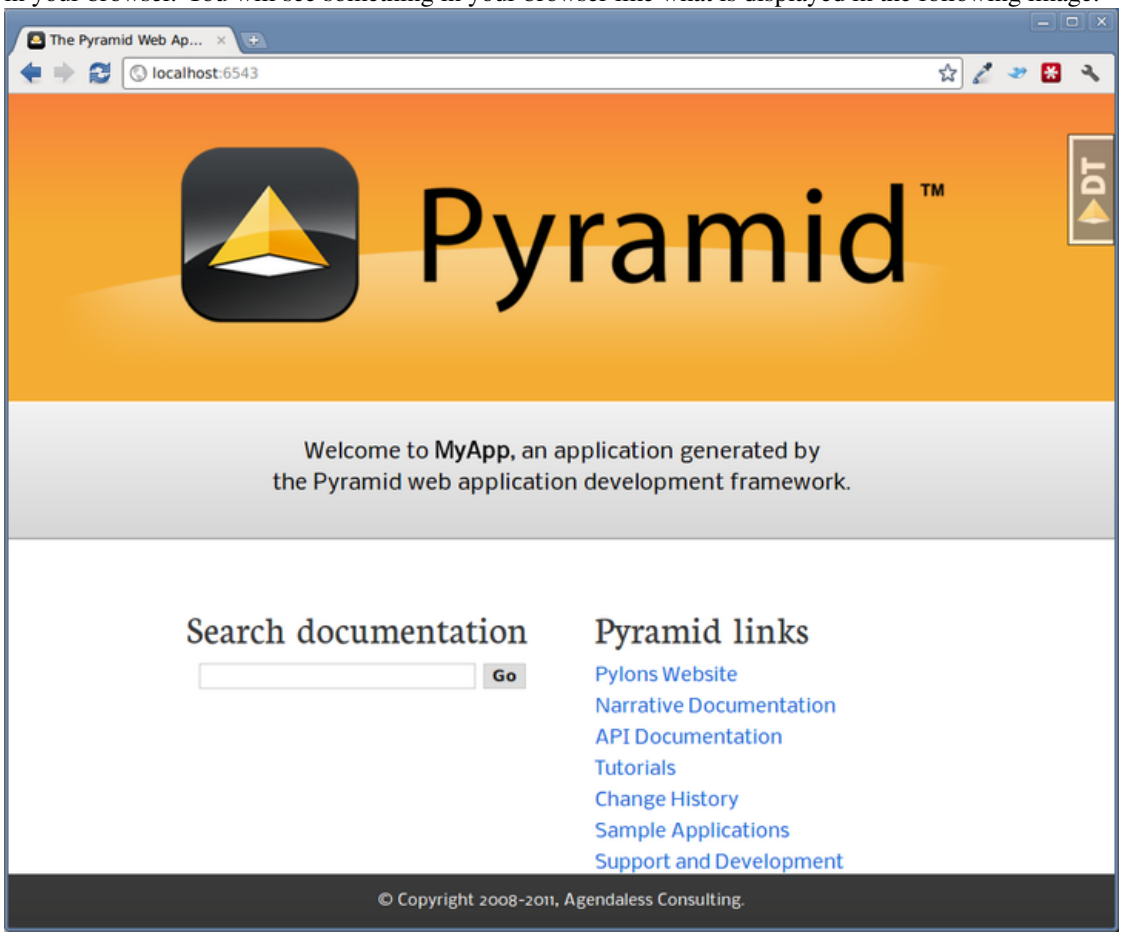
For example, on UNIX:

```
$ ../bin/paster serve development.ini --reload
Starting subprocess with file monitor
Starting server in PID 16601.
serving on 0.0.0.0:6543 view at http://127.0.0.1:6543
```

For more detailed information about the startup process, see *Startup*. For more information about environment variables and configuration file settings that influence startup and runtime behavior, see *Environment Variables and .ini File Settings*.

5.6 Viewing the Application

Once your application is running via `paster serve`, you may visit `http://localhost:6543/` in your browser. You will see something in your browser like what is displayed in the following image:

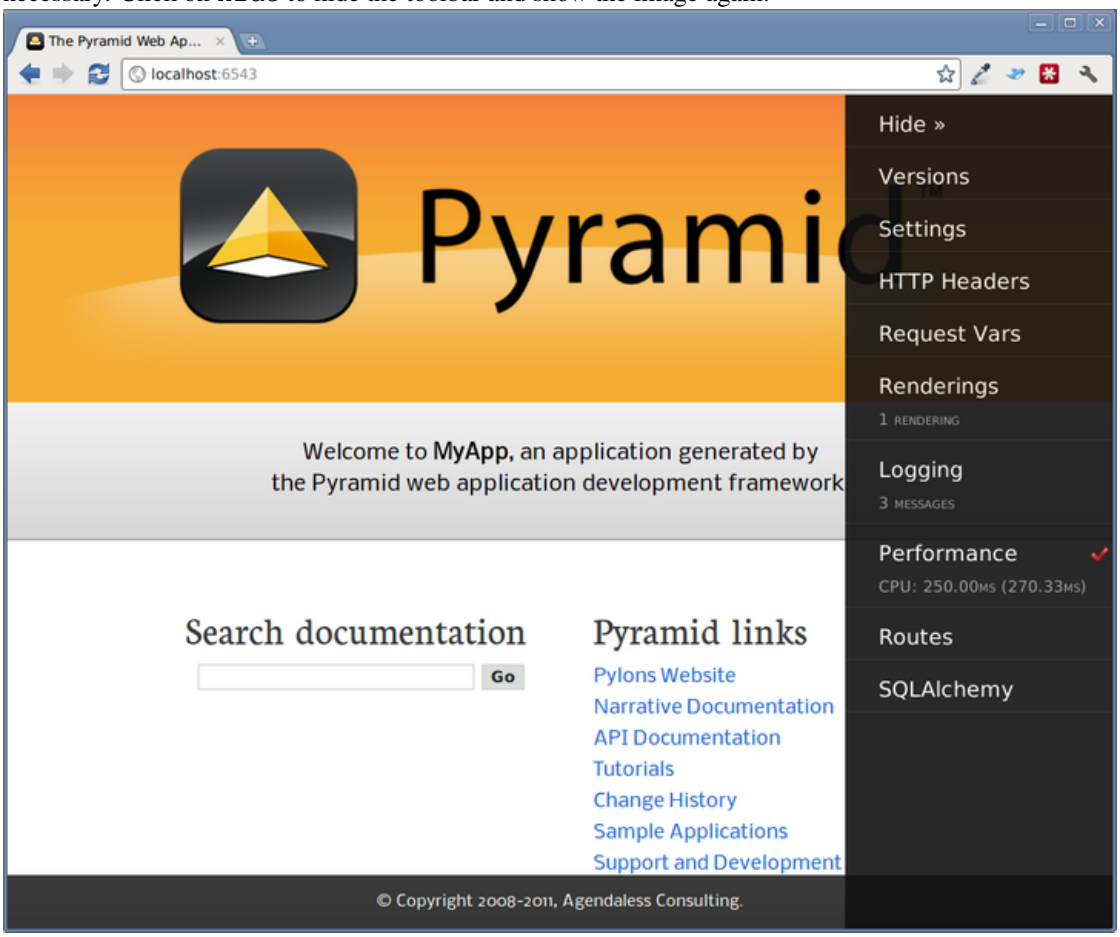


This is the page shown by default when you visit an unmodified `paster create` -generated `pyramid_starter` application in a browser.

5.6.1 The Debug Toolbar

If you click on the image shown at the right hand top of the page ("^DT"), you'll be presented with a debug toolbar that provides various niceties while you're developing. This image will float above every

HTML page served by Pyramid while you develop an application, and allows you show the toolbar as necessary. Click on `Hide` to hide the toolbar and show the image again.



For more information about what the debug toolbar allows you to do, see the documentation for pyramid_debugtoolbar.

The debug toolbar will not be shown (and all debugging will be turned off) when you use the `production.ini` file instead of the `development.ini` ini file to run the application.

You can also turn the debug toolbar off by editing `development.ini` and commenting out the line `pyramid.includes = pyramid_debugtoolbar`. For example, instead of:

```
[app:main]
...
pyramid.includes = pyramid_debugtoolbar
```

Put a hash mark in front of the `pyramid.includes` line:

```
[app:main]
...
#pyramid.includes = pyramid_debugtoolbar
```

Then restart the application to see that the toolbar has been turned off.

5.7 The Project Structure

The `pyramid_starter` scaffold generated a *project* (named `MyProject`), which contains a Python *package*. The package is *also* named `myproject`, but it's lowercased; the scaffold generates a project which contains a package that shares its name except for case.

All Pyramid `paster` -generated projects share a similar structure. The `MyProject` project we've generated has the following directory structure:

```
MyProject/
|-- CHANGES.txt
|-- development.ini
|-- MANIFEST.in
|-- myproject
|   |-- __init__.py
|   |-- resources.py
|   |-- static
|   |   |-- favicon.ico
|   |   |-- logo.png
|   |   `-- pylons.css
|   |-- templates
|   |   `-- mytemplate.pt
|   |-- tests.py
|   `-- views.py
|-- production.ini
|-- README.txt
|-- setup.cfg
`-- setup.py
```

5.8 The `MyProject` Project

The `MyProject` *project* directory is the distribution and deployment wrapper for your application. It contains both the `myproject` *package* representing your application as well as files used to describe, run, and test your application.

1. `CHANGES.txt` describes the changes you've made to the application. It is conventionally written in *ReStructuredText* format.

2. `README.txt` describes the application in general. It is conventionally written in *ReStructuredText* format.

3. `development.ini` is a *PasteDeploy* configuration file that can be used to execute your application during development.

4. `production.ini` is a *PasteDeploy* configuration file that can be used to execute your application in a production configuration.

5. `setup.cfg` is a *setuptools* configuration file used by `setup.py`.

6. `MANIFEST.in` is a *distutils* "manifest" file, naming which files should be included in a source distribution of the package when `python setup.py sdist` is run.

7. `setup.py` is the file you'll use to test and distribute your application. It is a standard *setuptools* `setup.py` file.

5.8.1 `development.ini`

The `development.ini` file is a *PasteDeploy* configuration file. Its purpose is to specify an application to run when you invoke `paster serve`, as well as the deployment settings provided to that application.

The generated `development.ini` file looks like so:

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

pyramid.reload_templates = true
pyramid.debug_authorization = false
pyramid.debug_notfound = false
pyramid.debug_routematch = false
pyramid.debug_templates = true
```

```
pyramid.default_locale_name = en
pyramid.includes = pyramid_debugtoolbar

[server:main]
use = egg:Paste#http
host = 0.0.0.0
port = 6543

# Begin logging configuration

[loggers]
keys = root, myproject

[handlers]
keys = console

[formatters]
keys = generic

[logger_root]
level = INFO
handlers = console

[logger_myproject]
level = DEBUG
handlers =
qualname = myproject

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

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

# End logging configuration
```

This file contains several sections including `[app:main]`, `[server:main]` and several other sections related to logging configuration.

The `[app:main]` section represents configuration for your Pyramid application. The `use` setting is the only setting required to be present in the `[app:main]` section. Its default value, `egg:MyProject`, indicates that our MyProject project contains the application that should be served. Other settings added to this section are passed as keyword arguments to the function named `main` in our package's

__init__.py module. You can provide startup-time configuration parameters to your application by adding more settings to this section.

 See *Entry Points and PasteDeploy .ini Files* for more information about the meaning of the use = egg:MyProject value in this section.

The pyramid.reload_templates setting in the [app:main] section is a Pyramid -specific setting which is passed into the framework. If it exists, and its value is true, *Chameleon* and *Mako* template changes will not require an application restart to be detected. See *Automatically Reloading Templates* for more information.

The pyramid.debug_templates setting in the [app:main] section is a Pyramid -specific setting which is passed into the framework. If it exists, and its value is true, *Chameleon* template exceptions will contain more detailed and helpful information about the error than when this value is false. See *Nicer Exceptions in Chameleon Templates* for more information.

 The pyramid.reload_templates and pyramid.debug_templates options should be turned off for production applications, as template rendering is slowed when either is turned on.

The pyramid.includes setting in the [app:main] section tells Pyramid to "include" configuration from another package. In this case, the line pyramid.includes = pyramid_debugtoolbar tells Pyramid to include configuration from the pyramid_debugtoolbar package. This turns on a debugging panel in development mode which will be shown on the right hand side of the screen. Including the debug toolbar will also make it possible to interactively debug exceptions when an error occurs.

Various other settings may exist in this section having to do with debugging or influencing runtime behavior of a Pyramid application. See *Environment Variables and .ini File Settings* for more information about these settings.

The name main in [app:main] signifies that this is the default application run by paster serve when it is invoked against this configuration file. The name main is a convention used by PasteDeploy signifying that it is the default application.

The [server:main] section of the configuration file configures a WSGI server which listens on TCP port 6543. It is configured to listen on all interfaces (0.0.0.0). This means that any remote system which has TCP access to your system can see your Pyramid application.

The sections that live between the markers # Begin logging configuration and # End logging configuration represent Python's standard library logging module configuration for your application. The sections between these two markers are passed to the logging module's config file configuration engine when the paster serve or paster pshell commands are executed. The default configuration sends application logging output to the standard error output of your terminal. For more information about logging configuration, see *Logging*.

See the *PasteDeploy* documentation for more information about other types of things you can put into this .ini file, such as other applications, *middleware* and alternate *WSGI* server implementations.

5.8.2 production.ini

The production.ini file is a *PasteDeploy* configuration file with a purpose much like that of development.ini. However, it disables the debug toolbar, and filters all log messages except those above the WARN level. It also turns off template development options such that templates are not automatically reloaded when changed, and turns off all debugging options. This file is appropriate to use instead of development.ini when you put your application into production.

It's important to use production.ini (and *not* development.ini) to benchmark your application and put it into production. development.ini configures your system with a debug toolbar that helps development, but the inclusion of this toolbar slows down page rendering times by over an order of magnitude. The debug toolbar is also a potential security risk if you have it configured incorrectly.

5.8.3 MANIFEST.in

The MANIFEST.in file is a *distutils* configuration file which specifies the non-Python files that should be included when a *distribution* of your Pyramid project is created when you run python setup.py sdist. Due to the information contained in the default MANIFEST.in, an sdist of your Pyramid project will include .txt files, .ini files, .rst files, graphics files, and template files, as well as .py files. See http://docs.python.org/distutils/sourcedist.html#the-manifest-in-template for more information about the syntax and usage of MANIFEST.in.

Without the presence of a MANIFEST.in file or without checking your source code into a version control repository, setup.py sdist places only *Python source files* (files ending with a .py extension) into tarballs generated by python setup.py sdist. This means, for example, if your project was not checked into a setuptools-compatible source control system, and your project directory didn't contain a MANIFEST.in file that told the sdist machinery to include *.pt files, the myproject/templates/mytemplate.pt file would not be included in the generated tarball.

Projects generated by Pyramid scaffolds include a default MANIFEST.in file. The MANIFEST.in file contains declarations which tell it to include files like *.pt, *.css and *.js in the generated tarball. If you include files with extensions other than the files named in the project's MANIFEST.in and you don't make use of a setuptools-compatible version control system, you'll need to edit the MANIFEST.in file and include the statements necessary to include your new files. See http://docs.python.org/distutils/sourcedist.html#principle for more information about how to do this.

You can also delete MANIFEST.in from your project and rely on a setuptools feature which simply causes all files checked into a version control system to be put into the generated tarball. To allow this to happen, check all the files that you'd like to be distributed along with your application's Python files into Subversion. After you do this, when you rerun setup.py sdist, all files checked into the version control system will be included in the tarball. If you don't use Subversion, and instead use a different version control system, you may need to install a setuptools add-on such as setuptools-git or setuptools-hg for this behavior to work properly.

5.8.4 `setup.py`

The `setup.py` file is a *setuptools* setup file. It is meant to be run directly from the command line to perform a variety of functions, such as testing your application, packaging, and distributing your application.

 `setup.py` is the defacto standard which Python developers use to distribute their reusable code. You can read more about `setup.py` files and their usage in the Setuptools documentation and The Hitchhiker's Guide to Packaging.

Our generated `setup.py` looks like this:

```
import os

from setuptools import setup, find_packages

here = os.path.abspath(os.path.dirname(__file__))
README = open(os.path.join(here, 'README.txt')).read()
CHANGES = open(os.path.join(here, 'CHANGES.txt')).read()

requires = ['pyramid', 'pyramid_debugtoolbar']

setup(name='MyProject',
      version='0.0',
      description='MyProject',
      long_description=README + '\n\n' +  CHANGES,
      classifiers=[
        "Programming Language :: Python",
        "Framework :: Pylons",
        "Topic :: Internet :: WWW/HTTP",
        "Topic :: Internet :: WWW/HTTP :: WSGI :: Application",
        ],
      author='',
      author_email='',
      url='',
      keywords='web pyramid pylons',
      packages=find_packages(),
      include_package_data=True,
      zip_safe=False,
      install_requires=requires,
      tests_require=requires,
      test_suite="myproject",
      entry_points = """\
      [paste.app_factory]
      main = myproject:main
```

```
34          """,
35          paster_plugins=['pyramid'],
36          )
37
```

The `setup.py` file calls the setuptools `setup` function, which does various things depending on the arguments passed to `setup.py` on the command line.

Within the arguments to this function call, information about your application is kept. While it's beyond the scope of this documentation to explain everything about setuptools setup files, we'll provide a whirlwind tour of what exists in this file in this section.

Your application's name can be any string; it is specified in the `name` field. The version number is specified in the `version` value. A short description is provided in the `description` field. The `long_description` is conventionally the content of the README and CHANGES file appended together. The `classifiers` field is a list of Trove classifiers describing your application. `author` and `author_email` are text fields which probably don't need any description. `url` is a field that should point at your application project's URL (if any). `packages=find_packages()` causes all packages within the project to be found when packaging the application. `include_package_data` will include non-Python files when the application is packaged if those files are checked into version control. `zip_safe` indicates that this package is not safe to use as a zipped egg; instead it will always unpack as a directory, which is more convenient. `install_requires` and `tests_require` indicate that this package depends on the `pyramid` package. `test_suite` points at the package for our application, which means all tests found in the package will be run when `setup.py test` is invoked. We examined `entry_points` in our discussion of the `development.ini` file; this file defines the `main` entry point that represents our project's application.

Usually you only need to think about the contents of the `setup.py` file when distributing your application to other people, when adding Python package dependencies, or when versioning your application for your own use. For fun, you can try this command now:

```
$ python setup.py sdist
```

This will create a tarball of your application in a `dist` subdirectory named `MyProject-0.1.tar.gz`. You can send this tarball to other people who want to install and use your application.

5.8.5 `setup.cfg`

The `setup.cfg` file is a *setuptools* configuration file. It contains various settings related to testing and internationalization:

Our generated `setup.cfg` looks like this:

```
[nosetests]
match = ^test
nocapture = 1
cover-package = myproject
with-coverage = 1
cover-erase = 1

[compile_catalog]
directory = myproject/locale
domain = MyProject
statistics = true

[extract_messages]
add_comments = TRANSLATORS:
output_file = myproject/locale/MyProject.pot
width = 80

[init_catalog]
domain = MyProject
input_file = myproject/locale/MyProject.pot
output_dir = myproject/locale

[update_catalog]
domain = MyProject
input_file = myproject/locale/MyProject.pot
output_dir = myproject/locale
previous = true
```

The values in the default setup file allow various commonly-used internationalization commands and testing commands to work more smoothly.

5.9 The `myproject` Package

The `myproject` *package* lives inside the `MyProject` *project*. It contains:

1. An `__init__.py` file signifies that this is a Python *package*. It also contains code that helps users run the application, including a `main` function which is used as a Paste entry point.

2. A `resources.py` module, which contains *resource* code.

3. A `templates` directory, which contains *Chameleon* (or other types of) templates.

4. A `tests.py` module, which contains unit test code for the application.

5. A `views.py` module, which contains view code for the application.

These are purely conventions established by the scaffold: Pyramid doesn't insist that you name things in any particular way. However, it's generally a good idea to follow Pyramid standards for naming, so that other Pyramid developers can get up to speed quickly on your code when you need help.

5.9.1 `__init__.py`

We need a small Python module that configures our application and which advertises an entry point for use by our *PasteDeploy* `.ini` file. This is the file named `__init__.py`. The presence of an `__init__.py` also informs Python that the directory which contains it is a *package*.

```
1  from pyramid.config import Configurator
2  from myproject.resources import Root
3
4  def main(global_config, **settings):
5      """ This function returns a Pyramid WSGI application.
6      """
7      config = Configurator(root_factory=Root, settings=settings)
8      config.add_view('myproject.views.my_view',
9                      context='myproject.resources.Root',
10                     renderer='myproject:templates/mytemplate.pt')
11     config.add_static_view('static', 'myproject:static')
12     return config.make_wsgi_app()
```

1. Line 1 imports the *Configurator* class from `pyramid.config` that we use later.

2. Line 2 imports the `Root` class from `myproject.resources` that we use later.

3. Lines 4-12 define a function named `main` that returns a Pyramid WSGI application. This function is meant to be called by the *PasteDeploy* framework as a result of running `paster serve`.

   Within this function, application configuration is performed.

   Lines 8-10 register a "default view" (a view that has no `name` attribute). It is registered so that it will be found when the *context* of the request is an instance of the `myproject.resources.Root` class. The first argument to `add_view` points at a Python function that does all the work for this view, also known as a *view callable*, via a *dotted Python name*. The view declaration also names a `renderer`, which in this case is a template that will be used to render the result of the view callable. This particular view declaration points at

`myproject:templates/mytemplate.pt`, which is a *asset specification* that specifies the `mytemplate.pt` file within the `templates` directory of the `myproject` package. The template file it actually points to is a *Chameleon* ZPT template file.

Line 11 registers a static view, which will serve up the files from the `mypackage:static` *asset specification* (the `static` directory of the `mypackage` package).

Line 12 returns a *WSGI* application to the caller of the function (Paste).

5.9.2 `views.py`

Much of the heavy lifting in a Pyramid application is done by *view callables*. A *view callable* is the main tool of a Pyramid web application developer; it is a bit of code which accepts a *request* and which returns a *response*.

```
1 def my_view(request):
2     return {'project':'MyProject'}
```

This bit of code was registered as the view callable within `__init__.py` (via `add_view`). `add_view` said that the default URL for instances that are of the class `myproject.resources.Root` should run this `myproject.views.my_view()` function.

This view callable function is handed a single piece of information: the *request*. The *request* is an instance of the *WebOb* `Request` class representing the browser's request to our server.

This view returns a dictionary. When this view is invoked, a *renderer* converts the dictionary returned by the view into HTML, and returns the result as the *response*. This view is configured to invoke a renderer which uses a *Chameleon* ZPT template (`mypackage:templates/my_template.pt`, as specified in the `__init__.py` file call to `add_view`).

See *Writing View Callables Which Use a Renderer* for more information about how views, renderers, and templates relate and cooperate.

Because our `development.ini` has a `pyramid.reload_templates = true` directive indicating that templates should be reloaded when they change, you won't need to restart the application server to see changes you make to templates. During development, this is handy. If this directive had been `false` (or if the directive did not exist), you would need to restart the application server for each template change. For production applications, you should set your project's `pyramid.reload_templates` to `false` to increase the speed at which templates may be rendered.

5.9.3 resources.py

The resources.py module provides the *resource* data and behavior for our application. Resources are objects which exist to provide site structure in applications which use *traversal* to map URLs to code. We write a class named Root that provides the behavior for the root resource.

```
1 class Root(object):
2     def __init__(self, request):
3         self.request = request
```

1. Lines 1-3 define the Root class. The Root class is a "root resource factory" function that will be called by the Pyramid *Router* for each request when it wants to find the root of the resource tree.

In a "real" application, the Root object would likely not be such a simple object. Instead, it might be an object that could access some persistent data store, such as a database. Pyramid doesn't make any assumption about which sort of data storage you'll want to use, so the sample application uses an instance of myproject.resources.Root to represent the root.

5.9.4 static

This directory contains static assets which support the mytemplate.pt template. It includes CSS and images.

5.9.5 templates/mytemplate.pt

The single *Chameleon* template that exists in the project. Its contents are too long to show here, but it displays a default page when rendered. It is referenced by the call to add_view as the renderer attribute in the __init__ file. See *Writing View Callables Which Use a Renderer* for more information about renderers.

Templates are accessed and used by view configurations and sometimes by view functions themselves. See *Using Templates Directly* and *Templates Used as Renderers via Configuration*.

5.9.6 tests.py

The tests.py module includes unit tests for your application.

```
import unittest

from pyramid import testing

class ViewTests(unittest.TestCase):
    def setUp(self):
        self.config = testing.setUp()

    def tearDown(self):
        testing.tearDown()

    def test_my_view(self):
        from myproject.views import my_view
        request = testing.DummyRequest()
        info = my_view(request)
        self.assertEqual(info['project'], 'MyProject')


```

This sample `tests.py` file has a single unit test defined within it. This test is executed when you run `python setup.py test`. You may add more tests here as you build your application. You are not required to write tests to use Pyramid, this file is simply provided as convenience and example.

See *Unit, Integration, and Functional Testing* for more information about writing Pyramid unit tests.

5.10 Modifying Package Structure

It is best practice for your application's code layout to not stray too much from accepted Pyramid scaffold defaults. If you refrain from changing things very much, other Pyramid coders will be able to more quickly understand your application. However, the code layout choices made for you by a scaffold are in no way magical or required. Despite the choices made for you by any scaffold, you can decide to lay your code out any way you see fit.

For example, the configuration method named `add_view()` requires you to pass a *dotted Python name* or a direct object reference as the class or function to be used as a view. By default, the `pyramid_starter` scaffold would have you add view functions to the `views.py` module in your package. However, you might be more comfortable creating a `views` *directory*, and adding a single file for each view.

If your project package name was `myproject` and you wanted to arrange all your views in a Python subpackage within the `myproject` *package* named `views` instead of within a single `views.py` file, you might:

- Create a `views` directory inside your `mypackage` package directory (the same directory which holds `views.py`).
- *Move* the existing `views.py` file to a file inside the new `views` directory named, say, `blog.py`.
- Create a file within the new `views` directory named `__init__.py` (it can be empty, this just tells Python that the `views` directory is a *package*.

Then change the __init__.py of your myproject project (*not* the `__init__.py` you just created in the `views` directory, the one in its parent directory). For example, from something like:

```
config.add_view('myproject.views.my_view',
                renderer='myproject:templates/mytemplate.pt')
```

To this:

```
config.add_view('myproject.views.blog.my_view',
                renderer='myproject:templates/mytemplate.pt')
```

You can then continue to add files to the `views` directory, and refer to view classes or functions within those files via the dotted name passed as the first argument to `add_view`. For example, if you added a file named `anothermodule.py` to the `views` subdirectory, and added a view callable named `my_view` to it:

```
config.add_view('myproject.views.anothermodule.my_view',
                renderer='myproject:templates/anothertemplate.pt')
```

This pattern can be used to rearrage code referred to by any Pyramid API argument which accepts a *dotted Python name* or direct object reference.

5.11 Using the Interactive Shell

It is possible to use a Python interpreter prompt loaded with a similar configuration as would be loaded if you were running your Pyramid application via `paster serve`. This can be a useful debugging tool. See *The Interactive Shell* for more details.

5.12 Using an Alternate WSGI Server

The code generated by a Pyramid scaffold assumes that you will be using the `paster serve` command to start your application while you do development. However, `paster serve` is by no means the only way to start up and serve a Pyramid application. As we saw in *Creating Your First Pyramid Application*, `paster serve` needn't be invoked at all to run a Pyramid application. The use of `paster serve` to run a Pyramid application is purely conventional based on the output of its scaffold.

Any *WSGI* server is capable of running a Pyramid application. Some WSGI servers don't require the *PasteDeploy* framework's `paster serve` command to do server process management at all. Each *WSGI* server has its own documentation about how it creates a process to run an application, and there are many of them, so we cannot provide the details for each here. But the concepts are largely the same, whatever server you happen to use.

One popular production alternative to a `paster`-invoked server is *mod_wsgi*. You can also use *mod_wsgi* to serve your Pyramid application using the Apache web server rather than any "pure-Python" server that is started as a result of `paster serve`. See *Running a Pyramid Application under mod_wsgi* for details. However, it is usually easier to *develop* an application using a `paster serve` -invoked webserver, as exception and debugging output will be sent to the console.

CHAPTER 6

URL Dispatch

URL dispatch provides a simple way to map URLs to *view* code using a simple pattern matching language. An ordered set of patterns is checked one-by-one. If one of the patterns matches the path information associated with a request, a particular *view callable* is invoked. A view callable is a specific bit of code, defined in your application, that receives the *request* and returns a *response* object.

6.1 High-Level Operational Overview

If route configuration is present in an application, the Pyramid *Router* checks every incoming request against an ordered set of URL matching patterns present in a *route map*.

If any route pattern matches the information in the *request*, Pyramid will invoke *view lookup* to find a matching view.

If no route pattern in the route map matches the information in the *request* provided in your application, Pyramid will fail over to using *traversal* to perform resource location and view lookup.

6.2 Route Configuration

Route configuration is the act of adding a new *route* to an application. A route has a *name*, which acts as an identifier to be used for URL generation. The name also allows developers to associate a view configuration with the route. A route also has a *pattern*, meant to match against the `PATH_INFO` portion of a URL (the portion following the scheme and port, e.g. `/foo/bar` in the URL `http://localhost:8080/foo/bar`). It also optionally has a `factory` and a set of *route predicate* attributes.

6.2.1 Configuring a Route to Match a View

The `pyramid.config.Configurator.add_route()` method adds a single *route configuration* to the *application registry*. Here's an example:

```
# "config" below is presumed to be an instance of the
# pyramid.config.Configurator class; "myview" is assumed
# to be a "view callable" function
from views import myview
config.add_route('myroute', '/prefix/{one}/{two}')
config.add_view(myview, route_name='myroute')
```

When a *view callable* added to the configuration by way of `add_view()` bcomes associated with a route via its `route_name` predicate, that view callable will always be found and invoked when the associated route pattern matches during a request.

More commonly, you will not use any `add_view` statements in your project's "setup" code, instead only using `add_route` statements using a *scan* for to associate view callables with routes. For example, if this is a portion of your project's `__init__.py`:

```
# in your project's __init__.py (mypackage.__init__)

config.add_route('myroute', '/prefix/{one}/{two}')
config.scan('mypackage')
```

Note that we don't call `add_view()` in this setup code. However, the above *scan* execution `config.scan('mypackage')` will pick up all *configuration decoration*, including any objects decorated with the `pyramid.view.view_config` decorator in the `mypackage` Python pakage. For example, if you have a `views.py` in your package, a scan will pick up any of its configuration decorators, so we can add one there that that references `myroute` as a `route_name` parameter:

```
# in your project's views.py module (mypackage.views)

from pyramid.view import view_config
from pyramid.response import Response

@view_config(route_name='myroute')
def myview(request):
    return Response('OK')
```

THe above combination of `add_route` and `scan` is completely equivalent to using the previous combination of `add_route` and `add_view`.

6.2.2 Route Pattern Syntax

The syntax of the pattern matching language used by Pyramid URL dispatch in the *pattern* argument is straightforward; it is close to that of the *Routes* system used by *Pylons*.

The *pattern* used in route configuration may start with a slash character. If the pattern does not start with a slash character, an implicit slash will be prepended to it at matching time. For example, the following patterns are equivalent:

```
{foo}/bar/baz
```

and:

```
/{foo}/bar/baz
```

A pattern segment (an individual item between `/` characters in the pattern) may either be a literal string (e.g. `foo`) *or* it may be a replacement marker (e.g. `{foo}`) or a certain combination of both. A replacement marker does not need to be preceded by a `/` character.

A replacement marker is in the format `{name}`, where this means "accept any characters up to the next slash character and use this as the `name` *matchdict* value."

A replacement marker in a pattern must begin with an uppercase or lowercase ASCII letter or an underscore, and can be composed only of uppercase or lowercase ASCII letters, underscores, and numbers. For example: `a`, `a_b`, `_b`, and `b9` are all valid replacement marker names, but `0a` is not.

 A replacement marker could not start with an underscore until Pyramid 1.2. Previous versions required that the replacement marker start with an uppercase or lowercase letter.

A matchdict is the dictionary representing the dynamic parts extracted from a URL based on the routing pattern. It is available as `request.matchdict`. For example, the following pattern defines one literal segment (`foo`) and two replacement markers (`baz`, and `bar`):

```
foo/{baz}/{bar}
```

The above pattern will match these URLs, generating the following matchdicts:

```
foo/1/2        -> {'baz':u'1', 'bar':u'2'}
foo/abc/def    -> {'baz':u'abc', 'bar':u'def'}
```

It will not match the following patterns however:

```
foo/1/2/        -> No match (trailing slash)
bar/abc/def     -> First segment literal mismatch
```

The match for a segment replacement marker in a segment will be done only up to the first non-alphanumeric character in the segment in the pattern. So, for instance, if this route pattern was used:

```
foo/{name}.html
```

The literal path `/foo/biz.html` will match the above route pattern, and the match result will be `{'name':u'biz'}`. However, the literal path `/foo/biz` will not match, because it does not contain a literal `.html` at the end of the segment represented by `{name}.html` (it only contains `biz`, not `biz.html`).

To capture both segments, two replacement markers can be used:

```
foo/{name}.{ext}
```

The literal path `/foo/biz.html` will match the above route pattern, and the match result will be `{'name': 'biz', 'ext': 'html'}`. This occurs because there is a literal part of `.` (period) between the two replacement markers `{name}` and `{ext}`.

Replacement markers can optionally specify a regular expression which will be used to decide whether a path segment should match the marker. To specify that a replacement marker should match only a specific set of characters as defined by a regular expression, you must use a slightly extended form of replacement marker syntax. Within braces, the replacement marker name must be followed by a colon, then directly thereafter, the regular expression. The *default* regular expression associated with a replacement marker `[^/]+` matches one or more characters which are not a slash. For example, under the hood, the replacement marker `{foo}` can more verbosely be spelled as `{foo:[^/]+}`. You can change this to be an arbitrary regular expression to match an arbitrary sequence of characters, such as `{foo:\d+}` to match only digits.

It is possible to use two replacement markers without any literal characters between them, for instance `/{foo}{bar}`. However, this would be a nonsensical pattern without specifying a custom regular expression to restrict what each marker captures.

Segments must contain at least one character in order to match a segment replacement marker. For example, for the URL `/abc/`:

- `/abc/{foo}` will not match.
- `/{foo}/` will match.

Note that values representing matched path segments will be url-unquoted and decoded from UTF-8 into Unicode within the matchdict. So for instance, the following pattern:

```
foo/{bar}
```

When matching the following URL:

```
http://example.com/foo/La%20Pe%C3%B1a
```

The matchdict will look like so (the value is URL-decoded / UTF-8 decoded):

```
{'bar':u'La Pe\xf1a'}
```

Literal strings in the path segment should represent the *decoded* value of the `PATH_INFO` provided to Pyramid. You don't want to use a URL-encoded value or a bytestring representing the literal's UTF-8 in the pattern. For example, rather than this:

```
/Foo%20Bar/{baz}
```

You'll want to use something like this:

```
/Foo Bar/{baz}
```

For patterns that contain "high-order" characters in its literals, you'll want to use a Unicode value as the pattern as opposed to any URL-encoded or UTF-8-encoded value. For example, you might be tempted to use a bytestring pattern like this:

```
/La Pe\xc3\xb1a/{x}
```

But this will either cause an error at startup time or it won't match properly. You'll want to use a Unicode value as the pattern instead rather than raw bytestring escapes. You can use a high-order Unicode value as the pattern by using Python source file encoding plus the "real" character in the Unicode pattern in the source, like so:

```
/La Peña/{x}
```

Or you can ignore source file encoding and use equivalent Unicode escape characters in the pattern.

```
/La Pe\xf1a/{x}
```

Dynamic segment names cannot contain high-order characters, so this applies only to literals in the pattern.

If the pattern has a * in it, the name which follows it is considered a "remainder match". A remainder match *must* come at the end of the pattern. Unlike segment replacement markers, it does not need to be preceded by a slash. For example:

```
foo/{baz}/{bar}*fizzle
```

The above pattern will match these URLs, generating the following matchdicts:

```
foo/1/2/           ->
         {'baz':u'1', 'bar':u'2', 'fizzle':()}

foo/abc/def/a/b/c  ->
         {'baz':u'abc', 'bar':u'def', 'fizzle':(u'a', u'b', u'c')}
```

Note that when a `*stararg` remainder match is matched, the value put into the matchdict is turned into a tuple of path segments representing the remainder of the path. These path segments are url-unquoted and decoded from UTF-8 into Unicode. For example, for the following pattern:

```
foo/*fizzle
```

When matching the following path:

```
/foo/La%20Pe%C3%B1a/a/b/c
```

Will generate the following matchdict:

```
{'fizzle':(u'La Pe\xf1a', u'a', u'b', u'c')}
```

By default, the `*stararg` will parse the remainder sections into a tuple split by segment. Changing the regular expression used to match a marker can also capture the remainder of the URL, for example:

```
foo/{baz}/{bar}{fizzle:.*}
```

The above pattern will match these URLs, generating the following matchdicts:

```
foo/1/2/           -> {'baz':u'1', 'bar':u'2', 'fizzle':()}
foo/abc/def/a/b/c  -> {'baz':u'abc', 'bar':u'def', 'fizzle': u'a/b/c')}
```

This occurs because the default regular expression for a marker is `[^/]+` which will match everything up to the first `/`, while `{fizzle:.*}` will result in a regular expression match of `.*` capturing the remainder into a single value.

6.2.3 Route Declaration Ordering

Route configuration declarations are evaluated in a specific order when a request enters the system. As a result, the order of route configuration declarations is very important. The order that routes declarations are evaluated is the order in which they are added to the application at startup time. (This is unlike a different way of mapping URLs to code that Pyramid provides, named *traversal*, which does not depend on pattern ordering).

For routes added via the `add_route` method, the order that routes are evaluated is the order in which they are added to the configuration imperatively.

For example, route configuration statements with the following patterns might be added in the following order:

```
members/{def}
members/abc
```

In such a configuration, the `members/abc` pattern would *never* be matched. This is because the match ordering will always match `members/{def}` first; the route configuration with `members/abc` will never be evaluated.

6.2.4 Route Configuration Arguments

Route configuration `add_route` statements may specify a large number of arguments. They are documented as part of the API documentation at `pyramid.config.Configurator.add_route()`.

Many of these arguments are *route predicate* arguments. A route predicate argument specifies that some aspect of the request must be true for the associated route to be considered a match during the route matching process. Examples of route predicate arguments are `pattern`, `xhr`, and `request_method`.

Other arguments are `name` and `factory`. These arguments represent neither predicates nor view configuration information.

 Some arguments are view-configuration related arguments, such as `view_renderer`. These only have an effect when the route configuration names a `view` and these arguments have been deprecated as of Pyramid 1.1.

6.3 Route Matching

The main purpose of route configuration is to match (or not match) the `PATH_INFO` present in the WSGI environment provided during a request against a URL path pattern. `PATH_INFO` represents the path portion of the URL that was requested.

The way that Pyramid does this is very simple. When a request enters the system, for each route configuration declaration present in the system, Pyramid checks the request's `PATH_INFO` against the pattern declared. This checking happens in the order that the routes were declared via `pyramid.config.Configurator.add_route()`.

When a route configuration is declared, it may contain *route predicate* arguments. All route predicates associated with a route declaration must be `True` for the route configuration to be used for a given request during a check. If any predicate in the set of *route predicate* arguments provided to a route configuration returns `False` during a check, that route is skipped and route matching continues through the ordered set of routes.

If any route matches, the route matching process stops and the *view lookup* subsystem takes over to find the most reasonable view callable for the matched route. Most often, there's only one view that will match (a view configured with a `route_name` argument matching the matched route). To gain a better understanding of how routes and views are associated in a real application, you can use the `paster pviews` command, as documented in *Displaying Matching Views for a Given URL*.

If no route matches after all route patterns are exhausted, Pyramid falls back to *traversal* to do *resource location* and *view lookup*.

6.3.1 The Matchdict

When the URL pattern associated with a particular route configuration is matched by a request, a dictionary named `matchdict` is added as an attribute of the *request* object. Thus, `request.matchdict` will contain the values that match replacement patterns in the `pattern` element. The keys in a matchdict will be strings. The values will be Unicode objects.

 If no route URL pattern matches, the `matchdict` object attached to the request will be `None`.

6.3.2 The Matched Route

When the URL pattern associated with a particular route configuration is matched by a request, an object named `matched_route` is added as an attribute of the *request* object. Thus, `request.matched_route` will be an object implementing the `IRoute` interface which matched the request. The most useful attribute of the route object is `name`, which is the name of the route that matched.

 If no route URL pattern matches, the `matched_route` object attached to the request will be `None`.

6.4 Routing Examples

Let's check out some examples of how route configuration statements might be commonly declared, and what will happen if they are matched by the information present in a request.

6.4.1 Example 1

The simplest route declaration which configures a route match to *directly* result in a particular view callable being invoked:

```
1 config.add_route('idea', 'site/{id}')
2 config.add_view('mypackage.views.site_view', route_name='idea')
```

When a route configuration with a `view` attribute is added to the system, and an incoming request matches the *pattern* of the route configuration, the *view callable* named as the `view` attribute of the route configuration will be invoked.

In the case of the above example, when the URL of a request matches `/site/{id}`, the view callable at the Python dotted path name `mypackage.views.site_view` will be called with the request. In other words, we've associated a view callable directly with a route pattern.

When the `/site/{id}` route pattern matches during a request, the `site_view` view callable is invoked with that request as its sole argument. When this route matches, a `matchdict` will be generated and attached to the request as `request.matchdict`. If the specific URL matched is `/site/1`, the `matchdict` will be a dictionary with a single key, `id`; the value will be the string `'1'`, ex.: `{'id':'1'}`.

The `mypackage.views` module referred to above might look like so:

```
from pyramid.response import Response

def site_view(request):
    return Response(request.matchdict['id'])
```

The view has access to the matchdict directly via the request, and can access variables within it that match keys present as a result of the route pattern.

See *Views*, and *View Configuration* for more information about views.

6.4.2 Example 2

Below is an example of a more complicated set of route statements you might add to your application:

```
config.add_route('idea', 'ideas/{idea}')
config.add_route('user', 'users/{user}')
config.add_route('tag', 'tags/{tags}')

config.add_view('mypackage.views.idea_view', route_name='idea')
config.add_view('mypackage.views.user_view', route_name='user')
config.add_view('mypackage.views.tag_view', route_name='tag')
```

The above configuration will allow Pyramid to service URLs in these forms:

```
/ideas/{idea}
/users/{user}
/tags/{tag}
```

- When a URL matches the pattern `/ideas/{idea}`, the view callable available at the dotted Python pathname `mypackage.views.idea_view` will be called. For the specific URL `/ideas/1`, the `matchdict` generated and attached to the *request* will consist of `{'idea':'1'}`.
- When a URL matches the pattern `/users/{user}`, the view callable available at the dotted Python pathname `mypackage.views.user_view` will be called. For the specific URL `/users/1`, the `matchdict` generated and attached to the *request* will consist of `{'user':'1'}`.
- When a URL matches the pattern `/tags/{tag}`, the view callable available at the dotted Python pathname `mypackage.views.tag_view` will be called. For the specific URL `/tags/1`, the `matchdict` generated and attached to the *request* will consist of `{'tag':'1'}`.

In this example we've again associated each of our routes with a *view callable* directly. In all cases, the request, which will have a `matchdict` attribute detailing the information found in the URL by the process will be passed to the view callable.

6.4.3 Example 3

The *context* resource object passed in to a view found as the result of URL dispatch will, by default, be an instance of the object returned by the *root factory* configured at startup time (the `root_factory` argument to the *Configurator* used to configure the application).

You can override this behavior by passing in a `factory` argument to the `add_route()` method for a particular route. The `factory` should be a callable that accepts a *request* and returns an instance of a class that will be the context resource used by the view.

An example of using a route with a factory:

```
config.add_route('idea', 'ideas/{idea}', factory='myproject.resources.Idea')
config.add_view('myproject.views.idea_view', route_name='idea')
```

The above route will manufacture an `Idea` resource as a *context*, assuming that `mypackage.resources.Idea` resolves to a class that accepts a request in its `__init__`. For example:

```
class Idea(object):
    def __init__(self, request):
        pass
```

In a more complicated application, this root factory might be a class representing a *SQLAlchemy* model.

See *Route Factories* for more details about how to use route factories.

6.5 Matching the Root URL

It's not entirely obvious how to use a route pattern to match the root URL ("/"). To do so, give the empty string as a pattern in a call to `add_route()`:

```
config.add_route('root', '')
```

Or provide the literal string `/` as the pattern:

```
config.add_route('root', '/')
```

6.6 Generating Route URLs

Use the `pyramid.request.Request.route_url()` method to generate URLs based on route patterns. For example, if you've configured a route with the `name` "foo" and the `pattern` "{a}/{b}/{c}", you might do this.

```
url = request.route_url('foo', a='1', b='2', c='3')
```

This would return something like the string `http://example.com/1/2/3` (at least if the current protocol and hostname implied `http://example.com`).

To generate only the *path* portion of a URL from a route, use the `pyramid.request.Request.route_path()` API instead of `route_url()`.

```
url = request.route_path('foo', a='1', b='2', c='3')
```

This will return the string `/1/2/3` rather than a full URL.

Replacement values passed to `route_url` or `route_path` must be Unicode or bytestrings encoded in UTF-8. One exception to this rule exists: if you're trying to replace a "remainder" match value (a `*stararg` replacement value), the value may be a tuple containing Unicode strings or UTF-8 strings.

Note that URLs and paths generated by `route_path` and `route_url` are always URL-quoted string types (they contain no non-ASCII characters). Therefore, if you've added a route like so:

```
config.add_route('la', u'/La Peña/{city}')
```

And you later generate a URL using `route_path` or `route_url` like so:

```
url = request.route_path('la', city=u'Québec')
```

You will wind up with the path encoded to UTF-8 and URL quoted like so:

```
/La%20Pe%C3%B1a/Qu%C3%A9bec
```

If you have a `*stararg` remainder dynamic part of your route pattern:

```
config.add_route('abc', 'a/b/c/*foo')
```

And you later generate a URL using `route_path` or `route_url` using a *string* as the replacement value:

```
url = request.route_path('abc', foo=u'Québec/biz')
```

The value you pass will be URL-quoted except for embedded slashes in the result:

```
/a/b/c/Qu%C3%A9bec/biz
```

You can get a similar result by passing a tuple composed of path elements:

```
url = request.route_path('abc', foo=(u'Québec', u'biz'))
```

Each value in the tuple will be url-quoted and joined by slashes in this case:

```
/a/b/c/Qu%C3%A9bec/biz
```

6.7 Static Routes

Routes may be added with a `static` keyword argument. For example:

```
config = Configurator()
config.add_route('page', '/page/{action}', static=True)
```

Routes added with a `True` `static` keyword argument will never be considered for matching at request time. Static routes are useful for URL generation purposes only. As a result, it is usually nonsensical to provide other non-`name` and non-`pattern` arguments to `add_route()` when `static` is passed as `True`, as none of the other arguments will ever be employed. A single exception to this rule is use of the `pregenerator` argument, which is not ignored when `static` is `True`.

 the `static` argument to `add_route()` is new as of Pyramid 1.1.

6.8 Redirecting to Slash-Appended Routes

For behavior like Django's `APPEND_SLASH=True`, use the `append_slash_notfound_view()` view as the *Not Found view* in your application. Defining this view as the *Not Found view* is a way to automatically redirect requests where the URL lacks a trailing slash, but requires one to match the proper route. When configured, along with at least one other route in your application, this view will be invoked if the value of `PATH_INFO` does not already end in a slash, and if the value of `PATH_INFO` *plus* a slash matches any route's pattern. In this case it does an HTTP redirect to the slash-appended `PATH_INFO`.

Let's use an example, because this behavior is a bit magical. If the `append_slash_notfound_view` is configured in your application and your route configuration looks like so:

```
config.add_route('noslash', 'no_slash')
config.add_route('hasslash', 'has_slash/')

config.add_view('myproject.views.no_slash', route_name='noslash')
config.add_view('myproject.views.has_slash', route_name='hasslash')
```

If a request enters the application with the `PATH_INFO` value of `/has_slash/`, the second route will match. If a request enters the application with the `PATH_INFO` value of `/has_slash`, a route *will* be found by the slash-appending not found view. An HTTP redirect to `/has_slash/` will be returned to the user's browser.

If a request enters the application with the `PATH_INFO` value of `/no_slash`, the first route will match. However, if a request enters the application with the `PATH_INFO` value of `/no_slash/`, *no* route will match, and the slash-appending not found view will *not* find a matching route with an appended slash.

 You **should not** rely on this mechanism to redirect `POST` requests. The redirect of the slash-appending not found view will turn a `POST` request into a `GET`, losing any `POST` data in the original request.

To configure the slash-appending not found view in your application, change the application's startup configuration, adding the following stanza:

```
config.add_view('pyramid.view.append_slash_notfound_view',
                context='pyramid.httpexceptions.HTTPNotFound')
```

See *pyramid.view* and *Changing the Not Found View* for more information about the slash-appending not found view and for a more general description of how to configure a not found view.

6.8.1 Custom Not Found View With Slash Appended Routes

There can only be one *Not Found view* in any Pyramid application. Even if you use `append_slash_notfound_view()` as the Not Found view, Pyramid still must generate a `404 Not Found` response when it cannot redirect to a slash-appended URL; this not found response will be visible to site users.

If you don't care what this 404 response looks like, and only you need redirections to slash-appended route URLs, you may use the `append_slash_notfound_view()` object as the Not Found view as described above. However, if you wish to use a *custom* notfound view callable when a URL cannot be redirected to a slash-appended URL, you may wish to use an instance of the `AppendSlashNotFoundViewFactory` class as the Not Found view, supplying a *view callable* to be used as the custom notfound view as the first argument to its constructor. For instance:

```
from pyramid.httpexceptions import HTTPNotFound
from pyramid.view import AppendSlashNotFoundViewFactory

def notfound_view(context, request):
    return HTTPNotFound('It aint there, stop trying!')

custom_append_slash = AppendSlashNotFoundViewFactory(notfound_view)
config.add_view(custom_append_slash, context=HTTPNotFound)
```

The `notfound_view` supplied must adhere to the two-argument view callable calling convention of `(context, request)` (`context` will be the exception object).

6.9 Debugging Route Matching

It's useful to be able to take a peek under the hood when requests that enter your application arent matching your routes as you expect them to. To debug route matching, use the `PYRAMID_DEBUG_ROUTEMATCH` environment variable or the `pyramid.debug_routematch` configuration file setting (set either to `true`). Details of the route matching decision for a particular request to the Pyramid application will be printed to the `stderr` of the console which you started the application from. For example:

```
[chrism@thinko pylonsbasic]$ PYRAMID_DEBUG_ROUTEMATCH=true \
                             bin/paster serve development.ini
Starting server in PID 13586.
serving on 0.0.0.0:6543 view at http://127.0.0.1:6543
2010-12-16 14:45:19,956 no route matched for url \
                                    http://localhost:6543/wontmatch
2010-12-16 14:45:20,010 no route matched for url \
                            http://localhost:6543/favicon.ico
2010-12-16 14:41:52,084 route matched for url \
                            http://localhost:6543/static/logo.png; \
                            route_name: 'static/', ....
```

See *Environment Variables and .ini File Settings* for more information about how, and where to set these values.

You can also use the `paster proutes` command to see a display of all the routes configured in your application; for more information, see *Displaying All Application Routes*.

6.10 Using a Route Prefix to Compose Applications

This feature is new as of Pyramid 1.2.

The `pyramid.config.Configurator.include()` method allows configuration statements to be included from separate files. See *Rules for Building An Extensible Application* for information about this method. Using `pyramid.config.Configurator.include()` allows you to build your application from small and potentially reusable components.

The `pyramid.config.Configurator.include()` method accepts an argument named `route_prefix` which can be useful to authors of URL-dispatch-based applications. If `route_prefix` is supplied to the include method, it must be a string. This string represents a route prefix that will be prepended to all route patterns added by the *included* configuration. Any calls to `pyramid.config.Configurator.add_route()` within the included callable will have their pattern prefixed with the value of `route_prefix`. This can be used to help mount a set of routes at a different location than the included callable's author intended while still maintaining the same route names. For example:

```
from pyramid.config import Configurator

def users_include(config):
    config.add_route('show_users', '/show')

def main(global_config, **settings):
    config = Configurator()
    config.include(users_include, route_prefix='/users')
```

In the above configuration, the `show_users` route will have an effective route pattern of `/users/show`, instead of `/show` because the `route_prefix` argument will be prepended to the pattern. The route will then only match if the URL path is `/users/show`, and when the `pyramid.request.Request.route_url()` function is called with the route name `show_users`, it will generate a URL with that same path.

Route prefixes are recursive, so if a callable executed via an include itself turns around and includes another callable, the second-level route prefix will be prepended with the first:

```
from pyramid.config import Configurator

def timing_include(config):
    config.add_route('show_times', /times')
```

```
5
6  def users_include(config):
7      config.add_route('show_users', '/show')
8      config.include(timing_include, route_prefix='/timing')
9
10 def main(global_config, **settings):
11     config = Configurator()
12     config.include(users_include, route_prefix='/users')
```

In the above configuration, the `show_users` route will still have an effective route pattern of `/users/show`. The `show_times` route however, will have an effective pattern of `/users/timing/show_times`.

Route prefixes have no impact on the requirement that the set of route *names* in any given Pyramid configuration must be entirely unique. If you compose your URL dispatch application out of many small subapplications using `pyramid.config.Configurator.include()`, it's wise to use a dotted name for your route names, so they'll be unlikely to conflict with other packages that may be added in the future. For example:

```
1  from pyramid.config import Configurator
2
3  def timing_include(config):
4      config.add_route('timing.show_times', /times')
5
6  def users_include(config):
7      config.add_route('users.show_users', '/show')
8      config.include(timing_include, route_prefix='/timing')
9
10 def main(global_config, **settings):
11     config = Configurator()
12     config.include(users_include, route_prefix='/users')
```

6.11 Custom Route Predicates

Each of the predicate callables fed to the `custom_predicates` argument of `add_route()` must be a callable accepting two arguments. The first argument passed to a custom predicate is a dictionary conventionally named `info`. The second argument is the current *request* object.

The `info` dictionary has a number of contained values: `match` is a dictionary: it represents the arguments matched in the URL by the route. `route` is an object representing the route which was matched (see `pyramid.interfaces.IRoute` for the API of such a route object).

`info['match']` is useful when predicates need access to the route match. For example:

```
def any_of(segment_name, *allowed):
    def predicate(info, request):
        if info['match'][segment_name] in allowed:
            return True
    return predicate

num_one_two_or_three = any_of('num', 'one', 'two', 'three')

config.add_route('route_to_num', '/{num}',
                 custom_predicates=(num_one_two_or_three,))
```

The above `any_of` function generates a predicate which ensures that the match value named `segment_name` is in the set of allowable values represented by `allowed`. We use this `any_of` function to generate a predicate function named `num_one_two_or_three`, which ensures that the `num` segment is one of the values `one`, `two`, or `three` , and use the result as a custom predicate by feeding it inside a tuple to the `custom_predicates` argument to `add_route()`.

A custom route predicate may also *modify* the `match` dictionary. For instance, a predicate might do some type conversion of values:

```
def integers(*segment_names):
    def predicate(info, request):
        match = info['match']
        for segment_name in segment_names:
            try:
                match[segment_name] = int(match[segment_name])
            except (TypeError, ValueError):
                pass
        return True
    return predicate

ymd_to_int = integers('year', 'month', 'day')

config.add_route('ymd', '/{year}/{month}/{day}',
                 custom_predicates=(ymd_to_int,))
```

Note that a conversion predicate is still a predicate so it must return `True` or `False`; a predicate that does *only* conversion, such as the one we demonstrate above should unconditionally return `True`.

To avoid the try/except uncertainty, the route pattern can contain regular expressions specifying requirements for that marker. For instance:

```
def integers(*segment_names):
    def predicate(info, request):
        match = info['match']
        for segment_name in segment_names:
            match[segment_name] = int(match[segment_name])
        return True
    return predicate

ymd_to_int = integers('year', 'month', 'day')

config.add_route('ymd', '/{year:\d+}/{month:\d+}/{day:\d+}',
                 custom_predicates=(ymd_to_int,))
```

Now the try/except is no longer needed because the route will not match at all unless these markers match `\d+` which requires them to be valid digits for an `int` type conversion.

The `match` dictionary passed within `info` to each predicate attached to a route will be the same dictionary. Therefore, when registering a custom predicate which modifies the `match` dict, the code registering the predicate should usually arrange for the predicate to be the *last* custom predicate in the custom predicate list. Otherwise, custom predicates which fire subsequent to the predicate which performs the `match` modification will receive the *modified* match dictionary.

It is a poor idea to rely on ordering of custom predicates to build a conversion pipeline, where one predicate depends on the side effect of another. For instance, it's a poor idea to register two custom predicates, one which handles conversion of a value to an int, the next which handles conversion of that integer to some custom object. Just do all that in a single custom predicate.

The `route` object in the `info` dict is an object that has two useful attributes: `name` and `pattern`. The `name` attribute is the route name. The `pattern` attribute is the route pattern. An example of using the route in a set of route predicates:

```
def twenty_ten(info, request):
    if info['route'].name in ('ymd', 'ym', 'y'):
        return info['match']['year'] == '2010'

config.add_route('y', '/{year}', custom_predicates=(twenty_ten,))
config.add_route('ym', '/{year}/{month}', custom_predicates=(twenty_ten,))
config.add_route('ymd', '/{year}/{month}/{day}',
                 custom_predicates=(twenty_ten,))
```

The above predicate, when added to a number of route configurations ensures that the year match argument is '2010' if and only if the route name is 'ymd', 'ym', or 'y'.

You can also caption the predicates by setting the `__text__` attribute. This will help you with the `paster pviews` command (see *Displaying All Application Routes*) and the `pyramid_debugtoolbar`.

If a predicate is a class just add __text__ property in a standard manner.

```
class DummyCustomPredicate1(object):
    def __init__(self):
        self.__text__ = 'my custom class predicate'

class DummyCustomPredicate2(object):
    __text__ = 'my custom class predicate'
```

If a predicate is a method you'll need to assign it after method declaration (see PEP 232)

```
def custom_predicate():
    pass
custom_predicate.__text__ = 'my custom method predicate'
```

If a predicate is a classmethod using @classmethod will not work, but you can still easily do it by wrapping it in classmethod call.

```
def classmethod_predicate():
    pass
classmethod_predicate.__text__ = 'my classmethod predicate'
classmethod_predicate = classmethod(classmethod_predicate)
```

Same will work with staticmethod, just use `staticmethod` instead of `classmethod`.

See also `pyramid.interfaces.IRoute` for more API documentation about route objects.

6.12 Route Factories

Although it is not a particular common need in basic applications, a "route" configuration declaration can mention a "factory". When that route matches a request, and a factory is attached to a route, the *root factory* passed at startup time to the *Configurator* is ignored; instead the factory associated with the route is used to generate a *root* object. This object will usually be used as the *context* resource of the view callable ultimately found via *view lookup*.

```
config.add_route('abc', '/abc',
                 factory='myproject.resources.root_factory')
config.add_view('myproject.views.theview', route_name='abc')
```

The factory can either be a Python object or a *dotted Python name* (a string) which points to such a Python object, as it is above.

In this way, each route can use a different factory, making it possible to supply a different *context* resource object to the view related to each particular route.

A factory must be a callable which accepts a request and returns an arbitrary Python object. For example, the below class can be used as a factory:

```
class Mine(object):
    def __init__(self, request):
        pass
```

A route factory is actually conceptually identical to the *root factory* described at *The Resource Tree*.

Supplying a different resource factory for each route is useful when you're trying to use a Pyramid *authorization policy* to provide declarative, "context sensitive" security checks; each resource can maintain a separate *ACL*, as documented in *Using Pyramid Security With URL Dispatch*. It is also useful when you wish to combine URL dispatch with *traversal* as documented within *Combining Traversal and URL Dispatch*.

6.13 Using Pyramid Security With URL Dispatch

Pyramid provides its own security framework which consults an *authorization policy* before allowing any application code to be called. This framework operates in terms of an access control list, which is stored as an `__acl__` attribute of a resource object. A common thing to want to do is to attach an `__acl__` to the resource object dynamically for declarative security purposes. You can use the `factory` argument that points at a factory which attaches a custom `__acl__` to an object at its creation time.

Such a `factory` might look like so:

```
class Article(object):
    def __init__(self, request):
       matchdict = request.matchdict
       article = matchdict.get('article', None)
       if article == '1':
           self.__acl__ = [ (Allow, 'editor', 'view') ]
```

If the route `archives/{article}` is matched, and the article number is `1`, Pyramid will generate an `Article` *context* resource with an ACL on it that allows the `editor` principal the `view` permission. Obviously you can do more generic things than inspect the routes match dict to see if the `article` argument matches a particular string; our sample `Article` factory class is not very ambitious.

See *Security* for more information about Pyramid security and ACLs.

6.14 Route View Callable Registration and Lookup Details

When a request enters the system which matches the pattern of the route, the usual result is simple: the view callable associated with the route is invoked with the request that caused the invocation.

For most usage, you needn't understand more than this; how it works is an implementation detail. In the interest of completeness, however, we'll explain how it *does* work in the this section. You can skip it if you're uninterested.

When a view is associated with a route configuration, Pyramid ensures that a *view configuration* is registered that will always be found when the route pattern is matched during a request. To do so:

- A special route-specific *interface* is created at startup time for each route configuration declaration.
- When an `add_view` statement mentions a `route name` attribute, a *view configuration* is registered at startup time. This view configuration uses a route-specific interface as a *request* type.
- At runtime, when a request causes any route to match, the *request* object is decorated with the route-specific interface.
- The fact that the request is decorated with a route-specific interface causes the *view lookup* machinery to always use the view callable registered using that interface by the route configuration to service requests that match the route pattern.

As we can see from the above description, technically, URL dispatch doesn't actually map a URL pattern directly to a view callable. Instead, URL dispatch is a *resource location* mechanism. A Pyramid *resource location* subsystem (i.e., *URL dispatch* or *traversal*) finds a *resource* object that is the *context* of a *request*. Once the *context* is determined, a separate subsystem named *view lookup* is then responsible for finding and invoking a *view callable* based on information available in the context and the request. When URL dispatch is used, the resource location and view lookup subsystems provided by Pyramid are still being utilized, but in a way which does not require a developer to understand either of them in detail.

If no route is matched using *URL dispatch*, Pyramid falls back to *traversal* to handle the *request*.

6.15 References

A tutorial showing how *URL dispatch* can be used to create a Pyramid application exists in *SQLAlchemy + URL Dispatch Wiki Tutorial*.

CHAPTER 7

Views

One of the primary jobs of Pyramid is to find and invoke a *view callable* when a *request* reaches your application. View callables are bits of code which do something interesting in response to a request made to your application. They are the "meat" of any interesting web application.

 A Pyramid *view callable* is often referred to in conversational shorthand as a *view*. In this documentation, however, we need to use less ambiguous terminology because there are significant differences between view *configuration*, the code that implements a view *callable*, and the process of view *lookup*.

This chapter describes how view callables should be defined. We'll have to wait until a following chapter (entitled *View Configuration*) to find out how we actually tell Pyramid to wire up view callables to particular URL patterns and other request circumstances.

7.1 View Callables

View callables are, at the risk of sounding obvious, callable Python objects. Specifically, view callables can be functions, classes, or instances that implement an `__call__` method (making the instance callable).

View callables must, at a minimum, accept a single argument named `request`. This argument represents a Pyramid *Request* object. A request object represents a *WSGI* environment provided to Pyramid by the upstream WSGI server. As you might expect, the request object contains everything your application needs to know about the specific HTTP request being made.

A view callable's ultimate responsibility is to create a `Pyramid` *Response* object. This can be done by creating a *Response* object in the view callable code and returning it directly or by raising special kinds of exceptions from within the body of a view callable.

7.2 Defining a View Callable as a Function

One of the easiest way to define a view callable is to create a function that accepts a single argument named `request`, and which returns a *Response* object. For example, this is a "hello world" view callable implemented as a function:

```
from pyramid.response import Response

def hello_world(request):
    return Response('Hello world!')
```

7.3 Defining a View Callable as a Class

A view callable may also be represented by a Python class instead of a function. When a view callable is a class, the calling semantics are slightly different than when it is a function or another non-class callable. When a view callable is a class, the class' `__init__` method is called with a `request` parameter. As a result, an instance of the class is created. Subsequently, that instance's `__call__` method is invoked with no parameters. Views defined as classes must have the following traits:

- an `__init__` method that accepts a `request` argument.
- a `__call__` (or other) method that accepts no parameters and which returns a response.

For example:

```
from pyramid.response import Response

class MyView(object):
    def __init__(self, request):
        self.request = request

    def __call__(self):
        return Response('hello')
```

The request object passed to `__init__` is the same type of request object described in *Defining a View Callable as a Function*.

If you'd like to use a different attribute than `__call__` to represent the method expected to return a response, you can use an `attr` value as part of the configuration for the view. See *View Configuration Parameters*. The same view callable class can be used in different view configuration statements with different `attr` values, each pointing at a different method of the class if you'd like the class to represent a collection of related view callables.

7.4 View Callable Responses

A view callable may return an object that implements the Pyramid *Response* interface. The easiest way to return something that implements the *Response* interface is to return a `pyramid.response.Response` object instance directly. For example:

```
from pyramid.response import Response

def view(request):
    return Response('OK')
```

Pyramid provides a range of different "exception" classes which inherit from `pyramid.response.Response`. For example, an instance of the class `pyramid.httpexceptions.HTTPFound` is also a valid response object because it inherits from `Response`. For examples, see *HTTP Exceptions* and *Using a View Callable to Do an HTTP Redirect*.

You can also return objects from view callables that aren't instances of `pyramid.response.Response` in various circumstances. This can be helpful when writing tests and when attempting to share code between view callables. See *Renderers* for the common way to allow for this. A much less common way to allow for view callables to return non-Response objects is documented in *Changing How Pyramid Treats View Responses*.

7.5 Using Special Exceptions In View Callables

Usually when a Python exception is raised within a view callable, Pyramid allows the exception to propagate all the way out to the *WSGI* server which invoked the application. It is usually caught and logged there.

However, for convenience, a special set of exceptions exists. When one of these exceptions is raised within a view callable, it will always cause Pyramid to generate a response. These are known as *HTTP exception* objects.

7.5.1 HTTP Exceptions

All classes documented in the `pyramid.httpexceptions` module documented as inheriting from the `pryamid.httpexceptions.HTTPException` are *http exception* objects. An instances of an HTTP exception object may either be *returned* or *raised* from within view code. In either case (return or raise) the instance will be used as as the view's response.

For example, the `pyramid.httpexceptions.HTTPUnauthorized` exception can be raised. This will cause a response to be generated with a `401 Unauthorized` status:

```
from pyramid.httpexceptions import HTTPUnauthorized

def aview(request):
    raise HTTPUnauthorized()
```

An HTTP exception, instead of being raised, can alternately be *returned* (HTTP exceptions are also valid response objects):

```
from pyramid.httpexceptions import HTTPUnauthorized

def aview(request):
    return HTTPUnauthorized()
```

A shortcut for creating an HTTP exception is the `pyramid.httpexceptions.exception_response()` function. This function accepts an HTTP status code and returns the corresponding HTTP exception. For example, instead of importing and constructing a `HTTPUnauthorized` response object, you can use the `exception_response()` function to construct and return the same object.

```
from pyramid.httpexceptions import exception_response

def aview(request):
    raise exception_response(401)
```

This is the case because `401` is the HTTP status code for "HTTP Unauthorized". Therefore, `raise exception_response(401)` is functionally equivalent to `raise HTTPUnauthorized()`. Documentation which maps each HTTP response code to its purpose and its associated HTTP exception object is provided within `pyramid.httpexceptions`.

The `exception_response()` function is new as of Pyramid 1.1.

7.5.2 How Pyramid Uses HTTP Exceptions

HTTP exceptions are meant to be used directly by application application developers. However, Pyramid itself will raise two HTTP exceptions at various points during normal operations: `pyramid.httpexceptions.HTTPNotFound` and `pyramid.httpexceptions.HTTPForbidden`. Pyramid will raise the `HTTPNotFound` exception are raised when it cannot find a view to service a request. Pyramid will raise the `Forbidden` exception or when authorization was forbidden by a security policy.

If `HTTPNotFound` is raised by Pyramid itself or within view code, the result of the *Not Found View* will be returned to the user agent which performed the request.

If `HTTPForbidden` is raised by Pyramid itself within view code, the result of the *Forbidden View* will be returned to the user agent which performed the request.

7.6 Custom Exception Views

The machinery which allows HTTP exceptions to be raised and caught by specialized views as described in *Using Special Exceptions In View Callables* can also be used by application developers to convert arbitrary exceptions to responses.

To register a view that should be called whenever a particular exception is raised from with Pyramid view code, use the exception class or one of its superclasses as the `context` of a view configuration which points at a view callable you'd like to generate a response.

For example, given the following exception class in a module named `helloworld.exceptions`:

```
class ValidationFailure(Exception):
    def __init__(self, msg):
        self.msg = msg
```

You can wire a view callable to be called whenever any of your *other* code raises a `helloworld.exceptions.ValidationFailure` exception:

```
from pyramid.view import view_config
from helloworld.exceptions import ValidationFailure

@view_config(context=ValidationFailure)
def failed_validation(exc, request):
    response =  Response('Failed validation: %s' % exc.msg)
    response.status_int = 500
    return response
```

Assuming that a *scan* was run to pick up this view registration, this view callable will be invoked whenever a `helloworld.exceptions.ValidationFailure` is raised by your application's view code. The same exception raised by a custom root factory, a custom traverser, or a custom view or route predicate is also caught and hooked.

Other normal view predicates can also be used in combination with an exception view registration:

```
from pyramid.view import view_config
from helloworld.exceptions import ValidationFailure

@view_config(context=ValidationFailure, route_name='home')
def failed_validation(exc, request):
    response =  Response('Failed validation: %s' % exc.msg)
    response.status_int = 500
    return response
```

The above exception view names the `route_name` of `home`, meaning that it will only be called when the route matched has a name of `home`. You can therefore have more than one exception view for any given exception in the system: the "most specific" one will be called when the set of request circumstances match the view registration.

The only view predicate that cannot be used successfully when creating an exception view configuration is `name`. The name used to look up an exception view is always the empty string. Views registered as exception views which have a name will be ignored.

Normal (i.e., non-exception) views registered against a context resource type which inherits from `Exception` will work normally. When an exception view configuration is processed, *two* views are registered. One as a "normal" view, the other as an "exception" view. This means that you can use an exception as `context` for a normal view.

Exception views can be configured with any view registration mechanism: `@view_config` decorator or imperative `add_view` styles.

7.7 Using a View Callable to Do an HTTP Redirect

You can issue an HTTP redirect by using the `pyramid.httpexceptions.HTTPFound` class. Raising or returning an instance of this class will cause the client to receive a "302 Found" response.

To do so, you can *return* a `pyramid.httpexceptions.HTTPFound` instance.

```
from pyramid.httpexceptions import HTTPFound

def myview(request):
    return HTTPFound(location='http://example.com')
```

Alternately, you can *raise* an HTTPFound exception instead of returning one.

```
from pyramid.httpexceptions import HTTPFound

def myview(request):
    raise HTTPFound(location='http://example.com')
```

When the instance is raised, it is caught by the default *exception response* handler and turned into a response.

7.8 Handling Form Submissions in View Callables (Unicode and Character Set Issues)

Most web applications need to accept form submissions from web browsers and various other clients. In Pyramid, form submission handling logic is always part of a *view*. For a general overview of how to handle form submission data using the *WebOb* API, see *Request and Response Objects* and "Query and POST variables" within the WebOb documentation. Pyramid defers to WebOb for its request and response implementations, and handling form submission data is a property of the request implementation. Understanding WebOb's request API is the key to understanding how to process form submission data.

There are some defaults that you need to be aware of when trying to handle form submission data in a Pyramid view. Having high-order (i.e., non-ASCII) characters in data contained within form submissions is exceedingly common, and the UTF-8 encoding is the most common encoding used on the web for character data. Since Unicode values are much saner than working with and storing bytestrings, Pyramid configures the *WebOb* request machinery to attempt to decode form submission values into Unicode from UTF-8 implicitly. This implicit decoding happens when view code obtains form field values via the `request.params`, `request.GET`, or `request.POST` APIs (see *pyramid.request* for details about these APIs).

Many people find the difference between Unicode and UTF-8 confusing. Unicode is a standard for representing text that supports most of the world's writing systems. However, there are many ways that Unicode data can be encoded into bytes for transit and storage. UTF-8 is a specific encoding for Unicode, that is backwards-compatible with ASCII. This makes UTF-8 very convenient for encoding data where a large subset of that data is ASCII characters, which is largely true on the web. UTF-8 is also the standard character encoding for URLs.

As an example, let's assume that the following form page is served up to a browser client, and its `action` points at some Pyramid view code:

```
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8"/>
  </head>
  <form method="POST" action="myview">
    <div>
      <input type="text" name="firstname"/>
    </div>
    <div>
      <input type="text" name="lastname"/>
    </div>
    <input type="submit" value="Submit"/>
  </form>
</html>
```

The `myview` view code in the Pyramid application *must* expect that the values returned by `request.params` will be of type `unicode`, as opposed to type `str`. The following will work to accept a form post from the above form:

```
def myview(request):
    firstname = request.params['firstname']
    lastname = request.params['lastname']
```

But the following `myview` view code *may not* work, as it tries to decode already-decoded (`unicode`) values obtained from `request.params`:

```
def myview(request):
    # the .decode('utf-8') will break below if there are any high-order
    # characters in the firstname or lastname
    firstname = request.params['firstname'].decode('utf-8')
    lastname = request.params['lastname'].decode('utf-8')
```

For implicit decoding to work reliably, you should ensure that every form you render that posts to a Pyramid view explicitly defines a charset encoding of UTF-8. This can be done via a response that has a `;charset=UTF-8` in its `Content-Type` header; or, as in the form above, with a `meta http-equiv` tag that implies that the charset is UTF-8 within the HTML `head` of the page containing the form. This must be done explicitly because all known browser clients assume that they should encode form data in the same character set implied by `Content-Type` value of the response containing the form when subsequently submitting that form. There is no other generally accepted way to tell browser clients which charset to use to encode form data. If you do not specify an encoding explicitly, the browser

client will choose to encode form data in its default character set before submitting it, which may not be UTF-8 as the server expects. If a request containing form data encoded in a non-UTF8 charset is handled by your view code, eventually the request code accessed within your view will throw an error when it can't decode some high-order character encoded in another character set within form data, e.g., when `request.params['somename']` is accessed.

If you are using the `Response` class to generate a response, or if you use the `render_template_*` templating APIs, the UTF-8 charset is set automatically as the default via the `Content-Type` header. If you return a `Content-Type` header without an explicit charset, a request will add a `;charset=utf-8` trailer to the `Content-Type` header value for you, for response content types that are textual (e.g. `text/html`, `application/xml`, etc) as it is rendered. If you are using your own response object, you will need to ensure you do this yourself.

Only the *values* of request params obtained via `request.params`, `request.GET` or `request.POST` are decoded to Unicode objects implicitly in the Pyramid default configuration. The keys are still (byte) strings.

7.9 Alternate View Callable Argument/Calling Conventions

Usually, view callables are defined to accept only a single argument: `request`. However, view callables may alternately be defined as classes, functions, or any callable that accept *two* positional arguments: a *context* resource as the first argument and a *request* as the second argument.

The *context* and *request* arguments passed to a view function defined in this style can be defined as follows:

context

The *resource* object found via tree *traversal* or *URL dispatch*.

request A Pyramid Request object representing the current WSGI request.

The following types work as view callables in this style:

1. Functions that accept two arguments: `context`, and `request`, e.g.:

```
from pyramid.response import Response

def view(context, request):
        return Response('OK')
```

2. Classes that have an `__init__` method that accepts `context, request` and a `__call__` method which accepts no arguments, e.g.:

```
from pyramid.response import Response

class view(object):
        def __init__(self, context, request):
                self.context = context
                self.request = request

        def __call__(self):
                return Response('OK')
```

3. Arbitrary callables that have a `__call__` method that accepts `context, request`, e.g.:

```
from pyramid.response import Response

class View(object):
        def __call__(self, context, request):
                return Response('OK')
view = View() # this is the view callable
```

This style of calling convention is most useful for *traversal* based applications, where the context object is frequently used within the view callable code itself.

No matter which view calling convention is used, the view code always has access to the context via `request.context`.

7.10 Pylons-1.0-Style "Controller" Dispatch

A package named *pyramid_handlers* (available from PyPI) provides an analogue of *Pylons* -style "controllers", which are a special kind of view class which provides more automation when your application uses *URL dispatch* solely.

CHAPTER 8

Renderers

A view callable needn't *always* return a *Response* object. If a view happens to return something which does not implement the Pyramid Response interface, Pyramid will attempt to use a *renderer* to construct a response. For example:

```
from pyramid.view import view_config

@view_config(renderer='json')
def hello_world(request):
    return {'content':'Hello!'}
```

The above example returns a *dictionary* from the view callable. A dictionary does not implement the Pyramid response interface, so you might believe that this example would fail. However, since a `renderer` is associated with the view callable through its *view configuration* (in this case, using a `renderer` argument passed to `view_config()`), if the view does *not* return a Response object, the renderer will attempt to convert the result of the view to a response on the developer's behalf.

Of course, if no renderer is associated with a view's configuration, returning anything except an object which implements the Response interface will result in an error. And, if a renderer *is* used, whatever is returned by the view must be compatible with the particular kind of renderer used, or an error may occur during view invocation.

One exception exists: it is *always* OK to return a Response object, even when a `renderer` is configured. If a view callable returns a response object from a view that is configured with a renderer, the renderer is bypassed entirely.

Various types of renderers exist, including serialization renderers and renderers which use templating systems. See also *Writing View Callables Which Use a Renderer*.

8.1 Writing View Callables Which Use a Renderer

As we've seen, view callables needn't always return a Response object. Instead, they may return an arbitrary Python object, with the expectation that a *renderer* will convert that object into a response instance on your behalf. Some renderers use a templating system; other renderers use object serialization techniques.

View configuration can vary the renderer associated with a view callable via the `renderer` attribute. For example, this call to `add_view()` associates the `json` renderer with a view callable:

```
config.add_view('myproject.views.my_view', renderer='json')
```

When this configuration is added to an application, the `myproject.views.my_view` view callable will now use a `json` renderer, which renders view return values to a *JSON* response serialization.

Other built-in renderers include renderers which use the *Chameleon* templating language to render a dictionary to a response. Additional renderers can be added by developers to the system as necessary (see *Adding and Changing Renderers*).

Views which use a renderer and return a non-Response value can vary non-body response attributes (such as headers and the HTTP status code) by attaching a property to the `request.response` attribute See *Varying Attributes of Rendered Responses*.

If the *view callable* associated with a *view configuration* returns a Response object directly, any renderer associated with the view configuration is ignored, and the response is passed back to Pyramid unchanged. For example, if your view callable returns an instance of the `pyramid.response.Response` class as a response, no renderer will be employed.

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config(renderer='json')
def view(request):
    return Response('OK') # json renderer avoided
```

Likewise for an *HTTP exception* response:

```
from pyramid.httpexceptions import HTTPNotFound
from pyramid.view import view_config

@view_config(renderer='json')
def view(request):
    return HTTPFound(location='http://example.com') # json renderer avoided
```

You can of course also return the `request.response` attribute instead to avoid rendering:

```
from pyramid.view import view_config

@view_config(renderer='json')
def view(request):
    request.response.body = 'OK'
    return request.response # json renderer avoided
```

8.2 Built-In Renderers

Several built-in renderers exist in Pyramid. These renderers can be used in the `renderer` attribute of view configurations.

8.2.1 `string`: String Renderer

The `string` renderer is a renderer which renders a view callable result to a string. If a view callable returns a non-Response object, and the `string` renderer is associated in that view's configuration, the result will be to run the object through the Python `str` function to generate a string. Note that if a Unicode object is returned by the view callable, it is not `str()` -ified.

Here's an example of a view that returns a dictionary. If the `string` renderer is specified in the configuration for this view, the view will render the returned dictionary to the `str()` representation of the dictionary:

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config(renderer='string')
def hello_world(request):
    return {'content':'Hello!'}
```

The body of the response returned by such a view will be a string representing the `str()` serialization of the return value:

```
{'content': 'Hello!'}
```

Views which use the string renderer can vary non-body response attributes by using the API of the `request.response` attribute. See *Varying Attributes of Rendered Responses*.

8.2.2 `json`: JSON Renderer

The `json` renderer renders view callable results to *JSON*. It passes the return value through the `json.dumps` standard library function, and wraps the result in a response object. It also sets the response content-type to `application/json`.

Here's an example of a view that returns a dictionary. Since the `json` renderer is specified in the configuration for this view, the view will render the returned dictionary to a JSON serialization:

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config(renderer='json')
def hello_world(request):
    return {'content':'Hello!'}
```

The body of the response returned by such a view will be a string representing the JSON serialization of the return value:

```
'{"content": "Hello!"}'
```

The return value needn't be a dictionary, but the return value must contain values serializable by `json.dumps()`.

You can configure a view to use the JSON renderer by naming `json` as the `renderer` argument of a view configuration, e.g. by using `add_view()`:

```
config.add_view('myproject.views.hello_world',
                name='hello',
                context='myproject.resources.Hello',
                renderer='json')
```

Views which use the JSON renderer can vary non-body response attributes by using the api of the `request.response` attribute. See *Varying Attributes of Rendered Responses*.

8.3 JSONP Renderer

This feature is new in Pyramid 1.1.

`pyramid.renderers.JSONP` is a JSONP renderer factory helper which implements a hybrid json/jsonp renderer. JSONP is useful for making cross-domain AJAX requests.

Unlike other renderers, a JSONP renderer needs to be configured at startup time "by hand". Configure a JSONP renderer using the `pyramid.config.Configurator.add_renderer()` method:

```
from pyramid.config import Configurator

config = Configurator()
config.add_renderer('jsonp', JSONP(param_name='callback'))
```

Once this renderer is registered via `add_renderer()` as above, you can use `jsonp` as the `renderer=` parameter to `@view_config` or `pyramid.config.Configurator.add_view`():

```
from pyramid.view import view_config

@view_config(renderer='jsonp')
def myview(request):
    return {'greeting':'Hello world'}
```

When a view is called that uses a JSONP renderer:

- If there is a parameter in the request's HTTP query string (aka `request.GET`) that matches the `param_name` of the registered JSONP renderer (by default, `callback`), the renderer will return a JSONP response.
- If there is no callback parameter in the request's query string, the renderer will return a 'plain' JSON response.

Javscript library AJAX functionality will help you make JSONP requests. For example, JQuery has a getJSON function, and has equivalent (but more complicated) functionality in its ajax function.

For example (Javascript):

```
var api_url = 'http://api.geonames.org/timezoneJSON' +
              '?lat=38.301733840000004' +
              '&lng=-77.45869621' +
              '&username=fred' +
              '&callback=?';
jqhxr = $.getJSON(api_url);
```

The string `callback=?` above in the the `url` param to the JQuery `getAjax` function indicates to jQuery that the query should be made as a JSONP request; the `callback` parameter will be automatically filled in for you and used.

8.3.1 `*.pt` or `*.txt`: Chameleon Template Renderers

Two built-in renderers exist for *Chameleon* templates.

If the `renderer` attribute of a view configuration is an absolute path, a relative path or *asset specification* which has a final path element with a filename extension of `.pt`, the Chameleon ZPT renderer is used. See *Chameleon ZPT Templates* for more information about ZPT templates.

If the `renderer` attribute of a view configuration is an absolute path or a *asset specification* which has a final path element with a filename extension of `.txt`, the *Chameleon* text renderer is used. See *Templating with Chameleon Text Templates* for more information about Chameleon text templates.

The behavior of these renderers is the same, except for the engine used to render the template.

When a `renderer` attribute that names a template path or *asset specification* (e.g. `myproject:templates/foo.pt` or `myproject:templates/foo.txt`) is used, the view must return a *Response* object or a Python *dictionary*. If the view callable with an associated template returns a Python dictionary, the named template will be passed the dictionary as its keyword arguments, and the template renderer implementation will return the resulting rendered template in a response to the user. If the view callable returns anything but a Response object or a dictionary, an error will be raised.

Before passing keywords to the template, the keyword arguments derived from the dictionary returned by the view are augmented. The callable object – whatever object was used to define the view – will be automatically inserted into the set of keyword arguments passed to the template as the `view` keyword. If the view callable was a class, the `view` keyword will be an instance of that class. Also inserted into the keywords passed to the template are `renderer_name` (the string used in the `renderer` attribute of the directive), `renderer_info` (an object containing renderer-related information), `context` (the context resource of the view used to render the template), and `request` (the request passed to the view used to render the template).

Here's an example view configuration which uses a Chameleon ZPT renderer:

```
# config is an instance of pyramid.config.Configurator

config.add_view('myproject.views.hello_world',
                name='hello',
                context='myproject.resources.Hello',
                renderer='myproject:templates/foo.pt')
```

Here's an example view configuration which uses a Chameleon text renderer:

```
config.add_view('myproject.views.hello_world',
                name='hello',
                context='myproject.resources.Hello',
                renderer='myproject:templates/foo.txt')
```

Views which use a Chameleon renderer can vary response attributes by using the API of the `request.response` attribute. See *Varying Attributes of Rendered Responses*.

8.3.2 `*.mak` or `*.mako`: Mako Template Renderer

The `Mako` template renderer renders views using a Mako template. When used, the view must return a Response object or a Python *dictionary*. The dictionary items will then be used in the global template space. If the view callable returns anything but a Response object or a dictionary, an error will be raised.

When using a `renderer` argument to a *view configuration* to specify a Mako template, the value of the `renderer` may be a path relative to the `mako.directories` setting (e.g. `some/template.mak`) or, alternately, it may be a *asset specification* (e.g. `apackage:templates/sometemplate.mak`). Mako templates may internally inherit other Mako templates using a relative filename or a *asset specification* as desired.

Here's an example view configuration which uses a relative path:

```
# config is an instance of pyramid.config.Configurator

config.add_view('myproject.views.hello_world',
                name='hello',
                context='myproject.resources.Hello',
                renderer='foo.mak')
```

It's important to note that in Mako's case, the 'relative' path name `foo.mak` above is not relative to the package, but is relative to the directory (or directories) configured for Mako via the `mako.directories` configuration file setting.

The renderer can also be provided in *asset specification* format. Here's an example view configuration which uses one:

```
config.add_view('myproject.views.hello_world',
                name='hello',
                context='myproject.resources.Hello',
                renderer='mypackage:templates/foo.mak')
```

The above configuration will use the file named `foo.mak` in the `templates` directory of the `mypackage` package.

The `Mako` template renderer can take additional arguments beyond the standard `pyramid.reload_templates` setting, see the *Environment Variables and .ini File Settings* for additional *Mako Template Render Settings*.

8.4 Varying Attributes of Rendered Responses

Before a response constructed by a *renderer* is returned to Pyramid, several attributes of the request are examined which have the potential to influence response behavior.

View callables that don't directly return a response should use the API of the `pyramid.response.Response` attribute available as `request.response` during their execution, to influence associated response behavior.

For example, if you need to change the response status from within a view callable that uses a renderer, assign the `status` attribute to the `response` attribute of the request before returning a result:

```
from pyramid.view import view_config

@view_config(name='gone', renderer='templates/gone.pt')
def myview(request):
    request.response.status = '404 Not Found'
    return {'URL':request.URL}
```

Note that mutations of `request.response` in views which return a Response object directly will have no effect unless the response object returned *is* `request.response`. For example, the following example calls `request.response.set_cookie`, but this call will have no effect, because a different Response object is returned.

```
from pyramid.response import Response

def view(request):
    request.response.set_cookie('abc', '123') # this has no effect
    return Response('OK') # because we're returning a different response
```

If you mutate `request.response` and you'd like the mutations to have an effect, you must return `request.response`:

```
def view(request):
    request.response.set_cookie('abc', '123')
    return request.response
```

For more information on attributes of the request, see the API documentation in *pyramid.request*. For more information on the API of `request.response`, see `pyramid.request.Request.response`.

8.5 Deprecated Mechanism to Vary Attributes of Rendered Responses

This section describes behavior deprecated in Pyramid 1.1.

In previous releases of Pyramid (1.0 and before), the `request.response` attribute did not exist. Instead, Pyramid required users to set special `response_` -prefixed attributes of the request to influence response behavior. As of Pyramid 1.1, those request attributes are deprecated and their use will cause a deprecation warning to be issued when used. Until their existence is removed completely, we document them below, for benefit of people with older code bases.

`response_content_type` Defines the content-type of the resulting response, e.g. `text/xml`.

`response_headerlist` A sequence of tuples describing header values that should be set in the response, e.g. `[('Set-Cookie', 'abc=123'), ('X-My-Header', 'foo')]`.

`response_status` A WSGI-style status code (e.g. `200 OK`) describing the status of the response.

`response_charset` The character set (e.g. `UTF-8`) of the response.

`response_cache_for` A value in seconds which will influence `Cache-Control` and `Expires` headers in the returned response. The same can also be achieved by returning various values in the `response_headerlist`, this is purely a convenience.

8.6 Adding and Changing Renderers

New templating systems and serializers can be associated with Pyramid renderer names. To this end, configuration declarations can be made which change an existing *renderer factory*, and which add a new renderer factory.

Renderers can be registered imperatively using the `pyramid.config.Configurator.add_renderer()` API.

For example, to add a renderer which renders views which have a `renderer` attribute that is a path that ends in `.jinja2`:

```
config.add_renderer('.jinja2', 'mypackage.MyJinja2Renderer')
```

The first argument is the renderer name. The second argument is a reference to an implementation of a *renderer factory* or a *dotted Python name* referring to such an object.

8.6.1 Adding a New Renderer

You may add a new renderer by creating and registering a *renderer factory*.

A renderer factory implementation is typically a class with the following interface:

```
class RendererFactory:
    def __init__(self, info):
        """ Constructor: info will be an object having the
        following attributes: name (the renderer name), package
        (the package that was 'current' at the time the
        renderer was registered), type (the renderer type
        name), registry (the current application registry) and
        settings (the deployment settings dictionary). """

    def __call__(self, value, system):
        """ Call the renderer implementation with the value
        and the system value passed in as arguments and return
        the result (a string or unicode object).  The value is
        the return value of a view.  The system value is a
        dictionary containing available system values
        (e.g. view, context, and request). """
```

The formal interface definition of the `info` object passed to a renderer factory constructor is available as `pyramid.interfaces.IRendererInfo`.

There are essentially two different kinds of renderer factories:

- A renderer factory which expects to accept an *asset specification*, or an absolute path, as the `name` attribute of the `info` object fed to its constructor. These renderer factories are registered with a `name` value that begins with a dot (`.`). These types of renderer factories usually relate to a file on the filesystem, such as a template.

- A renderer factory which expects to accept a token that does not represent a filesystem path or an asset specification in the `name` attribute of the `info` object fed to its constructor. These renderer factories are registered with a `name` value that does not begin with a dot. These renderer factories are typically object serializers.

Asset Specifications

An asset specification is a colon-delimited identifier for an *asset*. The colon separates a Python *package* name from a package subpath. For example, the asset specification `my.package:static/baz.css` identifies the file named `baz.css` in the `static` subdirectory of the `my.package` Python *package*.

Here's an example of the registration of a simple renderer factory via `add_renderer()`:

```
# config is an instance of pyramid.config.Configurator

config.add_renderer(name='amf', factory='my.package.MyAMFRenderer')
```

Adding the above code to your application startup configuration will allow you to use the `my.package.MyAMFRenderer` renderer factory implementation in view configurations. Your application can use this renderer by specifying `amf` in the `renderer` attribute of a *view configuration*:

```
from pyramid.view import view_config

@view_config(renderer='amf')
def myview(request):
    return {'Hello':'world'}
```

At startup time, when a *view configuration* is encountered, which has a `name` attribute that does not contain a dot, the full `name` value is used to construct a renderer from the associated renderer factory. In this case, the view configuration will create an instance of an `MyAMFRenderer` for each view configuration

which includes `amf` as its renderer value. The `name` passed to the `MyAMFRenderer` constructor will always be `amf`.

Here's an example of the registration of a more complicated renderer factory, which expects to be passed a filesystem path:

```
config.add_renderer(name='.jinja2',
                    factory='my.package.MyJinja2Renderer')
```

Adding the above code to your application startup will allow you to use the `my.package.MyJinja2Renderer` renderer factory implementation in view configurations by referring to any `renderer` which *ends in* `.jinja` in the `renderer` attribute of a *view configuration*:

```
from pyramid.view import view_config

@view_config(renderer='templates/mytemplate.jinja2')
def myview(request):
    return {'Hello':'world'}
```

When a *view configuration* is encountered at startup time, which has a `name` attribute that does contain a dot, the value of the name attribute is split on its final dot. The second element of the split is typically the filename extension. This extension is used to look up a renderer factory for the configured view. Then the value of `renderer` is passed to the factory to create a renderer for the view. In this case, the view configuration will create an instance of a `MyJinja2Renderer` for each view configuration which includes anything ending with `.jinja2` in its `renderer` value. The `name` passed to the `MyJinja2Renderer` constructor will be the full value that was set as `renderer=` in the view configuration.

8.6.2 Changing an Existing Renderer

You can associate more than one filename extension with the same existing renderer implementation as necessary if you need to use a different file extension for the same kinds of templates. For example, to associate the `.zpt` extension with the Chameleon ZPT renderer factory, use the `pyramid.config.Configurator.add_renderer()` method:

```
config.add_renderer('.zpt', 'pyramid.chameleon_zpt.renderer_factory')
```

After you do this, Pyramid will treat templates ending in both the `.pt` and `.zpt` filename extensions as Chameleon ZPT templates.

To change the default mapping in which files with a `.pt` extension are rendered via a Chameleon ZPT page template renderer, use a variation on the following in your application's startup code:

```
config.add_renderer('.pt', 'mypackage.pt_renderer')
```

After you do this, the *renderer factory* in `mypackage.pt_renderer` will be used to render templates which end in `.pt`, replacing the default Chameleon ZPT renderer.

To associate a *default* renderer with *all* view configurations (even ones which do not possess a `renderer` attribute), pass `None` as the `name` attribute to the renderer tag:

```
config.add_renderer(None, 'mypackage.json_renderer_factory')
```

8.7 Overriding A Renderer At Runtime

This is an advanced feature, not typically used by "civilians".

In some circumstances, it is necessary to instruct the system to ignore the static renderer declaration provided by the developer in view configuration, replacing the renderer with another *after a request starts*. For example, an "omnipresent" XML-RPC implementation that detects that the request is from an XML-RPC client might override a view configuration statement made by the user instructing the view to use a template renderer with one that uses an XML-RPC renderer. This renderer would produce an XML-RPC representation of the data returned by an arbitrary view callable.

To use this feature, create a `NewRequest` *subscriber* which sniffs at the request data and which conditionally sets an `override_renderer` attribute on the request itself, which is the *name* of a registered renderer. For example:

```
from pyramid.event import subscriber
from pyramid.event import NewRequest

@subscriber(NewRequest)
def set_xmlrpc_params(event):
    request = event.request
    if (request.content_type == 'text/xml'
            and request.method == 'POST'
            and not 'soapaction' in request.headers
            and not 'x-pyramid-avoid-xmlrpc' in request.headers):
        params, method = parse_xmlrpc_request(request)
        request.xmlrpc_params, request.xmlrpc_method = params, method
        request.is_xmlrpc = True
        request.override_renderer = 'xmlrpc'
        return True
```

The result of such a subscriber will be to replace any existing static renderer configured by the developer with a (notional, nonexistent) XML-RPC renderer if the request appears to come from an XML-RPC client.

CHAPTER 9

Templates

A *template* is a file on disk which can be used to render dynamic data provided by a *view*. Pyramid offers a number of ways to perform templating tasks out of the box, and provides add-on templating support through a set of bindings packages.

Out of the box, Pyramid provides templating via the *Chameleon* and *Mako* templating libraries. *Chameleon* provides support for two different types of templates: *ZPT* templates, and text templates.

Before discussing how built-in templates are used in detail, we'll discuss two ways to render templates within Pyramid in general: directly, and via renderer configuration.

9.1 Using Templates Directly

The most straightforward way to use a template within Pyramid is to cause it to be rendered directly within a *view callable*. You may use whatever API is supplied by a given templating engine to do so.

Pyramid provides various APIs that allow you to render templates directly from within a view callable. For example, if there is a *Chameleon* ZPT template named `foo.pt` in a directory named `templates` in your application, you can render the template from within the body of a view callable like so:

```
from pyramid.renderers import render_to_response

def sample_view(request):
    return render_to_response('templates/foo.pt',
                              {'foo':1, 'bar':2},
                              request=request)
```

Earlier iterations of this documentation (pre-version-1.3) encouraged the application developer to use ZPT-specific APIs such as `pyramid.chameleon_zpt.render_template_to_response()` and `pyramid.chameleon_zpt.render_template()` to render templates directly. This style of rendering still works, but at least for purposes of this documentation, those functions are deprecated. Application developers are encouraged instead to use the functions available in the *`pyramid.renderers`* module to perform rendering tasks. This set of functions works to render templates for all renderer extensions registered with Pyramid.

The `sample_view` *view callable* function above returns a *response* object which contains the body of the `templates/foo.pt` template. In this case, the `templates` directory should live in the same directory as the module containing the `sample_view` function. The template author will have the names `foo` and `bar` available as top-level names for replacement or comparison purposes.

In the example above, the path `templates/foo.pt` is relative to the directory containing the file which defines the view configuration. In this case, this is the directory containing the file that defines the `sample_view` function. Although a renderer path is usually just a simple relative pathname, a path named as a renderer can be absolute, starting with a slash on UNIX or a drive letter prefix on Windows.

Only *Chameleon* templates support defining a renderer for a template relative to the location of the module where the view callable is defined. Mako templates, and other templating system bindings work differently. In particular, Mako templates use a "lookup path" as defined by the `mako.directories` configuration file instead of treating relative paths as relative to the current view module. See *Templating With Mako Templates*.

The path can alternately be a *asset specification* in the form `some.dotted.package_name:relative/path`. This makes it possible to address template assets which live in another package. For example:

```
from pyramid.renderers import render_to_response

def sample_view(request):
    return render_to_response('mypackage:templates/foo.pt',
                              {'foo':1, 'bar':2},
                              request=request)
```

An asset specification points at a file within a Python *package*. In this case, it points at a file named `foo.pt` within the `templates` directory of the `mypackage` package. Using a asset specification instead of a relative template name is usually a good idea, because calls to `render_to_response` using asset specifications will continue to work properly if you move the code containing them around.

Mako templating system bindings also respect absolute asset specifications as an argument to any of the `render*` commands. If a template name defines a `:` (colon) character and is not an absolute path, it is treated as an absolute asset specification.

In the examples above we pass in a keyword argument named `request` representing the current Pyramid request. Passing a request keyword argument will cause the `render_to_response` function to supply the renderer with more correct system values (see *System Values Used During Rendering*), because most of the information required to compose proper system values is present in the request. If your template relies on the name `request` or `context`, or if you've configured special *renderer globals*, make sure to pass `request` as a keyword argument in every call to to a `pyramid.renderers.render_*` function.

Every view must return a *response* object, except for views which use a *renderer* named via view configuration (which we'll see shortly). The `pyramid.renderers.render_to_response()` function is a shortcut function that actually returns a response object. This allows the example view above to simply return the result of its call to `render_to_response()` directly.

Obviously not all APIs you might call to get response data will return a response object. For example, you might render one or more templates to a string that you want to use as response data. The `pyramid.renderers.render()` API renders a template to a string. We can manufacture a *response* object directly, and use that string as the body of the response:

```
from pyramid.renderers import render
from pyramid.response import Response

def sample_view(request):
    result = render('mypackage:templates/foo.pt',
                    {'foo':1, 'bar':2},
                    request=request)
    response = Response(result)
    return response
```

Because *view callable* functions are typically the only code in Pyramid that need to know anything about templates, and because view functions are very simple Python, you can use whatever templating system you're most comfortable with within Pyramid. Install the templating system, import its API functions into your views module, use those APIs to generate a string, then return that string as the body of a Pyramid *Response* object.

For example, here's an example of using "raw" Mako from within a Pyramid *view*:

```
from mako.template import Template
from pyramid.response import Response

def make_view(request):
    template = Template(filename='/templates/template.mak')
    result = template.render(name=request.params['name'])
    response = Response(result)
    return response
```

You probably wouldn't use this particular snippet in a project, because it's easier to use the Mako renderer bindings which already exist in Pyramid. But if your favorite templating system is not supported as a renderer extension for Pyramid, you can create your own simple combination as shown above.

If you use third-party templating languages without cooperating Pyramid bindings directly within view callables, the auto-template-reload strategy explained in *Automatically Reloading Templates* will not be available, nor will the template asset overriding capability explained in *Overriding Assets* be available, nor will it be possible to use any template using that language as a *renderer*. However, it's reasonably easy to write custom templating system binding packages for use under Pyramid so that templates written in the language can be used as renderers. See *Adding and Changing Renderers* for instructions on how to create your own template renderer and *Available Add-On Template System Bindings* for example packages.

If you need more control over the status code and content-type, or other response attributes from views that use direct templating, you may set attributes on the response that influence these values.

Here's an example of changing the content-type and status of the response object returned by `render_to_response()`:

```
from pyramid.renderers import render_to_response

def sample_view(request):
    response = render_to_response('templates/foo.pt',
                                  {'foo':1, 'bar':2},
                                  request=request)
    response.content_type = 'text/plain'
    response.status_int = 204
    return response
```

Here's an example of manufacturing a response object using the result of `render()` (a string):

```
from pyramid.renderers import render
from pyramid.response import Response

def sample_view(request):
    result = render('mypackage:templates/foo.pt',
                    {'foo':1, 'bar':2},
                    request=request)
    response = Response(result)
    response.content_type = 'text/plain'
    return response
```

9.2 System Values Used During Rendering

When a template is rendered using `render_to_response()` or `render()`, the renderer representing the template will be provided with a number of *system* values. These values are provided in a dictionary to the renderer and include:

`context` The current Pyramid context if `request` was provided as a keyword argument, or `None`.

`request` The request provided as a keyword argument.

`renderer_name` The renderer name used to perform the rendering, e.g. `mypackage:templates/foo.pt`.

`renderer_info` An object implementing the `pyramid.interfaces.IRendererInfo` interface. Basically, an object with the following attributes: `name`, `package` and `type`.

You can define more values which will be passed to every template executed as a result of rendering by defining *renderer globals*.

What any particular renderer does with these system values is up to the renderer itself, but most template renderers, including Chameleon and Mako renderers, make these names available as top-level template variables.

9.3 Templates Used as Renderers via Configuration

An alternative to using `render_to_response()` to render templates manually in your view callable code, is to specify the template as a *renderer* in your *view configuration*. This can be done with any of the templating languages supported by Pyramid.

To use a renderer via view configuration, specify a template *asset specification* as the `renderer` argument, or attribute to the *view configuration* of a *view callable*. Then return a *dictionary* from that view callable. The dictionary items returned by the view callable will be made available to the renderer template as top-level names.

The association of a template as a renderer for a *view configuration* makes it possible to replace code within a *view callable* that handles the rendering of a template.

Here's an example of using a `view_config` decorator to specify a *view configuration* that names a template renderer:

```
1 from pyramid.view import view_config
2
3 @view_config(renderer='templates/foo.pt')
4 def my_view(request):
5     return {'foo':1, 'bar':2}
```

You do not need to supply the `request` value as a key in the dictionary result returned from a renderer-configured view callable. Pyramid automatically supplies this value for you so that the "most correct" system values are provided to the renderer.

The `renderer` argument to the `@view_config` configuration decorator shown above is the template *path*. In the example above, the path `templates/foo.pt` is *relative*. Relative to what, you ask? Because we're using a Chameleon renderer, it means "relative to the directory in which the file which defines the view configuration lives". In this case, this is the directory containing the file that defines the `my_view` function. View-configuration-relative asset specifications work only in Chameleon, not in Mako templates.

Similar renderer configuration can be done imperatively. See *Writing View Callables Which Use a Renderer*. See also *Built-In Renderers*.

Although a renderer path is usually just a simple relative pathname, a path named as a renderer can be absolute, starting with a slash on UNIX or a drive letter prefix on Windows. The path can alternately

be an *asset specification* in the form `some.dotted.package_name:relative/path`, making it possible to address template assets which live in another package.

Not just any template from any arbitrary templating system may be used as a renderer. Bindings must exist specifically for Pyramid to use a templating language template as a renderer. Currently, Pyramid has built-in support for two Chameleon templating languages: ZPT and text, and the Mako templating system. See *Built-In Renderers* for a discussion of their details. Pyramid also supports the use of *Jinja2* templates as renderers. See *Available Add-On Template System Bindings*.

Why Use A Renderer via View Configuration

Using a renderer in view configuration is usually a better way to render templates than using any rendering API directly from within a *view callable* because it makes the view callable more unit-testable. Views which use templating or rendering APIs directly must return a *Response* object. Making testing assertions about response objects is typically an indirect process, because it means that your test code often needs to somehow parse information out of the response body (often HTML). View callables configured with renderers externally via view configuration typically return a dictionary, as above. Making assertions about results returned in a dictionary is almost always more direct and straightforward than needing to parse HTML.

By default, views rendered via a template renderer return a *Response* object which has a *status code* of `200 OK`, and a *content-type* of `text/html`. To vary attributes of the response of a view that uses a renderer, such as the content-type, headers, or status attributes, you must use the API of the `pyramid.response.Response` object exposed as `request.response` within the view before returning the dictionary. See *Varying Attributes of Rendered Responses* for more information.

The same set of system values are provided to templates rendered via a renderer view configuration as those provided to templates rendered imperatively. See *System Values Used During Rendering*.

9.4 Chameleon ZPT Templates

Like *Zope*, Pyramid uses *ZPT* (Zope Page Templates) as its default templating language. However, Pyramid uses a different implementation of the *ZPT* specification than Zope does: the *Chameleon* templating engine. The Chameleon engine complies largely with the Zope Page Template template specification. However, it is significantly faster.

The language definition documentation for Chameleon ZPT-style templates is available from the Chameleon website.

Chameleon only works on *CPython* platforms and *Google App Engine*. On *Jython* and other non-CPython platforms, you should use Mako (see *Templating With Mako Templates*) or `pyramid_jinja2` instead. See *Available Add-On Template System Bindings*.

Given a *Chameleon* ZPT template named `foo.pt` in a directory in your application named `templates`, you can render the template as a *renderer* like so:

```
from pyramid.view import view_config

@view_config(renderer='templates/foo.pt')
def my_view(request):
    return {'foo':1, 'bar':2}
```

See also *Built-In Renderers* for more general information about renderers, including Chameleon ZPT renderers.

9.4.1 A Sample ZPT Template

Here's what a simple *Chameleon* ZPT template used under Pyramid might look like:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
    <meta http-equiv="content-type" content="text/html; charset=utf-8" />
    <title>${project} Application</title>
</head>
  <body>
     <h1 class="title">Welcome to <code>${project}</code>, an
      application generated by the <a
      href="http://docs.pylonsproject.org/projects/pyramid/current/"
     >pyramid</a> web
      application framework.</h1>
  </body>
</html>
```

Note the use of *Genshi* -style `${replacements}` above. This is one of the ways that *Chameleon* ZPT differs from standard ZPT. The above template expects to find a `project` key in the set of keywords passed in to it via `render()` or `render_to_response()`. Typical ZPT attribute-based syntax (e.g. `tal:content` and `tal:replace`) also works in these templates.

9.4.2 Using ZPT Macros in Pyramid

When a *renderer* is used to render a template, Pyramid makes at least two top-level names available to the template by default: `context` and `request`. One of the common needs in ZPT-based templates is to use one template's "macros" from within a different template. In Zope, this is typically handled by retrieving the template from the `context`. But the context in Pyramid is a *resource* object, and templates cannot usually be retrieved from resources. To use macros in Pyramid, you need to make the macro template itself available to the rendered template by passing the macro template, or even the macro itself, *into* the rendered template. To do this you can use the `pyramid.renderers.get_renderer()` API to retrieve the macro template, and pass it into the template being rendered via the dictionary returned by the view. For example, using a *view configuration* via a `view_config` decorator that uses a *renderer*:

```
from pyramid.renderers import get_renderer
from pyramid.view import view_config

@view_config(renderer='templates/mytemplate.pt')
def my_view(request):
    main = get_renderer('templates/master.pt').implementation()
    return {'main':main}
```

Where `templates/master.pt` might look like so:

```
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:tal="http://xml.zope.org/namespaces/tal"
      xmlns:metal="http://xml.zope.org/namespaces/metal">
  <span metal:define-macro="hello">
    <h1>
      Hello <span metal:define-slot="name">Fred</span>!
    </h1>
  </span>
</html>
```

And `templates/mytemplate.pt` might look like so:

```
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:tal="http://xml.zope.org/namespaces/tal"
      xmlns:metal="http://xml.zope.org/namespaces/metal">
  <span metal:use-macro="main.macros['hello']">
    <span metal:fill-slot="name">Chris</span>
  </span>
</html>
```

9.5 Templating with Chameleon Text Templates

Pyramid also allows for the use of templates which are composed entirely of non-XML text via *Chameleon*. To do so, you can create templates that are entirely composed of text except for `${name}` -style substitution points.

Here's an example usage of a Chameleon text template. Create a file on disk named `mytemplate.txt` in your project's `templates` directory with the following contents:

```
Hello, ${name}!
```

Then in your project's `views.py` module, you can create a view which renders this template:

```
from pyramid.view import view_config

@view_config(renderer='templates/mytemplate.txt')
def my_view(request):
    return {'name':'world'}
```

When the template is rendered, it will show:

```
Hello, world!
```

If you'd rather use templates directly within a view callable (without the indirection of using a renderer), see *pyramid.chameleon_text* for the API description.

See also *Built-In Renderers* for more general information about renderers, including Chameleon text renderers.

9.6 Side Effects of Rendering a Chameleon Template

When a Chameleon template is rendered from a file, the templating engine writes a file in the same directory as the template file itself as a kind of cache, in order to do less work the next time the template needs to be read from disk. If you see "strange" `.py` files showing up in your `templates` directory (or otherwise directly "next" to your templates), it is due to this feature.

If you're using a version control system such as Subversion, you should configure it to ignore these files. Here's the contents of the author's `svn propedit svn:ignore .` in each of my `templates` directories.

```
*.pt.py
*.txt.py
```

Note that I always name my Chameleon ZPT template files with a `.pt` extension and my Chameleon text template files with a `.txt` extension so that these `svn:ignore` patterns work.

9.7 Nicer Exceptions in Chameleon Templates

The exceptions raised by Chameleon templates when a rendering fails are sometimes less than helpful. Pyramid allows you to configure your application development environment so that exceptions generated by Chameleon during template compilation and execution will contain nicer debugging information.

 Template-debugging behavior is not recommended for production sites as it slows renderings; it's usually only desirable during development.

In order to turn on template exception debugging, you can use an environment variable setting or a configuration file setting.

To use an environment variable, start your application under a shell using the `PYRAMID_DEBUG_TEMPLATES` operating system environment variable set to `1`, For example:

```
$ PYRAMID_DEBUG_TEMPLATES=1 bin/paster serve myproject.ini
```

To use a setting in the application `.ini` file for the same purpose, set the `pyramid.debug_templates` key to `true` within the application's configuration section, e.g.:

```
[app:main]
use = egg:MyProject
pyramid.debug_templates = true
```

With template debugging off, a `NameError` exception resulting from rendering a template with an undefined variable (e.g. `${wrong}`) might end like this:

```
File "...", in __getitem__
  raise NameError(key)
NameError: wrong
```

Note that the exception has no information about which template was being rendered when the error occured. But with template debugging on, an exception resulting from the same problem might end like so:

```
RuntimeError: Caught exception rendering template.
 - Expression: ``wrong``
 - Filename:   /home/fred/env/proj/proj/templates/mytemplate.pt
 - Arguments:  renderer_name: proj:templates/mytemplate.pt
               template: <PageTemplateFile - at 0x1d2ecf0>
               xincludes: <XIncludes - at 0x1d3a130>
               request: <Request - at 0x1d2ecd0>
               project: proj
               macros: <Macros - at 0x1d3aed0>
               context: <MyResource None at 0x1d39130>
               view: <function my_view at 0x1d23570>

NameError: wrong
```

The latter tells you which template the error occurred in, as well as displaying the arguments passed to the template itself.

 Turning on `pyramid.debug_templates` has the same effect as using the Chameleon environment variable `CHAMELEON_DEBUG`. See Chameleon Environment Variables for more information.

9.8 Chameleon Template Internationalization

See *Chameleon Template Support for Translation Strings* for information about supporting internationalized units of text within *Chameleon* templates.

9.9 Templating With Mako Templates

Mako is a templating system written by Mike Bayer. Pyramid has built-in bindings for the Mako templating system. The language definition documentation for Mako templates is available from the Mako website.

To use a Mako template, given a *Mako* template file named `foo.mak` in the `templates` subdirectory in your application package named `mypackage`, you can configure the template as a *renderer* like so:

```
from pyramid.view import view_config

@view_config(renderer='foo.mak')
def my_view(request):
    return {'project':'my project'}
```

For the above view callable to work, the following setting needs to be present in the application stanza of your configuration's `ini` file:

```
mako.directories = mypackage:templates
```

This lets the Mako templating system know that it should look for templates in the `templates` subdirectory of the `mypackage` Python package. See *Mako Template Render Settings* for more information about the `mako.directories` setting and other Mako-related settings that can be placed into the application's `ini` file.

9.9.1 A Sample Mako Template

Here's what a simple *Mako* template used under Pyramid might look like:

```
<html>
<head>
    <title>${project} Application</title>
</head>
  <body>
     <h1 class="title">Welcome to <code>${project}</code>, an
      application generated by the <a
      href="http://docs.pylonsproject.org/projects/pyramid/current/"
     >pyramid</a> web application framework.</h1>
  </body>
</html>
```

This template doesn't use any advanced features of Mako, only the `${}` replacement syntax for names that are passed in as *renderer globals*. See the the Mako documentation to use more advanced features.

9.10 Automatically Reloading Templates

It's often convenient to see changes you make to a template file appear immediately without needing to restart the application process. Pyramid allows you to configure your application development environment so that a change to a template will be automatically detected, and the template will be reloaded on the next rendering.

 Auto-template-reload behavior is not recommended for production sites as it slows rendering slightly; it's usually only desirable during development.

In order to turn on automatic reloading of templates, you can use an environment variable, or a configuration file setting.

To use an environment variable, start your application under a shell using the `PYRAMID_RELOAD_TEMPLATES` operating system environment variable set to `1`, For example:

```
$ PYRAMID_RELOAD_TEMPLATES=1 bin/paster serve myproject.ini
```

To use a setting in the application `.ini` file for the same purpose, set the `pyramid.reload_templates` key to `true` within the application's configuration section, e.g.:

```
[app:main]
use = egg:MyProject
pyramid.reload_templates = true
```

9.11 Available Add-On Template System Bindings

Jinja2 template bindings are available for Pyramid in the `pyramid_jinja2` package. You can get the latest release of this package from the Python package index (pypi).

CHAPTER 10

View Configuration

View lookup is the Pyramid subsystem responsible for finding and invoking a *view callable*. *View configuration* controls how *view lookup* operates in your application. During any given request, view configuration information is compared against request data by the view lookup subsystem in order to find the "best" view callable for that request.

In earlier chapters, you have been exposed to a few simple view configuration declarations without much explanation. In this chapter we will explore the subject in detail.

10.1 Mapping a Resource or URL Pattern to a View Callable

A developer makes a *view callable* available for use within a Pyramid application via *view configuration*. A view configuration associates a view callable with a set of statements that determine the set of circumstances which must be true for the view callable to be invoked.

A view configuration statement is made about information present in the *context* resource and the *request*.

View configuration is performed in one of two ways:

- by running a *scan* against application source code which has a `pyramid.view.view_config` decorator attached to a Python object as per *Adding View Configuration Using the @view_config Decorator*.

- by using the `pyramid.config.Configurator.add_view()` method as per *Adding View Configuration Using add_view()*.

10.1.1 View Configuration Parameters

All forms of view configuration accept the same general types of arguments.

Many arguments supplied during view configuration are *view predicate* arguments. View predicate arguments used during view configuration are used to narrow the set of circumstances in which *view lookup* will find a particular view callable.

View predicate attributes are an important part of view configuration that enables the *view lookup* subsystem to find and invoke the appropriate view. The greater number of predicate attributes possessed by a view's configuration, the more specific the circumstances need to be before the registered view callable will be invoked. The fewer number of predicates which are supplied to a particular view configuration, the more likely it is that the associated view callable will be invoked. A view with five predicates will always be found and evaluated before a view with two, for example. All predicates must match for the associated view to be called.

This does not mean however, that Pyramid "stops looking" when it finds a view registration with predicates that don't match. If one set of view predicates does not match, the "next most specific" view (if any) is consulted for predicates, and so on, until a view is found, or no view can be matched up with the request. The first view with a set of predicates all of which match the request environment will be invoked.

If no view can be found with predicates which allow it to be matched up with the request, Pyramid will return an error to the user's browser, representing a "not found" (404) page. See *Changing the Not Found View* for more information about changing the default notfound view.

Other view configuration arguments are non-predicate arguments. These tend to modify the response of the view callable or prevent the view callable from being invoked due to an authorization policy. The presence of non-predicate arguments in a view configuration does not narrow the circumstances in which the view callable will be invoked.

Non-Predicate Arguments

`permission` The name of a *permission* that the user must possess in order to invoke the *view callable*. See *Configuring View Security* for more information about view security and permissions.

If `permission` is not supplied, no permission is registered for this view (it's accessible by any caller).

attr The view machinery defaults to using the `__call__` method of the *view callable* (or the function itself, if the view callable is a function) to obtain a response. The `attr` value allows you to vary the method attribute used to obtain the response. For example, if your view was a class, and the class has a method named `index` and you wanted to use this method instead of the class' `__call__` method to return the response, you'd say `attr="index"` in the view configuration for the view. This is most useful when the view definition is a class.

If `attr` is not supplied, `None` is used (implying the function itself if the view is a function, or the `__call__` callable attribute if the view is a class).

renderer Denotes the *renderer* implementation which will be used to construct a *response* from the associated view callable's return value. (see also *Renderers*).

This is either a single string term (e.g. `json`) or a string implying a path or *asset specification* (e.g. `templates/views.pt`) naming a *renderer* implementation. If the `renderer` value does not contain a dot (`.`), the specified string will be used to look up a renderer implementation, and that renderer implementation will be used to construct a response from the view return value. If the `renderer` value contains a dot (`.`), the specified term will be treated as a path, and the filename extension of the last element in the path will be used to look up the renderer implementation, which will be passed the full path.

When the renderer is a path, although a path is usually just a simple relative pathname (e.g. `templates/foo.pt`, implying that a template named "foo.pt" is in the "templates" directory relative to the directory of the current *package*), a path can be absolute, starting with a slash on UNIX or a drive letter prefix on Windows. The path can alternately be a *asset specification* in the form `some.dotted.package_name:relative/path`, making it possible to address template assets which live in a separate package.

The `renderer` attribute is optional. If it is not defined, the "null" renderer is assumed (no rendering is performed and the value is passed back to the upstream Pyramid machinery unchanged). Note that if the view callable itself returns a *response* (see *View Callable Responses*), the specified renderer implementation is never called.

http_cache When you supply an `http_cache` value to a view configuration, the `Expires` and `Cache-Control` headers of a response generated by the associated view callable are modified. The value for `http_cache` may be one of the following:

- A nonzero integer. If it's a nonzero integer, it's treated as a number of seconds. This number of seconds will be used to compute the `Expires` header and the `Cache-Control: max-age` parameter of responses to requests which call this view. For example: `http_cache=3600` instructs the requesting browser to 'cache this response for an hour, please'.

- A `datetime.timedelta` instance. If it's a `datetime.timedelta` instance, it will be converted into a number of seconds, and that number of seconds will be used to compute the `Expires` header and the `Cache-Control: max-age` parameter of responses to requests which call this view. For example: `http_cache=datetime.timedelta(days=1)` instructs the requesting browser to 'cache this response for a day, please'.

- Zero (`0`). If the value is zero, the `Cache-Control` and `Expires` headers present in all responses from this view will be composed such that client browser cache (and any intermediate caches) are instructed to never cache the response.

- A two-tuple. If it's a two tuple (e.g. `http_cache=(1, {'public':True})`), the first value in the tuple may be a nonzero integer or a `datetime.timedelta` instance; in either case this value will be used as the number of seconds to cache the response. The second value in the tuple must be a dictionary. The values present in the dictionary will be used as input to the `Cache-Control` response header. For example: `http_cache=(3600, {'public':True})` means 'cache for an hour, and add `public` to the Cache-Control header of the response'. All keys and values supported by the `webob.cachecontrol.CacheControl` interface may be added to the dictionary. Supplying `{'public':True}` is equivalent to calling `response.cache_control.public = True`.

Providing a non-tuple value as `http_cache` is equivalent to calling `response.cache_expires(value)` within your view's body.

Providing a two-tuple value as `http_cache` is equivalent to calling `response.cache_expires(value[0], **value[1])` within your view's body.

If you wish to avoid influencing, the `Expires` header, and instead wish to only influence `Cache-Control` headers, pass a tuple as `http_cache` with the first element of `None`, e.g.: `(None, {'public':True})`.

`wrapper` The *view name* of a different *view configuration* which will receive the response body of this view as the `request.wrapped_body` attribute of its own *request*, and the *response* returned by this view as the `request.wrapped_response` attribute of its own request. Using a wrapper makes it possible to "chain" views together to form a composite response. The response of the outermost wrapper view will be returned to the user. The wrapper view will be found as any view is found: see *View Configuration*. The "best" wrapper view will be found based on the lookup ordering: "under the hood" this wrapper view is looked up via `pyramid.view.render_view_to_response(context, request, 'wrapper_viewname')`. The context and request of a wrapper view is the same context and request of the inner view.

If `wrapper` is not supplied, no wrapper view is used.

decorator A *dotted Python name* to a function (or the function itself) which will be used to decorate the registered *view callable*. The decorator function will be called with the view callable as a single argument. The view callable it is passed will accept `(context, request)`. The decorator must return a replacement view callable which also accepts `(context, request)`.

mapper A Python object or *dotted Python name* which refers to a *view mapper*, or `None`. By default it is `None`, which indicates that the view should use the default view mapper. This plug-point is useful for Pyramid extension developers, but it's not very useful for 'civilians' who are just developing stock Pyramid applications. Pay no attention to the man behind the curtain.

Predicate Arguments

These arguments modify view lookup behavior. In general, the more predicate arguments that are supplied, the more specific, and narrower the usage of the configured view.

name The *view name* required to match this view callable. A `name` argument is typically only used when your application uses *traversal*. Read *Traversal* to understand the concept of a view name.

If `name` is not supplied, the empty string is used (implying the default view).

context An object representing a Python class that the *context* resource must be an instance of *or* the *interface* that the *context* resource must provide in order for this view to be found and called. This predicate is true when the *context* resource is an instance of the represented class or if the *context* resource provides the represented interface; it is otherwise false.

If `context` is not supplied, the value `None`, which matches any resource, is used.

route_name If `route_name` is supplied, the view callable will be invoked only when the named route has matched.

This value must match the `name` of a *route configuration* declaration (see *URL Dispatch*) that must match before this view will be called. Note that the `route` configuration referred to by `route_name` will usually have a `*traverse` token in the value of its `pattern`, representing a part of the path that will be used by *traversal* against the result of the route's *root factory*.

If `route_name` is not supplied, the view callable will only have a chance of being invoked if no other route was matched. This is when the request/context pair found via *resource location* does not indicate it matched any configured route.

request_type This value should be an *interface* that the *request* must provide in order for this view to be found and called.

If `request_type` is not supplied, the value `None` is used, implying any request type.

This is an advanced feature, not often used by "civilians".

request_method This value can be one of the strings `GET`, `POST`, `PUT`, `DELETE`, or `HEAD` representing an HTTP `REQUEST_METHOD`. A view declaration with this argument ensures that the view will only be called when the request's `method` attribute (aka the `REQUEST_METHOD` of the WSGI environment) string matches the supplied value.

If `request_method` is not supplied, the view will be invoked regardless of the `REQUEST_METHOD` of the *WSGI* environment.

request_param This value can be any string. A view declaration with this argument ensures that the view will only be called when the *request* has a key in the `request.params` dictionary (an HTTP `GET` or `POST` variable) that has a name which matches the supplied value.

If the value supplied has a = sign in it, e.g. `request_param="foo=123"`, then the key (`foo`) must both exist in the `request.params` dictionary, *and* the value must match the right hand side of the expression (`123`) for the view to "match" the current request.

If `request_param` is not supplied, the view will be invoked without consideration of keys and values in the `request.params` dictionary.

match_param

This feature is new as of Pyramid 1.2.

This param may be either a single string of the format "key=value" or a dict of key/value pairs.

This argument ensures that the view will only be called when the *request* has key/value pairs in its *matchdict* that equal those supplied in the predicate. e.g. `match_param="action=edit"` `would require the ''action` parameter in the *matchdict* match the right hande side of the expression (`edit`) for the view to "match" the current request.

If the `match_param` is a dict, every key/value pair must match for the predicate to pass.

If `match_param` is not supplied, the view will be invoked without consideration of the keys and values in `request.matchdict`.

containment This value should be a reference to a Python class or *interface* that a parent object in the context resource's *lineage* must provide in order for this view to be found and called. The resources in your resource tree must be "location-aware" to use this feature.

If `containment` is not supplied, the interfaces and classes in the lineage are not considered when deciding whether or not to invoke the view callable.

See *Location-Aware Resources* for more information about location-awareness.

xhr This value should be either `True` or `False`. If this value is specified and is `True`, the *WSGI* environment must possess an `HTTP_X_REQUESTED_WITH` (aka `X-Requested-With`) header that has the value `XMLHttpRequest` for the associated view callable to be found and called. This is useful for detecting AJAX requests issued from jQuery, Prototype and other Javascript libraries.

If `xhr` is not specified, the `HTTP_X_REQUESTED_WITH` HTTP header is not taken into consideration when deciding whether or not to invoke the associated view callable.

accept The value of this argument represents a match query for one or more mimetypes in the `Accept` HTTP request header. If this value is specified, it must be in one of the following forms: a mimetype match token in the form `text/plain`, a wildcard mimetype match token in the form `text/*` or a match-all wildcard mimetype match token in the form `*/*`. If any of the forms matches the `Accept` header of the request, this predicate will be true.

If `accept` is not specified, the `HTTP_ACCEPT` HTTP header is not taken into consideration when deciding whether or not to invoke the associated view callable.

header This value represents an HTTP header name or a header name/value pair.

If `header` is specified, it must be a header name or a `headername:headervalue` pair.

If `header` is specified without a value (a bare header name only, e.g. `If-Modified-Since`), the view will only be invoked if the HTTP header exists with any value in the request.

If `header` is specified, and possesses a name/value pair (e.g. `User-Agent:Mozilla/.*`), the view will only be invoked if the HTTP header exists *and* the HTTP header matches the value requested. When the `headervalue` contains a `:` (colon), it will be considered a name/value pair (e.g. `User-Agent:Mozilla/.*` or `Host:localhost`). The value portion should be a regular expression.

Whether or not the value represents a header name or a header name/value pair, the case of the header name is not significant.

If `header` is not specified, the composition, presence or absence of HTTP headers is not taken into consideration when deciding whether or not to invoke the associated view callable.

path_info This value represents a regular expression pattern that will be tested against the `PATH_INFO` WSGI environment variable to decide whether or not to call the associated view callable. If the regex matches, this predicate will be `True`.

If `path_info` is not specified, the WSGI `PATH_INFO` is not taken into consideration when deciding whether or not to invoke the associated view callable.

custom_predicates If `custom_predicates` is specified, it must be a sequence of references to custom predicate callables. Use custom predicates when no set of predefined predicates do what you need. Custom predicates can be combined with predefined predicates as necessary. Each custom predicate callable should accept two arguments: `context` and `request` and should return either `True` or `False` after doing arbitrary evaluation of the context resource and/or the request. If all callables return `True`, the associated view callable will be considered viable for a given request.

If `custom_predicates` is not specified, no custom predicates are used.

10.1.2 Adding View Configuration Using the `@view_config` Decorator

Using this feature tends to slows down application startup slightly, as more work is performed at application startup to scan for view configuration declarations. For maximum startup performance, use the view configuration method described in *Adding View Configuration Using add_view()* instead.

The `view_config` decorator can be used to associate *view configuration* information with a function, method, or class that acts as a Pyramid view callable.

Here's an example of the `view_config` decorator that lives within a Pyramid application module `views.py`:

```
from resources import MyResource
from pyramid.view import view_config
from pyramid.response import Response

@view_config(route_name='ok', request_method='POST', permission='read')
def my_view(request):
    return Response('OK')
```

Using this decorator as above replaces the need to add this imperative configuration stanza:

```
config.add_view('mypackage.views.my_view', route_name='ok',
                request_method='POST', permission='read')
```

All arguments to `view_config` may be omitted. For example:

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config()
def my_view(request):
    """ My view """
    return Response()
```

Such a registration as the one directly above implies that the view name will be `my_view`, registered with a `context` argument that matches any resource type, using no permission, registered against requests with any request method, request type, request param, route name, or containment.

The mere existence of a `@view_config` decorator doesn't suffice to perform view configuration. All that the decorator does is "annotate" the function with your configuration declarations, it doesn't process them. To make Pyramid process your `pyramid.view.view_config` declarations, you *must* use the `scan` method of a `pyramid.config.Configurator`:

```
# config is assumed to be an instance of the
# pyramid.config.Configurator class
config.scan()
```

Please see *Declarative Configuration* for detailed information about what happens when code is scanned for configuration declarations resulting from use of decorators like `view_config`.

See *pyramid.config* for additional API arguments to the `scan()` method. For example, the method allows you to supply a `package` argument to better control exactly *which* code will be scanned.

All arguments to the `view_config` decorator mean precisely the same thing as they would if they were passed as arguments to the `pyramid.config.Configurator.add_view()` method save for the `view` argument. Usage of the `view_config` decorator is a form of *declarative configuration*, while `pyramid.config.Configurator.add_view()` is a form of *imperative configuration*. However, they both do the same thing.

`@view_config` Placement

A `view_config` decorator can be placed in various points in your application.

If your view callable is a function, it may be used as a function decorator:

```
from pyramid.view import view_config
from pyramid.response import Response

@view_config(route_name='edit')
def edit(request):
    return Response('edited!')
```

If your view callable is a class, the decorator can also be used as a class decorator in Python 2.6 and better (Python 2.5 and below do not support class decorators). All the arguments to the decorator are the same when applied against a class as when they are applied against a function. For example:

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config(route_name='hello')
class MyView(object):
    def __init__(self, request):
        self.request = request

    def __call__(self):
        return Response('hello')
```

You can use the `view_config` decorator as a simple callable to manually decorate classes in Python 2.5 and below without the decorator syntactic sugar, if you wish:

```
from pyramid.response import Response
from pyramid.view import view_config

class MyView(object):
    def __init__(self, request):
        self.request = request

    def __call__(self):
        return Response('hello')

my_view = view_config(route_name='hello')(MyView)
```

More than one `view_config` decorator can be stacked on top of any number of others. Each decorator creates a separate view registration. For example:

```
from pyramid.view import view_config
from pyramid.response import Response

@view_config(route_name='edit')
@view_config(route_name='change')
def edit(request):
    return Response('edited!')
```

This registers the same view under two different names.

The decorator can also be used against a method of a class:

```
from pyramid.response import Response
from pyramid.view import view_config

class MyView(object):
    def __init__(self, request):
        self.request = request

    @view_config(route_name='hello')
    def amethod(self):
        return Response('hello')
```

When the decorator is used against a method of a class, a view is registered for the *class*, so the class constructor must accept an argument list in one of two forms: either it must accept a single argument `request` or it must accept two arguments, `context, request`.

The method which is decorated must return a *response*.

Using the decorator against a particular method of a class is equivalent to using the `attr` parameter in a decorator attached to the class itself. For example, the above registration implied by the decorator being used against the `amethod` method could be spelled equivalently as the below:

```
from pyramid.response import Response
from pyramid.view import view_config

@view_config(attr='amethod', route_name='hello')
class MyView(object):
    def __init__(self, request):
        self.request = request

    def amethod(self):
        return Response('hello')
```

10.1.3 Adding View Configuration Using `add_view()`

The `pyramid.config.Configurator.add_view()` method within *pyramid.config* is used to configure a view "imperatively" (without a `view_config` decorator). The arguments to this method are very similar to the arguments that you provide to the `view_config` decorator. For example:

```
from pyramid.response import Response

def hello_world(request):
    return Response('hello!')

# config is assumed to be an instance of the
# pyramid.config.Configurator class
config.add_view(hello_world, route_name='hello')
```

The first argument, `view`, is required. It must either be a Python object which is the view itself or a *dotted Python name* to such an object. In the above example, `view` is the `hello_world` function. All other arguments are optional. See `pyramid.config.Configurator.add_view()` for more information.

When you use only `add_view()` to add view configurations, you don't need to issue a *scan* in order for the view configuration to take effect.

10.1.4 Configuring View Security

If an *authorization policy* is active, any *permission* attached to a *view configuration* found during view lookup will be verified. This will ensure that the currently authenticated user possesses that permission against the *context* resource before the view function is actually called. Here's an example of specifying a permission in a view configuration using `add_view()`:

```
# config is an instance of pyramid.config.Configurator

config.add_route('add', '/add.html', factory='mypackage.Blog')
config.add_view('myproject.views.add_entry', route_name='add',
                permission='add')
```

When an *authorization policy* is enabled, this view will be protected with the `add` permission. The view will *not be called* if the user does not possess the `add` permission relative to the current *context*. Instead the *forbidden view* result will be returned to the client as per *Protecting Views with Permissions*.

10.1.5 `NotFound` Errors

It's useful to be able to debug `NotFound` error responses when they occur unexpectedly due to an application registry misconfiguration. To debug these errors, use the `PYRAMID_DEBUG_NOTFOUND` environment variable or the `pyramid.debug_notfound` configuration file setting. Details of why a view was not found will be printed to `stderr`, and the browser representation of the error will include the same information. See *Environment Variables and .ini File Settings* for more information about how, and where to set these values.

10.2 Influencing HTTP Caching

This feature is new in Pyramid 1.1.

When a non-`None` `http_cache` argument is passed to a view configuration, Pyramid will set `Expires` and `Cache-Control` response headers in the resulting response, causing browsers to cache the response data for some time. See `http_cache` in *Non-Predicate Arguments* for the its allowable values and what they mean.

Sometimes it's undesirable to have these headers set as the result of returning a response from a view, even though you'd like to decorate the view with a view configuration decorator that has `http_cache`. Perhaps there's an alternate branch in your view code that returns a response that should never be cacheable, while the "normal" branch returns something that should always be cacheable. If this is the case, set the `prevent_auto` attribute of the `response.cache_control` object to a non-`False` value. For example, the below view callable is configured with a `@view_config` decorator that indicates any response from the view should be cached for 3600 seconds. However, the view itself prevents caching from taking place unless there's a `should_cache` GET or POST variable:

```
from pyramid.view import view_config

@view_config(http_cache=3600)
def view(request):
    response = Response()
    if not 'should_cache' in request.params:
        response.cache_control.prevent_auto = True
    return response
```

Note that the `http_cache` machinery will overwrite or add to caching headers you set within the view itself unless you use `preserve_auto`.

You can also turn of the effect of `http_cache` entirely for the duration of a Pyramid application lifetime. To do so, set the `PYRAMID_PREVENT_HTTP_CACHE` environment variable or the `pyramid.prevent_http_cache` configuration value setting to a true value. For more information, see *Preventing HTTP Caching*.

Note that setting `pyramid.prevent_http_cache` will have no effect on caching headers that your application code itself sets. It will only prevent caching headers that would have been set by the Pyramid HTTP caching machinery invoked as the result of the `http_cache` argument to view configuration.

10.3 Debugging View Configuration

See *Displaying Matching Views for a Given URL* for information about how to display each of the view callables that might match for a given URL. This can be an effective way to figure out why a particular view callable is being called instead of the one you'd like to be called.

CHAPTER 11

Static Assets

An *asset* is any file contained within a Python *package* which is *not* a Python source code file. For example, each of the following is an asset:

- a GIF image file contained within a Python package or contained within any subdirectory of a Python package.
- a CSS file contained within a Python package or contained within any subdirectory of a Python package.
- a JavaScript source file contained within a Python package or contained within any subdirectory of a Python package.
- A directory within a package that does not have an `__init__.py` in it (if it possessed an `__init__.py` it would *be* a package).
- a *Chameleon* or *Mako* template file contained within a Python package.

The use of assets is quite common in most web development projects. For example, when you create a Pyramid application using one of the available scaffolds, as described in *Creating the Project*, the directory representing the application contains a Python *package*. Within that Python package, there are directories full of files which are static assets. For example, there's a `static` directory which contains `.css`, `.js`, and `.gif` files. These asset files are delivered when a user visits an application URL.

11.1 Understanding Asset Specifications

Let's imagine you've created a Pyramid application that uses a *Chameleon* ZPT template via the `pyramid.renderers.render_to_response()` API. For example, the application might address the asset using the *asset specification* `myapp:templates/some_template.pt` using that API within a `views.py` file inside a `myapp` package:

```
from pyramid.renderers import render_to_response
render_to_response('myapp:templates/some_template.pt', {}, request)
```

"Under the hood", when this API is called, Pyramid attempts to make sense out of the string `myapp:templates/some_template.pt` provided by the developer. This string is an *asset specification*. It is composed of two parts:

- The *package name* (`myapp`)
- The *asset name* (`templates/some_template.pt`), relative to the package directory.

The two parts are separated by the colon character.

Pyramid uses the Python *pkg_resources* API to resolve the package name and asset name to an absolute (operating-system-specific) file name. It eventually passes this resolved absolute filesystem path to the Chameleon templating engine, which then uses it to load, parse, and execute the template file.

There is a second form of asset specification: a *relative* asset specification. Instead of using an "absolute" asset specification which includes the package name, in certain circumstances you can omit the package name from the specification. For example, you might be able to use `templates/mytemplate.pt` instead of `myapp:templates/some_template.pt`. Such asset specifications are usually relative to a "current package." The "current package" is usually the package which contains the code that *uses* the asset specification. Pyramid APIs which accept relative asset specifications typically describe what the asset is relative to in their individual documentation.

11.2 Serving Static Assets

Pyramid makes it possible to serve up static asset files from a directory on a filesystem to an application user's browser. Use the `pyramid.config.Configurator.add_static_view()` to instruct Pyramid to serve static assets such as JavaScript and CSS files. This mechanism makes a directory of static files available at a name relative to the application root URL, e.g. `/static` or as an external URL.

`add_static_view()` cannot serve a single file, nor can it serve a directory of static files directly relative to the root URL of a Pyramid application. For these features, see *Advanced: Serving Static Assets Using a View Callable*.

Here's an example of a use of `add_static_view()` that will serve files up from the `/var/www/static` directory of the computer which runs the Pyramid application as URLs beneath the `/static` URL prefix.

```
# config is an instance of pyramid.config.Configurator
config.add_static_view(name='static', path='/var/www/static')
```

The `name` prepresents a URL *prefix*. In order for files that live in the `path` directory to be served, a URL that requests one of them must begin with that prefix. In the example above, `name` is `static`, and `path` is `/var/www/static`. In English, this means that you wish to serve the files that live in `/var/www/static` as sub-URLs of the `/static` URL prefix. Therefore, the file `/var/www/static/foo.css` will be returned when the user visits your application's URL `/static/foo.css`.

A static directory named at `path` may contain subdirectories recursively, and any subdirectories may hold files; these will be resolved by the static view as you would expect. The `Content-Type` header returned by the static view for each particular type of file is dependent upon its file extension.

By default, all files made available via `add_static_view()` are accessible by completely anonymous users. Simple authorization can be required, however. To protect a set of static files using a permission, in addition to passing the required `name` and `path` arguments, also pass the `permission` keyword argument to `add_static_view()`. The value of the `permission` argument represents the *permission* that the user must have relative to the current *context* when the static view is invoked. A user will be required to possess this permission to view any of the files represented by `path` of the static view. If your static assets must be protected by a more complex authorization scheme, see *Advanced: Serving Static Assets Using a View Callable*.

Here's another example that uses an *asset specification* instead of an absolute path as the `path` argument. To convince `add_static_view()` to serve files up under the `/static` URL from the `a/b/c/static` directory of the Python package named `some_package`, we can use a fully qualified *asset specification* as the `path`:

```
# config is an instance of pyramid.config.Configurator
config.add_static_view(name='static', path='some_package:a/b/c/static')
```

The `path` provided to `add_static_view()` may be a fully qualified *asset specification* or an *absolute path*.

Instead of representing a URL prefix, the `name` argument of a call to `add_static_view()` can alternately be a *URL*. Each of examples we've seen so far have shown usage of the `name` argument as a URL prefix. However, when `name` is a *URL*, static assets can be served from an external webserver. In this mode, the `name` is used as the URL prefix when generating a URL using `pyramid.request.Request.static_url()`.

For example, `add_static_view()` may be fed a `name` argument which is `http://example.com/images`:

```
# config is an instance of pyramid.config.Configurator
config.add_static_view(name='http://example.com/images',
                       path='mypackage:images')
```

Because `add_static_view()` is provided with a `name` argument that is the URL `http://example.com/images`, subsequent calls to `static_url()` with paths that start with the `path` argument passed to `add_static_view()` will generate a URL something like `http://example.com/images/logo.png`. The external webserver listening on `example.com` must be itself configured to respond properly to such a request. The `static_url()` API is discussed in more detail later in this chapter.

11.2.1 Generating Static Asset URLs

When a `add_static_view()` method is used to register a static asset directory, a special helper API named `pyramid.request.Request.static_url()` can be used to generate the appropriate URL for an asset that lives in one of the directories named by the static registration `path` attribute.

For example, let's assume you create a set of static declarations like so:

```
config.add_static_view(name='static1', path='mypackage:assets/1')
config.add_static_view(name='static2', path='mypackage:assets/2')
```

These declarations create URL-accessible directories which have URLs that begin with `/static1` and `/static2`, respectively. The assets in the `assets/1` directory of the `mypackage` package are consulted when a user visits a URL which begins with `/static1`, and the assets in the `assets/2` directory of the `mypackage` package are consulted when a user visits a URL which begins with `/static2`.

You needn't generate the URLs to static assets "by hand" in such a configuration. Instead, use the `static_url()` API to generate them for you. For example:

```
from pyramid.chameleon_zpt import render_template_to_response

def my_view(request):
    css_url = request.static_url('mypackage:assets/1/foo.css')
    js_url = request.static_url('mypackage:assets/2/foo.js')
    return render_template_to_response('templates/my_template.pt',
                                       css_url = css_url,
                                       js_url = js_url)
```

If the request "application URL" of the running system is `http://example.com`, the `css_url` generated above would be: `http://example.com/static1/foo.css`. The `js_url` generated above would be `http://example.com/static2/foo.js`.

One benefit of using the `static_url()` function rather than constructing static URLs "by hand" is that if you need to change the `name` of a static URL declaration, the generated URLs will continue to resolve properly after the rename.

URLs may also be generated by `static_url()` to static assets that live *outside* the Pyramid application. This will happen when the `add_static_view()` API associated with the path fed to `static_url()` is a *URL* instead of a view name. For example, the `name` argument may be `http://example.com` while the the `path` given may be `mypackage:images`:

```
config.add_static_view(name='http://example.com/images',
                       path='mypackage:images')
```

Under such a configuration, the URL generated by `static_url` for assets which begin with `mypackage:images` will be prefixed with `http://example.com/images`:

```
request.static_url('mypackage:images/logo.png')
# -> http://example.com/images/logo.png
```

Using `static_url()` in conjunction with a `add_static_view()` makes it possible to put static media on a separate webserver during production (if the `name` argument to `add_static_view()` is a URL), while keeping static media package-internal and served by the development webserver during development (if the `name` argument to `add_static_view()` is a URL prefix). To create such a circumstance, we suggest using the `pyramid.registry.Registry.settings` API in conjunction with a setting in the application `.ini` file named `media_location`. Then set the value of `media_location` to either a prefix or a URL depending on whether the application is being run in development or in production (use a different `.ini` file for production than you do for development). This is just a suggestion for a pattern; any setting name other than `media_location` could be used.

11.3 Advanced: Serving Static Assets Using a View Callable

For more flexibility, static assets can be served by a *view callable* which you register manually. For example, if you're using *URL dispatch*, you may want static assets to only be available as a fallback if no previous route matches. Alternately, you might like to serve a particular static asset manually, because its download requires authentication.

Note that you cannot use the `static_url()` API to generate URLs against assets made accessible by registering a custom static view.

11.3.1 Root-Relative Custom Static View (URL Dispatch Only)

The `pyramid.static.static_view` helper class generates a Pyramid view callable. This view callable can serve static assets from a directory. An instance of this class is actually used by the `add_static_view()` configuration method, so its behavior is almost exactly the same once it's configured.

The following example *will not work* for applications that use *traversal*, it will only work if you use *URL dispatch* exclusively. The root-relative route we'll be registering will always be matched before traversal takes place, subverting any views registered via `add_view` (at least those without a `route_name`). A `static_view` static view cannot be made root-relative when you use traversal unless it's registered as a *Not Found view*.

To serve files within a directory located on your filesystem at `/path/to/static/dir` as the result of a "catchall" route hanging from the root that exists at the end of your routing table, create an instance of the `static_view` class inside a `static.py` file in your application root as below.

```
from pyramid.static import static
static_view = static_view('/path/to/static/dir', use_subpath=True)
```

For better cross-system flexibility, use an *asset specification* as the argument to `static_view` instead of a physical absolute filesystem path, e.g. `mypackage:static` instead of `/path/to/mypackage/static`.

Subsequently, you may wire the files that are served by this view up to be accessible as `/<filename>` using a configuration method in your application's startup code.

```
# .. every other add_route declaration should come
# before this one, as it will, by default, catch all requests

config.add_route('catchall_static', '/*subpath')
config.add_view('myapp.static.static_view', route_name='catchall_static')
```

The special name `*subpath` above is used by the `static_view` view callable to signify the path of the file relative to the directory you're serving.

11.3.2 Registering A View Callable to Serve a "Static" Asset

You can register a simple view callable to serve a single static asset. To do so, do things "by hand". First define the view callable.

```
import os
from pyramid.response import Response

def favicon_view(request):
    here = os.path.dirname(__file__)
    icon = open(os.path.join(here, 'static', 'favicon.ico'))
    return Response(content_type='image/x-icon', app_iter=icon)
```

The above bit of code within `favicon_view` computes "here", which is a path relative to the Python file in which the function is defined. It then uses the Python `open` function to obtain a file handle to a file within "here" named `static`, and returns a response using the open the file handle as the response's `app_iter`. It makes sure to set the right content_type too.

You might register such a view via configuration as a view callable that should be called as the result of a traversal:

```
config.add_view('myapp.views.favicon_view', name='favicon.ico')
```

Or you might register it to be the view callable for a particular route:

```
config.add_route('favicon', '/favicon.ico')
config.add_view('myapp.views.favicon_view', route_name='favicon')
```

Because this is a simple view callable, it can be protected with a *permission* or can be configured to respond under different circumstances using *view predicate* arguments.

11.4 Overriding Assets

It can often be useful to override specific assets from "outside" a given Pyramid application. For example, you may wish to reuse an existing Pyramid application more or less unchanged. However, some specific template file owned by the application might have inappropriate HTML, or some static asset (such as a logo file or some CSS file) might not be appropriate. You *could* just fork the application entirely, but it's often more convenient to just override the assets that are inappropriate and reuse the application "as is". This is particularly true when you reuse some "core" application over and over again for some set of

customers (such as a CMS application, or some bug tracking application), and you want to make arbitrary visual modifications to a particular application deployment without forking the underlying code.

To this end, Pyramid contains a feature that makes it possible to "override" one asset with one or more other assets. In support of this feature, a *Configurator* API exists named `pyramid.config.Configurator.override_asset()`. This API allows you to *override* the following kinds of assets defined in any Python package:

- Individual *Chameleon* templates.
- A directory containing multiple Chameleon templates.
- Individual static files served up by an instance of the `pyramid.static.static_view` helper class.
- A directory of static files served up by an instance of the `pyramid.static.static_view` helper class.
- Any other asset (or set of assets) addressed by code that uses the setuptools *pkg_resources* API.

11.4.1 The `override_asset` API

An individual call to `override_asset()` can override a single asset. For example:

```
config.override_asset(
          to_override='some.package:templates/mytemplate.pt',
          override_with='another.package:othertemplates/anothertemplate.pt')
```

The string value passed to both `to_override` and `override_with` sent to the `override_asset` API is called an *asset specification*. The colon separator in a specification separates the *package name* from the *asset name*. The colon and the following asset name are optional. If they are not specified, the override attempts to resolve every lookup into a package from the directory of another package. For example:

```
config.override_asset(to_override='some.package',
                      override_with='another.package')
```

Individual subdirectories within a package can also be overridden:

```
config.override_asset(to_override='some.package:templates/',
                      override_with='another.package:othertemplates/')
```

If you wish to override a directory with another directory, you *must* make sure to attach the slash to the end of both the `to_override` specification and the `override_with` specification. If you fail to attach a slash to the end of a specification that points to a directory, you will get unexpected results.

You cannot override a directory specification with a file specification, and vice versa: a startup error will occur if you try. You cannot override an asset with itself: a startup error will occur if you try.

Only individual *package* assets may be overridden. Overrides will not traverse through subpackages within an overridden package. This means that if you want to override assets for both `some.package:templates`, and `some.package.views:templates`, you will need to register two overrides.

The package name in a specification may start with a dot, meaning that the package is relative to the package in which the configuration construction file resides (or the `package` argument to the `Configurator` class construction). For example:

```
config.override_asset(to_override='.subpackage:templates/',
                      override_with='another.package:templates/')
```

Multiple calls to `override_asset` which name a shared `to_override` but a different `override_with` specification can be "stacked" to form a search path. The first asset that exists in the search path will be used; if no asset exists in the override path, the original asset is used.

Asset overrides can actually override assets other than templates and static files. Any software which uses the `pkg_resources.get_resource_filename()`, `pkg_resources.get_resource_stream()` or `pkg_resources.get_resource_string()` APIs will obtain an overridden file when an override is used.

CHAPTER 12

Request and Response Objects

 This chapter is adapted from a portion of the *WebOb* documentation, originally written by Ian Bicking.

Pyramid uses the *WebOb* package as a basis for its *request* and *response* object implementations. The *request* object that is passed to a Pyramid *view* is an instance of the `pyramid.request.Request` class, which is a subclass of `webob.Request`. The *response* returned from a Pyramid *view renderer* is an instance of the `pyramid.response.Response` class, which is a subclass of the `webob.Response` class. Users can also return an instance of `pyramid.response.Response` directly from a view as necessary.

WebOb is a project separate from Pyramid with a separate set of authors and a fully separate set of documentation. Pyramid adds some functionality to the standard WebOb request, which is documented in the *pyramid.request* API documentation.

WebOb provides objects for HTTP requests and responses. Specifically it does this by wrapping the WSGI request environment and response status, header list, and app_iter (body) values.

WebOb request and response objects provide many conveniences for parsing WSGI requests and forming WSGI responses. WebOb is a nice way to represent "raw" WSGI requests and responses; however, we won't cover that use case in this document, as users of Pyramid don't typically need to use the WSGI-related features of WebOb directly. The reference documentation shows many examples of creating requests and using response objects in this manner, however.

12.1 Request

The request object is a wrapper around the WSGI environ dictionary. This dictionary contains keys for each header, keys that describe the request (including the path and query string), a file-like object for the request body, and a variety of custom keys. You can always access the environ with `req.environ`.

Some of the most important/interesting attributes of a request object:

`req.method`: The request method, e.g., `'GET'`, `'POST'`

`req.GET`: A *multidict* with all the variables in the query string.

`req.POST`: A *multidict* with all the variables in the request body. This only has variables if the request was a `POST` and it is a form submission.

`req.params`: A *multidict* with a combination of everything in `req.GET` and `req.POST`.

`req.body`: The contents of the body of the request. This contains the entire request body as a string. This is useful when the request is a `POST` that is *not* a form submission, or a request like a `PUT`. You can also get `req.body_file` for a file-like object.

`req.json_body` The JSON-decoded contents of the body of the request. See *Dealing With A JSON-Encoded Request Body*.

`req.cookies`: A simple dictionary of all the cookies.

`req.headers`: A dictionary of all the headers. This dictionary is case-insensitive.

`req.urlvars` and `req.urlargs`: `req.urlvars` are the keyword parameters associated with the request URL. `req.urlargs` are the positional parameters. These are set by products like Routes and Selector.

Also, for standard HTTP request headers there are usually attributes, for instance: `req.accept_language`, `req.content_length`, `req.user_agent`, as an example. These properties expose the *parsed* form of each header, for whatever parsing makes sense. For instance, `req.if_modified_since` returns a datetime object (or None if the header is was not provided).

Full API documentation for the Pyramid request object is available in *pyramid.request*.

12.1.1 Special Attributes Added to the Request by Pyramid

In addition to the standard *WebOb* attributes, Pyramid adds special attributes to every request: `context`, `registry`, `root`, `subpath`, `traversed`, `view_name`, `virtual_root`, `virtual_root_path`, `session`, and `tmpl_context`, `matchdict`, and `matched_route`. These attributes are documented further within the `pyramid.request.Request` API documentation.

12.1.2 URLs

In addition to these attributes, there are several ways to get the URL of the request. I'll show various values for an example URL `http://localhost/app/blog?id=10`, where the application is mounted at `http://localhost/app`.

`req.url`: The full request URL, with query string, e.g., `http://localhost/app/blog?id=10`

`req.host`: The host information in the URL, e.g., `localhost`

`req.host_url`: The URL with the host, e.g., `http://localhost`

`req.application_url`: The URL of the application (just the SCRIPT_NAME portion of the path, not PATH_INFO). E.g., `http://localhost/app`

`req.path_url`: The URL of the application including the PATH_INFO. e.g., `http://localhost/app/blog`

`req.path`: The URL including PATH_INFO without the host or scheme. e.g., `/app/blog`

`req.path_qs`: The URL including PATH_INFO and the query string. e.g, `/app/blog?id=10`

`req.query_string`: The query string in the URL, e.g., `id=10`

`req.relative_url(url, to_application=False)`: Gives a URL, relative to the current URL. If `to_application` is True, then resolves it relative to `req.application_url`.

12.1.3 Methods

There are methods of request objects documented in `pyramid.request.Request` but you'll find that you won't use very many of them. Here are a couple that might be useful:

`Request.blank(base_url):` Creates a new request with blank information, based at the given URL. This can be useful for subrequests and artificial requests. You can also use `req.copy()` to copy an existing request, or for subrequests `req.copy_get()` which copies the request but always turns it into a GET (which is safer to share for subrequests).

`req.get_response(wsgi_application):` This method calls the given WSGI application with this request, and returns a `pyramid.response.Response` object. You can also use this for subrequests, or testing.

12.1.4 Unicode

Many of the properties in the request object will return unicode values if the request encoding/charset is provided. The client *can* indicate the charset with something like `Content-Type: application/x-www-form-urlencoded; charset=utf8`, but browsers seldom set this. You can set the charset with `req.charset = 'utf8'`, or during instantiation with `Request(environ, charset='utf8')`. If you subclass `Request` you can also set `charset` as a class-level attribute.

If it is set, then `req.POST`, `req.GET`, `req.params`, and `req.cookies` will contain unicode strings. Each has a corresponding `req.str_*` (e.g., `req.str_POST`) that is always a `str`, and never unicode.

12.1.5 Multidict

Several attributes of a WebOb request are "multidict"; structures (such as `request.GET`, `request.POST`, and `request.params`). A multidict is a dictionary where a key can have multiple values. The quintessential example is a query string like `?pref=red&pref=blue`; the `pref` variable has two values: `red` and `blue`.

In a multidict, when you do `request.GET['pref']` you'll get back only `'blue'` (the last value of `pref`). Sometimes returning a string, and sometimes returning a list, is the cause of frequent exceptions. If you want *all* the values back, use `request.GET.getall('pref')`. If you want to be sure there is *one and only one* value, use `request.GET.getone('pref')`, which will raise an exception if there is zero or more than one value for `pref`.

When you use operations like `request.GET.items()` you'll get back something like `[('pref', 'red'), ('pref', 'blue')]`. All the key/value pairs will show up. Similarly `request.GET.keys()` returns `['pref', 'pref']`. Multidict is a view on a list of tuples; all the keys are ordered, and all the values are ordered.

API documentation for a multidict exists as `pyramid.interfaces.IMultiDict`.

12.1.6 Dealing With A JSON-Encoded Request Body

 this feature is new as of Pyramid 1.1.

`pyramid.request.Request.json_body` is a property that returns a *JSON* -decoded representation of the request body. If the request does not have a body, or the body is not a properly JSON-encoded value, an exception will be raised when this attribute is accessed.

This attribute is useful when you invoke a Pyramid view callable via e.g. jQuery's `$.ajax` function, which has the potential to send a request with a JSON-encoded body.

Using `request.json_body` is equivalent to:

```
from json import loads
loads(request.body, encoding=request.charset)
```

Here's how to construct an AJAX request in Javascript using *jQuery* that allows you to use the `request.json_body` attribute when the request is sent to a Pyramid application:

```
jQuery.ajax({type:'POST',
             url: 'http://localhost:6543/', // the pyramid server
             data: JSON.stringify({'a':1}),
             contentType: 'application/json; charset=utf-8'});
```

When such a request reaches a view in your application, the `request.json_body` attribute will be available in the view callable body.

```
@view_config(renderer='string')
def aview(request):
    print request.json_body
    return 'OK'
```

For the above view, printed to the console will be:

```
{u'a': 1}
```

For bonus points, here's a bit of client-side code that will produce a request that has a body suitable for reading via `request.json_body` using Python's `urllib2` instead of a Javascript AJAX request:

```
import urllib2
import json

json_payload = json.dumps({'a':1})
headers = {'Content-Type':'application/json; charset=utf-8'}
req = urllib2.Request('http://localhost:6543/', json_payload, headers)
resp = urllib2.urlopen(req)
```

12.1.7 Cleaning Up After a Request

Sometimes it's required that some cleanup be performed at the end of a request when a database connection is involved.

For example, let's say you have a `mypackage` Pyramid application package that uses SQLAlchemy, and you'd like the current SQLAlchemy database session to be removed after each request. Put the following in the `mypackage.__init__` module:

```
from mypackage.models import DBSession

from pyramid.events import subscriber
from pyramid.events import NewRequest

def cleanup_callback(request):
    DBSession.remove()

@subscriber(NewRequest)
def add_cleanup_callback(event):
    event.request.add_finished_callback(cleanup_callback)
```

Registering the `cleanup_callback` finished callback at the start of a request (by causing the `add_cleanup_callback` to receive a `pyramid.events.NewRequest` event at the start of each request) will cause the DBSession to be removed whenever request processing has ended. Note that in the example above, for the `pyramid.events.subscriber` decorator to "work", the `pyramid.config.Configurator.scan()` method must be called against your `mypackage` package during application initialization.

This is only an example. In particular, it is not necessary to cause `DBSession.remove` to be called in an application generated from any Pyramid scaffold, because these all use the `pyramid_tm` package. The cleanup done by `DBSession.remove` is unnecessary when `pyramid_tm` middleware is configured into the application.

12.1.8 More Details

More detail about the request object API is available in:

- The `pyramid.request.Request` API documentation.
- The WebOb documentation. All methods and attributes of a `webob.Request` documented within the WebOb documentation will work with request objects created by Pyramid.

12.2 Response

The Pyramid response object can be imported as `pyramid.response.Response`. This class is a subclass of the `webob.Response` class. The subclass does not add or change any functionality, so the WebOb Response documentation will be completely relevant for this class as well.

A response object has three fundamental parts:

`response.status`: The response code plus reason message, like `'200 OK'`. To set the code without a message, use `status_int`, i.e.: `response.status_int = 200`.

`response.headerlist`: A list of all the headers, like `[('Content-Type', 'text/html')]`. There's a case-insensitive *multidict* in `response.headers` that also allows you to access these same headers.

`response.app_iter`: An iterable (such as a list or generator) that will produce the content of the response. This is also accessible as `response.body` (a string), `response.unicode_body` (a unicode object, informed by `response.charset`), and `response.body_file` (a file-like object; writing to it appends to `app_iter`).

Everything else in the object typically derives from this underlying state. Here are some highlights:

`response.content_type` The content type *not* including the `charset` parameter. Typical use: `response.content_type = 'text/html'`.

`response.charset`: The `charset` parameter of the content-type, it also informs encoding in `response.unicode_body`. `response.content_type_params` is a dictionary of all the parameters.

`response.set_cookie(key, value, max_age=None, path='/', ...)`: Set a cookie. The keyword arguments control the various cookie parameters. The `max_age` argument is the length for the cookie to live in seconds (you may also use a timedelta object). The `Expires` key will also be set based on the value of `max_age`.

`response.delete_cookie(key, path='/', domain=None)`: Delete a cookie from the client. This sets `max_age` to 0 and the cookie value to `''`.

`response.cache_expires(seconds=0)`: This makes this response cacheable for the given number of seconds, or if `seconds` is 0 then the response is uncacheable (this also sets the `Expires` header).

`response(environ, start_response)`: The response object is a WSGI application. As an application, it acts according to how you create it. It *can* do conditional responses if you pass `conditional_response=True` when instantiating (or set that attribute later). It can also do HEAD and Range requests.

12.2.1 Headers

Like the request, most HTTP response headers are available as properties. These are parsed, so you can do things like `response.last_modified = os.path.getmtime(filename)`.

The details are available in the extracted Response documentation.

12.2.2 Instantiating the Response

Of course most of the time you just want to *make* a response. Generally any attribute of the response can be passed in as a keyword argument to the class; e.g.:

```
from pyramid.response import Response
response = Response(body='hello world!', content_type='text/plain')
```

The status defaults to `'200 OK'`. The content_type does not default to anything, though if you subclass `pyramid.response.Response` and set `default_content_type` you can override this behavior.

12.2.3 Exception Responses

To facilitate error responses like `404 Not Found`, the module `pyramid.httpexceptions` contains classes for each kind of error response. These include boring, but appropriate error bodies. The exceptions exposed by this module, when used under Pyramid, should be imported from the `pyramid.httpexceptions` module. This import location contains subclasses and replacements that mirror those in the `webob.exc` module.

Each class is named `pyramid.httpexceptions.HTTP*`, where `*` is the reason for the error. For instance, `pyramid.httpexceptions.HTTPNotFound` subclasses `pyramid.Response`, so you can manipulate the instances in the same way. A typical example is:

```
from pyramid.httpexceptions import HTTPNotFound
from pyramid.httpexceptions import HTTPMovedPermanently

response = HTTPNotFound('There is no such resource')
# or:
response = HTTPMovedPermanently(location=new_url)
```

12.2.4 More Details

More details about the response object API are available in the *`pyramid.response`* documentation. More details about exception responses are in the `pyramid.httpexceptions` API documentation. The WebOb documentation is also useful.

CHAPTER 13

Sessions

A *session* is a namespace which is valid for some period of continual activity that can be used to represent a user's interaction with a web application.

This chapter describes how to configure sessions, what session implementations Pyramid provides out of the box, how to store and retrieve data from sessions, and two session-specific features: flash messages, and cross-site request forgery attack prevention.

13.1 Using The Default Session Factory

In order to use sessions, you must set up a *session factory* during your Pyramid configuration.

A very basic, insecure sample session factory implementation is provided in the Pyramid core. It uses a cookie to store session information. This implementation has the following limitation:

- The session information in the cookies used by this implementation is *not* encrypted, so it can be viewed by anyone with access to the cookie storage of the user's browser or anyone with access to the network along which the cookie travels.
- The maximum number of bytes that are storable in a serialized representation of the session is fewer than 4000. This is suitable only for very small data sets.

It is digitally signed, however, and thus its data cannot easily be tampered with.

You can configure this session factory in your Pyramid application by using the `session_factory` argument to the `Configurator` class:

```
from pyramid.session import UnencryptedCookieSessionFactoryConfig
my_session_factory = UnencryptedCookieSessionFactoryConfig('itsaseekreet')

from pyramid.config import Configurator
config = Configurator(session_factory = my_session_factory)
```

Note the very long, very explicit name for `UnencryptedCookieSessionFactoryConfig`. It's trying to tell you that this implementation is, by default, *unencrypted*. You should not use it when you keep sensitive information in the session object, as the information can be easily read by both users of your application and third parties who have access to your users' network traffic. Use a different session factory implementation (preferably one which keeps session data on the server) for anything but the most basic of applications where "session security doesn't matter".

13.2 Using a Session Object

Once a session factory has been configured for your application, you can access session objects provided by the session factory via the `session` attribute of any *request* object. For example:

```
from pyramid.response import Response

def myview(request):
    session = request.session
    if 'abc' in session:
        session['fred'] = 'yes'
    session['abc'] = '123'
    if 'fred' in session:
        return Response('Fred was in the session')
    else:
        return Response('Fred was not in the session')
```

You can use a session much like a Python dictionary. It supports all dictionary methods, along with some extra attributes, and methods.

Extra attributes:

`created` An integer timestamp indicating the time that this session was created.

`new` A boolean. If `new` is True, this session is new. Otherwise, it has been constituted from data that was already serialized.

Extra methods:

`changed()` Call this when you mutate a mutable value in the session namespace. See the gotchas below for details on when, and why you should call this.

`invalidate()` Call this when you want to invalidate the session (dump all data, and – perhaps – set a clearing cookie).

The formal definition of the methods and attributes supported by the session object are in the `pyramid.interfaces.ISession` documentation.

Some gotchas:

- Keys and values of session data must be *pickleable*. This means, typically, that they are instances of basic types of objects, such as strings, lists, dictionaries, tuples, integers, etc. If you place an object in a session data key or value that is not pickleable, an error will be raised when the session is serialized.

- If you place a mutable value (for example, a list or a dictionary) in a session object, and you subsequently mutate that value, you must call the `changed()` method of the session object. In this case, the session has no way to know that is was modified. However, when you modify a session object directly, such as setting a value (i.e., `__setitem__`), or removing a key (e.g., `del` or `pop`), the session will automatically know that it needs to re-serialize its data, thus calling `changed()` is unnecessary. There is no harm in calling `changed()` in either case, so when in doubt, call it after you've changed sessioning data.

13.3 Using Alternate Session Factories

At the time of this writing, exactly one alternate session factory implementation exists, named `pyramid_beaker`. This is a session factory that uses the Beaker library as a backend. Beaker has support for file-based sessions, database based sessions, and encrypted cookie-based sessions. See http://github.com/Pylons/pyramid_beaker for more information about `pyramid_beaker`.

13.4 Creating Your Own Session Factory

If none of the default or otherwise available sessioning implementations for Pyramid suit you, you may create your own session object by implementing a *session factory*. Your session factory should return a *session*. The interfaces for both types are available in `pyramid.interfaces.ISessionFactory` and `pyramid.interfaces.ISession`. You might use the cookie implementation in the `pyramid.session` module as inspiration.

13.5 Flash Messages

"Flash messages" are simply a queue of message strings stored in the *session*. To use flash messaging, you must enable a *session factory* as described in *Using The Default Session Factory* or *Using Alternate Session Factories*.

Flash messaging has two main uses: to display a status message only once to the user after performing an internal redirect, and to allow generic code to log messages for single-time display without having direct access to an HTML template. The user interface consists of a number of methods of the *session* object.

13.5.1 Using the `session.flash` Method

To add a message to a flash message queue, use a session object's `flash()` method:

```
request.session.flash('mymessage')
```

The `flash()` method appends a message to a flash queue, creating the queue if necessary.

`flash()` accepts three arguments:

`flash`(*message*, *queue=''*, *allow_duplicate=True*)

The `message` argument is required. It represents a message you wish to later display to a user. It is usually a string but the `message` you provide is not modified in any way.

The `queue` argument allows you to choose a queue to which to append the message you provide. This can be used to push different kinds of messages into flash storage for later display in different places on a page. You can pass any name for your queue, but it must be a string. Each queue is independent, and can be popped by `pop_flash()` or examined via `peek_flash()` separately. `queue` defaults to the empty string. The empty string represents the default flash message queue.

```
request.session.flash(msg, 'myappsqueue')
```

The `allow_duplicate` argument defaults to `True`. If this is `False`, and you attempt to add a message value which is already present in the queue, it will not be added.

13.5.2 Using the `session.pop_flash` Method

Once one or more messages have been added to a flash queue by the `session.flash()` API, the `session.pop_flash()` API can be used to pop an entire queue and return it for use.

To pop a particular queue of messages from the flash object, use the session object's `pop_flash()` method. This returns a list of the messages that were added to the flash queue, and empties the queue.

`pop_flash`(*queue=''*)

```
>>> request.session.flash('info message')
>>> request.session.pop_flash()
['info message']
```

Calling `session.pop_flash()` again like above without a corresponding call to `session.flash()` will return an empty list, because the queue has already been popped.

```
>>> request.session.flash('info message')
>>> request.session.pop_flash()
['info message']
>>> request.session.pop_flash()
[]
```

13.5.3 Using the `session.peek_flash` Method

Once one or more messages has been added to a flash queue by the `session.flash()` API, the `session.peek_flash()` API can be used to "peek" at that queue. Unlike `session.pop_flash()`, the queue is not popped from flash storage.

`peek_flash`(*queue=''*)

```
>>> request.session.flash('info message')
>>> request.session.peek_flash()
['info message']
>>> request.session.peek_flash()
['info message']
>>> request.session.pop_flash()
['info message']
>>> request.session.peek_flash()
[]
```

13.6 Preventing Cross-Site Request Forgery Attacks

Cross-site request forgery attacks are a phenomenon whereby a user with an identity on your website might click on a URL or button on another website which secretly redirects the user to your application to perform some command that requires elevated privileges.

You can avoid most of these attacks by making sure that the correct *CSRF token* has been set in an Pyramid session object before performing any actions in code which requires elevated privileges that is invoked via a form post. To use CSRF token support, you must enable a *session factory* as described in *Using The Default Session Factory* or *Using Alternate Session Factories*.

13.6.1 Using the `session.get_csrf_token` Method

To get the current CSRF token from the session, use the `session.get_csrf_token()` method.

```
token = request.session.get_csrf_token()
```

The `session.get_csrf_token()` method accepts no arguments. It returns a CSRF *token* string. If `session.get_csrf_token()` or `session.new_csrf_token()` was invoked previously for this session, the existing token will be returned. If no CSRF token previously existed for this session, a new token will be will be set into the session and returned. The newly created token will be opaque and randomized.

You can use the returned token as the value of a hidden field in a form that posts to a method that requires elevated privileges. The handler for the form post should use `session.get_csrf_token()` *again* to obtain the current CSRF token related to the user from the session, and compare it to the value of the hidden form field. For example, if your form rendering included the CSRF token obtained via `session.get_csrf_token()` as a hidden input field named `csrf_token`:

```
1 token = request.session.get_csrf_token()
2 if token != request.POST['csrf_token']:
3     raise ValueError('CSRF token did not match')
```

13.6.2 Using the `session.new_csrf_token` Method

To explicitly add a new CSRF token to the session, use the `session.new_csrf_token()` method. This differs only from `session.get_csrf_token()` inasmuch as it clears any existing CSRF token, creates a new CSRF token, sets the token into the session, and returns the token.

```
token = request.session.new_csrf_token()
```

CHAPTER 14

Using Events

An *event* is an object broadcast by the Pyramid framework at interesting points during the lifetime of an application. You don't need to use events in order to create most Pyramid applications, but they can be useful when you want to perform slightly advanced operations. For example, subscribing to an event can allow you to run some code as the result of every new request.

Events in Pyramid are always broadcast by the framework. However, they only become useful when you register a *subscriber*. A subscriber is a function that accepts a single argument named *event*:

```
1 def mysubscriber(event):
2     print event
```

The above is a subscriber that simply prints the event to the console when it's called.

The mere existence of a subscriber function, however, is not sufficient to arrange for it to be called. To arrange for the subscriber to be called, you'll need to use the `pyramid.config.Configurator.add_subscriber()` method or you'll need to use the `pyramid.events.subscriber()` decorator to decorate a function found via a *scan*.

14.1 Configuring an Event Listener Imperatively

You can imperatively configure a subscriber function to be called for some event type via the `add_subscriber()` method (see also *Configurator*):

```
from pyramid.events import NewRequest

from subscribers import mysubscriber

# "config" below is assumed to be an instance of a
# pyramid.config.Configurator object

config.add_subscriber(mysubscriber, NewRequest)
```

The first argument to `add_subscriber()` is the subscriber function (or a *dotted Python name* which refers to a subscriber callable); the second argument is the event type.

14.2 Configuring an Event Listener Using a Decorator

You can configure a subscriber function to be called for some event type via the `pyramid.events.subscriber()` function.

```
from pyramid.events import NewRequest
from pyramid.events import subscriber

@subscriber(NewRequest)
def mysubscriber(event):
        event.request.foo = 1
```

When the `subscriber()` decorator is used a *scan* must be performed against the package containing the decorated function for the decorator to have any effect.

Either of the above registration examples implies that every time the Pyramid framework emits an event object that supplies an `pyramid.events.NewRequest` interface, the `mysubscriber` function will be called with an *event* object.

As you can see, a subscription is made in terms of a *class* (such as `pyramid.events.NewResponse`). The event object sent to a subscriber will always be an object that possesses an *interface*. For `pyramid.events.NewResponse`, that interface is `pyramid.interfaces.INewResponse`. The interface documentation provides information about available attributes and methods of the event objects.

The return value of a subscriber function is ignored. Subscribers to the same event type are not guaranteed to be called in any particular order relative to each other.

All the concrete Pyramid event types are documented in the *pyramid.events* API documentation.

14.3 An Example

If you create event listener functions in a `subscribers.py` file in your application like so:

```
def handle_new_request(event):
    print 'request', event.request

def handle_new_response(event):
    print 'response', event.response
```

You may configure these functions to be called at the appropriate times by adding the following code to your application's configuration startup:

```
# config is an instance of pyramid.config.Configurator

config.add_subscriber('myproject.subscribers.handle_new_request',
                      'pyramid.events.NewRequest')
config.add_subscriber('myproject.subscribers.handle_new_response',
                      'pyramid.events.NewResponse')
```

Either mechanism causes the functions in `subscribers.py` to be registered as event subscribers. Under this configuration, when the application is run, each time a new request or response is detected, a message will be printed to the console.

Each of our subscriber functions accepts an `event` object and prints an attribute of the event object. This begs the question: how can we know which attributes a particular event has?

We know that `pyramid.events.NewRequest` event objects have a `request` attribute, which is a *request* object, because the interface defined at `pyramid.interfaces.INewRequest` says it must. Likewise, we know that `pyramid.interfaces.NewResponse` events have a `response` attribute, which is a response object constructed by your application, because the interface defined at `pyramid.interfaces.INewResponse` says it must (`pyramid.events.NewResponse` objects also have a `request`).

CHAPTER 15

Environment Variables and `.ini` File Settings

Pyramid behavior can be configured through a combination of operating system environment variables and `.ini` configuration file application section settings. The meaning of the environment variables and the configuration file settings overlap.


Where a configuration file setting exists with the same meaning as an environment variable, and both are present at application startup time, the environment variable setting takes precedence.

The term "configuration file setting name" refers to a key in the `.ini` configuration for your application. The configuration file setting names documented in this chapter are reserved for Pyramid use. You should not use them to indicate application-specific configuration settings.

15.1 Reloading Templates

When this value is true, templates are automatically reloaded whenever they are modified without restarting the application, so you can see changes to templates take effect immediately during development. This flag is meaningful to Chameleon and Mako templates, as well as most third-party template rendering extensions.

Environment Variable Name	Config File Setting Name
`PYRAMID_RELOAD_TEMPLATES`	**`pyramid.reload_templates`** or `reload_templates`

15.2 Reloading Assets

Don't cache any asset file data when this value is true. See also *Overriding Assets*.

Environment Variable Name	Config File Setting Name
PYRAMID_RELOAD_ASSETS	pyramid.reload_assets or reload_assets

For backwards compatibility purposes, aliases can be used for configurating asset reloading: PYRAMID_RELOAD_RESOURCES (envvar) and pyramid.reload_resources (config file).

15.3 Debugging Authorization

Print view authorization failure and success information to stderr when this value is true. See also *Debugging View Authorization Failures*.

Environment Variable Name	Config File Setting Name
PYRAMID_DEBUG_AUTHORIZATION	pyramid.debug_authorization or debug_authorization

15.4 Debugging Not Found Errors

Print view-related NotFound debug messages to stderr when this value is true. See also *NotFound Errors*.

Environment Variable Name	Config File Setting Name
PYRAMID_DEBUG_NOTFOUND	pyramid.debug_notfound or debug_notfound

15.5 Debugging Route Matching

Print debugging messages related to *url dispatch* route matching when this value is true. See also *Debugging Route Matching*.

Environment Variable Name	Config File Setting Name
PYRAMID_DEBUG_ROUTEMATCH	pyramid.debug_routematch or debug_routematch

15.6 Preventing HTTP Caching

Prevent the `http_cache` view configuration argument from having any effect globally in this process when this value is true. No http caching-related response headers will be set by the Pyramid `http_cache` view configuration feature when this is true. See also *Influencing HTTP Caching*.

Environment Variable Name	Config File Setting Name
`PYRAMID_PREVENT_HTTP_CACHE`	`pyramid.prevent_http_cache` or `prevent_http_cache`

15.7 Debugging All

Turns on all `debug*` settings.

Environment Variable Name	Config File Setting Name
`PYRAMID_DEBUG_ALL`	`pyramid.debug_all` or `debug_all`

15.8 Reloading All

Turns on all `reload*` settings.

Environment Variable Name	Config File Setting Name
`PYRAMID_RELOAD_ALL`	`pyramid.reload_all` or `reload_all`

15.9 Default Locale Name

The value supplied here is used as the default locale name when a *locale negotiator* is not registered. See also *Localization-Related Deployment Settings*.

Environment Variable Name	Config File Setting Name
`PYRAMID_DEFAULT_LOCALE_NAME`	`pyramid.default_locale_name` or `default_locale_name`

15.10 Including Packages

`pyramid.includes` instructs your application to include other packages. Using the setting is equivalent to using the `pyramid.config.Configurator.include()` method.

Config File Setting Name
`pyramid.includes`

The value supplied as `pyramid.includes` should be a sequence. The sequence can take several different forms.

1. It can be a string.

   If it is a string, the package names can be separated by spaces:

   ```
     package1 package2 package3

   The package names can also be separated by carriage returns::

      package1
      package2
      package3
   ```

2. It can be a Python list, where the values are strings:

   ```
   ['package1', 'package2', 'package3']
   ```

Each value in the sequence should be a *dotted Python name*.

15.10.1 `pyramid.includes` vs. `pyramid.config.Configurator.include()`

Two methods exist for including packages: `pyramid.includes` and `pyramid.config.Configurator.include()`. This section explains their equivalence.

Using PasteDeploy

Using the following `pyramid.includes` setting in the PasteDeploy `.ini` file in your application:

```
[app:main]
pyramid.includes = pyramid_debugtoolbar
                   pyramid_tm
```

Is equivalent to using the following statements in your configuration code:

```
from pyramid.config import Configurator

def main(global_config, **settings):
    config = Configurator(settings=settings)
    # ...
    config.include('pyramid_debugtoolbar')
    config.include('pyramid_tm')
    # ...
```

It is fine to use both or either form.

Plain Python

Using the following `pyramid.includes` setting in your plain-Python Pyramid application:

```
from pyramid.config import Configurator

if __name__ == '__main__':
    settings = {'pyramid.includes':'pyramid_debugtoolbar pyramid_tm'}
    config = Configurator(settings=settings)
```

Is equivalent to using the following statements in your configuration code:

```
from pyramid.config import Configurator

if __name__ == '__main__':
    settings = {}
    config = Configurator(settings=settings)
    config.include('pyramid_debugtoolbar')
    config.include('pyramid_tm')
```

It is fine to use both or either form.

15.11 Explicit Tween Configuration

This value allows you to perform explicit *tween* ordering in your configuration. Tweens are bits of code used by add-on authors to extend Pyramid. They form a chain, and require ordering.

Ideally, you won't need to use the `pyramid.tweens` setting at all. Tweens are generally ordered and included "implicitly" when an add-on package which registers a tween is "included". Packages are included when you name a `pyramid.includes` setting in your configuration or when you call `pyramid.config.Configuration.include()`.

Authors of included add-ons provide "implicit" tween configuration ordering hints to Pyramid when their packages are included. However, the implicit tween ordering is only best-effort. Pyramid will attempt to provide an implicit order of tweens as best it can using hints provided by add-on authors, but because it's only best-effort, if very precise tween ordering is required, the only surefire way to get it is to use an explicit tween order. You may be required to inspect your tween ordering (see *Displaying "Tweens"*) and add a `pyramid.tweens` configuration value at the behest of an add-on author.

Config File Setting Name
`pyramid.tweens`

The value supplied as `pyramid.tweens` should be a sequence. The sequence can take several different forms.

1. It can be a string.

   If it is a string, the tween names can be separated by spaces:

   ```
     pkg.tween_factory1 pkg.tween_factory2 pkg.tween_factory3

   The tween names can also be separated by carriage returns::

      pkg.tween_factory1
      pkg.tween_factory2
      pkg.tween_factory3
   ```

2. It can be a Python list, where the values are strings:

   ```
   ['pkg.tween_factory1', 'pkg.tween_factory2', 'pkg.tween_factory3']
   ```

Each value in the sequence should be a *dotted Python name*.

15.11.1 Paste Configuration vs. Plain-Python Configuration

Using the following `pyramid.tweens` setting in the PasteDeploy `.ini` file in your application:

```
[app:main]
pyramid.tweens = pyramid_debugtoolbar.toolbar.tween_factory
                 pyramid.tweens.excview_tween_factory
                 pyramid_tm.tm_tween_factory
```

Is equivalent to using the following statements in your configuration code:

```
from pyramid.config import Configurator

def main(global_config, **settings):
    settings['pyramid.tweens'] = [
            'pyramid_debugtoolbar.toolbar.tween_factory',
            'pyramid.tweebs.excview_tween_factory',
            'pyramid_tm.tm_tween_factory',
             ]
    config = Configurator(settings=settings)
```

It is fine to use both or either form.

15.12 Mako Template Render Settings

Mako derives additional settings to configure its template renderer that should be set when using it. Many of these settings are optional and only need to be set if they should be different from the default. The Mako Template Renderer uses a subclass of Mako's template lookup and accepts several arguments to configure it.

15.12.1 Mako Directories

The value(s) supplied here are passed in as the template directories. They should be in *asset specification* format, for example: `my.package:templates`.

Config File Setting Name
`mako.directories`

15.12.2 Mako Module Directory

The value supplied here tells Mako where to store compiled Mako templates. If omitted, compiled templates will be stored in memory. This value should be an absolute path, for example: `%(here)s/data/templates` would use a directory called `data/templates` in the same parent directory as the INI file.

Config File Setting Name
`mako.module_directory`

15.12.3 Mako Input Encoding

The encoding that Mako templates are assumed to have. By default this is set to `utf-8`. If you wish to use a different template encoding, this value should be changed accordingly.

Config File Setting Name
`mako.input_encoding`

15.12.4 Mako Error Handler

A callable (or a *dotted Python name* which names a callable) which is called whenever Mako compile or runtime exceptions occur. The callable is passed the current context as well as the exception. If the callable returns True, the exception is considered to be handled, else it is re-raised after the function completes. Is used to provide custom error-rendering functions.

Config File Setting Name
`mako.error_handler`

15.12.5 Mako Default Filters

List of string filter names that will be applied to all Mako expressions.

Config File Setting Name
`mako.default_filters`

15.12.6 Mako Import

String list of Python statements, typically individual "import" lines, which will be placed into the module level preamble of all generated Python modules.

Config File Setting Name
`mako.imports`

15.12.7 Mako Strict Undefined

`true` or `false`, representing the "strict undefined" behavior of Mako (see Mako Context Variables). By default, this is `false`.

Config File Setting Name
`mako.strict_undefined`

15.12.8 Mako Preprocessor

A callable (or a *dotted Python name* which names a callable) which is called to preprocess the source before the template is called. The callable will be passed the full template source before it is parsed. The return result of the callable will be used as the template source code.

 This feature is new in Pyramid 1.1.

Config File Setting Name
`mako.preprocessor`

15.13 Examples

Let's presume your configuration file is named `MyProject.ini`, and there is a section representing your application named `[app:main]` within the file that represents your Pyramid application. The configuration file settings documented in the above "Config File Setting Name" column would go in the `[app:main]` section. Here's an example of such a section:

```
[app:main]
use = egg:MyProject
pyramid.reload_templates = true
pyramid.debug_authorization = true
```

You can also use environment variables to accomplish the same purpose for settings documented as such. For example, you might start your Pyramid application using the following command line:

```
$ PYRAMID_DEBUG_AUTHORIZATION=1 PYRAMID_RELOAD_TEMPLATES=1 \
      bin/paster serve MyProject.ini
```

If you started your application this way, your Pyramid application would behave in the same manner as if you had placed the respective settings in the `[app:main]` section of your application's `.ini` file.

If you want to turn all `debug` settings (every setting that starts with `pyramid.debug_`). on in one fell swoop, you can use `PYRAMID_DEBUG_ALL=1` as an environment variable setting or you may use `pyramid.debug_all=true` in the config file. Note that this does not affect settings that do not start with `pyramid.debug_*` such as `pyramid.reload_templates`.

If you want to turn all `pyramid.reload` settings (every setting that starts with `pyramid.reload_`) on in one fell swoop, you can use `PYRAMID_RELOAD_ALL=1` as an environment variable setting or you may use `pyramid.reload_all=true` in the config file. Note that this does not affect settings that do not start with `pyramid.reload_*` such as `pyramid.debug_notfound`.

 Specifying configuration settings via environment variables is generally most useful during development, where you may wish to augment or override the more permanent settings in the configuration file. This is useful because many of the reload and debug settings may have performance or security (i.e., disclosure) implications that make them undesirable in a production environment.

15.14 Understanding the Distinction Between `reload_templates` and `reload_assets`

The difference between `pyramid.reload_assets` and `pyramid.reload_templates` is a bit subtle. Templates are themselves also treated by Pyramid as asset files (along with other static files), so the distinction can be confusing. It's helpful to read *Overriding Assets* for some context about assets in general.

When `pyramid.reload_templates` is true, Pyramid takes advantage of the underlying templating systems' ability to check for file modifications to an individual template file. When `pyramid.reload_templates` is true but `pyramid.reload_assets` is *not* true, the template filename returned by the `pkg_resources` package (used under the hood by asset resolution) is cached by Pyramid on the first request. Subsequent requests for the same template file will return a cached template filename. The underlying templating system checks for modifications to this particular file for every request. Setting `pyramid.reload_templates` to `True` doesn't affect performance dramatically (although it should still not be used in production because it has some effect).

However, when `pyramid.reload_assets` is true, Pyramid will not cache the template filename, meaning you can see the effect of changing the content of an overridden asset directory for templates without restarting the server after every change. Subsequent requests for the same template file may return different filenames based on the current state of overridden asset directories. Setting `pyramid.reload_assets` to `True` affects performance *dramatically*, slowing things down by an order of magnitude for each template rendering. However, it's convenient to enable when moving files around in overridden asset directories. `pyramid.reload_assets` makes the system *very slow* when templates are in use. Never set `pyramid.reload_assets` to `True` on a production system.

15.15 Adding A Custom Setting

From time to time, you may need to add a custom setting to your application. Here's how:

- If you're using an `.ini` file, change the `.ini` file, adding the setting to the `[app:foo]` section representing your Pyramid application. For example:

```
[app:main]
# .. other settings
debug_frobnosticator = True
```

- In the `main()` function that represents the place that your Pyramid WSGI application is created, anticipate that you'll be getting this key/value pair as a setting and do any type conversion necessary.

  If you've done any type conversion of your custom value, reset the converted values into the `settings` dictionary *before* you pass the dictionary as `settings` to the *Configurator*. For example:

```
def main(global_config, **settings):
    # ...
    from pyramid.settings import asbool
    debug_frobnosticator = asbool(settings.get(
                'debug_frobnosticator', 'false'))
    settings['debug_frobnosticator'] = debug_frobnosticator
    config = Configurator(settings=settings)
```

It's especially important that you mutate the `settings` dictionary with the converted version of the variable *before* passing it to the Configurator: the configurator makes a *copy* of `settings`, it doesn't use the one you pass directly.

- When creating an `includeme` function that will be later added to your application's configuration you may access the `settings` dictionary through the instance of the *Configurator* that is passed into the function as its only argument. For Example:

```
def includeme(config):
    settings = config.registry.settings
    debug_frobnosticator = settings['debug_frobnosticator']
```

- In the runtime code that you need to access the new settings value, find the value in the `registry.settings` dictionary and use it. In *view* code (or any other code that has access to the request), the easiest way to do this is via `request.registry.settings`. For example:

```
settings = request.registry.settings
debug_frobnosticator = settings['debug_frobnosticator']
```

If you wish to use the value in code that does not have access to the request and you wish to use the value, you'll need to use the `pyramid.threadlocal.get_current_registry()` API to obtain the current registry, then ask for its `settings` attribute. For example:

```
registry = pyramid.threadlocal.get_current_registry()
settings = registry.settings
debug_frobnosticator = settings['debug_frobnosticator']
```

CHAPTER 16

Logging

Pyramid allows you to make use of the Python standard library `logging` module. This chapter describes how to configure logging and how to send log messages to loggers that you've configured.

This chapter assumes you've used a *scaffold* to create a project which contains `development.ini` and `production.ini` files which help configure logging. All of the scaffolds which ship along with Pyramid do this. If you're not using a scaffold, or if you've used a third-party scaffold which does not create these files, the configuration information in this chapter will not be applicable.

16.1 Logging Configuration

A Pyramid project created from a *scaffold* is configured to allow you to send messages to Python standard library logging package loggers from within your application. In particular, the *PasteDeploy* `development.ini` and `production.ini` files created when you use a scaffold include a basic configuration for the Python `logging` package.

PasteDeploy `.ini` files use the Python standard library ConfigParser format; this the same format used as the Python logging module's Configuration file format. The application-related and logging-related sections in the configuration file can coexist peacefully, and the logging-related sections in the file are used from when you run `paster serve`.

The `paster serve` command calls the logging.fileConfig function using the specified ini file if it contains a `[loggers]` section (all of the scaffold-generated `.ini` files do). `logging.fileConfig` reads the logging configuration from the ini file upon which `paster serve` was invoked.

Default logging configuration is provided in both the default `development.ini` and the `production.ini` file. The logging configuration in the `development.ini` file is as follows:

```
# Begin logging configuration

[loggers]
keys = root, {{package_logger}}

[handlers]
keys = console

[formatters]
keys = generic

[logger_root]
level = INFO
handlers = console

[logger_{{package_logger}}]
level = DEBUG
handlers =
qualname = {{package}}

[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

# End logging configuration
```

The `production.ini` file uses the `WARN` level in its logger configuration, but it is otherwise identical.

The name `{{package_logger}}` above will be replaced with the name of your project's *package*, which is derived from the name you provide to your project. For instance, if you do:

```
paster create -t pyramid_starter MyApp
```

The logging configuration will literally be:

```
# Begin logging configuration

[loggers]
keys = root, myapp
```

```
5
6  [handlers]
7  keys = console
8
9  [formatters]
10 keys = generic
11
12 [logger_root]
13 level = INFO
14 handlers = console
15
16 [logger_myapp]
17 level = DEBUG
18 handlers =
19 qualname = myapp
20
21 [handler_console]
22 class = StreamHandler
23 args = (sys.stderr,)
24 level = NOTSET
25 formatter = generic
26
27 [formatter_generic]
28 format = %(asctime)s %(levelname)-5.5s [%(name)s][%(threadName)s] %(message)s
29
30 # End logging configuration
```

In this logging configuration:

- a logger named `root` is created that logs 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 [packagename]
                              Loading resource, id: 86
```

- a logger named `myapp` is configured that logs messages sent at a level above or equal to `DEBUG` to stderr in the same format as the root logger.

The `root` logger will be used by all applications in the Pyramid process that ask for a logger (via `logging.getLogger`) that has a name which begins with anything except your project's package name (e.g. `myapp`). The logger with the same name as your package name is reserved for your own usage in your Pyramid application. Its existence means that you can log to a known logging location from any Pyramid application generated via a scaffold.

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

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

Some scaffolds configure additional loggers for additional subsystems they use (such as SQLALchemy). Take a look at the `production.ini` and `development.ini` files rendered when you create a project from a scaffold.

16.2 Sending Logging Messages

Python's special `__name__` variable refers to the current module's fully qualified name. From any module in a package named `myapp`, the `__name__` builtin variable will always be something like `myapp`, or `myapp.subpackage` or `myapp.package.subpackage` if your project is named `myapp`. Sending a message to this logger will send it to the `myapp` logger.

To log messages to the package-specific logger configured in your `.ini` file, simply create a logger object using the `__name__` builtin and call methods on it.

```
import logging
log = logging.getLogger(__name__)

def myview(request):
    content_type = 'text/plain'
    content = 'Hello World!'
    log.debug('Returning: %s (content-type: %s)', content, content_type)
    request.response.content_type = content_type
    return request.response
```

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

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

16.3 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, myapp, 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`:

```
# Begin logging configuration

[loggers]
keys = root, myapp

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

All of the child loggers of the `myapp` logger will inherit the `DEBUG` level unless they're explicitly set differently. Meaning the `myapp.views`, `myapp.models` (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.

16.4 Advanced Configuration

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

```
[handler_filelog]
class = FileHandler
args = ('%(here)s/myapp.log','a')
level = INFO
formatter = generic
```

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

```
[handlers]
keys = console, myapp, filelog
```

and finally utilized by a logger.

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

These final 3 lines of configuration directs all of the root logger's output to the `myapp.log` as well as the console.

16.5 Logging Exceptions

To log (or email) exceptions generated by your Pyramid application, use the *pyramid_exclog* package. Details about its configuration are in its documentation.

16.6 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 using `.ini` file syntax. First, rename your Pyramid `.ini` file's `[app:main]` section to `[app:mypyramidapp]`, then add a `[filter:translogger]` section, then use a `[pipeline:main]` section file to form a WSGI pipeline with both the translogger and your application in it. For instance, change from this:

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

To this:

```
[app:mypyramidapp]
use = egg:MyProject

[filter:translogger]
paste.filter_app_factory = egg:Paste#translogger
setup_console_handler = False

[pipeline:main]
pipeline = translogger
           mypyramidapp
```

Using PasteDeploy this way to form and serve a pipeline is equivalent to wrapping your app in a TransLogger instance via the bottom the `main` function of your project's `__init__` file:

```
...
app = config.make_wsgi_app()
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 [myapp.views] Returning: Hello World!
                  (content-type: text/plain)
00:50:53,695 INFO [wsgi] 192.168.1.111 - - [11/Aug/2011:20:09:33 -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 an `access.log` FileHandler, we need to add that FileHandler to the wsgi logger's list of handlers:

```
# Begin logging configuration

[loggers]
keys = root, myapp, wsgi

[logger_wsgi]
level = INFO
handlers = handler_accesslog
qualname = wsgi
propagate = 0

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

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 = ('%(here)s/access.log','a')
level = INFO
formatter = accesslog
```

CHAPTER 17

Paste

Packages generated via a *scaffold* make use of a system created by Ian Bicking named *Paste*. Paste provides the following features:

- A way to declare *WSGI* application configuration in an `.ini` file (PasteDeploy).
- A *WSGI* server runner (`paster serve`) which can accept PasteDeploy `.ini` file values as input.
- A mechanism for rendering scaffolds into projects (`paster create`).

Paste is not a particularly integral part of Pyramid. It's more or less used directly only in projects created from scaffolds. It's possible to create a Pyramid application which does not use Paste at all. We show a Pyramid application that doesn't use Paste in *Creating Your First Pyramid Application*. However, all Pyramid scaffolds use the system, to provide new developers with a standardized way of starting, stopping, and setting deployment values. This chapter is not a replacement for documentation about Paste or PasteDeploy; it only contextualizes the use of Paste within Pyramid. For detailed documentation, see http://pythonpaste.org.

17.1 PasteDeploy

PasteDeploy is the system that Pyramid uses to allow *deployment settings* to be spelled using an `.ini` configuration file format. It also allows the `paster serve` command to work. Its configuration format provides a convenient place to define application *deployment settings* and WSGI server settings, and its server runner allows you to stop and start a Pyramid application easily.

17.1.1 Entry Points and PasteDeploy `.ini` Files

In the *Creating a Pyramid Project* chapter, we breezed over the meaning of a configuration line in the `deployment.ini` file. This was the `use = egg:MyProject` line in the `[app:main]` section. We breezed over it because it's pretty confusing and "too much information" for an introduction to the system. We'll try to give it a bit of attention here. Let's see the config file again:

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

pyramid.reload_templates = true
pyramid.debug_authorization = false
pyramid.debug_notfound = false
pyramid.debug_routematch = false
pyramid.debug_templates = true
pyramid.default_locale_name = en
pyramid.includes = pyramid_debugtoolbar

[server:main]
use = egg:Paste#http
host = 0.0.0.0
port = 6543

# Begin logging configuration

[loggers]
keys = root, myproject

[handlers]
keys = console

[formatters]
keys = generic

[logger_root]
level = INFO
handlers = console

[logger_myproject]
level = DEBUG
handlers =
qualname = myproject

[handler_console]
class = StreamHandler
args = (sys.stderr,)
```

```
level = NOTSET
formatter = generic

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

# End logging configuration
```

The line in `[app:main]` above that says `use = egg:MyProject` is actually shorthand for a longer spelling: `use = egg:MyProject#main`. The `#main` part is omitted for brevity, as `#main` is a default defined by PasteDeploy. `egg:MyProject#main` is a string which has meaning to PasteDeploy. It points at a *setuptools entry point* named `main` defined in the `MyProject` project.

Take a look at the generated `setup.py` file for this project.

```
import os

from setuptools import setup, find_packages

here = os.path.abspath(os.path.dirname(__file__))
README = open(os.path.join(here, 'README.txt')).read()
CHANGES = open(os.path.join(here, 'CHANGES.txt')).read()

requires = ['pyramid', 'pyramid_debugtoolbar']

setup(name='MyProject',
      version='0.0',
      description='MyProject',
      long_description=README + '\n\n' +  CHANGES,
      classifiers=[
        "Programming Language :: Python",
        "Framework :: Pylons",
        "Topic :: Internet :: WWW/HTTP",
        "Topic :: Internet :: WWW/HTTP :: WSGI :: Application",
        ],
      author='',
      author_email='',
      url='',
      keywords='web pyramid pylons',
      packages=find_packages(),
      include_package_data=True,
      zip_safe=False,
      install_requires=requires,
      tests_require=requires,
      test_suite="myproject",
```

```
        entry_points = """\
        [paste.app_factory]
        main = myproject:main
        """,
        paster_plugins=['pyramid'],
        )

```

Note that the `entry_point` line in `setup.py` points at a string which looks a lot like an `.ini` file. This string representation of an `.ini` file has a section named `[paste.app_factory]`. Within this section, there is a key named `main` (the entry point name) which has a value `myproject:main`. The *key* `main` is what our `egg:MyProject#main` value of the `use` section in our config file is pointing at, although it is actually shortened to `egg:MyProject` there. The value represents a *dotted Python name* path, which refers to a callable in our `myproject` package's `__init__.py` module.

The `egg:` prefix in `egg:MyProject` indicates that this is an entry point *URI* specifier, where the "scheme" is "egg". An "egg" is created when you run `setup.py install` or `setup.py develop` within your project.

In English, this entry point can thus be referred to as a "Paste application factory in the `MyProject` project which has the entry point named `main` where the entry point refers to a `main` function in the `mypackage` module". Indeed, if you open up the `__init__.py` module generated within any scaffold-generated package, you'll see a `main` function. This is the function called by *PasteDeploy* when the `paster serve` command is invoked against our application. It accepts a global configuration object and *returns* an instance of our application.

17.1.2 `[DEFAULTS]` Section of a PasteDeploy `.ini` File

You can add a `[DEFAULT]` section to your PasteDeploy `.ini` file. Such a section should consists of global parameters that are shared by all the applications, servers and *middleware* defined within the configuration file. The values in a `[DEFAULT]` section will be passed to your application's `main` function as `global_config` (see the reference to the `main` function in *__init__.py*).

CHAPTER 18

Command-Line Pyramid

Your Pyramid application can be controlled and inspected using a variety of command-line utilities. These utilities are documented in this chapter.

18.1 Displaying Matching Views for a Given URL

For a big application with several views, it can be hard to keep the view configuration details in your head, even if you defined all the views yourself. You can use the `paster pviews` command in a terminal window to print a summary of matching routes and views for a given URL in your application. The `paster pviews` command accepts two arguments. The first argument to `pviews` is the path to your application's `.ini` file and section name inside the `.ini` file which points to your application. This should be of the format `config_file#section_name`. The second argument is the URL to test for matching views. The `section_name` may be omitted; if it is, it's considered to be `main`.

Here is an example for a simple view configuration using *traversal*:

```
$ ../bin/paster pviews development.ini#tutorial /FrontPage

URL = /FrontPage

    context: <tutorial.models.Page object at 0xa12536c>
    view name:

    View:
    -----
    tutorial.views.view_page
    required permission = view
```

The output always has the requested URL at the top and below that all the views that matched with their view configuration details. In this example only one view matches, so there is just a single *View* section. For each matching view, the full code path to the associated view callable is shown, along with any permissions and predicates that are part of that view configuration.

A more complex configuration might generate something like this:

```
$ ../bin/paster pviews development.ini#shootout /about

URL = /about

    context: <shootout.models.RootFactory object at 0xa56668c>
    view name: about

    Route:
    ------
    route name: about
    route pattern: /about
    route path: /about
    subpath:
    route predicates (request method = GET)

        View:
        -----
        shootout.views.about_view
        required permission = view
        view predicates (request_param testing, header X/header)

    Route:
    ------
    route name: about_post
    route pattern: /about
    route path: /about
    subpath:
    route predicates (request method = POST)

        View:
        -----
        shootout.views.about_view_post
        required permission = view
        view predicates (request_param test)

        View:
        -----
        shootout.views.about_view_post2
        required permission = view
```

```
40          view predicates (request_param test2)
```

In this case, we are dealing with a *URL dispatch* application. This specific URL has two matching routes. The matching route information is displayed first, followed by any views that are associated with that route. As you can see from the second matching route output, a route can be associated with more than one view.

For a URL that doesn't match any views, `paster pviews` will simply print out a *Not found* message.

18.2 The Interactive Shell

Once you've installed your program for development using `setup.py develop`, you can use an interactive Python shell to execute expressions in a Python environment exactly like the one that will be used when your application runs "for real". To do so, use the `paster pshell` command.

The argument to `pshell` follows the format `config_file#section_name` where `config_file` is the path to your application's `.ini` file and `section_name` is the `app` section name inside the `.ini` file which points to your application. For example, if your application `.ini` file might have a `[app:main]` section that looks like so:

```
1 [app:main]
2 use = egg:MyProject
3 pyramid.reload_templates = true
4 pyramid.debug_authorization = false
5 pyramid.debug_notfound = false
6 pyramid.debug_templates = true
7 pyramid.default_locale_name = en
```

If so, you can use the following command to invoke a debug shell using the name `MyProject` as a section name:

```
chrism@thinko env26]$ bin/paster pshell starter/development.ini#MyProject
Python 2.6.5 (r265:79063, Apr 29 2010, 00:31:32)
[GCC 4.4.3] on linux2
Type "help" for more information.

Environment:
  app          The WSGI application.
  registry     Active Pyramid registry.
  request      Active request object.
```

```
  root         Root of the default resource tree.
  root_factory Default root factory used to create `root`.

>>> root
<myproject.resources.MyResource object at 0x445270>
>>> registry
<Registry myproject>
>>> registry.settings['pyramid.debug_notfound']
False
>>> from myproject.views import my_view
>>> from pyramid.request import Request
>>> r = Request.blank('/')
>>> my_view(r)
{'project': 'myproject'}
```

The WSGI application that is loaded will be available in the shell as the `app` global. Also, if the application that is loaded is the Pyramid app with no surrounding middleware, the `root` object returned by the default *root factory*, `registry`, and `request` will be available.

You can also simply rely on the `main` default section name by omitting any hash after the filename:

```
chrism@thinko env26]$ bin/paster pshell starter/development.ini
```

Press `Ctrl-D` to exit the interactive shell (or `Ctrl-Z` on Windows).

18.2.1 Extending the Shell

It is convenient when using the interactive shell often to have some variables significant to your application already loaded as globals when you start the `pshell`. To facilitate this, `pshell` will look for a special `[pshell]` section in your INI file and expose the subsequent key/value pairs to the shell. Each key is a variable name that will be global within the pshell session; each value is a *dotted Python name*. If specified, the special key `setup` should be a *dotted Python name* pointing to a callable that accepts the dictionary of globals that will be loaded into the shell. This allows for some custom initializing code to be executed each time the `pshell` is run. The `setup` callable can also be specified from the commandline using the `--setup` option which will override the key in the INI file.

For example, you want to expose your model to the shell, along with the database session so that you can mutate the model on an actual database. Here, we'll assume your model is stored in the `myapp.models` package.

```
[pshell]
setup = myapp.lib.pshell.setup
m = myapp.models
session = myapp.models.DBSession
t = transaction
```

By defining the `setup` callable, we will create the module `myapp.lib.pshell` containing a callable named `setup` that will receive the global environment before it is exposed to the shell. Here we mutate the environment's request as well as add a new value containing a WebTest version of the application to which we can easily submit requests.

```
# myapp/lib/pshell.py
from webtest import TestApp

def setup(env):
    env['request'].host = 'www.example.com'
    env['request'].scheme = 'https'
    env['testapp'] = TestApp(env['app'])
```

When this INI file is loaded, the extra variables `m`, `session` and `t` will be available for use immediately. Since a `setup` callable was also specified, it is executed and a new variable `testapp` is exposed, and the request is configured to generate urls from the host `http://www.example.com`. For example:

```
chrism@thinko env26]$ bin/paster pshell starter/development.ini
Python 2.6.5 (r265:79063, Apr 29 2010, 00:31:32)
[GCC 4.4.3] on linux2
Type "help" for more information.

Environment:
  app          The WSGI application.
  registry     Active Pyramid registry.
  request      Active request object.
  root         Root of the default resource tree.
  root_factory Default root factory used to create `root`.
  testapp      <webtest.TestApp object at ...>

Custom Variables:
  m            myapp.models
  session      myapp.models.DBSession
  t            transaction

>>> testapp.get('/')
<200 OK text/html body='<!DOCTYPE...l>\n'/3337>
```

```
>>> request.route_url('home')
'https://www.example.com/'
```

18.2.2 IPython or bpython

If you have IPython or bpython or both installed in the interpreter you use to invoke the `pshell` command, `pshell` will autodiscover them and use the first respectively found in this order : IPython, bpython, standard Python interpreter. However you could specifically invoke one of your choice with the `-p choice` or `--python-shell choice` option.

```
[chrism@vitaminf shellenv]$ ../bin/pshell -p ipython | bpython | python \
                            development.ini#MyProject
```

18.3 Displaying All Application Routes

You can use the `paster proutes` command in a terminal window to print a summary of routes related to your application. Much like the `paster pshell` command (see *The Interactive Shell*), the `paster proutes` command accepts one argument with the format `config_file#section_name`. The `config_file` is the path to your application's `.ini` file, and `section_name` is the `app` section name inside the `.ini` file which points to your application. By default, the `section_name` is `main` and can be omitted.

For example:

```
[chrism@thinko MyProject]$ ../bin/paster proutes development.ini#MyProject
Name            Pattern                         View
----            -------                         ----
home            /                               <function my_view>
home2           /                               <function my_view>
another         /another                        None
static/         static/*subpath                 <static_view object>
catchall        /*subpath                       <function static_view>
```

`paster proutes` generates a table. The table has three columns: a Name column, a Pattern column, and a View column. The items listed in the Name column are route names, the items listed in the Pattern column are route patterns, and the items listed in the View column are representations of the view callable that will be invoked when a request matches the associated route pattern. The view column may show `None` if no associated view callable could be found. If no routes are configured within your application, nothing will be printed to the console when `paster proutes` is executed.

18.4 Displaying “Tweens”

A *tween* is a bit of code that sits between the main Pyramid application request handler and the WSGI application which calls it. A user can get a representation of both the implicit tween ordering (the ordering specified by calls to `pyramid.config.Configurator.add_tween()`) and the explicit tween ordering (specified by the `pyramid.tweens` configuration setting) orderings using the `paster ptweens` command. Tween factories will show up represented by their standard Python dotted name in the `paster ptweens` output.

For example, here's the `paster pwteens` command run against a system configured without any explicit tweens:

```
[chrism@thinko pyramid]$ paster ptweens development.ini
"pyramid.tweens" config value NOT set (implicitly ordered tweens used)

Implicit Tween Chain

Position    Name                                                    Alias
--------    ----                                                    -----
-           -                                                       INGRESS
0           pyramid_debugtoolbar.toolbar.toolbar_tween_factory      pdbt
1           pyramid.tweens.excview_tween_factory                    excview
-           -                                                       MAIN
```

Here's the `paster pwteens` command run against a system configured *with* explicit tweens defined in its `development.ini` file:

```
[chrism@thinko pyramid]$ paster ptweens development.ini
"pyramid.tweens" config value set (explicitly ordered tweens used)

Explicit Tween Chain (used)

Position    Name
--------    ----
-           INGRESS
0           starter.tween_factory2
1           starter.tween_factory1
2           pyramid.tweens.excview_tween_factory
-           MAIN

Implicit Tween Chain (not used)

Position    Name                                                    Alias
--------    ----                                                    -----
```

```
-           -                                                   INGRESS
0           pyramid_debugtoolbar.toolbar.toolbar_tween_factory  pdbt
1           pyramid.tweens.excview_tween_factory                excview
-           -                                                   MAIN
```

Here's the application configuration section of the `development.ini` used by the above `paster ptweens` command which reprorts that the explicit tween chain is used:

```
[app:main]
use = egg:starter
reload_templates = true
debug_authorization = false
debug_notfound = false
debug_routematch = false
debug_templates = true
default_locale_name = en
pyramid.include = pyramid_debugtoolbar
pyramid.tweens = starter.tween_factory2
                 starter.tween_factory1
                 pyramid.tweens.excview_tween_factory
```

See *Registering "Tweens"* for more information about tweens.

18.5 Writing a Script

All web applications are, at their hearts, systems which accept a request and return a response. When a request is accepted by a Pyramid application, the system receives state from the request which is later relied on by your application code. For example, one *view callable* may assume it's working against a request that has a `request.matchdict` of a particular composition, while another assumes a different composition of the matchdict.

In the meantime, it's convenient to be able to write a Python script that can work "in a Pyramid environment", for instance to update database tables used by your Pyramid application. But a "real" Pyramid environment doesn't have a completely static state independent of a request; your application (and Pyramid itself) is almost always reliant on being able to obtain information from a request. When you run a Python script that simply imports code from your application and tries to run it, there just is no request data, because there isn't any real web request. Therefore some parts of your application and some Pyramid APIs will not work.

For this reason, Pyramid makes it possible to run a script in an environment much like the environment produced when a particular *request* reaches your Pyramid application. This is achieved by using the `pyramid.paster.bootstrap()` command in the body of your script.

 This feature is new as of Pyramid 1.1.

In the simplest case, `pyramid.paster.bootstrap()` can be used with a single argument, which accepts the *PasteDeploy* `.ini` file representing Pyramid your application configuration as a single argument:

```
from pyramid.paster import bootstrap
env = bootstrap('/path/to/my/development.ini')
print env['request'].route_url('home')
```

`pyramid.paster.bootstrap()` returns a dictionary containing framework-related information. This dictionary will always contain a *request* object as its `request` key.

The following keys are available in the `env` dictionary returned by `pyramid.paster.bootstrap()`:

request

A `pyramid.request.Request` object implying the current request state for your script.

app

The *WSGI* application object generated by bootstrapping.

root

The *resource* root of your Pyramid application. This is an object generated by the *root factory* configured in your application.

registry

The *application registry* of your Pyramid application.

closer

A parameterless callable that can be used to pop an internal Pyramid threadlocal stack (used by `pyramid.threadlocal.get_current_registry()` and `pyramid.threadlocal.get_current_request()`) when your scripting job is finished.

Let's assume that the `/path/to/my/development.ini` file used in the example above looks like so:

```
[pipeline:main]
pipeline = translogger
           another

[filter:translogger]
filter_app_factory = egg:Paste#translogger
setup_console_handler = False
logger_name = wsgi

[app:another]
use = egg:MyProject
```

The configuration loaded by the above bootstrap example will use the configuration implied by the `[pipeline:main]` section of your configuration file by default. Specifying `/path/to/my/development.ini` is logically equivalent to specifying `/path/to/my/development.ini#main`. In this case, we'll be using a configuration that includes an `app` object which is wrapped in the Paste "translogger" middleware (which logs requests to the console).

You can also specify a particular *section* of the PasteDeploy `.ini` file to load instead of `main`:

```
from pyramid.paster import bootstrap
env = bootstrap('/path/to/my/development.ini#another')
print env['request'].route_url('home')
```

The above example specifies the `another app`, `pipeline`, or `composite` section of your PasteDeploy configuration file. The `app` object present in the `env` dictionary returned by `pyramid.paster.bootstrap()` will be a Pyramid *router*.

18.5.1 Changing the Request

By default, Pyramid will generate a request object in the `env` dictionary for the URL `http://localhost:80/`. This means that any URLs generated by Pyramid during the execution of your script will be anchored here. This is generally not what you want.

So how do we make Pyramid generate the correct URLs?

Assuming that you have a route configured in your application like so:

```
config.add_route('verify', '/verify/{code}')
```

You need to inform the Pyramid environment that the WSGI application is handling requests from a certain base. For example, we want to mount our application at *example.com/prefix* and the generated URLs should use HTTPS. This can be done by mutating the request object:

```
from pyramid.paster import bootstrap
env = bootstrap('/path/to/my/development.ini#another')
env['request'].host = 'example.com'
env['request'].scheme = 'https'
env['request'].script_name = '/prefix'
print env['request'].application_url
# will print 'https://example.com/prefix/another/url'
```

Now you can readily use Pyramid's APIs for generating URLs:

```
env['request'].route_url('verify', code='1337')
# will return 'https://example.com/prefix/verify/1337'
```

18.5.2 Cleanup

When your scripting logic finishes, it's good manners (but not required) to call the `closer` callback:

```
from pyramid.paster import bootstrap
env = bootstrap('/path/to/my/development.ini')

# .. do stuff ...

env['closer']()
```

18.5.3 Setting Up Logging

By default, `pyramid.paster.bootstrap()` does not configure logging parameters present in the configuration file. If you'd like to configure logging based on `[logger]` and related sections in the configuration file, use the following command:

```
import logging.config
logging.config.fileConfig('/path/to/my/development.ini')
```

CHAPTER 19

Internationalization and Localization

Internationalization (i18n) is the act of creating software with a user interface that can potentially be displayed in more than one language or cultural context. *Localization* (l10n) is the process of displaying the user interface of an internationalized application in a *particular* language or cultural context.

Pyramid offers internationalization and localization subsystems that can be used to translate the text of buttons, error messages and other software- and template-defined values into the native language of a user of your application.

19.1 Creating a Translation String

While you write your software, you can insert specialized markup into your Python code that makes it possible for the system to translate text values into the languages used by your application's users. This markup creates a *translation string*. A translation string is an object that behaves mostly like a normal Unicode object, except that it also carries around extra information related to its job as part of the Pyramid translation machinery.

19.1.1 Using The `TranslationString` Class

The most primitive way to create a translation string is to use the `pyramid.i18n.TranslationString` callable:

```
from pyramid.i18n import TranslationString
ts = TranslationString('Add')
```

This creates a Unicode-like object that is a TranslationString.

For people more familiar with *Zope* i18n, a TranslationString is a lot like a `zope.i18nmessageid.Message` object. It is not a subclass, however. For people more familiar with *Pylons* or *Django* i18n, using a TranslationString is a lot like using "lazy" versions of related gettext APIs.

The first argument to `TranslationString` is the `msgid`; it is required. It represents the key into the translation mappings provided by a particular localization. The `msgid` argument must be a Unicode object or an ASCII string. The msgid may optionally contain *replacement markers*. For instance:

```
from pyramid.i18n import TranslationString
ts = TranslationString('Add ${number}')
```

Within the string above, `${number}` is a replacement marker. It will be replaced by whatever is in the *mapping* for a translation string. The mapping may be supplied at the same time as the replacement marker itself:

```
from pyramid.i18n import TranslationString
ts = TranslationString('Add ${number}', mapping={'number':1})
```

Any number of replacement markers can be present in the msgid value, any number of times. Only markers which can be replaced by the values in the *mapping* will be replaced at translation time. The others will not be interpolated and will be output literally.

A translation string should also usually carry a *domain*. The domain represents a translation category to disambiguate it from other translations of the same msgid, in case they conflict.

```
from pyramid.i18n import TranslationString
ts = TranslationString('Add ${number}', mapping={'number':1},
                       domain='form')
```

The above translation string named a domain of `form`. A *translator* function will often use the domain to locate the right translator file on the filesystem which contains translations for a given domain. In this case, if it were trying to translate our msgid to German, it might try to find a translation from a *gettext* file within a *translation directory* like this one:

```
locale/de/LC_MESSAGES/form.mo
```

In other words, it would want to take translations from the `form.mo` translation file in the German language.

Finally, the TranslationString constructor accepts a `default` argument. If a `default` argument is supplied, it replaces usages of the `msgid` as the *default value* for the translation string. When `default` is `None`, the `msgid` value passed to a TranslationString is used as an implicit message identifier. Message identifiers are matched with translations in translation files, so it is often useful to create translation strings with "opaque" message identifiers unrelated to their default text:

```
from pyramid.i18n import TranslationString
ts = TranslationString('add-number', default='Add ${number}',
                       domain='form', mapping={'number':1})
```

When default text is used, Default text objects may contain replacement values.

19.1.2 Using the `TranslationStringFactory` Class

Another way to generate a translation string is to use the `TranslationStringFactory` object. This object is a *translation string factory*. Basically a translation string factory presets the `domain` value of any *translation string* generated by using it. For example:

```
from pyramid.i18n import TranslationStringFactory
_ = TranslationStringFactory('pyramid')
ts = _('Add ${number}', msgid='add-number', mapping={'number':1})
```

We assigned the translation string factory to the name _. This is a convention which will be supported by translation file generation tools.

After assigning _ to the result of a `TranslationStringFactory()`, the subsequent result of calling _ will be a `TranslationString` instance. Even though a `domain` value was not passed to _ (as would have been necessary if the `TranslationString` constructor were used instead of a translation string factory), the `domain` attribute of the resulting translation string will be `pyramid`. As a result, the previous code example is completely equivalent (except for spelling) to:

```
from pyramid.i18n import TranslationString as _
ts = _('Add ${number}', msgid='add-number', mapping={'number':1},
       domain='pyramid')
```

You can set up your own translation string factory much like the one provided above by using the `TranslationStringFactory` class. For example, if you'd like to create a translation string factory which presets the `domain` value of generated translation strings to `form`, you'd do something like this:

```
from pyramid.i18n import TranslationStringFactory
_ = TranslationStringFactory('form')
ts = _('Add ${number}', msgid='add-number', mapping={'number':1})
```

Creating a unique domain for your application via a translation string factory is best practice. Using your own unique translation domain allows another person to reuse your application without needing to merge your translation files with his own. Instead, he can just include your package's *translation directory* via the `pyramid.config.Configurator.add_translation_dirs()` method.

For people familiar with Zope internationalization, a TranslationStringFactory is a lot like a `zope.i18nmessageid.MessageFactory` object. It is not a subclass, however.

19.2 Working With `gettext` Translation Files

The basis of Pyramid translation services is GNU *gettext*. Once your application source code files and templates are marked up with translation markers, you can work on translations by creating various kinds of gettext files.

The steps a developer must take to work with *gettext message catalog* files within a Pyramid application are very similar to the steps a *Pylons* developer must take to do the same. See the Pylons internationalization documentation for more information.

GNU gettext uses three types of files in the translation framework, `.pot` files, `.po` files and `.mo` files.

`.pot` (Portable Object Template) files

A `.pot` file is created by a program which searches through your project's source code and which picks out every *message identifier* passed to one of the `_()` functions (eg. *translation string* constructions). The list of all message identifiers is placed into a `.pot` file, which serves as a template for creating `.po` files.

`.po` (Portable Object) files

The list of messages in a `.pot` file are translated by a human to a particular language; the result is saved as a `.po` file.

`.mo` (Machine Object) files

A `.po` file is turned into a machine-readable binary file, which is the `.mo` file. Compiling the translations to machine code makes the localized program run faster.

The tools for working with *gettext* translation files related to a Pyramid application is *Babel* and *Lingua*. Lingua is a Balel extension that provides support for scraping i18n references out of Python and Chameleon files.

19.2.1 Installing Babel and Lingua

In order for the commands related to working with `gettext` translation files to work properly, you will need to have *Babel* and *Lingua* installed into the same environment in which Pyramid is installed.

Installation on UNIX

If the *virtualenv* into which you've installed your Pyramid application lives in `/my/virtualenv`, you can install Babel and Lingua like so:

```
$ cd /my/virtualenv
$ bin/easy_install Babel lingua
```

Installation on Windows

If the *virtualenv* into which you've installed your Pyramid application lives in `C:\my\virtualenv`, you can install Babel and Lingua like so:

```
C> cd \my\virtualenv
C> Scripts\easy_install Babel lingua
```

Changing the `setup.py`

You need to add a few boilerplate lines to your application's `setup.py` file in order to properly generate *gettext* files from your application.

See *Creating a Pyramid Project* to learn about about the composition of an application's `setup.py` file.

In particular, add the `Babel` and `lingua` distributions to the `install_requires` list and insert a set of references to *Babel message extractors* within the call to `setuptools.setup()` inside your application's `setup.py` file:

```
setup(name="mypackage",
      # ...
      install_requires = [
            # ...
            'Babel',
            'lingua',
            ],
      message_extractors = { '.': [
            ('**.py',   'lingua_python', None ),
            ('**.pt',   'lingua_xml', None ),
            ]},
      )
```

The `message_extractors` stanza placed into the `setup.py` file causes the *Babel* message catalog extraction machinery to also consider `*.pt` files when doing message id extraction.

19.2.2 Extracting Messages from Code and Templates

Once Babel and Lingua are installed and your application's `setup.py` file has the correct message extractor references, you may extract a message catalog template from the code and *Chameleon* templates which reside in your Pyramid application. You run a `setup.py` command to extract the messages:

```
$ cd /place/where/myapplication/setup.py/lives
$ mkdir -p myapplication/locale
$ python setup.py extract_messages
```

The message catalog `.pot` template will end up in:

`myapplication/locale/myapplication.pot`.

Translation Domains

The name `myapplication` above in the filename `myapplication.pot` denotes the *translation domain* of the translations that must be performed to localize your application. By default, the translation domain is the *project* name of your Pyramid application.

To change the translation domain of the extracted messages in your project, edit the `setup.cfg` file of your application, The default `setup.cfg` file of a Paster-generated Pyramid application has stanzas in it that look something like the following:

```
[compile_catalog]
directory = myproject/locale
domain = MyProject
statistics = true

[extract_messages]
add_comments = TRANSLATORS:
output_file = myproject/locale/MyProject.pot
width = 80

[init_catalog]
domain = MyProject
input_file = myproject/locale/MyProject.pot
output_dir = myproject/locale

[update_catalog]
domain = MyProject
input_file = myproject/locale/MyProject.pot
output_dir = myproject/locale
previous = true
```

In the above example, the project name is `MyProject`. To indicate that you'd like the domain of your translations to be `mydomain` instead, change the `setup.cfg` file stanzas to look like so:

```
[compile_catalog]
directory = myproject/locale
domain = mydomain
statistics = true

[extract_messages]
add_comments = TRANSLATORS:
output_file = myproject/locale/mydomain.pot
width = 80

[init_catalog]
domain = mydomain
input_file = myproject/locale/mydomain.pot
output_dir = myproject/locale

[update_catalog]
domain = mydomain
input_file = myproject/locale/mydomain.pot
output_dir = myproject/locale
previous = true
```

19.2.3 Initializing a Message Catalog File

Once you've extracted messages into a `.pot` file (see *Extracting Messages from Code and Templates*), to begin localizing the messages present in the `.pot` file, you need to generate at least one `.po` file. A `.po` file represents translations of a particular set of messages to a particular locale. Initialize a `.po` file for a specific locale from a pre-generated `.pot` template by using the `setup.py init_catalog` command:

```
$ cd /place/where/myapplication/setup.py/lives
$ python setup.py init_catalog -l es
```

By default, the message catalog `.po` file will end up in:

`myapplication/locale/es/LC_MESSAGES/myapplication.po`.

Once the file is there, it can be worked on by a human translator. One tool which may help with this is Poedit.

Note that Pyramid itself ignores the existence of all `.po` files. For a running application to have translations available, a `.mo` file must exist. See *Compiling a Message Catalog File*.

19.2.4 Updating a Catalog File

If more translation strings are added to your application, or translation strings change, you will need to update existing `.po` files based on changes to the `.pot` file, so that the new and changed messages can also be translated or re-translated.

First, regenerate the `.pot` file as per *Extracting Messages from Code and Templates*. Then use the `setup.py update_catalog` command.

```
$ cd /place/where/myapplication/setup.py/lives
$ python setup.py update_catalog
```

19.2.5 Compiling a Message Catalog File

Finally, to prepare an application for performing actual runtime translations, compile `.po` files to `.mo` files:

```
$ cd /place/where/myapplication/setup.py/lives
$ python setup.py compile_catalog
```

This will create a `.mo` file for each `.po` file in your application. As long as the *translation directory* in which the `.mo` file ends up in is configured into your application, these translations will be available to Pyramid.

19.3 Using a Localizer

A *localizer* is an object that allows you to perform translation or pluralization "by hand" in an application. You may use the `pyramid.i18n.get_localizer()` function to obtain a *localizer*. This function will return either the localizer object implied by the active *locale negotiator* or a default localizer object if no explicit locale negotiator is registered.

```
from pyramid.i18n import get_localizer

def aview(request):
    locale = get_localizer(request)
```

 If you need to create a localizer for a locale use the `pyramid.i18n.make_localizer()` function.

19.3.1 Performing a Translation

A *localizer* has a `translate` method which accepts either a *translation string* or a Unicode string and which returns a Unicode object representing the translation. So, generating a translation in a view component of an application might look like so:

```
from pyramid.i18n import get_localizer
from pyramid.i18n import TranslationString

ts = TranslationString('Add ${number}', mapping={'number':1},
                       domain='pyramid')

def aview(request):
    localizer = get_localizer(request)
    translated = localizer.translate(ts) # translation string
    # ... use translated ...
```

The `get_localizer()` function will return a `pyramid.i18n.Localizer` object bound to the locale name represented by the request. The translation returned from its `pyramid.i18n.Localizer.translate()` method will depend on the `domain` attribute of the provided translation string as well as the locale of the localizer.

 If you're using *Chameleon* templates, you don't need to pre-translate translation strings this way. See *Chameleon Template Support for Translation Strings*.

19.3.2 Performing a Pluralization

A *localizer* has a `pluralize` method with the following signature:

```
def pluralize(singular, plural, n, domain=None, mapping=None):
    ...
```

The `singular` and `plural` arguments should each be a Unicode value representing a *message identifier*. `n` should be an integer. `domain` should be a *translation domain*, and `mapping` should be a dictionary that is used for *replacement value* interpolation of the translated string. If `n` is plural for the current locale, `pluralize` will return a Unicode translation for the message id `plural`, otherwise it will return a Unicode translation for the message id `singular`.

The arguments provided as `singular` and/or `plural` may also be *translation string* objects, but the domain and mapping information attached to those objects is ignored.

```
from pyramid.i18n import get_localizer

def aview(request):
    localizer = get_localizer(request)
    translated = localizer.pluralize('Item', 'Items', 1, 'mydomain')
    # ... use translated ...
```

19.4 Obtaining the Locale Name for a Request

You can obtain the locale name related to a request by using the `pyramid.i18n.get_locale_name()` function.

```
from pyramid.i18n import get_locale_name

def aview(request):
    locale_name = get_locale_name(request)
```

This returns the locale name negotiated by the currently active *locale negotiator* or the *default locale name* if the locale negotiator returns `None`. You can change the default locale name by changing the `pyramid.default_locale_name` setting; see *Default Locale Name*.

Once `get_locale_name()` is first run, the locale name is stored on the request object. Subsequent calls to `get_locale_name()` will return the stored locale name without invoking the *locale negotiator*. To avoid this caching, you can use the `pyramid.i18n.negotiate_locale_name()` function:

```
from pyramid.i18n import negotiate_locale_name

def aview(request):
    locale_name = negotiate_locale_name(request)
```

You can also obtain the locale name related to a request using the `locale_name` attribute of a *localizer*.

```
from pyramid.i18n import get_localizer

def aview(request):
    localizer = get_localizer(request)
    locale_name = localizer.locale_name
```

Obtaining the locale name as an attribute of a localizer is equivalent to obtaining a locale name by calling the `get_locale_name()` function.

19.5 Performing Date Formatting and Currency Formatting

Pyramid does not itself perform date and currency formatting for different locales. However, *Babel* can help you do this via the `babel.core.Locale` class. The Babel documentation for this class provides minimal information about how to perform date and currency related locale operations. See *Installing Babel and Lingua* for information about how to install Babel.

The `babel.core.Locale` class requires a *locale name* as an argument to its constructor. You can use Pyramid APIs to obtain the locale name for a request to pass to the `babel.core.Locale` constructor; see *Obtaining the Locale Name for a Request*. For example:

```
from babel.core import Locale
from pyramid.i18n import get_locale_name

def aview(request):
    locale_name = get_locale_name(request)
    locale = Locale(locale_name)
```

19.6 Chameleon Template Support for Translation Strings

When a *translation string* is used as the subject of textual rendering by a *Chameleon* template renderer, it will automatically be translated to the requesting user's language if a suitable translation exists. This is true of both the ZPT and text variants of the Chameleon template renderers.

For example, in a Chameleon ZPT template, the translation string represented by "some_translation_string" in each example below will go through translation before being rendered:

```
<span tal:content="some_translation_string"/>
```

```
<span tal:replace="some_translation_string"/>
```

```
<span>${some_translation_string}</span>
```

```
<a tal:attributes="href some_translation_string">Click here</a>
```

The features represented by attributes of the `i18n` namespace of Chameleon will also consult the Pyramid translations. See http://chameleon.repoze.org/docs/latest/i18n.html#the-i18n-namespace.

Unlike when Chameleon is used outside of Pyramid, when it is used *within* Pyramid, it does not support use of the `zope.i18n` translation framework. Applications which use Pyramid should use the features documented in this chapter rather than `zope.i18n`.

Third party Pyramid template renderers might not provide this support out of the box and may need special code to do an equivalent. For those, you can always use the more manual translation facility described in *Performing a Translation*.

19.7 Mako Pyramid I18N Support

There exists a recipe within the *Pyramid Cookbook* named "Mako Internationalization" which explains how to add idiomatic I18N support to *Mako* templates.

19.8 Localization-Related Deployment Settings

A Pyramid application will have a `pyramid.default_locale_name` setting. This value represents the *default locale name* used when the *locale negotiator* returns `None`. Pass it to the `Configurator` constructor at startup time:

```
from pyramid.config import Configurator
config = Configurator(settings={'pyramid.default_locale_name':'de'})
```

You may alternately supply a `pyramid.default_locale_name` via an application's Paster `.ini` file:

```
[app:main]
use = egg:MyProject
pyramid.reload_templates = true
pyramid.debug_authorization = false
pyramid.debug_notfound = false
pyramid.default_locale_name = de
```

If this value is not supplied via the Configurator constructor or via a Paste config file, it will default to `en`.

If this setting is supplied within the Pyramid application `.ini` file, it will be available as a settings key:

```
from pyramid.threadlocal import get_current_registry
settings = get_current_registry().settings
default_locale_name = settings['pyramid.default_locale_name']
```

19.9 "Detecting" Available Languages

Other systems provide an API that returns the set of "available languages" as indicated by the union of all languages in all translation directories on disk at the time of the call to the API.

It is by design that Pyramid doesn't supply such an API. Instead, the application itself is responsible for knowing the "available languages". The rationale is this: any particular application deployment must always know which languages it should be translatable to anyway, regardless of which translation files are on disk.

Here's why: it's not a given that because translations exist in a particular language within the registered set of translation directories that this particular deployment wants to allow translation to that language. For example, some translations may exist but they may be incomplete or incorrect. Or there may be translations to a language but not for all translation domains.

Any nontrivial application deployment will always need to be able to selectively choose to allow only some languages even if that set of languages is smaller than all those detected within registered translation directories. The easiest way to allow for this is to make the application entirely responsible for knowing which languages are allowed to be translated to instead of relying on the framework to divine this information from translation directory file info.

You can set up a system to allow a deployer to select available languages based on convention by using the `pyramid.settings` mechanism:

Allow a deployer to modify your application's PasteDeploy .ini file:

```
[app:main]
use = egg:MyProject
# ...
available_languages = fr de en ru
```

Then as a part of the code of a custom *locale negotiator*:

```
from pyramid.threadlocal import get_current_registry
settings = get_current_registry().settings
languages = settings['available_languages'].split()
```

This is only a suggestion. You can create your own "available languages" configuration scheme as necessary.

19.10 Activating Translation

By default, a Pyramid application performs no translation. To turn translation on, you must:

- add at least one *translation directory* to your application.
- ensure that your application sets the *locale name* correctly.

19.10.1 Adding a Translation Directory

gettext is the underlying machinery behind the Pyramid translation machinery. A translation directory is a directory organized to be useful to *gettext*. A translation directory usually includes a listing of language directories, each of which itself includes an `LC_MESSAGES` directory. Each `LC_MESSAGES` directory should contain one or more `.mo` files. Each `.mo` file represents a *message catalog*, which is used to provide translations to your application.

Adding a *translation directory* registers all of its constituent *message catalog* files within your Pyramid application to be available to use for translation services. This includes all of the `.mo` files found within all `LC_MESSAGES` directories within each locale directory in the translation directory.

You can add a translation directory imperatively by using the `pyramid.config.Configurator.add_translation_dirs()` during application startup. For example:

```
from pyramid.config import Configurator
config.add_translation_dirs('my.application:locale/',
                            'another.application:locale/')
```

A message catalog in a translation directory added via `add_translation_dirs()` will be merged into translations from a message catalog added earlier if both translation directories contain translations for the same locale and *translation domain*.

19.10.2 Setting the Locale

When the *default locale negotiator* (see *The Default Locale Negotiator*) is in use, you can inform Pyramid of the current locale name by doing any of these things before any translations need to be performed:

- Set the `_LOCALE_` attribute of the request to a valid locale name (usually directly within view code). E.g. `request._LOCALE_ = 'de'`.

- Ensure that a valid locale name value is in the `request.params` dictionary under the key named `_LOCALE_`. This is usually the result of passing a `_LOCALE_` value in the query string or in the body of a form post associated with a request. For example, visiting `http://my.application?_LOCALE_=de`.

- Ensure that a valid locale name value is in the `request.cookies` dictionary under the key named `_LOCALE_`. This is usually the result of setting a `_LOCALE_` cookie in a prior response, e.g. `response.set_cookie('_LOCALE_', 'de')`.

 If this locale negotiation scheme is inappropriate for a particular application, you can configure a custom *locale negotiator* function into that application as required. See *Using a Custom Locale Negotiator*.

19.11 Locale Negotiators

A *locale negotiator* informs the operation of a *localizer* by telling it what *locale name* is related to a particular request. A locale negotiator is a bit of code which accepts a request and which returns a *locale name*. It is consulted when `pyramid.i18n.Localizer.translate()` or `pyramid.i18n.Localizer.pluralize()` is invoked. It is also consulted when `get_locale_name()` or `negotiate_locale_name()` is invoked.

19.11.1 The Default Locale Negotiator

Most applications can make use of the default locale negotiator, which requires no additional coding or configuration.

The default locale negotiator implementation named `default_locale_negotiator` uses the following set of steps to dermine the locale name.

- First, the negotiator looks for the `_LOCALE_` attribute of the request object (possibly set directly by view code or by a listener for an *event*).
- Then it looks for the `request.params['_LOCALE_']` value.
- Then it looks for the `request.cookies['_LOCALE_']` value.
- If no locale can be found via the request, it falls back to using the *default locale name* (see *Localization-Related Deployment Settings*).
- Finally, if the default locale name is not explicitly set, it uses the locale name `en`.

19.11.2 Using a Custom Locale Negotiator

Locale negotiation is sometimes policy-laden and complex. If the (simple) default locale negotiation scheme described in *Activating Translation* is inappropriate for your application, you may create and a special *locale negotiator*. Subsequently you may override the default locale negotiator by adding your newly created locale negotiator to your application's configuration.

A locale negotiator is simply a callable which accepts a request and returns a single *locale name* or `None` if no locale can be determined.

Here's an implementation of a simple locale negotiator:

```
def my_locale_negotiator(request):
    locale_name = request.params.get('my_locale')
    return locale_name
```

If a locale negotiator returns `None`, it signifies to Pyramid that the default application locale name should be used.

You may add your newly created locale negotiator to your application's configuration by passing an object which can act as the negotiator (or a *dotted Python name* referring to the object) as the `locale_negotiator` argument of the `Configurator` instance during application startup. For example:

```
from pyramid.config import Configurator
config = Configurator(locale_negotiator=my_locale_negotiator)
```

Alternately, use the `pyramid.config.Configurator.set_locale_negotiator()` method.

For example:

```
from pyramid.config import Configurator
config = Configurator()
config.set_locale_negotiator(my_locale_negotiator)
```

CHAPTER 20

Virtual Hosting

"Virtual hosting" is, loosely, the act of serving a Pyramid application or a portion of a Pyramid application under a URL space that it does not "naturally" inhabit.

Pyramid provides facilities for serving an application under a URL "prefix", as well as serving a *portion* of a *traversal* based application under a root URL.

20.1 Hosting an Application Under a URL Prefix

Pyramid supports a common form of virtual hosting whereby you can host a Pyramid application as a "subset" of some other site (e.g. under `http://example.com/mypyramidapplication/` as opposed to under `http://example.com/`).

If you use a "pure Python" environment, this functionality is provided by Paste's urlmap "composite" WSGI application. Alternately, you can use *mod_wsgi* to serve your application, which handles this virtual hosting translation for you "under the hood".

If you use the `urlmap` composite application "in front" of a Pyramid application or if you use *mod_wsgi* to serve up a Pyramid application, nothing special needs to be done within the application for URLs to be generated that contain a prefix. `paste.urlmap` and *mod_wsgi* manipulate the *WSGI* environment in such a way that the `PATH_INFO` and `SCRIPT_NAME` variables are correct for some given prefix.

Here's an example of a PasteDeploy configuration snippet that includes a `urlmap` composite.

```
[app:mypyramidapp]
use = egg:mypyramidapp

[composite:main]
use = egg:Paste#urlmap
/pyramidapp = mypyramidapp
```

This "roots" the Pyramid application at the prefix `/pyramidapp` and serves up the composite as the "main" application in the file.

 If you're using an Apache server to proxy to a Paste `urlmap` composite, you may have to use the ProxyPreserveHost directive to pass the original `HTTP_HOST` header along to the application, so URLs get generated properly. As of this writing the `urlmap` composite does not seem to respect the `HTTP_X_FORWARDED_HOST` parameter, which will contain the original host header even if `HTTP_HOST` is incorrect.

If you use *mod_wsgi*, you do not need to use a `composite` application in your `.ini` file. The `WSGIScriptAlias` configuration setting in a *mod_wsgi* configuration does the work for you:

```
WSGIScriptAlias /pyramidapp /Users/chrism/projects/modwsgi/env/pyramid.wsgi
```

In the above configuration, we root a Pyramid application at `/pyramidapp` within the Apache configuration.

20.2 Virtual Root Support

Pyramid also supports "virtual roots", which can be used in *traversal* -based (but not *URL dispatch* -based) applications.

Virtual root support is useful when you'd like to host some resource in a Pyramid resource tree as an application under a URL pathname that does not include the resource path itself. For example, you might want to serve the object at the traversal path `/cms` as an application reachable via `http://example.com/` (as opposed to `http://example.com/cms`).

To specify a virtual root, cause an environment variable to be inserted into the WSGI environ named `HTTP_X_VHM_ROOT` with a value that is the absolute pathname to the resource object in the resource tree that should behave as the "root" resource. As a result, the traversal machinery will respect this value during traversal (prepending it to the PATH_INFO before traversal starts), and the

`pyramid.request.Request.resource_url()` API will generate the "correct" virtually-rooted URLs.

An example of an Apache `mod_proxy` configuration that will host the `/cms` subobject as `http://www.example.com/` using this facility is below:

```
NameVirtualHost *:80

<VirtualHost *:80>
  ServerName www.example.com
  RewriteEngine On
  RewriteRule ^/(.*) http://127.0.0.1:6543/$1 [L,P]
  ProxyPreserveHost on
  RequestHeader add X-Vhm-Root /cms
</VirtualHost>
```

 Use of the `RequestHeader` directive requires that the Apache mod_headers module be available in the Apache environment you're using.

For a Pyramid application running under *mod_wsgi*, the same can be achieved using `SetEnv`:

```
<Location />
  SetEnv HTTP_X_VHM_ROOT /cms
</Location>
```

Setting a virtual root has no effect when using an application based on *URL dispatch*.

20.3 Further Documentation and Examples

The API documentation in *pyramid.traversal* documents a `pyramid.traversal.virtual_root()` API. When called, it returns the virtual root object (or the physical root object if no virtual root has been specified).

Running a Pyramid Application under mod_wsgi has detailed information about using *mod_wsgi* to serve Pyramid applications.

CHAPTER 21

Unit, Integration, and Functional Testing

Unit testing is, not surprisingly, the act of testing a "unit" in your application. In this context, a "unit" is often a function or a method of a class instance. The unit is also referred to as a "unit under test".

The goal of a single unit test is to test **only** some permutation of the "unit under test". If you write a unit test that aims to verify the result of a particular codepath through a Python function, you need only be concerned about testing the code that *lives in the function body itself*. If the function accepts a parameter that represents a complex application "domain object" (such as a resource, a database connection, or an SMTP server), the argument provided to this function during a unit test *need not be* and likely *should not be* a "real" implementation object. For example, although a particular function implementation may accept an argument that represents an SMTP server object, and the function may call a method of this object when the system is operating normally that would result in an email being sent, a unit test of this codepath of the function does *not* need to test that an email is actually sent. It just needs to make sure that the function calls the method of the object provided as an argument that *would* send an email if the argument happened to be the "real" implementation of an SMTP server object.

An *integration test*, on the other hand, is a different form of testing in which the interaction between two or more "units" is explicitly tested. Integration tests verify that the components of your application work together. You *might* make sure that an email was actually sent in an integration test.

A *functional test* is a form of integration test in which the application is run "literally". You would *have to* make sure that an email was actually sent in a functional test, because it tests your code end to end.

It is often considered best practice to write each type of tests for any given codebase. Unit testing often provides the opportunity to obtain better "coverage": it's usually possible to supply a unit under test with arguments and/or an environment which causes *all* of its potential codepaths to be executed. This is usually not as easy to do with a set of integration or functional tests, but integration and functional testing

provides a measure of assurance that your "units" work together, as they will be expected to when your application is run in production.

The suggested mechanism for unit and integration testing of a Pyramid application is the Python `unittest` module. Although this module is named `unittest`, it is actually capable of driving both unit and integration tests. A good `unittest` tutorial is available within Dive Into Python by Mark Pilgrim.

Pyramid provides a number of facilities that make unit, integration, and functional tests easier to write. The facilities become particularly useful when your code calls into Pyramid -related framework functions.

21.1 Test Set Up and Tear Down

Pyramid uses a "global" (actually *thread local*) data structure to hold on to two items: the current *request* and the current *application registry*. These data structures are available via the `pyramid.threadlocal.get_current_request()` and `pyramid.threadlocal.get_current_registry()` functions, respectively. See *Thread Locals* for information about these functions and the data structures they return.

If your code uses these `get_current_*` functions or calls Pyramid code which uses `get_current_*` functions, you will need to call `pyramid.testing.setUp()` in your test setup and you will need to call `pyramid.testing.tearDown()` in your test teardown. `setUp()` pushes a registry onto the *thread local* stack, which makes the `get_current_*` functions work. It returns a *Configurator* object which can be used to perform extra configuration required by the code under test. `tearDown()` pops the thread local stack.

Normally when a Configurator is used directly with the `main` block of a Pyramid application, it defers performing any "real work" until its `.commit` method is called (often implicitly by the `pyramid.config.Configurator.make_wsgi_app()` method). The Configurator returned by `setUp()` is an *autocommitting* Configurator, however, which performs all actions implied by methods called on it immediately. This is more convenient for unit-testing purposes than needing to call `pyramid.config.Configurator.commit()` in each test after adding extra configuration statements.

The use of the `setUp()` and `tearDown()` functions allows you to supply each unit test method in a test case with an environment that has an isolated registry and an isolated request for the duration of a single test. Here's an example of using this feature:

```
import unittest
from pyramid import testing

class MyTest(unittest.TestCase):
    def setUp(self):
        self.config = testing.setUp()

    def tearDown(self):
        testing.tearDown()
```

The above will make sure that `get_current_registry()` called within a test case method of `MyTest` will return the *application registry* associated with the `config` Configurator instance. Each test case method attached to `MyTest` will use an isolated registry.

The `setUp()` and `tearDown()` functions accepts various arguments that influence the environment of the test. See the *pyramid.testing* chapter for information about the extra arguments supported by these functions.

If you also want to make `get_current_request()` return something other than `None` during the course of a single test, you can pass a *request* object into the `pyramid.testing.setUp()` within the `setUp` method of your test:

```
import unittest
from pyramid import testing

class MyTest(unittest.TestCase):
    def setUp(self):
        request = testing.DummyRequest()
        self.config = testing.setUp(request=request)

    def tearDown(self):
        testing.tearDown()
```

If you pass a *request* object into `pyramid.testing.setUp()` within your test case's `setUp`, any test method attached to the `MyTest` test case that directly or indirectly calls `get_current_request()` will receive the request object. Otherwise, during testing, `get_current_request()` will return `None`. We use a "dummy" request implementation supplied by `pyramid.testing.DummyRequest` because it's easier to construct than a "real" Pyramid request object.

21.1.1 What?

Thread local data structures are always a bit confusing, especially when they're used by frameworks. Sorry. So here's a rule of thumb: if you don't *know* whether you're calling code that uses the `get_current_registry()` or `get_current_request()` functions, or you don't care about any of this, but you still want to write test code, just always call `pyramid.testing.setUp()` in your test's `setUp` method and `pyramid.testing.tearDown()` in your tests' `tearDown` method. This won't really hurt anything if the application you're testing does not call any `get_current*` function.

21.2 Using the `Configurator` and `pyramid.testing` APIs in Unit Tests

The `Configurator` API and the `pyramid.testing` module provide a number of functions which can be used during unit testing. These functions make *configuration declaration* calls to the current *application registry*, but typically register a "stub" or "dummy" feature in place of the "real" feature that the code would call if it was being run normally.

For example, let's imagine you want to unit test a Pyramid view function.

```
from pyramid.security import has_permission
from pyramid.httpexceptions import HTTPForbidden

def view_fn(request):
    if not has_permission('edit', request.context, request):
        raise HTTPForbidden
    return {'greeting':'hello'}
```

Without doing anything special during a unit test, the call to `has_permission()` in this view function will always return a `True` value. When a Pyramid application starts normally, it will populate a *application registry* using *configuration declaration* calls made against a *Configurator*. But if this application registry is not created and populated (e.g. by initializing the configurator with an authorization policy), like when you invoke application code via a unit test, Pyramid API functions will tend to either fail or return default results. So how do you test the branch of the code in this view function that raises `HTTPForbidden`?

The testing API provided by Pyramid allows you to simulate various application registry registrations for use under a unit testing framework without needing to invoke the actual application configuration implied by its `main` function. For example, if you wanted to test the above `view_fn` (assuming it lived in the package named `my.package`), you could write a `unittest.TestCase` that used the testing API.

```
import unittest
from pyramid import testing

class MyTest(unittest.TestCase):
    def setUp(self):
        self.config = testing.setUp()

    def tearDown(self):
        testing.tearDown()

    def test_view_fn_forbidden(self):
        from pyramid.httpexceptions import HTTPForbidden
        from my.package import view_fn
        self.config.testing_securitypolicy(userid='hank',
                                           permissive=False)
        request = testing.DummyRequest()
        request.context = testing.DummyResource()
        self.assertRaises(HTTPForbidden, view_fn, request)

    def test_view_fn_allowed(self):
        from my.package import view_fn
        self.config.testing_securitypolicy(userid='hank',
                                           permissive=True)
        request = testing.DummyRequest()
        request.context = testing.DummyResource()
        response = view_fn(request)
        self.assertEqual(response, {'greeting':'hello'})
```

In the above example, we create a `MyTest` test case that inherits from `unittest.TestCase`. If it's in our Pyramid application, it will be found when `setup.py test` is run. It has two test methods.

The first test method, `test_view_fn_forbidden` tests the `view_fn` when the authentication policy forbids the current user the `edit` permission. Its third line registers a "dummy" "non-permissive" authorization policy using the `testing_securitypolicy()` method, which is a special helper method for unit testing.

We then create a `pyramid.testing.DummyRequest` object which simulates a WebOb request object API. A `pyramid.testing.DummyRequest` is a request object that requires less setup than a "real" Pyramid request. We call the function being tested with the manufactured request. When the function is called, `pyramid.security.has_permission()` will call the "dummy" authentication policy we've registered through `testing_securitypolicy()`, which denies access. We check that the view function raises a `HTTPForbidden` error.

The second test method, named `test_view_fn_allowed` tests the alternate case, where the authentication policy allows access. Notice that we pass different values to `testing_securitypolicy()` to obtain this result. We assert at the end of this that the view function returns a value.

Note that the test calls the `pyramid.testing.setUp()` function in its `setUp` method and the `pyramid.testing.tearDown()` function in its `tearDown` method. We assign the result of `pyramid.testing.setUp()` as `config` on the unittest class. This is a *Configurator* object and all methods of the configurator can be called as necessary within tests. If you use any of the `Configurator` APIs during testing, be sure to use this pattern in your test case's `setUp` and `tearDown`; these methods make sure you're using a "fresh" *application registry* per test run.

See the *pyramid.testing* chapter for the entire Pyramid -specific testing API. This chapter describes APIs for registering a security policy, registering resources at paths, registering event listeners, registering views and view permissions, and classes representing "dummy" implementations of a request and a resource.

See also the various methods of the *Configurator* documented in *pyramid.config* that begin with the `testing_` prefix.

21.3 Creating Integration Tests

In Pyramid, a *unit test* typically relies on "mock" or "dummy" implementations to give the code under test only enough context to run.

"Integration testing" implies another sort of testing. In the context of a Pyramid, integration test, the test logic tests the functionality of some code *and* its integration with the rest of the Pyramid framework.

In Pyramid applications that are plugins to Pyramid, you can create an integration test by including it's `includeme` function via `pyramid.config.Configurator.include()` in the test's setup code. This causes the entire Pyramid environment to be set up and torn down as if your application was running "for real". This is a heavy-hammer way of making sure that your tests have enough context to run properly, and it tests your code's integration with the rest of Pyramid.

Let's demonstrate this by showing an integration test for a view. The below test assumes that your application's package name is `myapp`, and that there is a `views` module in the app with a function with the name `my_view` in it that returns the response 'Welcome to this application' after accessing some values that require a fully set up environment.

```
import unittest

from pyramid import testing

class ViewIntegrationTests(unittest.TestCase):
    def setUp(self):
        """ This sets up the application registry with the
        registrations your application declares in its ``includeme``
```

```
        function.
        """
        import myapp
        self.config = testing.setUp()
        self.config.include('myapp')

    def tearDown(self):
        """ Clear out the application registry """
        testing.tearDown()

    def test_my_view(self):
        from myapp.views import my_view
        request = testing.DummyRequest()
        result = my_view(request)
        self.assertEqual(result.status, '200 OK')
        body = result.app_iter[0]
        self.failUnless('Welcome to' in body)
        self.assertEqual(len(result.headerlist), 2)
        self.assertEqual(result.headerlist[0],
                         ('Content-Type', 'text/html; charset=UTF-8'))
        self.assertEqual(result.headerlist[1], ('Content-Length',
                                                str(len(body))))
```

Unless you cannot avoid it, you should prefer writing unit tests that use the `Configurator` API to set up the right "mock" registrations rather than creating an integration test. Unit tests will run faster (because they do less for each test) and the result of a unit test is usually easier to make assertions about.

21.4 Creating Functional Tests

Functional tests test your literal application.

The below test assumes that your application's package name is `myapp`, and that there is view that returns an HTML body when the root URL is invoked. It further assumes that you've added a `tests_require` dependency on the `WebTest` package within your `setup.py` file. *WebTest* is a functional testing package written by Ian Bicking.

```
import unittest

class FunctionalTests(unittest.TestCase):
    def setUp(self):
        from myapp import main
```

```
6           app = main({})
7           from webtest import TestApp
8           self.testapp = TestApp(app)
9
10      def test_root(self):
11          res = self.testapp.get('/', status=200)
12          self.failUnless('Pyramid' in res.body)
```

When this test is run, each test creates a "real" WSGI application using the `main` function in your `myapp.__init__` module and uses *WebTest* to wrap that WSGI application. It assigns the result to `self.testapp`. In the test named `test_root`, we use the testapp's `get` method to invoke the root URL. We then assert that the returned HTML has the string `Pyramid` in it.

See the *WebTest* documentation for further information about the methods available to a `webtest.TestApp` instance.

CHAPTER 22

Resources

A *resource* is an object that represents a "place" in a tree related to your application. Every Pyramid application has at least one resource object: the *root* resource. Even if you don't define a root resource manually, a default one is created for you. The root resource is the root of a *resource tree*. A resource tree is a set of nested dictionary-like objects which you can use to represent your website's structure.

In an application which uses *traversal* to map URLs to code, the resource tree structure is used heavily to map each URL to a *view callable*. When *traversal* is used, Pyramid will walk through the resource tree by traversing through its nested dictionary structure in order to find a *context* resource. Once a context resource is found, the context resource and data in the request will be used to find a *view callable*.

In an application which uses *URL dispatch*, the resource tree is only used indirectly, and is often "invisible" to the developer. In URL dispatch applications, the resource "tree" is often composed of only the root resource by itself. This root resource sometimes has security declarations attached to it, but is not required to have any. In general, the resource tree is much less important in applications that use URL dispatch than applications that use traversal.

In "Zope-like" Pyramid applications, resource objects also often store data persistently, and offer methods related to mutating that persistent data. In these kinds of applications, resources not only represent the site structure of your website, but they become the *domain model* of the application.

Also:

- The `context` and `containment` predicate arguments to `add_view()` (or a `view_config()` decorator) reference a resource class or resource *interface*.
- A *root factory* returns a resource.
- A resource is exposed to *view* code as the *context* of a view.
- Various helpful Pyramid API methods expect a resource as an argument (e.g. `resource_url()` and others).

22.1 Defining a Resource Tree

When *traversal* is used (as opposed to a purely *url dispatch* based application), Pyramid expects to be able to traverse a tree composed of resources (the *resource tree*). Traversal begins at a root resource, and descends into the tree recursively, trying each resource's `__getitem__` method to resolve a path segment to another resource object. Pyramid imposes the following policy on resource instances in the tree:

- A container resource (a resource which contains other resources) must supply a `__getitem__` method which is willing to resolve a unicode name to a sub-resource. If a sub-resource by a particular name does not exist in a container resource, `__getitem__` method of the container resource must raise a `KeyError`. If a sub-resource by that name *does* exist, the container's `__getitem__` should return the sub-resource.

- Leaf resources, which do not contain other resources, must not implement a `__getitem__`, or if they do, their `__getitem__` method must always raise a `KeyError`.

See *Traversal* for more information about how traversal works against resource instances.

Here's a sample resource tree, represented by a variable named `root`:

```
class Resource(dict):
    pass

root = Resource({'a':Resource({'b':Resource({'c':Resource()})})})
```

The resource tree we've created above is represented by a dictionary-like root object which has a single child named `'a'`. `'a'` has a single child named `'b'`, and `'b'` has a single child named `'c'`, which has no children. It is therefore possible to access the `'c'` leaf resource like so:

```
root['a']['b']['c']
```

If you returned the above `root` object from a *root factory*, the path `/a/b/c` would find the `'c'` object in the resource tree as the result of *traversal*.

In this example, each of the resources in the tree is of the same class. This is not a requirement. Resource elements in the tree can be of any type. We used a single class to represent all resources in the tree for the sake of simplicity, but in a "real" app, the resources in the tree can be arbitrary.

Although the example tree above can service a traversal, the resource instances in the above example are not aware of *location*, so their utility in a "real" application is limited. To make best use of built-in Pyramid API facilities, your resources should be "location-aware". The next section details how to make resources location-aware.

22.2 Location-Aware Resources

In order for certain Pyramid location, security, URL-generation, and traversal APIs to work properly against the resources in a resource tree, all resources in the tree must be *location* -aware. This means they must have two attributes: `__parent__` and `__name__`.

The `__parent__` attribute of a location-aware resource should be a reference to the resource's parent resource instance in the tree. The `__name__` attribute should be the name with which a resource's parent refers to the resource via `__getitem__`.

The `__parent__` of the root resource should be `None` and its `__name__` should be the empty string. For instance:

```
class MyRootResource(object):
    __name__ = ''
    __parent__ = None
```

A resource returned from the root resource's `__getitem__` method should have a `__parent__` attribute that is a reference to the root resource, and its `__name__` attribute should match the name by which it is reachable via the root resource's `__getitem__`. A container resource within the root resource should have a `__getitem__` that returns resources with a `__parent__` attribute that points at the container, and these subobjects should have a `__name__` attribute that matches the name by which they are retrieved from the container via `__getitem__`. This pattern continues recursively "up" the tree from the root.

The `__parent__` attributes of each resource form a linked list that points "downwards" toward the root. This is analogous to the `..` entry in filesystem directories. If you follow the `__parent__` values from any resource in the resource tree, you will eventually come to the root resource, just like if you keep executing the `cd ..` filesystem command, eventually you will reach the filesystem root directory.

If your root resource has a `__name__` argument that is not `None` or the empty string, URLs returned by the `resource_url()` function and paths generated by the `resource_path()` and `resource_path_tuple()` APIs will be generated improperly. The value of `__name__` will be prepended to every path and URL generated (as opposed to a single leading slash or empty tuple element).

Using `pyramid_traversalwrapper`

If you'd rather not manage the `__name__` and `__parent__` attributes of your resources "by hand", an add-on package named `pyramid_traversalwrapper` can help.
In order to use this helper feature, you must first install the `pyramid_traversalwrapper` package (available via PyPI), then register its `ModelGraphTraverser` as the traversal policy, rather than the default Pyramid traverser. The package contains instructions for doing so.
Once Pyramid is configured with this feature, you will no longer need to manage the `__parent__` and `__name__` attributes on resource objects "by hand". Instead, as necessary, during traversal Pyramid will wrap each resource (even the root resource) in a `LocationProxy` which will dynamically assign a `__name__` and a `__parent__` to the traversed resource (based on the last traversed resource and the name supplied to `__getitem__`). The root resource will have a `__name__` attribute of `None` and a `__parent__` attribute of `None`.

Applications which use tree-walking Pyramid APIs require location-aware resources. These APIs include (but are not limited to) `resource_url()`, `find_resource()`, `find_root()`, `find_interface()`, `resource_path()`, `resource_path_tuple()`, or `traverse()`, `virtual_root()`, and (usually) `has_permission()` and `principals_allowed_by_permission()`.

In general, since so much Pyramid infrastructure depends on location-aware resources, it's a good idea to make each resource in your tree location-aware.

22.3 Generating The URL Of A Resource

If your resources are *location* aware, you can use the `pyramid.request.Request.resource_url()` API to generate a URL for the resource. This URL will use the resource's position in the parent tree to create a resource path, and it will prefix the path with the current application URL to form a fully-qualified URL with the scheme, host, port, and path. You can also pass extra arguments to `resource_url()` to influence the generated URL.

The simplest call to `resource_url()` looks like this:

```
1 url = request.resource_url(resource)
```

The `request` in the above example is an instance of a Pyramid *request* object.

If the resource referred to as `resource` in the above example was the root resource, and the host that was used to contact the server was `example.com`, the URL generated would be

`http://example.com/`. However, if the resource was a child of the root resource named `a`, the generated URL would be `http://example.com/a/`.

A slash is appended to all resource URLs when `resource_url()` is used to generate them in this simple manner, because resources are "places" in the hierarchy, and URLs are meant to be clicked on to be visited. Relative URLs that you include on HTML pages rendered as the result of the default view of a resource are more apt to be relative to these resources than relative to their parent.

You can also pass extra elements to `resource_url()`:

```
url = request.resource_url(resource, 'foo', 'bar')
```

If the resource referred to as `resource` in the above example was the root resource, and the host that was used to contact the server was `example.com`, the URL generated would be `http://example.com/foo/bar`. Any number of extra elements can be passed to `resource_url()` as extra positional arguments. When extra elements are passed, they are appended to the resource's URL. A slash is not appended to the final segment when elements are passed.

You can also pass a query string:

```
url = request.resource_url(resource, query={'a':'1'})
```

If the resource referred to as `resource` in the above example was the root resource, and the host that was used to contact the server was `example.com`, the URL generated would be `http://example.com/?a=1`.

When a *virtual root* is active, the URL generated by `resource_url()` for a resource may be "shorter" than its physical tree path. See *Virtual Root Support* for more information about virtually rooting a resource.

For more information about generating resource URLs, see the documentation for `pyramid.request.Request.resource_url()`.

22.3.1 Overriding Resource URL Generation

If a resource object implements a `__resource_url__` method, this method will be called when `resource_url()` is called to generate a URL for the resource, overriding the default URL returned for the resource by `resource_url()`.

The `__resource_url__` hook is passed two arguments: `request` and `info`. `request` is the *request* object passed to `resource_url()`. `info` is a dictionary with two keys:

physical_path The "physical path" computed for the resource, as defined by `pyramid.traversal.resource_path(resource)`.

virtual_path The "virtual path" computed for the resource, as defined by *Virtual Root Support*. This will be identical to the physical path if virtual rooting is not enabled.

The `__resource_url__` method of a resource should return a string representing a URL. If it cannot override the default, it should return `None`. If it returns `None`, the default URL will be returned.

Here's an example `__resource_url__` method.

```
class Resource(object):
    def __resource_url__(self, request, info):
        return request.application_url + info['virtual_path']
```

The above example actually just generates and returns the default URL, which would have been what was returned anyway, but your code can perform arbitrary logic as necessary. For example, your code may wish to override the hostname or port number of the generated URL.

Note that the URL generated by `__resource_url__` should be fully qualified, should end in a slash, and should not contain any query string or anchor elements (only path elements) to work best with `resource_url()`.

22.4 Generating the Path To a Resource

`pyramid.traversal.resource_path()` returns a string object representing the absolute physical path of the resource object based on its position in the resource tree. Each segment of the path is separated with a slash character.

```
from pyramid.traversal import resource_path
url = resource_path(resource)
```

If `resource` in the example above was accessible in the tree as `root['a']['b']`, the above example would generate the string `/a/b`.

Any positional arguments passed in to `resource_path()` will be appended as path segments to the end of the resource path.

```
from pyramid.traversal import resource_path
url = resource_path(resource, 'foo', 'bar')
```

If `resource` in the example above was accessible in the tree as `root['a']['b']`, the above example would generate the string `/a/b/foo/bar`.

The resource passed in must be *location*-aware.

The presence or absence of a *virtual root* has no impact on the behavior of `resource_path()`.

22.5 Finding a Resource by Path

If you have a string path to a resource, you can grab the resource from that place in the application's resource tree using `pyramid.traversal.find_resource()`.

You can resolve an absolute path by passing a string prefixed with a `/` as the `path` argument:

```
from pyramid.traversal import find_resource
url = find_resource(anyresource, '/path')
```

Or you can resolve a path relative to the resource you pass in by passing a string that isn't prefixed by `/`:

```
from pyramid.traversal import find_resource
url = find_resource(anyresource, 'path')
```

Often the paths you pass to `find_resource()` are generated by the `resource_path()` API. These APIs are "mirrors" of each other.

If the path cannot be resolved when calling `find_resource()` (if the respective resource in the tree does not exist), a `KeyError` will be raised.

See the `pyramid.traversal.find_resource()` documentation for more information about resolving a path to a resource.

22.6 Obtaining the Lineage of a Resource

`pyramid.location.lineage()` returns a generator representing the *lineage* of the *location* aware *resource* object.

The `lineage()` function returns the resource it is passed, then each parent of the resource, in order. For example, if the resource tree is composed like so:

```
class Thing(object): pass

thing1 = Thing()
thing2 = Thing()
thing2.__parent__ = thing1
```

Calling `lineage(thing2)` will return a generator. When we turn it into a list, we will get:

```
list(lineage(thing2))
[ <Thing object at thing2>, <Thing object at thing1> ]
```

The generator returned by `lineage()` first returns the resource it was passed unconditionally. Then, if the resource supplied a `__parent__` attribute, it returns the resource represented by `resource.__parent__`. If *that* resource has a `__parent__` attribute, return that resource's parent, and so on, until the resource being inspected either has no `__parent__` attribute or has a `__parent__` attribute of `None`.

See the documentation for `pyramid.location.lineage()` for more information.

22.7 Determining if a Resource is In The Lineage of Another Resource

Use the `pyramid.location.inside()` function to determine if one resource is in the *lineage* of another resource.

For example, if the resource tree is:

```
class Thing(object): pass

a = Thing()
b = Thing()
b.__parent__ = a
```

Calling `inside(b, a)` will return `True`, because `b` has a lineage that includes `a`. However, calling `inside(a, b)` will return `False` because `a` does not have a lineage that includes `b`.

The argument list for `inside()` is `(resource1, resource2)`. `resource1` is 'inside' `resource2` if `resource2` is a *lineage* ancestor of `resource1`. It is a lineage ancestor if its parent (or one of its parent's parents, etc.) is an ancestor.

See `pyramid.location.inside()` for more information.

22.8 Finding the Root Resource

Use the `pyramid.traversal.find_root()` API to find the *root* resource. The root resource is the root resource of the *resource tree*. The API accepts a single argument: `resource`. This is a resource that is *location* aware. It can be any resource in the tree for which you want to find the root.

For example, if the resource tree is:

```
class Thing(object): pass

a = Thing()
b = Thing()
b.__parent__ = a
```

Calling `find_root(b)` will return `a`.

The root resource is also available as `request.root` within *view callable* code.

The presence or absence of a *virtual root* has no impact on the behavior of `find_root()`. The root object returned is always the *physical* root object.

22.9 Resources Which Implement Interfaces

Resources can optionally be made to implement an *interface*. An interface is used to tag a resource object with a "type" that can later be referred to within *view configuration* and by `pyramid.traversal.find_interface()`.

Specifying an interface instead of a class as the `context` or `containment` predicate arguments within *view configuration* statements makes it possible to use a single view callable for more than one class of resource object. If your application is simple enough that you see no reason to want to do this, you can skip reading this section of the chapter.

For example, here's some code which describes a blog entry which also declares that the blog entry implements an *interface*.

```
import datetime
from zope.interface import implements
from zope.interface import Interface

class IBlogEntry(Interface):
    pass

class BlogEntry(object):
    implements(IBlogEntry)
    def __init__(self, title, body, author):
        self.title = title
        self.body = body
        self.author = author
        self.created = datetime.datetime.now()
```

This resource consists of two things: the class which defines the resource constructor as the class `BlogEntry`, and an *interface* attached to the class via an `implements` statement at class scope using the `IBlogEntry` interface as its sole argument.

The interface object used must be an instance of a class that inherits from `zope.interface.Interface`.

A resource class may implement zero or more interfaces. You specify that a resource implements an interface by using the `zope.interface.implements()` function at class scope. The above `BlogEntry` resource implements the `IBlogEntry` interface.

You can also specify that a particular resource *instance* provides an interface, as opposed to its class. When you declare that a class implements an interface, all instances of that class will also provide that interface. However, you can also just say that a single object provides the interface. To do so, use the `zope.interface.directlyProvides()` function:

```
import datetime
from zope.interface import directlyProvides
from zope.interface import Interface

class IBlogEntry(Interface):
    pass

class BlogEntry(object):
    def __init__(self, title, body, author):
        self.title = title
        self.body = body
        self.author = author
        self.created = datetime.datetime.now()
```

```
14
15 entry = BlogEntry('title', 'body', 'author')
16 directlyProvides(entry, IBlogEntry)
```

`zope.interface.directlyProvides()` will replace any existing interface that was previously provided by an instance. If a resource object already has instance-level interface declarations that you don't want to replace, use the `zope.interface.alsoProvides()` function:

```
1  import datetime
2  from zope.interface import alsoProvides
3  from zope.interface import directlyProvides
4  from zope.interface import Interface
5
6  class IBlogEntry1(Interface):
7      pass
8
9  class IBlogEntry2(Interface):
10     pass
11
12 class BlogEntry(object):
13     def __init__(self, title, body, author):
14         self.title = title
15         self.body = body
16         self.author = author
17         self.created = datetime.datetime.now()
18
19 entry = BlogEntry('title', 'body', 'author')
20 directlyProvides(entry, IBlogEntry1)
21 alsoProvides(entry, IBlogEntry2)
```

`zope.interface.alsoProvides()` will augment the set of interfaces directly provided by an instance instead of overwriting them like `zope.interface.directlyProvides()` does.

For more information about how resource interfaces can be used by view configuration, see *Using Resource Interfaces In View Configuration*.

22.10 Finding a Resource With a Class or Interface in Lineage

Use the `find_interface()` API to locate a parent that is of a particular Python class, or which implements some *interface*.

For example, if your resource tree is composed as follows:

```
class Thing1(object): pass
class Thing2(object): pass

a = Thing1()
b = Thing2()
b.__parent__ = a
```

Calling `find_interface(a, Thing1)` will return the `a` resource because `a` is of class `Thing1` (the resource passed as the first argument is considered first, and is returned if the class or interface spec matches).

Calling `find_interface(b, Thing1)` will return the `a` resource because `a` is of class `Thing1` and `a` is the first resource in `b`'s lineage of this class.

Calling `find_interface(b, Thing2)` will return the `b` resource.

The second argument to find_interface may also be a *interface* instead of a class. If it is an interface, each resource in the lineage is checked to see if the resource implements the specificed interface (instead of seeing if the resource is of a class). See also *Resources Which Implement Interfaces*.

22.11 Pyramid API Functions That Act Against Resources

A resource object is used as the *context* provided to a view. See *Traversal* and *URL Dispatch* for more information about how a resource object becomes the context.

The APIs provided by *pyramid.traversal* are used against resource objects. These functions can be used to find the "path" of a resource, the root resource in a resource tree, or to generate a URL for a resource.

The APIs provided by *pyramid.location* are used against resources. These can be used to walk down a resource tree, or conveniently locate one resource "inside" another.

Some APIs in *pyramid.security* accept a resource object as a parameter. For example, the `has_permission()` API accepts a resource object as one of its arguments; the ACL is obtained from this resource or one of its ancestors. Other APIs in the `pyramid.security` module also accept *context* as an argument, and a context is always a resource.

CHAPTER 23

Much Ado About Traversal

 This chapter was adapted, with permission, from a blog post by Rob Miller, originally published at http://blog.nonsequitarian.org/2010/much-ado-about-traversal/ .

Traversal is an alternative to *URL dispatch* which allows Pyramid applications to map URLs to code.

 Ex-Zope users whom are already familiar with traversal and view lookup conceptually may want to skip directly to the *Traversal* chapter, which discusses technical details. This chapter is mostly aimed at people who have previous *Pylons* experience or experience in another framework which does not provide traversal, and need an introduction to the "why" of traversal.

Some folks who have been using Pylons and its Routes-based URL matching for a long time are being exposed for the first time, via Pyramid, to new ideas such as "*traversal*" and "*view lookup*" as a way to route incoming HTTP requests to callable code. Some of the same folks believe that traversal is hard to understand. Others question its usefulness; URL matching has worked for them so far, why should they even consider dealing with another approach, one which doesn't fit their brain and which doesn't provide any immediately obvious value?

You can be assured that if you don't want to understand traversal, you don't have to. You can happily build Pyramid applications with only *URL dispatch*. However, there are some straightforward, real-world use cases that are much more easily served by a traversal-based approach than by a pattern-matching mechanism. Even if you haven't yet hit one of these use cases yourself, understanding these new ideas is worth the effort for any web developer so you know when you might want to use them. *Traversal* is actually a straightforward metaphor easily comprehended by anyone who's ever used a run-of-the-mill file system with folders and files.

23.1 URL Dispatch

Let's step back and consider the problem we're trying to solve. An HTTP request for a particular path has been routed to our web application. The requested path will possibly invoke a specific *view callable* function defined somewhere in our app. We're trying to determine *which* callable function, if any, should be invoked for a given requested URL.

Many systems, including Pyramid, offer a simple solution. They offer the concept of "URL matching". URL matching approaches this problem by parsing the URL path and comparing the results to a set of registered "patterns", defined by a set of regular expressions, or some other URL path templating syntax. Each pattern is mapped to a callable function somewhere; if the request path matches a specific pattern, the associated function is called. If the request path matches more than one pattern, some conflict resolution scheme is used, usually a simple order precedence so that the first match will take priority over any subsequent matches. If a request path doesn't match any of the defined patterns, a "404 Not Found" response is returned.

In Pyramid, we offer an implementation of URL matching which we call *URL dispatch*. Using Pyramid syntax, we might have a match pattern such as `/{userid}/photos/{photoid}`, mapped to a `photo_view()` function defined somewhere in our code. Then a request for a path such as `/joeschmoe/photos/photo1` would be a match, and the `photo_view()` function would be invoked to handle the request. Similarly, `/{userid}/blog/{year}/{month}/{postid}` might map to a `blog_post_view()` function, so `/joeschmoe/blog/2010/12/urlmatching` would trigger the function, which presumably would know how to find and render the `urlmatching` blog post.

23.2 Historical Refresher

Now that we've refreshed our understanding of *URL dispatch*, we'll dig in to the idea of traversal. Before we do, though, let's take a trip down memory lane. If you've been doing web work for a while, you may remember a time when we didn't have fancy web frameworks like *Pylons* and Pyramid. Instead, we had general purpose HTTP servers that primarily served files off of a file system. The "root" of a given site mapped to a particular folder somewhere on the file system. Each segment of the request URL path represented a subdirectory. The final path segment would be either a directory or a file, and once the server found the right file it would package it up in an HTTP response and send it back to the client. So serving up a request for `/joeschmoe/photos/photo1` literally meant that there was a `joeschmoe` folder somewhere, which contained a `photos` folder, which in turn contained a `photo1` file. If at any point along the way we find that there is not a folder or file matching the requested path, we return a 404 response.

As the web grew more dynamic, however, a little bit of extra complexity was added. Technologies such as CGI and HTTP server modules were developed. Files were still looked up on the file system, but if the

file ended with (for example) `.cgi` or `.php`, or if it lived in a special folder, instead of simply sending the file to the client the server would read the file, execute it using an interpreter of some sort, and then send the output from this process to the client as the final result. The server configuration specified which files would trigger some dynamic code, with the default case being to just serve the static file.

23.3 Traversal (aka Resource Location)

Believe it or not, if you understand how serving files from a file system works, you understand traversal. And if you understand that a server might do something different based on what type of file a given request specifies, then you understand view lookup.

The major difference between file system lookup and traversal is that a file system lookup steps through nested directories and files in a file system tree, while traversal steps through nested dictionary-type objects in a *resource tree*. Let's take a detailed look at one of our example paths, so we can see what I mean:

The path `/joeschmoe/photos/photo1`, has four segments: `/`, `joeschmoe`, `photos` and `photo1`. With file system lookup we might have a root folder (`/`) containing a nested folder (`joeschmoe`), which contains another nested folder (`photos`), which finally contains a JPG file (`photo1`). With traversal, we instead have a dictionary-like root object. Asking for the `joeschmoe` key gives us another dictionary-like object. Asking this in turn for the `photos` key gives us yet another mapping object, which finally (hopefully) contains the resource that we're looking for within its values, referenced by the `photo1` key.

In pure Python terms, then, the traversal or "resource location" portion of satisfying the `/joeschmoe/photos/photo1` request will look something like this pseudocode:

```
get_root()['joeschmoe']['photos']['photo1']
```

`get_root()` is some function that returns a root traversal *resource*. If all of the specified keys exist, then the returned object will be the resource that is being requested, analogous to the JPG file that was retrieved in the file system example. If a `KeyError` is generated anywhere along the way, Pyramid will return 404. (This isn't precisely true, as you'll see when we learn about view lookup below, but the basic idea holds.)

23.4 What Is a "Resource"?

"Files on a file system I understand", you might say. "But what are these nested dictionary things? Where do these objects, these 'resources', live? What *are* they?"

Since Pyramid is not a highly opinionated framework, it makes no restriction on how a *resource* is implemented; a developer can implement them as he wishes. One common pattern used is to persist all of the resources, including the root, in a database as a graph. The root object is a dictionary-like object. Dictionary-like objects in Python supply a `__getitem__` method which is called when key lookup is done. Under the hood, when `adict` is a dictionary-like object, Python translates `adict['a']` to `adict.__getitem__('a')`. Try doing this in a Python interpreter prompt if you don't believe us:

```
Python 2.4.6 (#2, Apr 29 2010, 00:31:48)
[GCC 4.4.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> adict = {}
>>> adict['a'] = 1
>>> adict['a']
1
>>> adict.__getitem__('a')
1
```

The dictionary-like root object stores the ids of all of its subresources as keys, and provides a `__getitem__` implementation that fetches them. So `get_root()` fetches the unique root object, while `get_root()['joeschmoe']` returns a different object, also stored in the database, which in turn has its own subresources and `__getitem__` implementation, etc. These resources might be persisted in a relational database, one of the many "NoSQL" solutions that are becoming popular these days, or anywhere else, it doesn't matter. As long as the returned objects provide the dictionary-like API (i.e. as long as they have an appropriately implemented `__getitem__` method) then traversal will work.

In fact, you don't need a "database" at all. You could use plain dictionaries, with your site's URL structure hard-coded directly in the Python source. Or you could trivially implement a set of objects with `__getitem__` methods that search for files in specific directories, and thus precisely recreate the traditional mechanism of having the URL path mapped directly to a folder structure on the file system. Traversal is in fact a superset of file system lookup.

See the chapter entitled *Resources* for a more technical overview of resources.

23.5 View Lookup

At this point we're nearly there. We've covered traversal, which is the process by which a specific resource is retrieved according to a specific URL path. But what is "view lookup"?

The need for view lookup is simple: there is more than one possible action that you might want to take after finding a *resource*. With our photo example, for instance, you might want to view the photo in a page, but you might also want to provide a way for the user to edit the photo and any associated metadata. We'll call the former the `view` view, and the latter will be the `edit` view. (Original, I know.) Pyramid has a centralized view *application registry* where named views can be associated with specific resource types. So in our example, we'll assume that we've registered `view` and `edit` views for photo objects, and that we've specified the `view` view as the default, so that `/joeschmoe/photos/photo1/view` and `/joeschmoe/photos/photo1` are equivalent. The edit view would sensibly be provided by a request for `/joeschmoe/photos/photo1/edit`.

Hopefully it's clear that the first portion of the edit view's URL path is going to resolve to the same resource as the non-edit version, specifically the resource returned by `get_root()['joeschmoe']['photos']['photo1']`. But traveral ends there; the `photo1` resource doesn't have an `edit` key. In fact, it might not even be a dictionary-like object, in which case `photo1['edit']` would be meaningless. When the Pyramid resource location has been resolved to a *leaf* resource, but the entire request path has not yet been expended, the *very next* path segment is treated as a *view name*. The registry is then checked to see if a view of the given name has been specified for a resource of the given type. If so, the view callable is invoked, with the resource passed in as the related `context` object (also available as `request.context`). If a view callable could not be found, Pyramid will return a "404 Not Found" response.

You might conceptualize a request for `/joeschmoe/photos/photo1/edit` as ultimately converted into the following piece of Pythonic pseudocode:

```
context = get_root()['joeschmoe']['photos']['photo1']
view_callable = get_view(context, 'edit')
request.context = context
view_callable(request)
```

The `get_root` and `get_view` functions don't really exist. Internally, Pyramid does something more complicated. But the example above is a reasonable approximation of the view lookup algorithm in pseudocode.

23.6 Use Cases

Why should we care about traversal? URL matching is easier to explain, and it's good enough, right?

In some cases, yes, but certainly not in all cases. So far we've had very structured URLs, where our paths have had a specific, small number of pieces, like this:

```
/{userid}/{typename}/{objectid}[/{view_name}]
```

In all of the examples thus far, we've hard coded the typename value, assuming that we'd know at development time what names were going to be used ("photos", "blog", etc.). But what if we don't know what these names will be? Or, worse yet, what if we don't know *anything* about the structure of the URLs inside a user's folder? We could be writing a CMS where we want the end user to be able to arbitrarily add content and other folders inside his folder. He might decide to nest folders dozens of layers deep. How will you construct matching patterns that could account for every possible combination of paths that might develop?

It might be possible, but it certainly won't be easy. The matching patterns are going to become complex quickly as you try to handle all of the edge cases.

With traversal, however, it's straightforward. Twenty layers of nesting would be no problem. Pyramid will happily call `__getitem__` as many times as it needs to, until it runs out of path segments or until a resource raises a `KeyError`. Each resource only needs to know how to fetch its immediate children, the traversal algorithm takes care of the rest. Also, since the structure of the resource tree can live in the database and not in the code, it's simple to let users modify the tree at runtime to set up their own personalized "directory" structures.

Another use case in which traversal shines is when there is a need to support a context-dependent security policy. One example might be a document management infrastructure for a large corporation, where members of different departments have varying access levels to the various other departments' files. Reasonably, even specific files might need to be made available to specific individuals. Traversal does well here if your resources actually represent the data objects related to your documents, because the idea of a resource authorization is baked right into the code resolution and calling process. Resource objects can store ACLs, which can be inherited and/or overridden by the subresources.

If each resource can thus generate a context-based ACL, then whenever view code is attempting to perform a sensitive action, it can check against that ACL to see whether the current user should be allowed to perform the action. In this way you achieve so called "instance based" or "row level" security which is considerably harder to model using a traditional tabular approach. Pyramid actively supports such a scheme, and in fact if you register your views with guard permissions and use an authorization policy, Pyramid can check against a resource's ACL when deciding whether or not the view itself is available to the current user.

In summary, there are entire classes of problems that are more easily served by traversal and view lookup than by *URL dispatch*. If your problems don't require it, great: stick with *URL dispatch*. But if you're using Pyramid and you ever find that you *do* need to support one of these use cases, you'll be glad you have traversal in your toolkit.

 It is even possible to mix and match *traversal* with *URL dispatch* in the same Pyramid application. See the *Combining Traversal and URL Dispatch* chapter for details.

CHAPTER 24

Traversal

A *traversal* uses the URL (Universal Resource Locator) to find a *resource* located in a *resource tree*, which is a set of nested dictionary-like objects. Traversal is done by using each segment of the path portion of the URL to navigate through the *resource tree*. You might think of this as looking up files and directories in a file system. Traversal walks down the path until it finds a published resource, analogous to a file system "directory" or "file". The resource found as the result of a traversal becomes the *context* of the *request*. Then, the *view lookup* subsystem is used to find some view code willing to "publish" this resource by generating a *response*.

Using *Traversal* to map a URL to code is optional. It is often less easy to understand than *URL dispatch*, so if you're a rank beginner, it probably makes sense to use URL dispatch to map URLs to code instead of traversal. In that case, you can skip this chapter.

24.1 Traversal Details

Traversal is dependent on information in a *request* object. Every *request* object contains URL path information in the `PATH_INFO` portion of the *WSGI* environment. The `PATH_INFO` string is the portion of a request's URL following the hostname and port number, but before any query string elements or fragment element. For example the `PATH_INFO` portion of the URL `http://example.com:8080/a/b/c?foo=1` is `/a/b/c`.

Traversal treats the `PATH_INFO` segment of a URL as a sequence of path segments. For example, the `PATH_INFO` string `/a/b/c` is converted to the sequence `['a', 'b', 'c']`.

This path sequence is then used to descend through the *resource tree*, looking up a resource for each path segment. Each lookup uses the `__getitem__` method of a resource in the tree.

For example, if the path info sequence is `['a', 'b', 'c']`:

- *Traversal* starts by acquiring the *root* resource of the application by calling the *root factory*. The *root factory* can be configured to return whatever object is appropriate as the traversal root of your application.

- Next, the first element (`'a'`) is popped from the path segment sequence and is used as a key to lookup the corresponding resource in the root. This invokes the root resource's `__getitem__` method using that value (`'a'`) as an argument.

- If the root resource "contains" a resource with key `'a'`, its `__getitem__` method will return it. The *context* temporarily becomes the "A" resource.

- The next segment (`'b'`) is popped from the path sequence, and the "A" resource's `__getitem__` is called with that value (`'b'`) as an argument; we'll presume it succeeds.

- The "A" resource's `__getitem__` returns another resource, which we'll call "B". The *context* temporarily becomes the "B" resource.

Traversal continues until the path segment sequence is exhausted or a path element cannot be resolved to a resource. In either case, the *context* resource is the last object that the traversal successfully resolved. If any resource found during traversal lacks a `__getitem__` method, or if its `__getitem__` method raises a `KeyError`, traversal ends immediately, and that resource becomes the *context*.

The results of a *traversal* also include a *view name*. If traversal ends before the path segment sequence is exhausted, the *view name* is the *next* remaining path segment element. If the *traversal* expends all of the path segments, then the *view name* is the empty string (`''`).

The combination of the context resource and the *view name* found via traversal is used later in the same request by the *view lookup* subsystem to find a *view callable*. How Pyramid performs view lookup is explained within the *View Configuration* chapter.

24.2 The Resource Tree

The resource tree is a set of nested dictionary-like resource objects that begins with a *root* resource. In order to use *traversal* to resolve URLs to code, your application must supply a *resource tree* to Pyramid.

In order to supply a root resource for an application the Pyramid *Router* is configured with a callback known as a *root factory*. The root factory is supplied by the application, at startup time, as the `root_factory` argument to the *Configurator*.

The root factory is a Python callable that accepts a *request* object, and returns the root object of the *resource tree*. A function, or class is typically used as an application's root factory. Here's an example of a simple root factory class:

```
class Root(dict):
    def __init__(self, request):
        pass
```

Here's an example of using this root factory within startup configuration, by passing it to an instance of a *Configurator* named `config`:

```
config = Configurator(root_factory=Root)
```

The `root_factory` argument to the `Configurator` constructor registers this root factory to be called to generate a root resource whenever a request enters the application. The root factory registered this way is also known as the global root factory. A root factory can alternately be passed to the `Configurator` as a *dotted Python name* which can refer to a root factory defined in a different module.

If no *root factory* is passed to the Pyramid *Configurator* constructor, or if the `root_factory` value specified is `None`, a *default* root factory is used. The default root factory always returns a resource that has no child resources; it is effectively empty.

Usually a root factory for a traversal-based application will be more complicated than the above `Root` class; in particular it may be associated with a database connection or another persistence mechanism.

Emulating the Default Root Factory

For purposes of understanding the default root factory better, we'll note that you can emulate the default root factory by using this code as an explicit root factory in your application setup:

```
class Root(object):
    def __init__(self, request):
        pass

config = Configurator(root_factory=Root)
```

The default root factory is just a really stupid object that has no behavior or state. Using *traversal* against an application that uses the resource tree supplied by the default root resource is not very interesting, because the default root resource has no children. Its availability is more useful when you're developing an application using *URL dispatch*.

 If the items contained within the resource tree are "persistent" (they have state that lasts longer than the execution of a single process), they become analogous to the concept of *domain model* objects used by many other frameworks.

The resource tree consists of *container* resources and *leaf* resources. There is only one difference between a *container* resource and a *leaf* resource: *container* resources possess a `__getitem__` method (making it "dictionary-like") while *leaf* resources do not. The `__getitem__` method was chosen as the signifying difference between the two types of resources because the presence of this method is how Python itself typically determines whether an object is "containerish" or not (dictionary objects are "containerish").

Each container resource is presumed to be willing to return a child resource or raise a `KeyError` based on a name passed to its `__getitem__`.

Leaf-level instances must not have a `__getitem__`. If instances that you'd like to be leaves already happen to have a `__getitem__` through some historical inequity, you should subclass these resource types and cause their `__getitem__` methods to simply raise a `KeyError`. Or just disuse them and think up another strategy.

Usually, the traversal root is a *container* resource, and as such it contains other resources. However, it doesn't *need* to be a container. Your resource tree can be as shallow or as deep as you require.

In general, the resource tree is traversed beginning at its root resource using a sequence of path elements described by the `PATH_INFO` of the current request; if there are path segments, the root resource's `__getitem__` is called with the next path segment, and it is expected to return another resource. The resulting resource's `__getitem__` is called with the very next path segment, and it is expected to return another resource. This happens *ad infinitum* until all path segments are exhausted.

24.3 The Traversal Algorithm

This section will attempt to explain the Pyramid traversal algorithm. We'll provide a description of the algorithm, a diagram of how the algorithm works, and some example traversal scenarios that might help you understand how the algorithm operates against a specific resource tree.

We'll also talk a bit about *view lookup*. The *View Configuration* chapter discusses *view lookup* in detail, and it is the canonical source for information about views. Technically, *view lookup* is a Pyramid subsystem that is separated from traversal entirely. However, we'll describe the fundamental behavior of view lookup in the examples in the next few sections to give you an idea of how traversal and view lookup cooperate, because they are almost always used together.

24.3.1 A Description of The Traversal Algorithm

When a user requests a page from your traversal-powered application, the system uses this algorithm to find a *context* resource and a *view name*.

1. The request for the page is presented to the Pyramid *router* in terms of a standard *WSGI* request, which is represented by a WSGI environment and a WSGI `start_response` callable.

2. The router creates a *request* object based on the WSGI environment.

3. The *root factory* is called with the *request*. It returns a *root* resource.

4. The router uses the WSGI environment's `PATH_INFO` information to determine the path segments to traverse. The leading slash is stripped off `PATH_INFO`, and the remaining path segments are split on the slash character to form a traversal sequence.

   The traversal algorithm by default attempts to first URL-unquote and then Unicode-decode each path segment derived from `PATH_INFO` from its natural byte string (`str` type) representation. URL unquoting is performed using the Python standard library `urllib.unquote` function. Conversion from a URL-decoded string into Unicode is attempted using the UTF-8 encoding. If any URL-unquoted path segment in `PATH_INFO` is not decodeable using the UTF-8 decoding, a `TypeError` is raised. A segment will be fully URL-unquoted and UTF8-decoded before it is passed in to the `__getitem__` of any resource during traversal.

   Thus, a request with a `PATH_INFO` variable of `/a/b/c` maps to the traversal sequence `[u'a', u'b', u'c']`.

5. *Traversal* begins at the root resource returned by the root factory. For the traversal sequence `[u'a', u'b', u'c']`, the root resource's `__getitem__` is called with the name `'a'`. Traversal continues through the sequence. In our example, if the root resource's `__getitem__` called with the name `a` returns a resource (aka resource "A"), that resource's `__getitem__` is called with the name `'b'`. If resource "A" returns a resource "B" when asked for `'b'`, resource B's `__getitem__` is then asked for the name `'c'`, and may return resource "C".

6. Traversal ends when a) the entire path is exhausted or b) when any resouce raises a `KeyError` from its `__getitem__` or c) when any non-final path element traversal does not have a `__getitem__` method (resulting in a `AttributeError`) or d) when any path element is prefixed with the set of characters `@@` (indicating that the characters following the `@@` token should be treated as a *view name*).

7. When traversal ends for any of the reasons in the previous step, the last resource found during traversal is deemed to be the *context*. If the path has been exhausted when traversal ends, the *view name* is deemed to be the empty string (`''`). However, if the path was *not* exhausted before traversal terminated, the first remaining path segment is treated as the view name.

8. Any subsequent path elements after the *view name* is found are deemed the *subpath*. The subpath is always a sequence of path segments that come from `PATH_INFO` that are "left over" after traversal has completed.

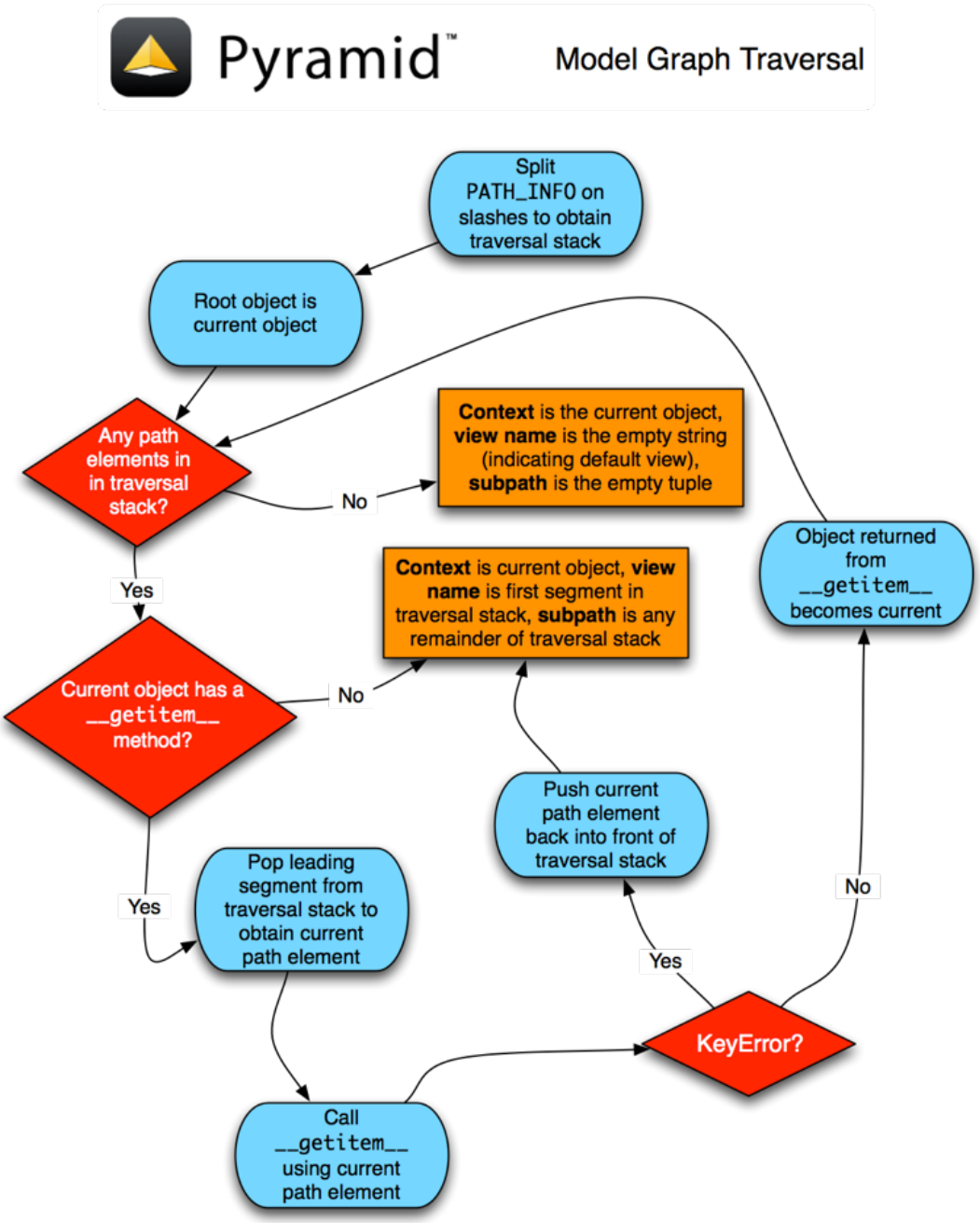
Once the *context* resource, the *view name*, and associated attributes such as the *subpath* are located, the job of *traversal* is finished. It passes back the information it obtained to its caller, the Pyramid *Router*, which subsequently invokes *view lookup* with the context and view name information.

The traversal algorithm exposes two special cases:

- You will often end up with a *view name* that is the empty string as the result of a particular traversal. This indicates that the view lookup machinery should look up the *default view*. The default view is a view that is registered with no name or a view which is registered with a name that equals the empty string.

- If any path segment element begins with the special characters `@@` (think of them as goggles), the value of that segment minus the goggle characters is considered the *view name* immediately and traversal stops there. This allows you to address views that may have the same names as resource names in the tree unambiguously.

Finally, traversal is responsible for locating a *virtual root*. A virtual root is used during "virtual hosting"; see the *Virtual Hosting* chapter for information. We won't speak more about it in this chapter.


Pyramid™
Model Graph Traversal
Split PATH_INFO on slashes to obtain traversal stack
Root object is current object
Any path elements in in traversal stack?
No
Context is the current object, view name is the empty string (indicating default view), subpath is the empty tuple
Yes
Context is current object, view name is first segment in traversal stack, subpath is any remainder of traversal stack
Object returned from __getitem__ becomes current
Current object has a __getitem__ method?
No
Push current path element back into front of traversal stack
Yes
Pop leading segment from traversal stack to obtain current path element
No
Yes
KeyError?
Call __getitem__ using current path element

24.3.2 Traversal Algorithm Examples

No one can be expected to understand the traversal algorithm by analogy and description alone, so let's examine some traversal scenarios that use concrete URLs and resource tree compositions.

Let's pretend the user asks for `http://example.com/foo/bar/baz/biz/buz.txt`. The request's `PATH_INFO` in that case is `/foo/bar/baz/biz/buz.txt`. Let's further pretend that when this request comes in that we're traversing the following resource tree:

```
/--
   |
   |-- foo
        |
        ----bar
```

Here's what happens:

- `traversal` traverses the root, and attempts to find "foo", which it finds.
- `traversal` traverses "foo", and attempts to find "bar", which it finds.
- `traversal` traverses "bar", and attempts to find "baz", which it does not find (the "bar" resource raises a `KeyError` when asked for "baz").

The fact that it does not find "baz" at this point does not signify an error condition. It signifies that:

- the *context* is the "bar" resource (the context is the last resource found during traversal).
- the *view name* is `baz`
- the *subpath* is `('biz', 'buz.txt')`

At this point, traversal has ended, and *view lookup* begins.

Because it's the "context" resource, the view lookup machinery examines "bar" to find out what "type" it is. Let's say it finds that the context is a `Bar` type (because "bar" happens to be an instance of the class `Bar`). Using the *view name* (`baz`) and the type, view lookup asks the *application registry* this question:

- Please find me a *view callable* registered using a *view configuration* with the name "baz" that can be used for the class `Bar`.

Let's say that view lookup finds no matching view type. In this circumstance, the Pyramid *router* returns the result of the *not found view* and the request ends.

However, for this tree:

```
/--
   |
   |-- foo
        |
        ----bar
             |
             ----baz
                    |
                   biz
```

The user asks for `http://example.com/foo/bar/baz/biz/buz.txt`

- `traversal` traverses "foo", and attempts to find "bar", which it finds.
- `traversal` traverses "bar", and attempts to find "baz", which it finds.
- `traversal` traverses "baz", and attempts to find "biz", which it finds.
- `traversal` traverses "biz", and attempts to find "buz.txt" which it does not find.

The fact that it does not find a resource related to "buz.txt" at this point does not signify an error condition. It signifies that:

- the *context* is the "biz" resource (the context is the last resource found during traversal).
- the *view name* is "buz.txt"
- the *subpath* is an empty sequence (`()`).

At this point, traversal has ended, and *view lookup* begins.

Because it's the "context" resource, the view lookup machinery examines the "biz" resource to find out what "type" it is. Let's say it finds that the resource is a `Biz` type (because "biz" is an instance of the Python class `Biz`). Using the *view name* (`buz.txt`) and the type, view lookup asks the *application registry* this question:

- Please find me a *view callable* registered with a *view configuration* with the name `buz.txt` that can be used for class `Biz`.

Let's say that question is answered by the application registry; in such a situation, the application registry returns a *view callable*. The view callable is then called with the current *WebOb request* as the sole argument: `request`; it is expected to return a response.

The Example View Callables Accept Only a Request; How Do I Access the Context Resource?

Most of the examples in this book assume that a view callable is typically passed only a *request* object. Sometimes your view callables need access to the *context* resource, especially when you use *traversal*. You might use a supported alternate view callable argument list in your view callables such as the `(context, request)` calling convention described in *Alternate View Callable Argument/Calling Conventions*. But you don't need to if you don't want to. In view callables that accept only a request, the *context* resource found by traversal is available as the `context` attribute of the request object, e.g. `request.context`. The *view name* is available as the `view_name` attribute of the request object, e.g. `request.view_name`. Other Pyramid -specific request attributes are also available as described in *Special Attributes Added to the Request by Pyramid*.

24.3.3 Using Resource Interfaces In View Configuration

Instead of registering your views with a `context` that names a Python resource *class*, you can optionally register a view callable with a `context` which is an *interface*. An interface can be attached arbitrarily to any resource object. View lookup treats context interfaces specially, and therefore the identity of a resource can be divorced from that of the class which implements it. As a result, associating a view with an interface can provide more flexibility for sharing a single view between two or more different implementations of a resource type. For example, if two resource objects of different Python class types share the same interface, you can use the same view configuration to specify both of them as a `context`.

In order to make use of interfaces in your application during view dispatch, you must create an interface and mark up your resource classes or instances with interface declarations that refer to this interface.

To attach an interface to a resource *class*, you define the interface and use the `zope.interface.implements()` function to associate the interface with the class.

```
from zope.interface import Interface
from zope.interface import implements

class IHello(Interface):
    """ A marker interface """

class Hello(object):
    implements(IHello)
```

To attach an interface to a resource *instance*, you define the interface and use the `zope.interface.alsoProvides()` function to associate the interface with the instance. This function mutates the instance in such a way that the interface is attached to it.

```
from zope.interface import Interface
from zope.interface import alsoProvides

class IHello(Interface):
    """ A marker interface """

class Hello(object):
    pass

def make_hello():
    hello = Hello()
    alsoProvides(hello, IHello)
    return hello
```

Regardless of how you associate an interface, with a resource instance, or a resource class, the resulting code to associate that interface with a view callable is the same. Assuming the above code that defines an `IHello` interface lives in the root of your application, and its module is named "resources.py", the interface declaration below will associate the `mypackage.views.hello_world` view with resources that implement, or provide, this interface.

```
# config is an instance of pyramid.config.Configurator

config.add_view('mypackage.views.hello_world', name='hello.html',
                context='mypackage.resources.IHello')
```

Any time a resource that is determined to be the *context* provides this interface, and a view named `hello.html` is looked up against it as per the URL, the `mypackage.views.hello_world` view callable will be invoked.

Note, in cases where a view is registered against a resource class, and a view is also registered against an interface that the resource class implements, an ambiguity arises. Views registered for the resource class take precedence over any views registered for any interface the resource class implements. Thus, if one view configuration names a `context` of both the class type of a resource, and another view configuration names a `context` of interface implemented by the resource's class, and both view configurations are otherwise identical, the view registered for the context's class will "win".

For more information about defining resources with interfaces for use within view configuration, see *Resources Which Implement Interfaces*.

24.4 References

A tutorial showing how *traversal* can be used within a Pyramid application exists in *ZODB + Traversal Wiki Tutorial*.

See the *View Configuration* chapter for detailed information about *view lookup*.

The `pyramid.traversal` module contains API functions that deal with traversal, such as traversal invocation from within application code.

The `pyramid.request.Request.resource_url()` method generates a URL when given a resource retrieved from a resource tree.

CHAPTER 25

Security

Pyramid provides an optional declarative authorization system that can prevent a *view* from being invoked based on an *authorization policy*. Before a view is invoked, the authorization system can use the credentials in the *request* along with the *context* resource to determine if access will be allowed. Here's how it works at a high level:

- A *request* is generated when a user visits the application.
- Based on the request, a *context* resource is located through *resource location*. A context is located differently depending on whether the application uses *traversal* or *URL dispatch*, but a context is ultimately found in either case. See the *URL Dispatch* chapter for more information.
- A *view callable* is located by *view lookup* using the context as well as other attributes of the request.
- If an *authentication policy* is in effect, it is passed the request; it returns some number of *principal* identifiers.
- If an *authorization policy* is in effect and the *view configuration* associated with the view callable that was found has a *permission* associated with it, the authorization policy is passed the *context*, some number of *principal* identifiers returned by the authentication policy, and the *permission* associated with the view; it will allow or deny access.
- If the authorization policy allows access, the view callable is invoked.
- If the authorization policy denies access, the view callable is not invoked; instead the *forbidden view* is invoked.

Security in Pyramid, unlike many systems, cleanly and explicitly separates authentication and authorization. Authentication is merely the mechanism by which credentials provided in the *request* are resolved to one or more *principal* identifiers. These identifiers represent the users and groups in effect during the request. Authorization then determines access based on the *principal* identifiers, the *view callable* being invoked, and the *context* resource.

Authorization is enabled by modifying your application to include an *authentication policy* and *authorization policy*. Pyramid comes with a variety of implementations of these policies. To provide maximal flexibility, Pyramid also allows you to create custom authentication policies and authorization policies.

25.1 Enabling an Authorization Policy

By default, Pyramid enables no authorization policy. All views are accessible by completely anonymous users. In order to begin protecting views from execution based on security settings, you need to enable an authorization policy.

25.1.1 Enabling an Authorization Policy Imperatively

Passing an `authorization_policy` argument to the constructor of the `Configurator` class enables an authorization policy.

You must also enable an *authentication policy* in order to enable the authorization policy. This is because authorization, in general, depends upon authentication. Use the `authentication_policy` argument to the `Configurator` class during application setup to specify an authentication policy.

For example:

```
from pyramid.config import Configurator
from pyramid.authentication import AuthTktAuthenticationPolicy
from pyramid.authorization import ACLAuthorizationPolicy
authentication_policy = AuthTktAuthenticationPolicy('seekrit')
authorization_policy = ACLAuthorizationPolicy()
config = Configurator(authentication_policy=authentication_policy,
                      authorization_policy=authorization_policy)
```

the `authentication_policy` and `authorization_policy` arguments may also be passed to the Configurator as *dotted Python name* values, each representing the dotted name path to a suitable implementation global defined at Python module scope.

The above configuration enables a policy which compares the value of an "auth ticket" cookie passed in the request's environment which contains a reference to a single *principal* against the principals present in any *ACL* found in the resource tree when attempting to call some *view*.

While it is possible to mix and match different authentication and authorization policies, it is an error to pass an authentication policy without the authorization policy or vice versa to a *Configurator* constructor.

See also the `pyramid.authorization` and `pyramid.authentication` modules for alternate implementations of authorization and authentication policies.

25.2 Protecting Views with Permissions

To protect a *view callable* from invocation based on a user's security settings when a particular type of resource becomes the *context*, you must pass a *permission* to *view configuration*. Permissions are usually just strings, and they have no required composition: you can name permissions whatever you like.

For example, the following view declaration protects the view named `add_entry.html` when the context resource is of type `Blog` with the `add` permission using the `pyramid.config.Configurator.add_view()` API:

```
# config is an instance of pyramid.config.Configurator

config.add_view('mypackage.views.blog_entry_add_view',
                name='add_entry.html',
                context='mypackage.resources.Blog',
                permission='add')
```

The equivalent view registration including the `add` permission name may be performed via the `@view_config` decorator:

```
from pyramid.view import view_config
from resources import Blog

@view_config(context=Blog, name='add_entry.html', permission='add')
def blog_entry_add_view(request):
    """ Add blog entry code goes here """
    pass
```

As a result of any of these various view configuration statements, if an authorization policy is in place when the view callable is found during normal application operations, the requesting user will need to possess the `add` permission against the *context* resource in order to be able to invoke the `blog_entry_add_view` view. If he does not, the *Forbidden view* will be invoked.

25.2.1 Setting a Default Permission

If a permission is not supplied to a view configuration, the registered view will always be executable by entirely anonymous users: any authorization policy in effect is ignored.

In support of making it easier to configure applications which are "secure by default", Pyramid allows you to configure a *default* permission. If supplied, the default permission is used as the permission string to all view registrations which don't otherwise name a `permission` argument.

These APIs are in support of configuring a default permission for an application:

- The `default_permission` constructor argument to the `Configurator` constructor.
- The `pyramid.config.Configurator.set_default_permission()` method.

When a default permission is registered:

- If a view configuration names an explicit `permission`, the default permission is ignored for that view registration, and the view-configuration-named permission is used.
- If a view configuration names the permission `pyramid.security.NO_PERMISSION_REQUIRED`, the default permission is ignored, and the view is registered *without* a permission (making it available to all callers regardless of their credentials).

 When you register a default permission, *all* views (even *exception view* views) are protected by a permission. For all views which are truly meant to be anonymously accessible, you will need to associate the view's configuration with the `pyramid.security.NO_PERMISSION_REQUIRED` permission.

25.3 Assigning ACLs to your Resource Objects

When the default Pyramid *authorization policy* determines whether a user possesses a particular permission with respect to a resource, it examines the *ACL* associated with the resource. An ACL is associated with a resource by adding an `__acl__` attribute to the resource object. This attribute can be defined on the resource *instance* if you need instance-level security, or it can be defined on the resource *class* if you just need type-level security.

For example, an ACL might be attached to the resource for a blog via its class:

```
from pyramid.security import Everyone
from pyramid.security import Allow

class Blog(object):
    __acl__ = [
        (Allow, Everyone, 'view'),
        (Allow, 'group:editors', 'add'),
        (Allow, 'group:editors', 'edit'),
        ]
```

Or, if your resources are persistent, an ACL might be specified via the `__acl__` attribute of an *instance* of a resource:

```
from pyramid.security import Everyone
from pyramid.security import Allow

class Blog(object):
    pass

blog = Blog()

blog.__acl__ = [
        (Allow, Everyone, 'view'),
        (Allow, 'group:editors', 'add'),
        (Allow, 'group:editors', 'edit'),
        ]
```

Whether an ACL is attached to a resource's class or an instance of the resource itself, the effect is the same. It is useful to decorate individual resource instances with an ACL (as opposed to just decorating their class) in applications such as "CMS" systems where fine-grained access is required on an object-by-object basis.

25.4 Elements of an ACL

Here's an example ACL:

```
from pyramid.security import Everyone
from pyramid.security import Allow

__acl__ = [
        (Allow, Everyone, 'view'),
        (Allow, 'group:editors', 'add'),
        (Allow, 'group:editors', 'edit'),
        ]
```

The example ACL indicates that the `pyramid.security.Everyone` principal – a special system-defined principal indicating, literally, everyone – is allowed to view the blog, the `group:editors` principal is allowed to add to and edit the blog.

Each element of an ACL is an *ACE* or access control entry. For example, in the above code block, there are three ACEs: `(Allow, Everyone, 'view')`, `(Allow, 'group:editors', 'add')`, and `(Allow, 'group:editors', 'edit')`.

The first element of any ACE is either `pyramid.security.Allow`, or `pyramid.security.Deny`, representing the action to take when the ACE matches. The second element is a *principal*. The third argument is a permission or sequence of permission names.

A principal is usually a user id, however it also may be a group id if your authentication system provides group information and the effective *authentication policy* policy is written to respect group information. For example, the `pyramid.authentication.RepozeWho1AuthenicationPolicy` respects group information if you configure it with a `callback`.

Each ACE in an ACL is processed by an authorization policy *in the order dictated by the ACL*. So if you have an ACL like this:

```
from pyramid.security import Everyone
from pyramid.security import Allow
from pyramid.security import Deny

__acl__ = [
    (Allow, Everyone, 'view'),
    (Deny, Everyone, 'view'),
    ]
```

The default authorization policy will *allow* everyone the view permission, even though later in the ACL you have an ACE that denies everyone the view permission. On the other hand, if you have an ACL like this:

```
from pyramid.security import Everyone
from pyramid.security import Allow
from pyramid.security import Deny

__acl__ = [
    (Deny, Everyone, 'view'),
    (Allow, Everyone, 'view'),
    ]
```

The authorization policy will deny everyone the view permission, even though later in the ACL is an ACE that allows everyone.

The third argument in an ACE can also be a sequence of permission names instead of a single permission name. So instead of creating multiple ACEs representing a number of different permission grants to a single `group:editors` group, we can collapse this into a single ACE, as below.

```
from pyramid.security import Everyone
from pyramid.security import Allow

__acl__ = [
    (Allow, Everyone, 'view'),
    (Allow, 'group:editors', ('add', 'edit')),
    ]
```

25.5 Special Principal Names

Special principal names exist in the `pyramid.security` module. They can be imported for use in your own code to populate ACLs, e.g. `pyramid.security.Everyone`.

`pyramid.security.Everyone`

> Literally, everyone, no matter what. This object is actually a string "under the hood" (`system.Everyone`). Every user "is" the principal named Everyone during every request, even if a security policy is not in use.

`pyramid.security.Authenticated`

> Any user with credentials as determined by the current security policy. You might think of it as any user that is "logged in". This object is actually a string "under the hood" (`system.Authenticated`).

25.6 Special Permissions

Special permission names exist in the `pyramid.security` module. These can be imported for use in ACLs. `pyramid.security.ALL_PERMISSIONS`

> An object representing, literally, *all* permissions. Useful in an ACL like so: `(Allow, 'fred', ALL_PERMISSIONS)`. The `ALL_PERMISSIONS` object is actually a stand-in object that has a `__contains__` method that always returns `True`, which, for all known authorization policies, has the effect of indicating that a given principal "has" any permission asked for by the system.

25.7 Special ACEs

A convenience *ACE* is defined representing a deny to everyone of all permissions in `pyramid.security.DENY_ALL`. This ACE is often used as the *last* ACE of an ACL to explicitly cause inheriting authorization policies to "stop looking up the traversal tree" (effectively breaking any inheritance). For example, an ACL which allows *only* `fred` the view permission for a particular resource despite what inherited ACLs may say when the default authorization policy is in effect might look like so:

```
from pyramid.security import Allow
from pyramid.security import DENY_ALL

__acl__ = [ (Allow, 'fred', 'view'), DENY_ALL ]
```

"Under the hood", the `pyramid.security.DENY_ALL` ACE equals the following:

```
from pyramid.security import ALL_PERMISSIONS
__acl__ = [ (Deny, Everyone, ALL_PERMISSIONS) ]
```

25.8 ACL Inheritance and Location-Awareness

While the default *authorization policy* is in place, if a resource object does not have an ACL when it is the context, its *parent* is consulted for an ACL. If that object does not have an ACL, *its* parent is consulted for an ACL, ad infinitum, until we've reached the root and there are no more parents left.

In order to allow the security machinery to perform ACL inheritance, resource objects must provide *location-awareness*. Providing *location-awareness* means two things: the root object in the resource tree must have a `__name__` attribute and a `__parent__` attribute.

```
class Blog(object):
    __name__ = ''
    __parent__ = None
```

An object with a `__parent__` attribute and a `__name__` attribute is said to be *location-aware*. Location-aware objects define an `__parent__` attribute which points at their parent object. The root object's `__parent__` is `None`.

See *pyramid.location* for documentations of functions which use location-awareness. See also *Location-Aware Resources*.

25.9 Changing the Forbidden View

When Pyramid denies a view invocation due to an authorization denial, the special `forbidden` view is invoked. "Out of the box", this forbidden view is very plain. See *Changing the Forbidden View* within *Using Hooks* for instructions on how to create a custom forbidden view and arrange for it to be called when view authorization is denied.

25.10 Debugging View Authorization Failures

If your application in your judgment is allowing or denying view access inappropriately, start your application under a shell using the `PYRAMID_DEBUG_AUTHORIZATION` environment variable set to `1`. For example:

```
$ PYRAMID_DEBUG_AUTHORIZATION=1 bin/paster serve myproject.ini
```

When any authorization takes place during a top-level view rendering, a message will be logged to the console (to stderr) about what ACE in which ACL permitted or denied the authorization based on authentication information.

This behavior can also be turned on in the application `.ini` file by setting the `pyramid.debug_authorization` key to `true` within the application's configuration section, e.g.:

```
[app:main]
use = egg:MyProject
pyramid.debug_authorization = true
```

With this debug flag turned on, the response sent to the browser will also contain security debugging information in its body.

25.11 Debugging Imperative Authorization Failures

The `pyramid.security.has_permission()` API is used to check security within view functions imperatively. It returns instances of objects that are effectively booleans. But these objects are not raw `True` or `False` objects, and have information attached to them about why the permission was allowed or denied. The object will be one of `pyramid.security.ACLAllowed`, `pyramid.security.ACLDenied`, `pyramid.security.Allowed`, or `pyramid.security.Denied`, as documented in *pyramid.security*. At the very minimum these objects will have a `msg` attribute, which is a string indicating why the permission was denied or allowed. Introspecting this information in the debugger or via print statements when a call to `has_permission()` fails is often useful.

25.12 Creating Your Own Authentication Policy

Pyramid ships with a number of useful out-of-the-box security policies (see `pyramid.authentication`). However, creating your own authentication policy is often necessary when you want to control the "horizontal and vertical" of how your users authenticate. Doing so is a matter of creating an instance of something that implements the following interface:

```
class IAuthenticationPolicy(object):
    """ An object representing a Pyramid authentication policy. """

    def authenticated_userid(self, request):
        """ Return the authenticated userid or ``None`` if no
        authenticated userid can be found. This method of the policy
        should ensure that a record exists in whatever persistent store is
        used related to the user (the user should not have been deleted);
        if a record associated with the current id does not exist in a
        persistent store, it should return ``None``."""

    def unauthenticated_userid(self, request):
        """ Return the *unauthenticated* userid.  This method performs the
        same duty as ``authenticated_userid`` but is permitted to return the
        userid based only on data present in the request; it needn't (and
        shouldn't) check any persistent store to ensure that the user record
        related to the request userid exists."""

    def effective_principals(self, request):
        """ Return a sequence representing the effective principals
        including the userid and any groups belonged to by the current
        user, including 'system' groups such as
        ``pyramid.security.Everyone`` and
        ``pyramid.security.Authenticated``. """

    def remember(self, request, principal, **kw):
        """ Return a set of headers suitable for 'remembering' the
        principal named ``principal`` when set in a response.  An
        individual authentication policy and its consumers can decide
        on the composition and meaning of **kw. """

    def forget(self, request):
        """ Return a set of headers suitable for 'forgetting' the
        current user on subsequent requests. """
```

After you do so, you can pass an instance of such a class into the `Configurator` class at configuration time as `authentication_policy` to use it.

25.13 Creating Your Own Authorization Policy

An authorization policy is a policy that allows or denies access after a user has been authenticated. By default, Pyramid will use the `pyramid.authorization.ACLAuthorizationPolicy` if an authentication policy is activated and an authorization policy isn't otherwise specified.

In some cases, it's useful to be able to use a different authorization policy than the default `ACLAuthorizationPolicy`. For example, it might be desirable to construct an alternate authorization policy which allows the application to use an authorization mechanism that does not involve *ACL* objects.

Pyramid ships with only a single default authorization policy, so you'll need to create your own if you'd like to use a different one. Creating and using your own authorization policy is a matter of creating an instance of an object that implements the following interface:

```
class IAuthorizationPolicy(object):
    """ An object representing a Pyramid authorization policy. """
    def permits(self, context, principals, permission):
        """ Return ``True`` if any of the ``principals`` is allowed the
        ``permission`` in the current ``context``, else return ``False``
        """

    def principals_allowed_by_permission(self, context, permission):
        """ Return a set of principal identifiers allowed by the
        ``permission`` in ``context``.  This behavior is optional; if you
        choose to not implement it you should define this method as
        something which raises a ``NotImplementedError``.  This method
        will only be called when the
        ``pyramid.security.principals_allowed_by_permission`` API is
        used."""
```

After you do so, you can pass an instance of such a class into the `Configurator` class at configuration time as `authorization_policy` to use it.

CHAPTER 26

Combining Traversal and URL Dispatch

When you write most Pyramid applications, you'll be using one or the other of two available *resource location* subsystems: traversal or URL dispatch. However, to solve a limited set of problems, it's useful to use *both* traversal and URL dispatch together within the same application. Pyramid makes this possible via *hybrid* applications.

 Reasoning about the behavior of a "hybrid" URL dispatch + traversal application can be challenging. To successfully reason about using URL dispatch and traversal together, you need to understand URL pattern matching, root factories, and the *traversal* algorithm, and the potential interactions between them. Therefore, we don't recommend creating an application that relies on hybrid behavior unless you must.

26.1 A Review of Non-Hybrid Applications

When used according to the tutorials in its documentation Pyramid is a "dual-mode" framework: the tutorials explain how to create an application in terms of using either *url dispatch or traversal*. This chapter details how you might combine these two dispatch mechanisms, but we'll review how they work in isolation before trying to combine them.

26.1.1 URL Dispatch Only

An application that uses *url dispatch* exclusively to map URLs to code will often have statements like this within application startup configuration:

```
# config is an instance of pyramid.config.Configurator

config.add_route('foobar', '{foo}/{bar}')
config.add_route('bazbuz', '{baz}/{buz}')

config.add_view('myproject.views.foobar', route_name='foobar')
config.add_view('myproject.views.bazbuz', route_name='bazbuz')
```

Each *route* corresponds to one or more view callables. Each view callable is associated with a route by passing a `route_name` parameter that matches its name during a call to `add_view()`. When a route is matched during a request, *view lookup* is used to match the request to its associated view callable. The presence of calls to `add_route()` signify that an application is using URL dispatch.

26.1.2 Traversal Only

An application that uses only traversal will have view configuration declarations that look like this:

```
# config is an instance of pyramid.config.Configurator

config.add_view('mypackage.views.foobar', name='foobar')
config.add_view('mypackage.views.bazbuz', name='bazbuz')
```

When the above configuration is applied to an application, the `mypackage.views.foobar` view callable above will be called when the URL `/foobar` is visited. Likewise, the view `mypackage.views.bazbuz` will be called when the URL `/bazbuz` is visited.

Typically, an application that uses traversal exclusively won't perform any calls to `pyramid.config.Configurator.add_route()` in its startup code.

26.2 Hybrid Applications

Either traversal or url dispatch alone can be used to create a Pyramid application. However, it is also possible to combine the concepts of traversal and url dispatch when building an application: the result is a hybrid application. In a hybrid application, traversal is performed *after* a particular route has matched.

A hybrid application is a lot more like a "pure" traversal-based application than it is like a "pure" URL-dispatch based application. But unlike in a "pure" traversal-based application, in a hybrid application, *traversal* is performed during a request after a route has already matched. This means that the URL

pattern that represents the `pattern` argument of a route must match the `PATH_INFO` of a request, and after the route pattern has matched, most of the "normal" rules of traversal with respect to *resource location* and *view lookup* apply.

There are only four real differences between a purely traversal-based application and a hybrid application:

- In a purely traversal based application, no routes are defined; in a hybrid application, at least one route will be defined.

- In a purely traversal based application, the root object used is global, implied by the *root factory* provided at startup time; in a hybrid application, the *root* object at which traversal begins may be varied on a per-route basis.

- In a purely traversal-based application, the `PATH_INFO` of the underlying *WSGI* environment is used wholesale as a traversal path; in a hybrid application, the traversal path is not the entire `PATH_INFO` string, but a portion of the URL determined by a matching pattern in the matched route configuration's pattern.

- In a purely traversal based application, view configurations which do not mention a `route_name` argument are considered during *view lookup*; in a hybrid application, when a route is matched, only view configurations which mention that route's name as a `route_name` are considered during *view lookup*.

More generally, a hybrid application *is* a traversal-based application except:

- the traversal *root* is chosen based on the route configuration of the route that matched instead of from the `root_factory` supplied during application startup configuration.

- the traversal *path* is chosen based on the route configuration of the route that matched rather than from the `PATH_INFO` of a request.

- the set of views that may be chosen during *view lookup* when a route matches are limited to those which specifically name a `route_name` in their configuration that is the same as the matched route's `name`.

To create a hybrid mode application, use a *route configuration* that implies a particular *root factory* and which also includes a `pattern` argument that contains a special dynamic part: either `*traverse` or `*subpath`.

26.2.1 The Root Object for a Route Match

A hybrid application implies that traversal is performed during a request after a route has matched. Traversal, by definition, must always begin at a root object. Therefore it's important to know *which* root object will be traversed after a route has matched.

Figuring out which *root* object results from a particular route match is straightforward. When a route is matched:

- If the route's configuration has a `factory` argument which points to a *root factory* callable, that callable will be called to generate a *root* object.
- If the route's configuration does not have a `factory` argument, the *global root factory* will be called to generate a *root* object. The global root factory is the callable implied by the `root_factory` argument passed to the `Configurator` at application startup time.
- If a `root_factory` argument is not provided to the `Configurator` at startup time, a *default* root factory is used. The default root factory is used to generate a root object.

 Root factories related to a route were explained previously within *Route Factories*. Both the global root factory and default root factory were explained previously within *The Resource Tree*.

26.2.2 Using `*traverse` In a Route Pattern

A hybrid application most often implies the inclusion of a route configuration that contains the special token `*traverse` at the end of a route's pattern:

```
1 config.add_route('home', '{foo}/{bar}/*traverse')
```

A `*traverse` token at the end of the pattern in a route's configuration implies a "remainder" *capture* value. When it is used, it will match the remainder of the path segments of the URL. This remainder becomes the path used to perform traversal.

 The `*remainder` route pattern syntax is explained in more detail within *Route Pattern Syntax*.

A hybrid mode application relies more heavily on *traversal* to do *resource location* and *view lookup* than most examples indicate within *URL Dispatch*.

Because the pattern of the above route ends with `*traverse`, when this route configuration is matched during a request, Pyramid will attempt to use *traversal* against the *root* object implied by the *root factory* that is implied by the route's configuration. Since no `root_factory` argument is explicitly specified for this route, this will either be the *global* root factory for the application, or the *default* root factory. Once *traversal* has found a *context* resource, *view lookup* will be invoked in almost exactly the same way it would have been invoked in a "pure" traversal-based application.

Let's assume there is no *global root factory* configured in this application. The *default root factory* cannot be traversed: it has no useful `__getitem__` method. So we'll need to associate this route configuration with a custom root factory in order to create a useful hybrid application. To that end, let's imagine that we've created a root factory that looks like so in a module named `routes.py`:

```
class Resource(object):
    def __init__(self, subobjects):
       self.subobjects = subobjects

    def __getitem__(self, name):
       return self.subobjects[name]

root = Resource(
        {'a': Resource({'b': Resource({'c': Resource({})})})}
       )

def root_factory(request):
    return root
```

Above, we've defined a (bogus) resource tree that can be traversed, and a `root_factory` function that can be used as part of a particular route configuration statement:

```
config.add_route('home', '{foo}/{bar}/*traverse',
                 factory='mypackage.routes.root_factory')
```

The `factory` above points at the function we've defined. It will return an instance of the `Resource` class as a root object whenever this route is matched. Instances of the `Resource` class can be used for tree traversal because they have a `__getitem__` method that does something nominally useful. Since traversal uses `__getitem__` to walk the resources of a resource tree, using traversal against the root resource implied by our route statement is a reasonable thing to do.

We could have also used our `root_factory` function as the `root_factory` argument of the `Configurator` constructor, instead of associating it with a particular route inside the route's configuration. Every hybrid route configuration that is matched but which does *not* name a `factory` attribute will use the use global `root_factory` function to generate a root object.

When the route configuration named `home` above is matched during a request, the matchdict generated will be based on its pattern: `{foo}/{bar}/*traverse`. The "capture value" implied by the `*traverse` element in the pattern will be used to traverse the resource tree in order to find a context resource, starting from the root object returned from the root factory. In the above example, the *root* object found will be the instance named `root` in `routes.py`.

If the URL that matched a route with the pattern `{foo}/{bar}/*traverse`, is `http://example.com/one/two/a/b/c`, the traversal path used against the root object will be `a/b/c`. As a result, Pyramid will attempt to traverse through the edges `'a'`, `'b'`, and `'c'`, beginning at the root object.

In our above example, this particular set of traversal steps will mean that the *context* resource of the view would be the `Resource` object we've named `'c'` in our bogus resource tree and the *view name* resulting from traversal will be the empty string; if you need a refresher about why this outcome is presumed, see *The Traversal Algorithm*.

At this point, a suitable view callable will be found and invoked using *view lookup* as described in *View Configuration*, but with a caveat: in order for view lookup to work, we need to define a view configuration that will match when *view lookup* is invoked after a route matches:

```
config.add_route('home', '{foo}/{bar}/*traverse',
                 factory='mypackage.routes.root_factory')
config.add_view('mypackage.views.myview', route_name='home')
```

Note that the above call to `add_view()` includes a `route_name` argument. View configurations that include a `route_name` argument are meant to associate a particular view declaration with a route, using the route's name, in order to indicate that the view should *only be invoked when the route matches*.

Calls to `add_view()` may pass a `route_name` attribute, which refers to the value of an existing route's `name` argument. In the above example, the route name is `home`, referring to the name of the route defined above it.

The above `mypackage.views.myview` view callable will be invoked when:

- the route named "home" is matched
- the *view name* resulting from traversal is the empty string.
- the *context* resource is any object.

It is also possible to declare alternate views that may be invoked when a hybrid route is matched:

```
config.add_route('home', '{foo}/{bar}/*traverse',
                 factory='mypackage.routes.root_factory')
config.add_view('mypackage.views.myview', route_name='home')
config.add_view('mypackage.views.another_view', route_name='home',
                name='another')
```

The `add_view` call for `mypackage.views.another_view` above names a different view and, more importantly, a different *view name*. The above `mypackage.views.another_view` view will be invoked when:

- the route named "home" is matched
- the *view name* resulting from traversal is `another`.
- the *context* resource is any object.

For instance, if the URL `http://example.com/one/two/a/another` is provided to an application that uses the previously mentioned resource tree, the `mypackage.views.another` view callable will be called instead of the `mypackage.views.myview` view callable because the *view name* will be `another` instead of the empty string.

More complicated matching can be composed. All arguments to *route* configuration statements and *view* configuration statements are supported in hybrid applications (such as *predicate* arguments).

26.2.3 Using the `traverse` Argument In a Route Definition

Rather than using the `*traverse` remainder marker in a pattern, you can use the `traverse` argument to the `add_route()` method.

When you use the `*traverse` remainder marker, the traversal path is limited to being the remainder segments of a request URL when a route matches. However, when you use the `traverse` argument or attribute, you have more control over how to compose a traversal path.

Here's a use of the `traverse` pattern in a call to `add_route()`:

```
config.add_route('abc', '/articles/{article}/edit',
                 traverse='/{article}')
```

The syntax of the `traverse` argument is the same as it is for `pattern`.

If, as above, the `pattern` provided is `/articles/{article}/edit`, and the `traverse` argument provided is `/{article}`, when a request comes in that causes the route to match in such a way that the `article` match value is `1` (when the request URI is `/articles/1/edit`), the traversal path will be generated as `/1`. This means that the root object's `__getitem__` will be called with the name `1` during the traversal phase. If the `1` object exists, it will become the *context* of the request. The *Traversal* chapter has more information about traversal.

If the traversal path contains segment marker names which are not present in the pattern argument, a runtime error will occur. The `traverse` pattern should not contain segment markers that do not exist in the `path`.

Note that the `traverse` argument is ignored when attached to a route that has a `*traverse` remainder marker in its pattern.

Traversal will begin at the root object implied by this route (either the global root, or the object returned by the `factory` associated with this route).

Making Global Views Match

By default, only view configurations that mention a `route_name` will be found during view lookup when a route that has a `*traverse` in its pattern matches. You can allow views without a `route_name` attribute to match a route by adding the `use_global_views` flag to the route definition. For example, the `myproject.views.bazbuz` view below will be found if the route named `abc` below is matched and the `PATH_INFO` is `/abc/bazbuz`, even though the view configuration statement does not have the `route_name="abc"` attribute.

```
config.add_route('abc', '/abc/*traverse', use_global_views=True)
config.add_view('myproject.views.bazbuz', name='bazbuz')
```

26.2.4 Using `*subpath` in a Route Pattern

There are certain extremely rare cases when you'd like to influence the traversal *subpath* when a route matches without actually performing traversal. For instance, the `pyramid.wsgi.wsgiapp2()` decorator and the `pyramid.static.static_view` helper attempt to compute `PATH_INFO` from the request's subpath when its `use_subpath` argument is `True`, so it's useful to be able to influence this value.

When `*subpath` exists in a pattern, no path is actually traversed, but the traversal algorithm will return a *subpath* list implied by the capture value of `*subpath`. You'll see this pattern most commonly in route declarations that look like this:

```
from pryamid.static import static_view

www = static_view('mypackage:static', use_subpath=True)

config.add_route('static', '/static/*subpath')
config.add_view(www, route_name='static')
```

`mypackage.views.www` is an instance of `pyramid.static.static_view`. This effectively tells the static helper to traverse everything in the subpath as a filename.

26.3 Corner Cases

A number of corner case "gotchas" exist when using a hybrid application. We'll detail them here.

26.3.1 Registering a Default View for a Route That Has a `view` Attribute

As of Pyramid 1.1 this section is slated to be removed in a later documentation release because the the ability to add views directly to the *route configuration* by passing a `view` argument to `add_route` has been deprecated.

It is an error to provide *both* a `view` argument to a *route configuration and* a *view configuration* which names a `route_name` that has no `name` value or the empty `name` value. For example, this pair of declarations will generate a conflict error at startup time.

```
config.add_route('home', '{foo}/{bar}/*traverse',
                 view='myproject.views.home')
config.add_view('myproject.views.another', route_name='home')
```

This is because the `view` argument to the `add_route()` above is an *implicit* default view when that route matches. `add_route` calls don't *need* to supply a view attribute. For example, this `add_route` call:

```
config.add_route('home', '{foo}/{bar}/*traverse',
                 view='myproject.views.home')
```

Can also be spelled like so:

```
config.add_route('home', '{foo}/{bar}/*traverse')
config.add_view('myproject.views.home', route_name='home')
```

The two spellings are logically equivalent. In fact, the former is just a syntactical shortcut for the latter.

26.3.2 Binding Extra Views Against a Route Configuration that Doesn't Have a `*traverse` Element In Its Pattern

Here's another corner case that just makes no sense:

```
config.add_route('abc', '/abc', view='myproject.views.abc')
config.add_view('myproject.views.bazbuz', name='bazbuz',
                route_name='abc')
```

The above view declaration is useless, because it will never be matched when the route it references has matched. Only the view associated with the route itself (`myproject.views.abc`) will ever be invoked when the route matches, because the default view is always invoked when a route matches and when no post-match traversal is performed.

To make the above view declaration useful, the special `*traverse` token must end the route's pattern. For example:

```
config.add_route('abc', '/abc/*traverse', view='myproject.views.abc')
config.add_view('myproject.views.bazbuz', name='bazbuz',
                route_name='abc')
```

With the above configuration, the `myproject.views.bazbuz` view will be invoked when the request URI is `/abc/bazbuz`, assuming there is no object contained by the root object with the key `bazbuz`. A different request URI, such as `/abc/foo/bar`, would invoke the default `myproject.views.abc` view.

CHAPTER 27

Using Hooks

"Hooks" can be used to influence the behavior of the Pyramid framework in various ways.

27.1 Changing the Not Found View

When Pyramid can't map a URL to view code, it invokes a *not found view*, which is a *view callable*. A default notfound view exists. The default not found view can be overridden through application configuration.

The *not found view* callable is a view callable like any other. The *view configuration* which causes it to be a "not found" view consists only of naming the `pyramid.httpexceptions.HTTPNotFound` class as the `context` of the view configuration.

If your application uses *imperative configuration*, you can replace the Not Found view by using the `pyramid.config.Configurator.add_view()` method to register an "exception view":

```
from pyramid.httpexceptions import HTTPNotFound
from helloworld.views import notfound_view
config.add_view(notfound_view, context=HTTPNotFound)
```

Replace `helloworld.views.notfound_view` with a reference to the *view callable* you want to use to represent the Not Found view.

Like any other view, the notfound view must accept at least a `request` parameter, or both `context` and `request`. The `request` is the current *request* representing the denied action. The `context` (if used in the call signature) will be the instance of the `HTTPNotFound` exception that caused the view to be called.

Here's some sample code that implements a minimal NotFound view callable:

```
from pyramid.httpexceptions import HTTPNotFound

def notfound_view(request):
    return HTTPNotFound()
```

When a NotFound view callable is invoked, it is passed a *request*. The `exception` attribute of the request will be an instance of the `HTTPNotFound` exception that caused the not found view to be called. The value of `request.exception.message` will be a value explaining why the not found error was raised. This message will be different when the `pyramid.debug_notfound` environment setting is true than it is when it is false.

When a NotFound view callable accepts an argument list as described in *Alternate View Callable Argument/Calling Conventions*, the `context` passed as the first argument to the view callable will be the `HTTPNotFound` exception instance. If available, the resource context will still be available as `request.context`.

27.2 Changing the Forbidden View

When Pyramid can't authorize execution of a view based on the *authorization policy* in use, it invokes a *forbidden view*. The default forbidden response has a 403 status code and is very plain, but the view which generates it can be overridden as necessary.

The *forbidden view* callable is a view callable like any other. The *view configuration* which causes it to be a "forbidden" view consists only of naming the `pyramid.httpexceptions.HTTPForbidden` class as the `context` of the view configuration.

You can replace the forbidden view by using the `pyramid.config.Configurator.add_view()` method to register an "exception view":

```
from helloworld.views import forbidden_view
from pyramid.httpexceptions import HTTPForbidden
config.add_view(forbidden_view, context=HTTPForbidden)
```

Replace `helloworld.views.forbidden_view` with a reference to the Python *view callable* you want to use to represent the Forbidden view.

Like any other view, the forbidden view must accept at least a `request` parameter, or both `context` and `request`. The `context` (available as `request.context` if you're using the request-only view argument pattern) is the context found by the router when the view invocation was denied. The `request` is the current *request* representing the denied action.

Here's some sample code that implements a minimal forbidden view:

```
from pyramid.views import view_config
from pyramid.response import Response

def forbidden_view(request):
    return Response('forbidden')
```

When a forbidden view callable is invoked, it is passed a *request*. The `exception` attribute of the request will be an instance of the `HTTPForbidden` exception that caused the forbidden view to be called. The value of `request.exception.message` will be a value explaining why the forbidden was raised and `request.exception.result` will be extended information about the forbidden exception. These messages will be different when the `pyramid.debug_authorization` environment setting is true than it is when it is false.

27.3 Changing the Request Factory

Whenever Pyramid handles a *WSGI* request, it creates a *request* object based on the WSGI environment it has been passed. By default, an instance of the `pyramid.request.Request` class is created to represent the request object.

The class (aka "factory") that Pyramid uses to create a request object instance can be changed by passing a `request_factory` argument to the constructor of the *configurator*. This argument can be either a callable or a *dotted Python name* representing a callable.

```
from pyramid.request import Request

class MyRequest(Request):
    pass

config = Configurator(request_factory=MyRequest)
```

If you're doing imperative configuration, and you'd rather do it after you've already constructed a *configurator* it can also be registered via the `pyramid.config.Configurator.set_request_factory()` method:

```
from pyramid.config import Configurator
from pyramid.request import Request

class MyRequest(Request):
    pass

config = Configurator()
config.set_request_factory(MyRequest)
```

27.4 Using The Before Render Event

Subscribers to the `pyramid.events.BeforeRender` event may introspect and modify the set of *renderer globals* before they are passed to a *renderer*. This event object iself has a dictionary-like interface that can be used for this purpose. For example:

```
from pyramid.events import subscriber
from pyramid.events import BeforeRender

@subscriber(BeforeRender)
def add_global(event):
    event['mykey'] = 'foo'
```

An object of this type is sent as an event just before a *renderer* is invoked (but *after* the application-level renderer globals factory added via `set_renderer_globals_factory`, if any, has injected its own keys into the renderer globals dictionary).

If a subscriber attempts to add a key that already exist in the renderer globals dictionary, a `KeyError` is raised. This limitation is enforced because event subscribers do not possess any relative ordering. The set of keys added to the renderer globals dictionary by all `pyramid.events.BeforeRender` subscribers and renderer globals factories must be unique.

See the API documentation for the `BeforeRender` event interface at `pyramid.interfaces.IBeforeRender`.

Another (deprecated) mechanism which allows event subscribers more control when adding renderer global values exists in *Adding Renderer Globals (Deprecated)*.

27.5 Adding Renderer Globals (Deprecated)

 this feature is deprecated as of Pyramid 1.1. A non-deprecated mechanism which allows event subscribers to add renderer global values is documented in *Using The Before Render Event*.

Whenever Pyramid handles a request to perform a rendering (after a view with a `renderer=` configuration attribute is invoked, or when any of the methods beginning with `render` within the `pyramid.renderers` module are called), *renderer globals* can be injected into the *system* values sent to the renderer. By default, no renderer globals are injected, and the "bare" system values (such as `request`, `context`, and `renderer_name`) are the only values present in the system dictionary passed to every renderer.

A callback that Pyramid will call every time a renderer is invoked can be added by passing a `renderer_globals_factory` argument to the constructor of the *configurator*. This callback can either be a callable object or a *dotted Python name* representing such a callable.

```
def renderer_globals_factory(system):
    return {'a': 1}

config = Configurator(
         renderer_globals_factory=renderer_globals_factory)
```

Such a callback must accept a single positional argument (notionally named `system`) which will contain the original system values. It must return a dictionary of values that will be merged into the system dictionary. See *System Values Used During Rendering* for description of the values present in the system dictionary.

If you're doing imperative configuration, and you'd rather do it after you've already constructed a *configurator* it can also be registered via the `pyramid.config.Configurator.set_renderer_globals_factory()` method:

```
from pyramid.config import Configurator

def renderer_globals_factory(system):
    return {'a': 1}

config = Configurator()
config.set_renderer_globals_factory(renderer_globals_factory)
```

27.6 Using Response Callbacks

Unlike many other web frameworks, Pyramid does not eagerly create a global response object. Adding a *response callback* allows an application to register an action to be performed against whatever response object is returned by a view, usually in order to mutate the response.

The `pyramid.request.Request.add_response_callback()` method is used to register a response callback.

A response callback is a callable which accepts two positional parameters: `request` and `response`. For example:

```
def cache_callback(request, response):
    """Set the cache_control max_age for the response"""
    if request.exception is not None:
        response.cache_control.max_age = 360
request.add_response_callback(cache_callback)
```

No response callback is called if an unhandled exception happens in application code, or if the response object returned by a *view callable* is invalid. Response callbacks *are*, however, invoked when a *exception view* is rendered successfully: in such a case, the `request.exception` attribute of the request when it enters a response callback will be an exception object instead of its default value of `None`.

Response callbacks are called in the order they're added (first-to-most-recently-added). All response callbacks are called *after* the `NewResponse` event is sent. Errors raised by response callbacks are not handled specially. They will be propagated to the caller of the Pyramid router application.

A response callback has a lifetime of a *single* request. If you want a response callback to happen as the result of *every* request, you must re-register the callback into every new request (perhaps within a subscriber of a `NewRequest` event).

27.7 Using Finished Callbacks

A *finished callback* is a function that will be called unconditionally by the Pyramid *router* at the very end of request processing. A finished callback can be used to perform an action at the end of a request unconditionally.

The `pyramid.request.Request.add_finished_callback()` method is used to register a finished callback.

A finished callback is a callable which accepts a single positional parameter: `request`. For example:

```
import transaction

def commit_callback(request):
    '''commit or abort the transaction associated with request'''
    if request.exception is not None:
        transaction.abort()
    else:
        transaction.commit()
request.add_finished_callback(commit_callback)
```

Finished callbacks are called in the order they're added (first-to-most-recently-added). Finished callbacks (unlike a *response callback*) are *always* called, even if an exception happens in application code that prevents a response from being generated.

The set of finished callbacks associated with a request are called *very late* in the processing of that request; they are essentially the very last thing called by the *router* before a request "ends". They are called after response processing has already occurred in a top-level `finally:` block within the router request processing code. As a result, mutations performed to the `request` provided to a finished callback will have no meaningful effect, because response processing will have already occurred, and the request's scope will expire almost immediately after all finished callbacks have been processed.

It is often necessary to tell whether an exception occurred within *view callable* code from within a finished callback: in such a case, the `request.exception` attribute of the request when it enters a response callback will be an exception object instead of its default value of `None`.

Errors raised by finished callbacks are not handled specially. They will be propagated to the caller of the Pyramid router application.

A finished callback has a lifetime of a *single* request. If you want a finished callback to happen as the result of *every* request, you must re-register the callback into every new request (perhaps within a subscriber of a `NewRequest` event).

27.8 Changing the Traverser

The default *traversal* algorithm that Pyramid uses is explained in *The Traversal Algorithm*. Though it is rarely necessary, this default algorithm can be swapped out selectively for a different traversal pattern via configuration.

```
from pyramid.interfaces import ITraverser
from zope.interface import Interface
from myapp.traversal import Traverser

config.registry.registerAdapter(Traverser, (Interface,), ITraverser)
```

In the example above, `myapp.traversal.Traverser` is assumed to be a class that implements the following interface:

```
class Traverser(object):
    def __init__(self, root):
        """ Accept the root object returned from the root factory """

    def __call__(self, request):
        """ Return a dictionary with (at least) the keys ``root``,
        ``context``, ``view_name``, ``subpath``, ``traversed``,
        ``virtual_root``, and ``virtual_root_path``.  These values are
        typically the result of a resource tree traversal.  ``root``
        is the physical root object, ``context`` will be a resource
        object, ``view_name`` will be the view name used (a Unicode
        name), ``subpath`` will be a sequence of Unicode names that
        followed the view name but were not traversed, ``traversed``
        will be a sequence of Unicode names that were traversed
        (including the virtual root path, if any) ``virtual_root``
        will be a resource object representing the virtual root (or the
        physical root if traversal was not performed), and
        ``virtual_root_path`` will be a sequence representing the
        virtual root path (a sequence of Unicode names) or None if
        traversal was not performed.

        Extra keys for special purpose functionality can be added as
        necessary.

        All values returned in the dictionary will be made available
        as attributes of the ``request`` object.
        """
```

More than one traversal algorithm can be active at the same time. For instance, if your *root factory* returns more than one type of object conditionally, you could claim that an alternate traverser adapter is `for` only one particular class or interface. When the root factory returned an object that implemented that class or interface, a custom traverser would be used. Otherwise, the default traverser would be used. For example:

```
from pyramid.interfaces import ITraverser
from zope.interface import Interface
```

```
from myapp.traversal import Traverser
from myapp.resources import MyRoot

config.registry.registerAdapter(Traverser, (MyRoot,), ITraverser)
```

If the above stanza was added to a Pyramid __init__.py file's main function, Pyramid would use the myapp.traversal.Traverser only when the application *root factory* returned an instance of the myapp.resources.MyRoot object. Otherwise it would use the default Pyramid traverser to do traversal.

27.9 Changing How pyramid.request.Request.resource_url() Generates a URL

When you add a traverser as described in *Changing the Traverser*, it's often convenient to continue to use the pyramid.request.Request.resource_url() API. However, since the way traversal is done will have been modified, the URLs it generates by default may be incorrect.

If you've added a traverser, you can change how resource_url() generates a URL for a specific type of resource by adding a registerAdapter call for pyramid.interfaces.IContextURL to your application:

```
from pyramid.interfaces import ITraverser
from zope.interface import Interface
from myapp.traversal import URLGenerator
from myapp.resources import MyRoot

config.registry.registerAdapter(URLGenerator, (MyRoot, Interface),
                                IContextURL)
```

In the above example, the myapp.traversal.URLGenerator class will be used to provide services to resource_url() any time the *context* passed to resource_url is of class myapp.resources.MyRoot. The second argument in the (MyRoot, Interface) tuple represents the type of interface that must be possessed by the *request* (in this case, any interface, represented by zope.interface.Interface).

The API that must be implemented by a class that provides IContextURL is as follows:

```
from zope.interface import Interface

class IContextURL(Interface):
    """ An adapter which deals with URLs related to a context.
    """
    def __init__(self, context, request):
        """ Accept the context and request """

    def virtual_root(self):
        """ Return the virtual root object related to a request and the
        current context"""

    def __call__(self):
        """ Return a URL that points to the context """
```

The default context URL generator is available for perusal as the class `pyramid.traversal.TraversalContextURL` in the traversal module of the *Pylons* GitHub Pyramid repository.

27.10 Changing How Pyramid Treats View Responses

It is possible to control how Pyramid treats the result of calling a view callable on a per-type basis by using a hook involving `pyramid.config.Configurator.add_response_adapter()` or the `response_adapter` decorator.

This feature is new as of Pyramid 1.1.

Pyramid, in various places, adapts the result of calling a view callable to the `IResponse` interface to ensure that the object returned by the view callable is a "true" response object. The vast majority of time, the result of this adaptation is the result object itself, as view callables written by "civilians" who read the narrative documentation contained in this manual will always return something that implements the `IResponse` interface. Most typically, this will be an instance of the `pyramid.response.Response` class or a subclass. If a civilian returns a non-Response object from a view callable that isn't configured to use a *renderer*, he will typically expect the router to raise an error. However, you can hook Pyramid in such a way that users can return arbitrary values from a view callable by providing an adapter which converts the arbitrary return value into something that implements `IResponse`.

For example, if you'd like to allow view callables to return bare string objects (without requiring a a *renderer* to convert a string to a response object), you can register an adapter which converts the string to a Response:

```
from pyramid.response import Response

def string_response_adapter(s):
    response = Response(s)
    return response

# config is an instance of pyramid.config.Configurator

config.add_response_adapter(string_response_adapter, str)
```

Likewise, if you want to be able to return a simplified kind of response object from view callables, you can use the IResponse hook to register an adapter to the more complex IResponse interface:

```
from pyramid.response import Response

class SimpleResponse(object):
    def __init__(self, body):
        self.body = body

def simple_response_adapter(simple_response):
    response = Response(simple_response.body)
    return response

# config is an instance of pyramid.config.Configurator

config.add_response_adapter(simple_response_adapter, SimpleResponse)
```

If you want to implement your own Response object instead of using the `pyramid.response.Response` object in any capacity at all, you'll have to make sure the object implements every attribute and method outlined in `pyramid.interfaces.IResponse` and you'll have to ensure that it's marked up with `zope.interface.implements(IResponse)`:

```
from pyramid.interfaces import IResponse
from zope.interface import implements

class MyResponse(object):
    implements(IResponse)
    # ... an implementation of every method and attribute
    # documented in IResponse should follow ...
```

When an alternate response object implementation is returned by a view callable, if that object asserts that it implements `IResponse` (via `zope.interface.implements(IResponse)`), an adapter needn't be registered for the object; Pyramid will use it directly.

An IResponse adapter for `webob.Response` (as opposed to `pyramid.response.Response`) is registered by Pyramid by default at startup time, as by their nature, instances of this class (and instances of subclasses of the class) will natively provide IResponse. The adapter registered for `webob.Response` simply returns the response object.

Instead of using `pyramid.config.Configurator.add_response_adapter()`, you can use the `pyramid.response.response_adapter` decorator:

```
from pyramid.response import Response
from pyramid.response import response_adapter

@response_adapter(str)
def string_response_adapter(s):
    response = Response(s)
    return response
```

The above example, when scanned, has the same effect as:

```
config.add_response_adapter(string_response_adapter, str)
```

The `response_adapter` decorator will have no effect until activated by a *scan*.

27.11 Using a View Mapper

The default calling conventions for view callables are documented in the *Views* chapter. You can change the way users define view callables by employing a *view mapper*.

A view mapper is an object that accepts a set of keyword arguments and which returns a callable. The returned callable is called with the *view callable* object. The returned callable should itself return another callable which can be called with the "internal calling protocol" `(context, request)`.

You can use a view mapper in a number of ways:

- by setting a `__view_mapper__` attribute (which is the view mapper object) on the view callable itself
- by passing the mapper object to `pyramid.config.Configurator.add_view()` (or its declarative/decorator equivalents) as the `mapper` argument.
- by registering a *default* view mapper.

Here's an example of a view mapper that emulates (somewhat) a Pylons "controller". The mapper is initialized with some keyword arguments. Its `__call__` method accepts the view object (which will be a class). It uses the `attr` keyword argument it is passed to determine which attribute should be used as an action method. The wrapper method it returns accepts `(context, request)` and returns the result of calling the action method with keyword arguments implied by the *matchdict* after popping the `action` out of it. This somewhat emulates the Pylons style of calling action methods with routing parameters pulled out of the route matching dict as keyword arguments.

```
# framework

class PylonsControllerViewMapper(object):
    def __init__(self, **kw):
        self.kw = kw

    def __call__(self, view):
        attr = self.kw['attr']
        def wrapper(context, request):
            matchdict = request.matchdict.copy()
            matchdict.pop('action', None)
            inst = view()
            meth = getattr(inst, attr)
            return meth(**matchdict)
        return wrapper

class BaseController(object):
    __view_mapper__ = PylonsControllerViewMapper
```

A user might make use of these framework components like so:

```
# user application

from pyramid.response import Response
from pyramid.config import Configurator
import pyramid_handlers
from paste.httpserver import serve

class MyController(BaseController):
    def index(self, id):
        return Response(id)

if __name__ == '__main__':
    config = Configurator()
    config.include(pyramid_handlers)
    config.add_handler('one', '/{id}', MyController, action='index')
    config.add_handler('two', '/{action}/{id}', MyController)
```

```
17      serve(config.make_wsgi_app())
```

The `pyramid.config.Configurator.set_view_mapper()` method can be used to set a *default* view mapper (overriding the superdefault view mapper used by Pyramid itself).

A *single* view registration can use a view mapper by passing the mapper as the `mapper` argument to `add_view()`.

27.12 Registering Configuration Decorators

Decorators such as `view_config` don't change the behavior of the functions or classes they're decorating. Instead, when a *scan* is performed, a modified version of the function or class is registered with Pyramid.

You may wish to have your own decorators that offer such behaviour. This is possible by using the *Venusian* package in the same way that it is used by Pyramid.

By way of example, let's suppose you want to write a decorator that registers the function it wraps with a *Zope Component Architecture* "utility" within the *application registry* provided by Pyramid. The application registry and the utility inside the registry is likely only to be available once your application's configuration is at least partially completed. A normal decorator would fail as it would be executed before the configuration had even begun.

However, using *Venusian*, the decorator could be written as follows:

```
1  import venusian
2  from mypackage.interfaces import IMyUtility
3
4  class registerFunction(object):
5
6      def __init__(self, path):
7          self.path = path
8
9      def register(self, scanner, name, wrapped):
10         registry = scanner.config.registry
11         registry.getUtility(IMyUtility).register(
12             self.path, wrapped)
13
14     def __call__(self, wrapped):
15         venusian.attach(wrapped, self.register)
16         return wrapped
```

This decorator could then be used to register functions throughout your code:

```
@registerFunction('/some/path')
def my_function():
    do_stuff()
```

However, the utility would only be looked up when a *scan* was performed, enabling you to set up the utility in advance:

```
from paste.httpserver import serve
from pyramid.config import Configurator
from mypackage.interfaces import IMyUtility

class UtilityImplementation:

    implements(IMyUtility)

    def __init__(self):
        self.registrations = {}

    def register(self, path, callable_):
        self.registrations[path] = callable_

if __name__ == '__main__':
    config = Configurator()
    config.registry.registerUtility(UtilityImplementation())
    config.scan()
    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

For full details, please read the Venusian documentation.

27.13 Registering “Tweens”

Tweens are a feature which were added in Pyramid 1.2. They are not available in any previous version.

A *tween* (a contraction of the word “between”) is a bit of code that sits between the Pyramid router’s main request handling function and the upstream WSGI component that uses Pyramid as its “app”. This is a

feature that may be used by Pyramid framework extensions, to provide, for example, Pyramid-specific view timing support bookkeeping code that examines exceptions before they are returned to the upstream WSGI application. Tweens behave a bit like *WSGI* middleware but they have the benefit of running in a context in which they have access to the Pyramid *application registry* as well as the Pyramid rendering machinery.

27.13.1 Creating a Tween Factory

To make use of tweens, you must construct a "tween factory". A tween factory must be a globally importable callable which accepts two arguments: `handler` and `registry`. `handler` will be the either the main Pyramid request handling function or another tween. `registry` will be the Pyramid *application registry* represented by this Configurator. A tween factory must return a tween when it is called.

A tween is a callable which accepts a *request* object and returns a *response* object.

Here's an example of a tween factory:

```
# in a module named myapp.tweens

import time
from pyramid.settings import asbool
import logging

log = logging.getLogger(__name__)

def timing_tween_factory(handler, registry):
    if asbool(registry.settings.get('do_timing')):
        # if timing support is enabled, return a wrapper
        def timing_tween(request):
            start = time.time()
            try:
                response = handler(request)
            finally:
                end = time.time()
                log.debug('The request took %s seconds' %
                          (end - start))
            return response
        return timing_tween
    # if timing support is not enabled, return the original
    # handler
    return handler
```

If you remember, a tween is an object which accepts a *request* object and which returns a *response* argument. The `request` argument to a tween will be the request created by Pyramid's router when it receives a WSGI request. The response object will be generated by the downstream Pyramid application and it should be returned by the tween.

In the above example, the tween factory defines a `timing_tween` tween and returns it if `asbool(registry.settings.get('do_timing'))` is true. It otherwise simply returns the handler it was given. The `registry.settings` attribute is a handle to the deployment settings provided by the user (usually in an `.ini` file). In this case, if the user has defined a `do_timing` setting, and that setting is `True`, the user has said she wants to do timing, so the tween factory returns the timing tween; it otherwise just returns the handler it has been provided, preventing any timing.

The example timing tween simply records the start time, calls the downstream handler, logs the number of seconds consumed by the downstream handler, and returns the response.

27.13.2 Registering an Implicit Tween Factory

Once you've created a tween factory, you can register it into the implicit tween chain using the `pyramid.config.Configurator.add_tween()` method using its *dotted Python name*.

Here's an example of registering the a tween factory as an "implicit" tween in a Pyramid application:

```
from pyramid.config import Configurator
config = Configurator()
config.add_tween('myapp.tweens.timing_tween_factory')
```

Note that you must use a *dotted Python name* as the first argument to `pyramid.config.Configurator.add_tween()`; this must point at a tween factory. You cannot pass the tween factory object itself to the method: it must be *dotted Python name* that points to a globally importable object. In the above example, we assume that a `timing_tween_factory` tween factory was defined in a module named `myapp.tweens`, so the tween factory is importable as `myapp.tweens.timing_tween_factory`.

When you use `pyramid.config.Configurator.add_tween()`, you're instructing the system to use your tween factory at startup time unless the user has provided an explicit tween list in his configuration. This is what's meant by an "implicit" tween. A user can always elect to supply an explicit tween list, reordering or disincluding implicitly added tweens. See *Explicit Tween Ordering* for more information about explicit tween ordering.

If more than one call to `pyramid.config.Configurator.add_tween()` is made within a single application configuration, the tweens will be chained together at application startup time. The *first*

tween factory added via `add_tween` will be called with the Pyramid exception view tween factory as its `handler` argument, then the tween factory added directly after that one will be called with the result of the first tween factory as its `handler` argument, and so on, ad infinitum until all tween factories have been called. The Pyramid router will use the outermost tween produced by this chain (the tween generated by the very last tween factory added) as its request handler function. For example:

```
from pyramid.config import Configurator

config = Configurator()
config.add_tween('myapp.tween_factory1')
config.add_tween('myapp.tween_factory2')
```

The above example will generate an implicit tween chain that looks like this:

```
INGRESS (implicit)
myapp.tween_factory2
myapp.tween_factory1
pyramid.tweens.excview_tween_factory (implicit)
MAIN (implicit)
```

27.13.3 Suggesting Implicit Tween Ordering

By default, as described above, the ordering of the chain is controlled entirely by the relative ordering of calls to `pyramid.config.Configurator.add_tween()`. However, the caller of add_tween can provide an optional hint that can influence the implicit tween chain ordering by supplying `under` or `over` (or both) arguments to `add_tween()`. These hints are only used used when an explicit tween ordering is not used. See *Explicit Tween Ordering* for a description of how to set an explicit tween ordering.

Allowable values for `under` or `over` (or both) are:

- `None` (the default).
- A *dotted Python name* to a tween factory: a string representing the predicted dotted name of a tween factory added in a call to `add_tween` in the same configuration session.
- One of the constants `pyramid.tweens.MAIN`, `pyramid.tweens.INGRESS`, or `pyramid.tweens.EXCVIEW`.
- An iterable of any combination of the above. This allows the user to specify fallbacks if the desired tween is not included, as well as compatibility with multiple other tweens.

Effectively, `under` means “closer to the main Pyramid application than”, `over` means “closer to the request ingress than”.

For example, the following call to `add_tween()` will attempt to place the tween factory represented by `myapp.tween_factory` directly ‘above’ (in `paster ptweens` order) the main Pyramid request handler.

```
import pyramid.tweens

config.add_tween('myapp.tween_factory', over=pyramid.tweens.MAIN)
```

The above example will generate an implicit tween chain that looks like this:

```
INGRESS (implicit)
pyramid.tweens.excview_tween_factory (implicit)
myapp.tween_factory
MAIN (implicit)
```

Likewise, calling the following call to `add_tween()` will attempt to place this tween factory ‘above’ the main handler but ‘below’ a separately added tween factory:

```
import pyramid.tweens

config.add_tween('myapp.tween_factory1',
                 over=pyramid.tweens.MAIN)
config.add_tween('myapp.tween_factory2',
                 over=pyramid.tweens.MAIN,
                 under='myapp.tween_factory1')
```

The above example will generate an implicit tween chain that looks like this:

```
INGRESS (implicit)
pyramid.tweens.excview_tween_factory (implicit)
myapp.tween_factory1
myapp.tween_factory2
MAIN (implicit)
```

Specifying neither `over` nor `under` is equivalent to specifying `under=INGRESS`.

If all options for `under` (or `over`) cannot be found in the current configuration, it is an error. If some options are specified purely for compatibilty with other tweens, just add a fallback of MAIN or INGRESS. For example, `under=('someothertween', 'someothertween2', INGRESS)`. This constraint will require the tween to be located under both the ‘someothertween’ tween, the ‘someothertween2’ tween, and INGRESS. If any of these is not in the current configuration, this constraint will only organize itself based on the tweens that are present.

27.13.4 Explicit Tween Ordering

Implicit tween ordering is obviously only best-effort. Pyramid will attempt to provide an implicit order of tweens as best it can using hints provided by calls to `add_tween()`, but because it's only best-effort, if very precise tween ordering is required, the only surefire way to get it is to use an explicit tween order. The deploying user can override the implicit tween inclusion and ordering implied by calls to `add_tween()` entirely by using the `pyramid.tweens` settings value. When used, this settings value must be a list of Python dotted names which will override the ordering (and inclusion) of tween factories in the implicit tween chain. For example:

```
[app:main]
use = egg:MyApp
pyramid.reload_templates = true
pyramid.debug_authorization = false
pyramid.debug_notfound = false
pyramid.debug_routematch = false
pyramid.debug_templates = true
pyramid.tweens = myapp.my_cool_tween_factory
                 pyramid.tweens.excview_tween_factory
```

In the above configuration, calls made during configuration to `pyramid.config.Configurator.add_tween()` are ignored, and the user is telling the system to use the tween factories he has listed in the `pyramid.tweens` configuration setting (each is a *dotted Python name* which points to a tween factory) instead of any tween factories added via `pyramid.config.Configurator.add_tween()`. The *first* tween factory in the `pyramid.tweens` list will be used as the producer of the effective Pyramid request handling function; it will wrap the tween factory declared directly "below" it, ad infinitum. The "main" Pyramid request handler is implicit, and always "at the bottom".

Pyramid's own *exception view* handling logic is implemented as a tween factory function: `pyramid.tweens.excview_tween_factory()`. If Pyramid exception view handling is desired, and tween factories are specified via the `pyramid.tweens` configuration setting, the `pyramid.tweens.excview_tween_factory()` function must be added to the `pyramid.tweens` configuration setting list explicitly. If it is not present, Pyramid will not perform exception view handling.

27.13.5 Tween Conflicts and Ordering Cycles

Pyramid will prevent the same tween factory from being added to the tween chain more than once using configuration conflict detection. If you wish to add the same tween factory more than

once in a configuration, you should either: a) use a tween factory that is a separate globally importable instance object from the factory that it conflicts with b) use a function or class as a tween factory with the same logic as the other tween factory it conflicts with but with a different `__name__` attribute or c) call `pyramid.config.Configurator.commit()` between calls to `pyramid.config.Configurator.add_tween()`.

If a cycle is detected in implicit tween ordering when `over` and `under` are used in any call to “add_tween”, an exception will be raised at startup time.

27.13.6 Displaying Tween Ordering

The `paster ptweens` command-line utility can be used to report the current implict and explicit tween chains used by an application. See *Displaying “Tweens”*.

CHAPTER 28

Advanced Configuration

To support application extensibility, the Pyramid *Configurator*, by default, detects configuration conflicts and allows you to include configuration imperatively from other packages or modules. It also, by default, performs configuration in two separate phases. This allows you to ignore relative configuration statement ordering in some circumstances.

28.1 Conflict Detection

Here's a familiar example of one of the simplest Pyramid applications, configured imperatively:

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response

def hello_world(request):
    return Response('Hello world!')

if __name__ == '__main__':
    config = Configurator()
    config.add_view(hello_world)
    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

When you start this application, all will be OK. However, what happens if we try to add another view to the configuration with the same set of *predicate* arguments as one we've already added?

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response

def hello_world(request):
    return Response('Hello world!')

def goodbye_world(request):
    return Response('Goodbye world!')

if __name__ == '__main__':
    config = Configurator()

    config.add_view(hello_world, name='hello')

    # conflicting view configuration
    config.add_view(goodbye_world, name='hello')

    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

The application now has two conflicting view configuration statements. When we try to start it again, it won't start. Instead, we'll receive a traceback that ends something like this:

```
Traceback (most recent call last):
  File "app.py", line 12, in <module>
    app = config.make_wsgi_app()
  File "pyramid/config.py", line 839, in make_wsgi_app
    self.commit()
  File "pyramid/pyramid/config.py", line 473, in commit
    self._ctx.execute_actions()
  ... more code ...
pyramid.exceptions.ConfigurationConflictError:
        Conflicting configuration actions
  For: ('view', None, '', None, <InterfaceClass pyramid.interfaces.IView>,
        None, None, None, None, None, False, None, None, None)
 ('app.py', 14, '<module>', 'config.add_view(hello_world)')
 ('app.py', 17, '<module>', 'config.add_view(hello_world)')
```

This traceback is trying to tell us:

- We've got conflicting information for a set of view configuration statements (The `For:` line).
- There are two statements which conflict, shown beneath the `For:` line: `config.add_view(hello_world, 'hello')` on line 14 of `app.py`, and `config.add_view(goodbye_world, 'hello')` on line 17 of `app.py`.

These two configuration statements are in conflict because we've tried to tell the system that the set of *predicate* values for both view configurations are exactly the same. Both the `hello_world` and `goodbye_world` views are configured to respond under the same set of circumstances. This circumstance: the *view name* (represented by the `name=` predicate) is `hello`.

This presents an ambiguity that Pyramid cannot resolve. Rather than allowing the circumstance to go unreported, by default Pyramid raises a `ConfigurationConflictError` error and prevents the application from running.

Conflict detection happens for any kind of configuration: imperative configuration or configuration that results from the execution of a *scan*.

28.1.1 Manually Resolving Conflicts

There are a number of ways to manually resolve conflicts: the "right" way, by strategically using `pyramid.config.Configurator.commit()`, or by using an "autocommitting" configurator.

The Right Thing

The most correct way to resolve conflicts is to "do the needful": change your configuration code to not have conflicting configuration statements. The details of how this is done depends entirely on the configuration statements made by your application. Use the detail provided in the `ConfigurationConflictError` to track down the offending conflicts and modify your configuration code accordingly.

If you're getting a conflict while trying to extend an existing application, and that application has a function which performs configuration like this one:

```
def add_routes(config):
    config.add_route(...)
```

Don't call this function directly with `config` as an argument. Instead, use `pyramid.config.Configuration.include()`:

```
config.include(add_routes)
```

Using `include()` instead of calling the function directly provides a modicum of automated conflict resolution, with the configuration statements you define in the calling code overriding those of the included function. See also *Automatic Conflict Resolution* and *Including Configuration from External Sources*.

Using `config.commit()`

You can manually commit a configuration by using the `commit()` method between configuration calls. For example, we prevent conflicts from occurring in the application we examined previously as the result of adding a `commit`. Here's the application that generates conflicts:

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response

def hello_world(request):
    return Response('Hello world!')

def goodbye_world(request):
    return Response('Goodbye world!')

if __name__ == '__main__':
    config = Configurator()

    config.add_view(hello_world, name='hello')

    # conflicting view configuration
    config.add_view(goodbye_world, name='hello')

    app = config.make_wsgi_app()
    serve(app, host='0.0.0.0')
```

We can prevent the two `add_view` calls from conflicting by issuing a call to `commit()` between them:

```
from paste.httpserver import serve
from pyramid.config import Configurator
from pyramid.response import Response

def hello_world(request):
    return Response('Hello world!')

def goodbye_world(request):
    return Response('Goodbye world!')

if __name__ == '__main__':
    config = Configurator()

    config.add_view(hello_world, name='hello')

    config.commit() # commit any pending configuration actions
```

```
17
18      # no-longer-conflicting view configuration
19      config.add_view(goodbye_world, name='hello')
20
21      app = config.make_wsgi_app()
22      serve(app, host='0.0.0.0')
```

In the above example we've issued a call to `commit()` between the two `add_view` calls. `commit()` will cause any pending configuration statements.

Calling `commit()` is safe at any time. It executes all pending configuration actions and leaves the configuration action list "clean".

Note that `commit()` has no effect when you're using an *autocommitting* configurator (see *Using An Autocommitting Configurator*).

Using An Autocommitting Configurator

You can also use a heavy hammer to circumvent conflict detection by using a configurator constructor parameter: `autocommit=True`. For example:

```
1  from pyramid.config import Configurator
2
3  if __name__ == '__main__':
4      config = Configurator(autocommit=True)
```

When the `autocommit` parameter passed to the Configurator is `True`, conflict detection (and *Two-Phase Configuration*) is disabled. Configuration statements will be executed immediately, and succeeding statements will override preceding ones.

`commit()` has no effect when `autocommit` is `True`.

If you use a Configurator in code that performs unit testing, it's usually a good idea to use an autocommitting Configurator, because you are usually unconcerned about conflict detection or two-phase configuration in test code.

28.1.2 Automatic Conflict Resolution

If your code uses the `include()` method to include external configuration, some conflicts are automatically resolved. Configuration statements that are made as the result of an "include" will be overridden by configuration statements that happen within the caller of the "include" method.

Automatic conflict resolution supports this goal: if a user wants to reuse a Pyramid application, and they want to customize the configuration of this application without hacking its code "from outside", they can "include" a configuration function from the package and override only some of its configuration statements within the code that does the include. No conflicts will be generated by configuration statements within the code which does the including, even if configuration statements in the included code would conflict if it was moved "up" to the calling code.

28.1.3 Methods Which Provide Conflict Detection

These are the methods of the configurator which provide conflict detection:

`add_view()`, `add_route()`, `add_renderer()`, `set_request_factory()`, `set_renderer_globals_factory()`, `set_locale_negotiator()` and `set_default_permission()`.

`add_static_view()` also indirectly provides conflict detection, because it's implemented in terms of the conflict-aware `add_route` and `add_view` methods.

28.2 Including Configuration from External Sources

Some application programmers will factor their configuration code in such a way that it is easy to reuse and override configuration statements. For example, such a developer might factor out a function used to add routes to his application:

```
1 def add_routes(config):
2     config.add_route(...)
```

Rather than calling this function directly with `config` as an argument. Instead, use `pyramid.config.Configuration.include()`:

```
config.include(add_routes)
```

Using `include` rather than calling the function directly will allow *Automatic Conflict Resolution* to work.

`include()` can also accept a *module* as an argument:

```
import myapp

config.include(myapp)
```

For this to work properly, the `myapp` module must contain a callable with the special name `includeme`, which should perform configuration (like the `add_routes` callable we showed above as an example).

`include()` can also accept a *dotted Python name* to a function or a module.

28.3 Two-Phase Configuration

When a non-autocommitting *Configurator* is used to do configuration (the default), configuration execution happens in two phases. In the first phase, "eager" configuration actions (actions that must happen before all others, such as registering a renderer) are executed, and *discriminators* are computed for each of the actions that depend on the result of the eager actions. In the second phase, the discriminators of all actions are compared to do conflict detection.

Due to this, for configuration methods that have no internal ordering constraints, execution order of configuration method calls is not important. For example, the relative ordering of `add_view()` and `add_renderer()` is unimportant when a non-autocommitting configurator is used. This code snippet:

```
config.add_view('some.view', renderer='path_to_custom/renderer.rn')
config.add_renderer('.rn', SomeCustomRendererFactory)
```

Has the same result as:

```
config.add_renderer('.rn', SomeCustomRendererFactory)
config.add_view('some.view', renderer='path_to_custom/renderer.rn')
```

Even though the view statement depends on the registration of a custom renderer, due to two-phase configuration, the order in which the configuration statements are issued is not important. `add_view` will be able to find the `.rn` renderer even if `add_renderer` is called after `add_view`.

The same is untrue when you use an *autocommitting* configurator (see *Using An Autocommitting Configurator*). When an autocommitting configurator is used, two-phase configuration is disabled, and configuration statements must be ordered in dependency order.

Some configuration methods, such as `add_route()` have internal ordering constraints: the routes they imply require relative ordering. Such ordering constraints are not absolved by two-phase configuration. Routes are still added in configuration execution order.

28.4 Adding Methods to the Configurator via `add_directive`

Framework extension writers can add arbitrary methods to a *Configurator* by using the `pyramid.config.Configurator.add_directive()` method of the configurator. This makes it possible to extend a Pyramid configurator in arbitrary ways, and allows it to perform application-specific tasks more succinctly.

The `add_directive()` method accepts two positional arguments: a method name and a callable object. The callable object is usually a function that takes the configurator instance as its first argument and accepts other arbitrary positional and keyword arguments. For example:

```
from pyramid.events import NewRequest
from pyramid.config import Configurator

def add_newrequest_subscriber(config, subscriber):
    config.add_subscriber(subscriber, NewRequest).

if __name__ == '__main__':
   config = Configurator()
   config.add_directive('add_newrequest_subscriber',
                        add_newrequest_subscriber)
```

Once `add_directive()` is called, a user can then call the method by its given name as if it were a built-in method of the Configurator:

```
def mysubscriber(event):
   print event.request

config.add_newrequest_subscriber(mysubscriber)
```

A call to `add_directive()` is often "hidden" within an `includeme` function within a "frameworky" package meant to be included as per *Including Configuration from External Sources* via `include()`. For example, if you put this code in a package named `pyramid_subscriberhelpers`:

```
def includeme(config)
   config.add_directive('add_newrequest_subscriber',
                        add_newrequest_subscriber)
```

The user of the add-on package `pyramid_subscriberhelpers` would then be able to install it and subsequently do:

```
def mysubscriber(event):
   print event.request

from pyramid.config import Configurator
config = Configurator()
config.include('pyramid_subscriberhelpers')
config.add_newrequest_subscriber(mysubscriber)
```

CHAPTER 29

Extending An Existing Pyramid Application

If a Pyramid developer has obeyed certain constraints while building an application, a third party should be able to change the application's behavior without needing to modify its source code. The behavior of a Pyramid application that obeys certain constraints can be *overridden* or *extended* without modification.

We'll define some jargon here for the benefit of identifying the parties involved in such an effort.

Developer The original application developer.

Integrator Another developer who wishes to reuse the application written by the original application developer in an unanticipated context. He may also wish to modify the original application without changing the original application's source code.

29.1 The Difference Between "Extensible" and "Pluggable" Applications

Other web frameworks, such as *Django*, advertise that they allow developers to create "pluggable applications". They claim that if you create an application in a certain way, it will be integratable in a sensible, structured way into another arbitrarily-written application or project created by a third-party developer.

Pyramid, as a platform, does not claim to provide such a feature. The platform provides no guarantee that you can create an application and package it up such that an arbitrary integrator can use it as a subcomponent in a larger Pyramid application or project. Pyramid does not mandate the constraints necessary for such a pattern to work satisfactorily. Because Pyramid is not very "opinionated", developers are able to use wildly different patterns and technologies to build an application. A given Pyramid application

may happen to be reusable by a particular third party integrator, because the integrator and the original developer may share similar base technology choices (such as the use of a particular relational database or ORM). But the same application may not be reusable by a different developer, because he has made different technology choices which are incompatible with the original developer's.

As a result, the concept of a "pluggable application" is left to layers built above Pyramid, such as a "CMS" layer or "application server" layer. Such layers are apt to provide the necessary "opinions" (such as mandating a storage layer, a templating system, and a structured, well-documented pattern of registering that certain URLs map to certain bits of code) which makes the concept of a "pluggable application" possible. "Pluggable applications", thus, should not plug in to Pyramid itself but should instead plug into a system written atop Pyramid.

Although it does not provide for "pluggable applications", Pyramid *does* provide a rich set of mechanisms which allows for the extension of a single existing application. Such features can be used by frameworks built using Pyramid as a base. All Pyramid applications may not be *pluggable*, but all Pyramid applications are *extensible*.

29.2 Rules for Building An Extensible Application

There is only one rule you need to obey if you want to build a maximally extensible Pyramid application: as a developer, you should factor any overrideable *imperative configuration* you've created into functions which can be used via `pyramid.config.Configurator.include()` rather than inlined as calls to methods of a *Configurator* within the `main` function in your application's `__init__.py`. For example, rather than:

```
from pyramid.config import Configurator

if __name__ == '__main__':
    config = Configurator()
    config.add_view('myapp.views.view1', name='view1')
    config.add_view('myapp.views.view2', name='view2')
```

You should do move the calls to `add_view` outside of the (non-reusable) `if __name__ == '__main__'` block, and into a reusable function:

```
from pyramid.config import Configurator

if __name__ == '__main__':
    config = Configurator()
    config.include(add_views)

```

```
def add_views(config):
    config.add_view('myapp.views.view1', name='view1')
    config.add_view('myapp.views.view2', name='view2')
```

Doing this allows an integrator to maximally reuse the configuration statements that relate to your application by allowing him to selectively include or disinclude the configuration functions you've created from an "override package".

Alternately, you can use *ZCML* for the purpose of making configuration extensible and overrideable. *ZCML* declarations that belong to an application can be overridden and extended by integrators as necessary in a similar fashion. If you use only *ZCML* to configure your application, it will automatically be maximally extensible without any manual effort. See *pyramid_zcml* for information about using ZCML.

29.2.1 Fundamental Plugpoints

The fundamental "plug points" of an application developed using Pyramid are *routes*, *views*, and *assets*. Routes are declarations made using the `pyramid.config.Configurator.add_route()` method. Views are declarations made using the `pyramid.config.Configurator.add_view()` method. Assets are files that are accessed by Pyramid using the *pkg_resources* API such as static files and templates via a *asset specification*. Other directives and configurator methods also deal in routes, views, and assets. For example, the `add_handler` directive of the `pyramid_handlers` package adds a single route, and some number of views.

29.3 Extending an Existing Application

The steps for extending an existing application depend largely on whether the application does or does not use configuration decorators and/or imperative code.

29.3.1 If The Application Has Configuration Decorations

You've inherited a Pyramid application which you'd like to extend or override that uses `pyramid.view.view_config` decorators or other *configuration decoration* decorators.

If you just want to *extend* the application, you can run a *scan* against the application's package, then add additional configuration that registers more views or routes.

```
if __name__ == '__main__':
    config.scan('someotherpackage')
    config.add_view('mypackage.views.myview', name='myview')
```

If you want to *override* configuration in the application, you *may* need to run `pyramid.config.Configurator.commit()` after performing the scan of the original package, then add additional configuration that registers more views or routes which performs overrides.

```
if __name__ == '__main__':
    config.scan('someotherpackage')
    config.commit()
    config.add_view('mypackage.views.myview', name='myview')
```

Once this is done, you should be able to extend or override the application like any other (see *Extending the Application*).

You can alternately just prevent a *scan* from happening (by omitting any call to the `pyramid.config.Configurator.scan()` method). This will cause the decorators attached to objects in the target application to do nothing. At this point, you will need to convert all the configuration done in decorators into equivalent imperative configuration or ZCML and add that configuration or ZCML to a separate Python package as described in *Extending the Application*.

29.3.2 Extending the Application

To extend or override the behavior of an existing application, you will need to create a new package which includes the configuration of the old package, and you'll perhaps need to create implementations of the types of things you'd like to override (such as views), which are referred to within the original package.

The general pattern for extending an existing application looks something like this:

- Create a new Python package. The easiest way to do this is to create a new Pyramid application using the scaffold mechanism. See *Creating the Project* for more information.
- In the new package, create Python files containing views and other overridden elements, such as templates and static assets as necessary.
- Install the new package into the same Python environment as the original application (e.g. `python setup.py develop` or `python setup.py install`).

- Change the `main` function in the new package's `__init__.py` to include the original Pyramid application's configuration functions via `pyramid.config.Configurator.include()` statements or a *scan*.

- Wire the new views and assets created in the new package up using imperative registrations within the `main` function of the `__init__.py` file of the new application. These wiring should happen *after* including the configuration functions of the old application. These registrations will extend or override any registrations performed by the original application. See *Overriding Views*, *Overriding Routes* and *Overriding Assets*.

29.3.3 Overriding Views

The *view configuration* declarations you make which *override* application behavior will usually have the same *view predicate* attributes as the original you wish to override. These `<view>` declarations will point at "new" view code, in the override package you've created. The new view code itself will usually be cut-n-paste copies of view callables from the original application with slight tweaks.

For example, if the original application has the following `configure_views` configuration method:

```
def configure_views(config):
    config.add_view('theoriginalapp.views.theview', name='theview')
```

You can override the first view configuration statement made by `configure_views` within the override package, after loading the original configuration function:

```
from pyramid.config import Configurator
from originalapp import configure_views

if __name__ == '__main__':
    config = Configurator()
    config.include(configure_views)
    config.add_view('theoverrideapp.views.theview', name='theview')
```

In this case, the `theoriginalapp.views.theview` view will never be executed. Instead, a new view, `theoverrideapp.views.theview` will be executed instead, when request circumstances dictate.

A similar pattern can be used to *extend* the application with `add_view` declarations. Just register a new view against some other set of predicates to make sure the URLs it implies are available on some other page rendering.

29.3.4 Overriding Routes

Route setup is currently typically performed in a sequence of ordered calls to `add_route()`. Because these calls are ordered relative to each other, and because this ordering is typically important, you should retain their relative ordering when performing an override. Typically, this means *copying* all the `add_route` statements into the override package's file and changing them as necessary. Then disinclude any `add_route` statements from the original application.

29.3.5 Overriding Assets

Assets are files on the filesystem that are accessible within a Python *package*. An entire chapter is devoted to assets: *Static Assets*. Within this chapter is a section named *Overriding Assets*. This section of that chapter describes in detail how to override package assets with other assets by using the `pyramid.config.Configurator.override_asset()` method. Add such `override_asset` calls to your override package's `__init__.py` to perform overrides.

CHAPTER 30

Startup

When you cause a Pyramid application to start up in a console window, you'll see something much like this show up on the console:

```
$ paster serve myproject/MyProject.ini
Starting server in PID 16601.
serving on 0.0.0.0:6543 view at http://127.0.0.1:6543
```

This chapter explains what happens between the time you press the "Return" key on your keyboard after typing `paster serve myproject/MyProject.ini` and the time the line `serving on 0.0.0.0:6543 ...` is output to your console.

30.1 The Startup Process

The easiest and best-documented way to start and serve a Pyramid application is to use the `paster serve` command against a *PasteDeploy* `.ini` file. This uses the `.ini` file to infer settings and starts a server listening on a port. For the purposes of this discussion, we'll assume that you are using this command to run your Pyramid application.

Here's a high-level time-ordered overview of what happens when you press `return` after running `paster serve development.ini`.

1. The *PasteDeploy* `paster` command is invoked under your shell with the arguments `serve` and `development.ini`. As a result, the *PasteDeploy* framework recognizes that it is meant to begin to run and serve an application using the information contained within the `development.ini` file.

2. The PasteDeploy framework finds a section named either `[app:main]`, `[pipeline:main]`, or `[composite:main]` in the `.ini` file. This section represents the configuration of a *WSGI* application that will be served. If you're using a simple application (e.g. `[app:main]`), the application *entry point* or *dotted Python name* will be named on the `use=` line within the section's configuration. If, instead of a simple application, you're using a WSGI *pipeline* (e.g. a `[pipeline:main]` section), the application named on the "last" element will refer to your Pyramid application. If instead of a simple application or a pipeline, you're using a Paste "composite" (e.g. `[composite:main]`), refer to the documentation for that particular composite to understand how to make it refer to your Pyramid application. In most cases, a Pyramid application built from a scaffold will have a single `[app:main]` section in it, and this will be the application served.

3. The PasteDeploy framework finds all `logging` related configuration in the `.ini` file and uses it to configure the Python standard library logging system for this application.

4. The application's *constructor* (named by the entry point reference or dotted Python name on the `use=` line of the section representing your Pyramid application) is passed the key/value parameters mentioned within the section in which it's defined. The constructor is meant to return a *router* instance, which is a *WSGI* application.

   For Pyramid applications, the constructor will be a function named `main` in the `__init__.py` file within the *package* in which your application lives. If this function succeeds, it will return a Pyramid *router* instance. Here's the contents of an example `__init__.py` module:

```
from pyramid.config import Configurator
from myproject.resources import Root

def main(global_config, **settings):
    """ This function returns a Pyramid WSGI application.
    """
    config = Configurator(root_factory=Root, settings=settings)
    config.add_view('myproject.views.my_view',
                    context='myproject.resources.Root',
                    renderer='myproject:templates/mytemplate.pt')
    config.add_static_view('static', 'myproject:static')
    return config.make_wsgi_app()
```

   Note that the constructor function accepts a `global_config` argument, which is a dictionary of key/value pairs mentioned in the `[DEFAULT]` section of an `.ini` file. It also accepts a `**settings` argument, which collects another set of arbitrary key/value pairs. The arbitrary key/value pairs received by this function in `**settings` will be composed of all the key/value pairs that are present in the `[app:main]` section (except for the `use=` setting) when this function is called by the *PasteDeploy* framework when you run `paster serve`.

   Our generated `development.ini` file looks like so:

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

pyramid.reload_templates = true
pyramid.debug_authorization = false
pyramid.debug_notfound = false
pyramid.debug_routematch = false
pyramid.debug_templates = true
pyramid.default_locale_name = en
pyramid.includes = pyramid_debugtoolbar

[server:main]
use = egg:Paste#http
host = 0.0.0.0
port = 6543

# Begin logging configuration

[loggers]
keys = root, myproject

[handlers]
keys = console

[formatters]
keys = generic

[logger_root]
level = INFO
handlers = console

[logger_myproject]
level = DEBUG
handlers =
qualname = myproject

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

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

# End logging configuration
```

In this case, the `myproject.__init__:main` function referred to by the entry point URI `egg:MyProject` (see *development.ini* for more information about entry point URIs, and how they relate to callables), will receive the key/value pairs `{'pyramid.reload_templates':'true', 'pyramid.debug_authorization':'false', 'pyramid.debug_notfound':'false', 'pyramid.debug_routematch':'false', 'pyramid.debug_templates':'true', 'pyramid.default_locale_name':'en'}`.

5. The `main` function first constructs a `Configurator` instance, passing a root resource factory (constructor) to it as its `root_factory` argument, and `settings` dictionary captured via the `**settings` kwarg as its `settings` argument.

   The root resource factory is invoked on every request to retrieve the application's root resource. It is not called during startup, only when a request is handled.

   The `settings` dictionary contains all the options in the `[app:main]` section of our .ini file except the `use` option (which is internal to Paste) such as `pyramid.reload_templates`, `pyramid.debug_authorization`, etc.

6. The `main` function then calls various methods on the instance of the class `Configurator` created in the previous step. The intent of calling these methods is to populate an *application registry*, which represents the Pyramid configuration related to the application.

7. The `make_wsgi_app()` method is called. The result is a *router* instance. The router is associated with the *application registry* implied by the configurator previously populated by other methods run against the Configurator. The router is a WSGI application.

8. A `ApplicationCreated` event is emitted (see *Using Events* for more information about events).

9. Assuming there were no errors, the `main` function in `myproject` returns the router instance created by `pyramid.config.Configurator.make_wsgi_app()` back to PasteDeploy. As far as PasteDeploy is concerned, it is "just another WSGI application".

10. PasteDeploy starts the WSGI *server* defined within the `[server:main]` section. In our case, this is the `Paste#http` server (`use = egg:Paste#http`), and it will listen on all interfaces (`host = 0.0.0.0`), on port number 6543 (`port = 6543`). The server code itself is what prints `serving on 0.0.0.0:6543 view at http://127.0.0.1:6543`. The server serves the application, and the application is running, waiting to receive requests.

30.2 Deployment Settings

Note that an augmented version of the values passed as `**settings` to the `Configurator` constructor will be available in Pyramid *view callable* code as `request.registry.settings`. You can create objects you wish to access later from view code, and put them into the dictionary you pass to the configurator as `settings`. They will then be present in the `request.registry.settings` dictionary at application runtime.

CHAPTER 31

Thread Locals

A *thread local* variable is a variable that appears to be a "global" variable to an application which uses it. However, unlike a true global variable, one thread or process serving the application may receive a different value than another thread or process when that variable is "thread local".

When a request is processed, Pyramid makes two *thread local* variables available to the application: a "registry" and a "request".

31.1 Why and How Pyramid Uses Thread Local Variables

How are thread locals beneficial to Pyramid and application developers who use Pyramid? Well, usually they're decidedly **not**. Using a global or a thread local variable in any application usually makes it a lot harder to understand for a casual reader. Use of a thread local or a global is usually just a way to avoid passing some value around between functions, which is itself usually a very bad idea, at least if code readability counts as an important concern.

For historical reasons, however, thread local variables are indeed consulted by various Pyramid API functions. For example, the implementation of the `pyramid.security` function named `authenticated_userid()` retrieves the thread local *application registry* as a matter of course to find an *authentication policy*. It uses the `pyramid.threadlocal.get_current_registry()` function to retrieve the application registry, from which it looks up the authentication policy; it then uses the authentication policy to retrieve the authenticated user id. This is how Pyramid allows arbitrary authentication policies to be "plugged in".

When they need to do so, Pyramid internals use two API functions to retrieve the *request* and *application registry*: `get_current_request()` and `get_current_registry()`. The former returns the

"current" request; the latter returns the "current" registry. Both `get_current_*` functions retrieve an object from a thread-local data structure. These API functions are documented in *pyramid.threadlocal*.

These values are thread locals rather than true globals because one Python process may be handling multiple simultaneous requests or even multiple Pyramid applications. If they were true globals, Pyramid could not handle multiple simultaneous requests or allow more than one Pyramid application instance to exist in a single Python process.

Because one Pyramid application is permitted to call *another* Pyramid application from its own *view* code (perhaps as a *WSGI* app with help from the `pyramid.wsgi.wsgiapp2()` decorator), these variables are managed in a *stack* during normal system operations. The stack instance itself is a threading.local.

During normal operations, the thread locals stack is managed by a *Router* object. At the beginning of a request, the Router pushes the application's registry and the request on to the stack. At the end of a request, the stack is popped. The topmost request and registry on the stack are considered "current". Therefore, when the system is operating normally, the very definition of "current" is defined entirely by the behavior of a pyramid *Router*.

However, during unit testing, no Router code is ever invoked, and the definition of "current" is defined by the boundary between calls to the `pyramid.config.Configurator.begin()` and `pyramid.config.Configurator.end()` methods (or between calls to the `pyramid.testing.setUp()` and `pyramid.testing.tearDown()` functions). These functions push and pop the threadlocal stack when the system is under test. See *Test Set Up and Tear Down* for the definitions of these functions.

Scripts which use Pyramid machinery but never actually start a WSGI server or receive requests via HTTP such as scripts which use the `pyramid.scripting` API will never cause any Router code to be executed. However, the `pyramid.scripting` APIs also push some values on to the thread locals stack as a matter of course. Such scripts should expect the `get_current_request()` function to always return `None`, and should expect the `get_current_registry()` function to return exactly the same *application registry* for every request.

31.2 Why You Shouldn't Abuse Thread Locals

You probably should almost never use the `get_current_request()` or `get_current_registry()` functions, except perhaps in tests. In particular, it's almost always a mistake to use `get_current_request` or `get_current_registry` in application code because its usage makes it possible to write code that can be neither easily tested nor scripted. Inappropriate usage is defined as follows:

- `get_current_request` should never be called within the body of a *view callable*, or within code called by a view callable. View callables already have access to the request (it's passed in to each as `request`).

- `get_current_request` should never be called in *resource* code. If a resource needs access to the request, it should be passed the request by a *view callable*.

- `get_current_request` function should never be called because it's "easier" or "more elegant" to think about calling it than to pass a request through a series of function calls when creating some API design. Your application should instead almost certainly pass data derived from the request around rather than relying on being able to call this function to obtain the request in places that actually have no business knowing about it. Parameters are *meant* to be passed around as function arguments, this is why they exist. Don't try to "save typing" or create "nicer APIs" by using this function in the place where a request is required; this will only lead to sadness later.

- Neither `get_current_request` nor `get_current_registry` should ever be called within application-specific forks of third-party library code. The library you've forked almost certainly has nothing to do with Pyramid, and making it dependent on Pyramid (rather than making your `pyramid` application depend upon it) means you're forming a dependency in the wrong direction.

Use of the `get_current_request()` function in application code *is* still useful in very limited circumstances. As a rule of thumb, usage of `get_current_request` is useful **within code which is meant to eventually be removed**. For instance, you may find yourself wanting to deprecate some API that expects to be passed a request object in favor of one that does not expect to be passed a request object. But you need to keep implementations of the old API working for some period of time while you deprecate the older API. So you write a "facade" implementation of the new API which calls into the code which implements the older API. Since the new API does not require the request, your facade implementation doesn't have local access to the request when it needs to pass it into the older API implementation. After some period of time, the older implementation code is disused and the hack that uses `get_current_request` is removed. This would be an appropriate place to use the `get_current_request`.

Use of the `get_current_registry()` function should be limited to testing scenarios. The registry made current by use of the `pyramid.config.Configurator.begin()` method during a test (or via `pyramid.testing.setUp()`) when you do not pass one in is available to you via this API.

CHAPTER 32

Using the Zope Component Architecture in Pyramid

Under the hood, Pyramid uses a *Zope Component Architecture* component registry as its *application registry*. The Zope Component Architecture is referred to colloquially as the "ZCA."

The `zope.component` API used to access data in a traditional Zope application can be opaque. For example, here is a typical "unnamed utility" lookup using the `zope.component.getUtility()` global API as it might appear in a traditional Zope application:

```
from pyramid.interfaces import ISettings
from zope.component import getUtility
settings = getUtility(ISettings)
```

After this code runs, `settings` will be a Python dictionary. But it's unlikely that any "civilian" will be able to figure this out just by reading the code casually. When the `zope.component.getUtility` API is used by a developer, the conceptual load on a casual reader of code is high.

While the ZCA is an excellent tool with which to build a *framework* such as Pyramid, it is not always the best tool with which to build an *application* due to the opacity of the `zope.component` APIs. Accordingly, Pyramid tends to hide the presence of the ZCA from application developers. You needn't understand the ZCA to create a Pyramid application; its use is effectively only a framework implementation detail.

However, developers who are already used to writing *Zope* applications often still wish to use the ZCA while building a Pyramid application; `pyramid` makes this possible.

32.1 Using the ZCA Global API in a Pyramid Application

Zope uses a single ZCA registry – the "global" ZCA registry – for all Zope applications that run in the same Python process, effectively making it impossible to run more than one Zope application in a single process.

However, for ease of deployment, it's often useful to be able to run more than a single application per process. For example, use of a *Paste* "composite" allows you to run separate individual WSGI applications in the same process, each answering requests for some URL prefix. This makes it possible to run, for example, a TurboGears application at `/turbogears` and a Pyramid application at `/pyramid`, both served up using the same *WSGI* server within a single Python process.

Most production Zope applications are relatively large, making it impractical due to memory constraints to run more than one Zope application per Python process. However, a Pyramid application may be very small and consume very little memory, so it's a reasonable goal to be able to run more than one Pyramid application per process.

In order to make it possible to run more than one Pyramid application in a single process, Pyramid defaults to using a separate ZCA registry *per application*.

While this services a reasonable goal, it causes some issues when trying to use patterns which you might use to build a typical *Zope* application to build a Pyramid application. Without special help, ZCA "global" APIs such as `zope.component.getUtility` and `zope.component.getSiteManager` will use the ZCA "global" registry. Therefore, these APIs will appear to fail when used in a Pyramid application, because they'll be consulting the ZCA global registry rather than the component registry associated with your Pyramid application.

There are three ways to fix this: by disusing the ZCA global API entirely, by using `pyramid.config.Configurator.hook_zca()` or by passing the ZCA global registry to the *Configurator* constructor at startup time. We'll describe all three methods in this section.

32.1.1 Disusing the Global ZCA API

ZCA "global" API functions such as `zope.component.getSiteManager`, `zope.component.getUtility`, `zope.component.getAdapter`, and `zope.component.getMultiAdapter` aren't strictly necessary. Every component registry has a method API that offers the same functionality; it can be used instead. For example, presuming the `registry` value below is a Zope Component Architecture component registry, the following bit of code is equivalent to `zope.component.getUtility(IFoo)`:

```
registry.getUtility(IFoo)
```

The full method API is documented in the `zope.component` package, but it largely mirrors the "global" API almost exactly.

If you are willing to disuse the "global" ZCA APIs and use the method interface of a registry instead, you need only know how to obtain the Pyramid component registry.

There are two ways of doing so:

- use the `pyramid.threadlocal.get_current_registry()` function within Pyramid view or resource code. This will always return the "current" Pyramid application registry.
- use the attribute of the *request* object named `registry` in your Pyramid view code, eg. `request.registry`. This is the ZCA component registry related to the running Pyramid application.

See *Thread Locals* for more information about `pyramid.threadlocal.get_current_registry()`.

32.1.2 Enabling the ZCA Global API by Using `hook_zca`

Consider the following bit of idiomatic Pyramid startup code:

```
from zope.component import getGlobalSiteManager
from pyramid.config import Configurator

def app(global_settings, **settings):
    config = Configurator(settings=settings)
    config.include('some.other.package')
    return config.make_wsgi_app()
```

When the `app` function above is run, a *Configurator* is constructed. When the configurator is created, it creates a *new application registry* (a ZCA component registry). A new registry is constructed whenever the `registry` argument is omitted when a *Configurator* constructor is called, or when a `registry` argument with a value of `None` is passed to a *Configurator* constructor.

During a request, the application registry created by the Configurator is "made current". This means calls to `get_current_registry()` in the thread handling the request will return the component registry associated with the application.

As a result, application developers can use `get_current_registry` to get the registry and thus get access to utilities and such, as per *Disusing the Global ZCA API*. But they still cannot use the global ZCA API. Without special treatment, the ZCA global APIs will always return the global ZCA registry (the one in `zope.component.globalregistry.base`).

To "fix" this and make the ZCA global APIs use the "current" Pyramid registry, you need to call `hook_zca()` within your setup code. For example:

```
1 from zope.component import getGlobalSiteManager
2 from pyramid.config import Configurator
3
4 def app(global_settings, **settings):
5     config = Configurator(settings=settings)
6     config.hook_zca()
7     config.include('some.other.application')
8     return config.make_wsgi_app()
```

We've added a line to our original startup code, line number 6, which calls `config.hook_zca()`. The effect of this line under the hood is that an analogue of the following code is executed:

```
1 from zope.component import getSiteManager
2 from pyramid.threadlocal import get_current_registry
3 getSiteManager.sethook(get_current_registry)
```

This causes the ZCA global API to start using the Pyramid application registry in threads which are running a Pyramid request.

Calling `hook_zca` is usually sufficient to "fix" the problem of being able to use the global ZCA API within a Pyramid application. However, it also means that a Zope application that is running in the same process may start using the Pyramid global registry instead of the Zope global registry, effectively inverting the original problem. In such a case, follow the steps in the next section, *Enabling the ZCA Global API by Using The ZCA Global Registry*.

32.1.3 Enabling the ZCA Global API by Using The ZCA Global Registry

You can tell your Pyramid application to use the ZCA global registry at startup time instead of constructing a new one:

```
1 from zope.component import getGlobalSiteManager
2 from pyramid.config import Configurator
3
4 def app(global_settings, **settings):
5     globalreg = getGlobalSiteManager()
6     config = Configurator(registry=globalreg)
7     config.setup_registry(settings=settings)
8     config.include('some.other.application')
9     return config.make_wsgi_app()
```

Lines 5, 6, and 7 above are the interesting ones. Line 5 retrieves the global ZCA component registry. Line 6 creates a *Configurator*, passing the global ZCA registry into its constructor as the `registry` argument. Line 7 "sets up" the global registry with Pyramid-specific registrations; this is code that is normally executed when a registry is constructed rather than created, but we must call it "by hand" when we pass an explicit registry.

At this point, Pyramid will use the ZCA global registry rather than creating a new application-specific registry; since by default the ZCA global API will use this registry, things will work as you might expect a Zope app to when you use the global ZCA API.

Part II

Tutorials

CHAPTER 33

ZODB + Traversal Wiki Tutorial

This tutorial introduces a *traversal* -based Pyramid application to a developer familiar with Python. It will be most familiar to developers with previous *Zope* experience. When we're done with the tutorial, the developer will have created a basic Wiki application with authentication.

For cut and paste purposes, the source code for all stages of this tutorial can be browsed at http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki/src/.

33.1 Background

This version of the Pyramid wiki tutorial presents a Pyramid application that uses technologies which will be familiar to someone with *Zope* experience. It uses *ZODB* as a persistence mechanism and *traversal* to map URLs to code. It can also be followed by people without any prior Python web framework experience.

To code along with this tutorial, the developer will need a UNIX machine with development tools (Mac OS X with XCode, any Linux or BSD variant, etc) *or* a Windows system of any kind.

Have fun!

33.2 Installation

For the most part, the installation process for this tutorial duplicates the steps described in *Installing Pyramid* and *Creating a Pyramid Project*, however it also explains how to install additional libraries for tutorial purposes.

33.2.1 Preparation

Please take the following steps to prepare for the tutorial. The steps to prepare for the tutorial are slightly different depending on whether you're using UNIX or Windows.

Preparation, UNIX

1. If you don't already have a Python 2.6 interpreter installed on your system, obtain, install, or find Python 2.6 for your system.

2. Make sure the Python development headers are installed on your system. If you've installed Python from source, these will already be installed. If you're using a system Python, you may have to install a `python-dev` package (e.g. `apt-get python-dev`). The headers are not required for Pyramid itself, just for dependencies of the tutorial.

3. Install the latest *setuptools* into the Python you obtained/installed/found in the step above: download ez_setup.py and run it using the `python` interpreter of your Python 2.6 installation:

```
$ /path/to/my/Python-2.6/bin/python ez_setup.py
```

4. Use that Python's *bin/easy_install* to install *virtualenv*:

```
$ /path/to/my/Python-2.6/bin/easy_install virtualenv
```

5. Use that Python's virtualenv to make a workspace:

```
$ path/to/my/Python-2.6/bin/virtualenv --no-site-packages \
          pyramidtut
```

6. Switch to the `pyramidtut` directory:

```
$ cd pyramidtut
```

7. (Optional) Consider using `source bin/activate` to make your shell environment wired to use the virtualenv.

8. Use `easy_install` to get Pyramid and its direct dependencies installed:

```
$ bin/easy_install pyramid
```

9. Use `easy_install` to install `docutils`, `pyramid_tm`, `pyramid_zodbconn`, `pyramid_debugtoolbar`, `nose` and `coverage`:

```
$ bin/easy_install docutils pyramid_tm pyramid_zodbconn \
          pyramid_debugtoolbar nose coverage
```

Preparation, Windows

1. Install, or find Python 2.6 for your system.

2. Install the latest *setuptools* into the Python you obtained/installed/found in the step above: download ez_setup.py and run it using the `python` interpreter of your Python 2.6 installation using a command prompt:

```
c:\> c:\Python26\python ez_setup.py
```

3. Use that Python's *bin/easy_install* to install *virtualenv*:

```
c:\> c:\Python26\Scripts\easy_install virtualenv
```

4. Use that Python's virtualenv to make a workspace:

```
c:\> c:\Python26\Scripts\virtualenv --no-site-packages pyramidtut
```

5. Switch to the `pyramidtut` directory:

```
c:\> cd pyramidtut
```

6. (Optional) Consider using `bin\activate.bat` to make your shell environment wired to use the virtualenv.

7. Use `easy_install` to get Pyramid and its direct dependencies installed:

```
c:\pyramidtut> Scripts\easy_install pyramid
```

8. Use `easy_install` to install `docutils`, `pyramid_tm`, `pyramid_zodbconn`, `pyramid_debugtoolbar`, `nose` and `coverage`:

```
c:\pyramidtut> Scripts\easy_install docutils pyramid_tm \
      pyramid_zodbconn pyramid_debugtoolbar nose coverage
```

33.2.2 Making a Project

Your next step is to create a project. Pyramid supplies a variety of scaffolds to generate sample projects. For this tutorial, we will use the *ZODB* -oriented scaffold named `pyramid_zodb`.

The below instructions assume your current working directory is the "virtualenv" named "pyramidtut".

On UNIX:

```
$ bin/paster create -t pyramid_zodb tutorial
```

On Windows:

```
c:\pyramidtut> Scripts\paster create -t pyramid_zodb tutorial
```

 If you are using Windows, the `pyramid_zodb` Paster scaffold doesn't currently deal gracefully with installation into a location that contains spaces in the path. If you experience startup problems, try putting both the virtualenv and the project into directories that do not contain spaces in their paths.

33.2.3 Installing the Project in "Development Mode"

In order to do development on the project easily, you must "register" the project as a development egg in your workspace using the `setup.py develop` command. In order to do so, cd to the "tutorial" directory you created in *Making a Project*, and run the "setup.py develop" command using virtualenv Python interpreter.

On UNIX:

```
$ cd tutorial
$ ../bin/python setup.py develop
```

On Windows:

```
C:\pyramidtut> cd tutorial
C:\pyramidtut\tutorial> ..\Scripts\python setup.py develop
```

33.2.4 Running the Tests

After you've installed the project in development mode, you may run the tests for the project.

On UNIX:

```
$ ../bin/python setup.py test -q
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\python setup.py test -q
```

33.2.5 Starting the Application

Start the application.

On UNIX:

```
$ ../bin/paster serve development.ini --reload
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\paster serve development.ini --reload
```

33.2.6 Exposing Test Coverage Information

You can run the `nosetests` command to see test coverage information. This runs the tests in the same way that `setup.py test` does but provides additional "coverage" information, exposing which lines of your project are "covered" (or not covered) by the tests.

On UNIX:

```
$ ../bin/nosetests --cover-package=tutorial --cover-erase --with-coverage
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\nosetests --cover-package=tutorial ^
     --cover-erase --with-coverage
```

Looks like the code in the `pyramid_zodb` scaffold for ZODB projects is missing some test coverage, particularly in the file named `models.py`.

33.2.7 Visit the Application in a Browser

In a browser, visit http://localhost:6543/. You will see the generated application's default page.

One thing you'll notice is the "debug toolbar" icon on right hand side of the page. You can read more about the purpose of the icon at *The Debug Toolbar*. It allows you to get information about your application while you develop.

33.2.8 Decisions the `pyramid_zodb` Scaffold Has Made For You

Creating a project using the `pyramid_zodb` scaffold makes the following assumptions:

- you are willing to use *ZODB* as persistent storage
- you are willing to use *traversal* to map URLs to code.

 Pyramid supports any persistent storage mechanism (e.g. a SQL database or filesystem files, etc). Pyramid also supports an additional mechanism to map URLs to code (*URL dispatch*). However, for the purposes of this tutorial, we'll only be using traversal and ZODB.

33.3 Basic Layout

The starter files generated by the `pyramid_zodb` scaffold are basic, but they provide a good orientation for the high-level patterns common to most *traversal* -based Pyramid (and *ZODB* based) projects.

The source code for this tutorial stage can be browsed via http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki/src/basiclayout/.

33.3.1 App Startup with `__init__.py`

A directory on disk can be turned into a Python *package* by containing an `__init__.py` file. Even if empty, this marks a directory as a Python package. Our application uses `__init__.py` as both a package marker, as well as to contain application configuration code.

When you run the application using the `paster` command using the `development.ini` generated config file, the application configuration points at a Setuptools *entry point* described as `egg:tutorial`. In our application, because the application's `setup.py` file says so, this entry point happens to be the `main` function within the file named `__init__.py`:

```
1  from pyramid.config import Configurator
2  from pyramid_zodbconn import get_connection
3  from tutorial.models import appmaker
4
5  def root_factory(request):
6      conn = get_connection(request)
7      return appmaker(conn.root())
8
9  def main(global_config, **settings):
10     """ This function returns a Pyramid WSGI application.
11     """
12     config = Configurator(root_factory=root_factory, settings=settings)
13     config.add_static_view('static', 'tutorial:static', cache_max_age=3600)
14     config.scan('tutorial')
15     return config.make_wsgi_app()
```

1. *Lines 1-3*. Perform some dependency imports.

2. *Lines 5-7* Define a root factory for our Pyramid application.

3. *Line 12*. We construct a *Configurator* with a *root factory* and the settings keywords parsed by PasteDeploy. The root factory is named `get_root`.

4. *Line 13*. Register a 'static view' which answers requests which start with with URL path `/static` using the `pyramid.config.Configurator.add_static_view method()`. This statement registers a view that will serve up static assets, such as CSS and image files, for us, in this case, at `http://localhost:6543/static/` and below. The first argument is the "name" `static`, which indicates that the URL path prefix of the view will be `/static`. the The second argument of this tag is the "path", which is an *asset specification*, so it finds the resources it should serve within the `static` directory inside the `tutorial` package.

5. *Line 14*. Perform a *scan*. A scan will find *configuration decoration*, such as view configuration decorators (e.g. `@view_config`) in the source code of the `tutorial` package and will take actions based on these decorators. The argument to `scan()` is the package name to scan, which is `tutorial`.

6. *Line 15*. Use the `pyramid.config.Configurator.make_wsgi_app()` method to return a *WSGI* application.

33.3.2 Resources and Models with `models.py`

Pyramid uses the word *resource* to describe objects arranged hierarchically in a *resource tree*. This tree is consulted by *traversal* to map URLs to code. In this application, the resource tree represents the site structure, but it *also* represents the *domain model* of the application, because each resource is a node stored persistently in a *ZODB* database. The `models.py` file is where the `pyramid_zodb` scaffold put the classes that implement our resource objects, each of which happens also to be a domain model object.

Here is the source for `models.py`:

```
1  from persistent.mapping import PersistentMapping
2
3  class MyModel(PersistentMapping):
4      __parent__ = __name__ = None
5
6  def appmaker(zodb_root):
7      if not 'app_root' in zodb_root:
8          app_root = MyModel()
9          zodb_root['app_root'] = app_root
10         import transaction
11         transaction.commit()
12     return zodb_root['app_root']
```

1. *Lines 3-4*. The `MyModel` *resource* class is implemented here. Instances of this class will be capable of being persisted in *ZODB* because the class inherits from the `persistent.mapping.PersistentMapping` class. The `__parent__` and `__name__` are important parts of the *traversal* protocol. By default, have these as `None` indicating that this is the *root* object.

2. *Lines 6-12*. `appmaker` is used to return the *application root* object. It is called on *every request* to the Pyramid application. It also performs bootstrapping by *creating* an application root (inside the ZODB root object) if one does not already exist. It is used by the "root_factory" we've defined in our `__init__.py`.

   We do so by first seeing if the database has the persistent application root. If not, we make an instance, store it, and commit the transaction. We then return the application root object.

33.3.3 Views With `views.py`

Our scaffold generated a default `views.py` on our behalf. It contains a single view, which is used to render the page shown when you visit the URL `http://localhost:6543/`.

Here is the source for `views.py`:

```
1  from pyramid.view import view_config
2  from tutorial.models import MyModel
3
4  @view_config(context=MyModel,
5               renderer='tutorial:templates/mytemplate.pt')
6  def my_view(request):
7      return {'project':'tutorial'}
```

Let's try to understand the components in this module:

1. *Lines 1-2*. Perform some dependency imports.

2. *Line 4*. Use the `pyramid.view.view_config()` *configuration decoration* to perform a *view configuration* registration. This view configuration registration will be activated when the application is started. It will be activated by virtue of it being found as the result of a *scan* (when Line 17 of `__init__.py` is run).

   The `@view_config` decorator accepts a number of keyword arguments. We use two keyword arguments here: `context` and `renderer`.

The `context` argument signifies that the decorated view callable should only be run when *traversal* finds the `tutorial.models.MyModel` *resource* to be the *context* of a request. In English, this means that when the URL `/` is visited, because `MyModel` is the root model, this view callable will be invoked.

The `renderer` argument names an *asset specification* of `tutorial:templates/mytemplate.pt`. This asset specification points at a *Chameleon* template which lives in the `mytemplate.pt` file within the `templates` directory of the `tutorial` package. And indeed if you look in the `templates` directory of this package, you'll see a `mytemplate.pt` template file, which renders the default home page of the generated project.

Since this call to `@view_config` doesn't pass a `name` argument, the `my_view` function which it decorates represents the "default" view callable used when the context is of the type `MyModel`.

3. *Lines 5-6*. We define a *view callable* named `my_view`, which we decorated in the step above. This view callable is a *function* we write generated by the `pyramid_zodb` scaffold that is given a `request` and which returns a dictionary. The `mytemplate.pt` *renderer* named by the asset specification in the step above will convert this dictionary to a *response* on our behalf.

   The function returns the dictionary `{'project':'tutorial'}`. This dictionary is used by the template named by the `mytemplate.pt` asset specification to fill in certain values on the page.

33.3.4 Configuration in `development.ini`

The `development.ini` (in the tutorial *project* directory, as opposed to the tutorial *package* directory) looks like this:

```
[app:main]
use = egg:tutorial
pyramid.reload_templates = true
pyramid.debug_authorization = false
pyramid.debug_notfound = false
pyramid.debug_routematch = false
pyramid.debug_templates = true
pyramid.default_locale_name = en
pyramid.includes = pyramid_debugtoolbar
                   pyramid_zodbconn
                   pyramid_tm
tm.attempts = 3
zodbconn.uri = file://%(here)s/Data.fs?connection_cache_size=20000

[server:main]
```

```
use = egg:Paste#http
host = 0.0.0.0
port = 6543

# Begin 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] %(message)s

# End logging configuration
```

Note the existence of an `[app:main]` section which specifies our WSGI application. Our ZODB database settings are specified as the `zodbconn.uri` setting within this section. This value, and the other values within this section are passed as `**settings` to the `main` function we defined in `__init__.py` when the server is started via `paster serve`.

33.4 Defining the Domain Model

The first change we'll make to our stock paster-generated application will be to define two *resource* constructors, one representing a wiki page, and another representing the wiki as a mapping of wiki page names to page objects. We'll do this inside our `models.py` file.

Because we're using *ZODB* to represent our *resource tree*, each of these resource constructors represents a *domain model* object, so we'll call these constructors "model constructors". Both our Page and Wiki

constructors will be class objects. A single instance of the "Wiki" class will serve as a container for "Page" objects, which will be instances of the "Page" class.

The source code for this tutorial stage can be browsed via http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki/src/models/.

33.4.1 Deleting the Database

In the next step, we're going to remove the `MyModel` Python model class from our `models.py` file. Since this class is referred to within our persistent storage (represented on disk as a file named `Data.fs`), we'll have strange things happen the next time we want to visit the application in a browser. Remove the `Data.fs` from the `tutorial` directory before proceeding any further. It's always fine to do this as long as you don't care about the content of the database; the database itself will be recreated as necessary.

33.4.2 Making Edits to `models.py`

There is nothing automagically special about the filename `models.py`. A project may have many models throughout its codebase in arbitrarily-named files. Files implementing models often have `model` in their filenames, or they may live in a Python subpackage of your application package named `models`, but this is only by convention.

The first thing we want to do is remove the `MyModel` class from the generated `models.py` file. The `MyModel` class is only a sample and we're not going to use it.

Then, we'll add a `Wiki` class. We want it to inherit from the `persistent.mapping.PersistentMapping` class because it provides mapping behavior, and it makes sure that our Wiki page is stored as a "first-class" persistent object in our ZODB database.

Our `Wiki` class should have two attributes set to `None` at class scope: `__parent__` and `__name__`. If a model has a `__parent__` attribute of `None` in a traversal-based Pyramid application, it means that it's the *root* model. The `__name__` of the root model is also always `None`.

Then we'll add a `Page` class. This class should inherit from the `persistent.Persistent` class. We'll also give it an `__init__` method that accepts a single parameter named `data`. This parameter will contain the *ReStructuredText* body representing the wiki page content. Note that `Page` objects don't have an initial `__name__` or `__parent__` attribute. All objects in a traversal graph must have a `__name__` and a `__parent__` attribute. We don't specify these here because both `__name__` and `__parent__` will be set by by a *view* function when a Page is added to our Wiki mapping.

As a last step, we want to change the `appmaker` function in our `models.py` file so that the *root resource* of our application is a Wiki instance. We'll also slot a single page object (the front page) into the Wiki within the `appmaker`. This will provide *traversal* a *resource tree* to work against when it attempts to resolve URLs to resources.

33.4.3 Looking at the Result of Our Edits to `models.py`

The result of all of our edits to `models.py` will end up looking something like this:

```
from persistent import Persistent
from persistent.mapping import PersistentMapping

class Wiki(PersistentMapping):
    __name__ = None
    __parent__ = None

class Page(Persistent):
    def __init__(self, data):
        self.data = data

def appmaker(zodb_root):
    if not 'app_root' in zodb_root:
        app_root = Wiki()
        frontpage = Page('This is the front page')
        app_root['FrontPage'] = frontpage
        frontpage.__name__ = 'FrontPage'
        frontpage.__parent__ = app_root
        zodb_root['app_root'] = app_root
        import transaction
        transaction.commit()
    return zodb_root['app_root']
```

33.4.4 Viewing the Application in a Browser

We can't. At this point, our system is in a "non-runnable" state; we'll need to change view-related files in the next chapter to be able to start the application successfully. If you try to start the application, you'll wind up with a Python traceback on your console that ends with this exception:

```
ImportError: cannot import name MyModel
```

This will also happen if you attempt to run the tests.

33.5 Defining Views

A *view callable* in a *traversal* -based Pyramid application is typically a simple Python function that accepts two parameters: *context* and *request*. A view callable is assumed to return a *response* object.

A Pyramid view can also be defined as callable which accepts *only* a *request* argument. You'll see this one-argument pattern used in other Pyramid tutorials and applications. Either calling convention will work in any Pyramid application; the calling conventions can be used interchangeably as necessary. In *traversal* based applications, URLs are mapped to a context *resource*, and since our *resource tree* also represents our application's "domain model", we're often interested in the context, because it represents the persistent storage of our application. For this reason, in this tutorial we define views as callables that accept `context` in the callable argument list. If you do need the `context` within a view function that only takes the request as a single argument, you can obtain it via `request.context`.

We're going to define several *view callable* functions, then wire them into Pyramid using some *view configuration*.

The source code for this tutorial stage can be browsed via http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki/src/views/.

33.5.1 Declaring Dependencies in Our `setup.py` File

The view code in our application will depend on a package which is not a dependency of the original "tutorial" application. The original "tutorial" application was generated by the `paster create` command; it doesn't know about our custom application requirements. We need to add a dependency on the `docutils` package to our `tutorial` package's `setup.py` file by assigning this dependency to the `install_requires` parameter in the `setup` function.

Our resulting `setup.py` should look like so:

```
import os

from setuptools import setup, find_packages

here = os.path.abspath(os.path.dirname(__file__))
README = open(os.path.join(here, 'README.txt')).read()
CHANGES = open(os.path.join(here, 'CHANGES.txt')).read()

requires = [
    'pyramid',
    'pyramid_zodbconn',
    'pyramid_tm',
    'pyramid_debugtoolbar',
    'ZODB3',
    'docutils',
```

```
    ]

setup(name='tutorial',
      version='0.0',
      description='tutorial',
      long_description=README + '\n\n' +  CHANGES,
      classifiers=[
        "Intended Audience :: Developers",
        "Framework :: Pylons",
        "Programming Language :: Python",
        "Topic :: Internet :: WWW/HTTP",
        "Topic :: Internet :: WWW/HTTP :: WSGI :: Application",
        ],
      author='',
      author_email='',
      url='',
      keywords='web pylons pyramid',
      packages=find_packages(),
      include_package_data=True,
      zip_safe=False,
      install_requires=requires,
      tests_require=requires,
      test_suite="tutorial",
      entry_points = """\
      [paste.app_factory]
      main = tutorial:main
      """,
      paster_plugins=['pyramid'],
      )
```

 After these new dependencies are added, you will need to rerun `python setup.py develop` inside the root of the `tutorial` package to obtain and register the newly added dependency package.

33.5.2 Adding View Functions

We're going to add four *view callable* functions to our `views.py` module. One view named `view_wiki` will display the wiki itself (it will answer on the root URL), another named `view_page` will display an individual page, another named `add_page` will allow a page to be added, and a final view named `edit_page` will allow a page to be edited.

 There is nothing special about the filename `views.py`. A project may have many view callables throughout its codebase in arbitrarily-named files. Files implementing view callables often have `view` in their filenames (or may live in a Python subpackage of your application package named `views`), but this is only by convention.

The `view_wiki` view function

The `view_wiki` function will be configured to respond as the default view callable for a Wiki resource. We'll provide it with a `@view_config` decorator which names the class `tutorial.models.Wiki` as its context. This means that when a Wiki resource is the context, and no *view name* exists in the request, this view will be used. The view configuration associated with `view_wiki` does not use a `renderer` because the view callable always returns a *response* object rather than a dictionary. No renderer is necessary when a view returns a response object.

The `view_wiki` view callable always redirects to the URL of a Page resource named "FrontPage". To do so, it returns an instance of the `pyramid.httpexceptions.HTTPFound` class (instances of which implement the `pyramid.interfaces.IResponse` interface like `pyramid.response.Response` does). The `pyramid.request.Request.resource_url()` API. `pyramid.request.Request.resource_url()` constructs a URL to the `FrontPage` page resource (e.g. `http://localhost:6543/FrontPage`), and uses it as the "location" of the HTTPFound response, forming an HTTP redirect.

The `view_page` view function

The `view_page` function will be configured to respond as the default view of a Page resource. We'll provide it with a `@view_config` decorator which names the class `tutorial.models.Page` as its context. This means that when a Page resource is the context, and no *view name* exists in the request, this view will be used. We inform Pyramid this view will use the `templates/view.pt` template file as a `renderer`.

The `view_page` function generates the *ReStructuredText* body of a page (stored as the `data` attribute of the context passed to the view; the context will be a Page resource) as HTML. Then it substitutes an HTML anchor for each *WikiWord* reference in the rendered HTML using a compiled regular expression.

The curried function named `check` is used as the first argument to `wikiwords.sub`, indicating that it should be called to provide a value for each WikiWord match found in the content. If the wiki (our page's `__parent__`) already contains a page with the matched WikiWord name, the `check` function generates

a view link to be used as the substitution value and returns it. If the wiki does not already contain a page with with the matched WikiWord name, the function generates an "add" link as the substitution value and returns it.

As a result, the `content` variable is now a fully formed bit of HTML containing various view and add links for WikiWords based on the content of our current page resource.

We then generate an edit URL (because it's easier to do here than in the template), and we wrap up a number of arguments in a dictionary and return it.

The arguments we wrap into a dictionary include `page`, `content`, and `edit_url`. As a result, the *template* associated with this view callable (via `renderer=` in its configuration) will be able to use these names to perform various rendering tasks. The template associated with this view callable will be a template which lives in `templates/view.pt`.

Note the contrast between this view callable and the `view_wiki` view callable. In the `view_wiki` view callable, we unconditionally return a *response* object. In the `view_page` view callable, we return a *dictionary*. It is *always* fine to return a *response* object from a Pyramid view. Returning a dictionary is allowed only when there is a *renderer* associated with the view callable in the view configuration.

The `add_page` view function

The `add_page` function will be configured to respond when the context resource is a Wiki and the *view name* is `add_page`. We'll provide it with a `@view_config` decorator which names the string `add_page` as its *view name* (via name=), the class `tutorial.models.Wiki` as its context, and the renderer named `templates/edit.pt`. This means that when a Wiki resource is the context, and a *view name* named `add_page` exists as the result of traversal, this view will be used. We inform Pyramid this view will use the `templates/edit.pt` template file as a `renderer`. We share the same template between add and edit views, thus `edit.pt` instead of `add.pt`.

The `add_page` function will be invoked when a user clicks on a WikiWord which isn't yet represented as a page in the system. The `check` function within the `view_page` view generates URLs to this view. It also acts as a handler for the form that is generated when we want to add a page resource. The `context` of the `add_page` view is always a Wiki resource (*not* a Page resource).

The request *subpath* in Pyramid is the sequence of names that are found *after* the *view name* in the URL segments given in the `PATH_INFO` of the WSGI request as the result of *traversal*. If our add view is invoked via, e.g. `http://localhost:6543/add_page/SomeName`, the *subpath* will be a tuple: `('SomeName',)`.

The add view takes the zeroth element of the subpath (the wiki page name), and aliases it to the name attribute in order to know the name of the page we're trying to add.

If the view rendering is *not* a result of a form submission (if the expression `'form.submitted' in request.params` is `False`), the view renders a template. To do so, it generates a "save url" which the template use as the form post URL during rendering. We're lazy here, so we're trying to use the same template (`templates/edit.pt`) for the add view as well as the page edit view. To do so, we create a dummy Page resource object in order to satisfy the edit form's desire to have *some* page object exposed as `page`, and we'll render the template to a response.

If the view rendering *is* a result of a form submission (if the expression `'form.submitted' in request.params` is `True`), we scrape the page body from the form data, create a Page object using the name in the subpath and the page body, and save it into "our context" (the Wiki) using the `__setitem__` method of the context. We then redirect back to the `view_page` view (the default view for a page) for the newly created page.

The `edit_page` view function

The `edit_page` function will be configured to respond when the context is a Page resource and the *view name* is `edit_page`. We'll provide it with a `@view_config` decorator which names the string `edit_page` as its *view name* (via `name=`), the class `tutorial.models.Page` as its context, and the renderer named `templates/edit.pt`. This means that when a Page resource is the context, and a *view name* exists as the result of traversal named `edit_page`, this view will be used. We inform Pyramid this view will use the `templates/edit.pt` template file as a `renderer`.

The `edit_page` function will be invoked when a user clicks the "Edit this Page" button on the view form. It renders an edit form but it also acts as the form post view callable for the form it renders. The `context` of the `edit_page` view will *always* be a Page resource (never a Wiki resource).

If the view execution is *not* a result of a form submission (if the expression `'form.submitted' in request.params` is `False`), the view simply renders the edit form, passing the page resource, and a `save_url` which will be used as the action of the generated form.

If the view execution *is* a result of a form submission (if the expression `'form.submitted' in request.params` is `True`), the view grabs the `body` element of the request parameter and sets it as the `data` attribute of the page context. It then redirects to the default view of the context (the page), which will always be the `view_page` view.

33.5.3 Viewing the Result of all Our Edits to `views.py`

The result of all of our edits to `views.py` will leave it looking like this:

```
from docutils.core import publish_parts
import re

from pyramid.httpexceptions import HTTPFound
from pyramid.view import view_config

from tutorial.models import Page

# regular expression used to find WikiWords
wikiwords = re.compile(r"\b([A-Z]\w+[A-Z]+\w+)")

@view_config(context='tutorial.models.Wiki')
def view_wiki(context, request):
    return HTTPFound(location=request.resource_url(context, 'FrontPage'))

@view_config(context='tutorial.models.Page',
             renderer='tutorial:templates/view.pt')
def view_page(context, request):
    wiki = context.__parent__

    def check(match):
        word = match.group(1)
        if word in wiki:
            page = wiki[word]
            view_url = request.resource_url(page)
            return '<a href="%s">%s</a>' % (view_url, word)
        else:
            add_url = request.application_url + '/add_page/' + word
            return '<a href="%s">%s</a>' % (add_url, word)

    content = publish_parts(context.data, writer_name='html')['html_body']
    content = wikiwords.sub(check, content)
    edit_url = request.resource_url(context, 'edit_page')
    return dict(page = context, content = content, edit_url = edit_url)

@view_config(name='add_page', context='tutorial.models.Wiki',
             renderer='tutorial:templates/edit.pt')
def add_page(context, request):
    name = request.subpath[0]
    if 'form.submitted' in request.params:
        body = request.params['body']
        page = Page(body)
        page.__name__ = name
        page.__parent__ = context
        context[name] = page
        return HTTPFound(location = request.resource_url(page))
```

```
47      save_url = request.resource_url(context, 'add_page', name)
48      page = Page('')
49      page.__name__ = name
50      page.__parent__ = context
51      return dict(page = page, save_url = save_url)
52
53  @view_config(name='edit_page', context='tutorial.models.Page',
54               renderer='tutorial:templates/edit.pt')
55  def edit_page(context, request):
56      if 'form.submitted' in request.params:
57          context.data = request.params['body']
58          return HTTPFound(location = request.resource_url(context))
59
60      return dict(page = context,
61                  save_url = request.resource_url(context, 'edit_page'))
62
63
```

33.5.4 Adding Templates

Most view callables we've added expected to be rendered via a *template*. The default templating systems in Pyramid are *Chameleon* and *Mako*. Chameleon is a variant of *ZPT*, which is an XML-based templating language. Mako is a non-XML-based templating language. Because we had to pick one, we chose Chameleon for this tutorial.

The templates we create will live in the `templates` directory of our tutorial package. Chameleon templates must have a `.pt` extension to be recognized as such.

The `view.pt` Template

The `view.pt` template is used for viewing a single Page. It is used by the `view_page` view function. It should have a div that is "structure replaced" with the `content` value provided by the view. It should also have a link on the rendered page that points at the "edit" URL (the URL which invokes the `edit_page` view for the page being viewed).

Once we're done with the `view.pt` template, it will look a lot like the below:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.__name__} - Pyramid tutorial wiki (based on
      TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Viewing <b><span tal:replace="page.__name__">Page Name Goes
          Here</span></b><br/>
          You can return to the
          <a href="${request.application_url}">FrontPage</a>.<br/>
        </div>
        <div id="right" class="app-welcome align-right"></div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <div tal:replace="structure content">
          Page text goes here.
```

```
        </div>
        <p>
          <a tal:attributes="href edit_url" href="">
            Edit this page
          </a>
        </p>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

The names available for our use in a template are always those that are present in the dictionary returned by the view callable. But our templates make use of a `request` object that none of our tutorial views return in their dictionary. This value appears as if "by magic". However, `request` is one of several names that are available "by default" in a template when a template renderer is used. See **.pt or *.txt: Chameleon Template Renderers* for more information about other names that are available by default in a template when a template is used as a renderer.

The `edit.pt` Template

The `edit.pt` template is used for adding and editing a Page. It is used by the `add_page` and `edit_page` view functions. It should display a page containing a form that POSTs back to the "save_url" argument supplied by the view. The form should have a "body" textarea field (the page data), and a submit button that has the name "form.submitted". The textarea in the form should be filled with any existing page data when it is rendered.

Once we're done with the `edit.pt` template, it will look a lot like the below:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.__name__} - Pyramid tutorial wiki (based on
    TurboGears 20-Minute Wiki)</title>
```

```
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Editing <b><span tal:replace="page.__name__">Page Name Goes
            Here</span></b><br/>
          You can return to the
          <a href="${request.application_url}">FrontPage</a>.<br/>
        </div>
        <div id="right" class="app-welcome align-right"></div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <form action="${save_url}" method="post">
          <textarea name="body" tal:content="page.data" rows="10"
                    cols="60"/><br/>
          <input type="submit" name="form.submitted" value="Save"/>
        </form>
      </div>
    </div>
  </div>
  <div id="footer">
```

```
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

Static Assets

Our templates name a single static asset named `pylons.css`. We don't need to create this file within our package's `static` directory because it was provided at the time we created the project. This file is a little too long to replicate within the body of this guide, however it is available online.

This CSS file will be accessed via e.g. `http://localhost:6543/static/pylons.css` by virtue of the call to `add_static_view` directive we've made in the `__init__.py` file. Any number and type of static assets can be placed in this directory (or subdirectories) and are just referred to by URL or by using the convenience method `static_url` e.g. `request.static_url('{{package}}:static/foo.css')` within templates.

33.5.5 Viewing the Application in a Browser

We can finally examine our application in a browser. The views we'll try are as follows:

- Visiting `http://localhost:6543/` in a browser invokes the `view_wiki` view. This always redirects to the `view_page` view of the `FrontPage` Page resource.
- Visiting `http://localhost:6543/FrontPage/` in a browser invokes the `view_page` view of the front page resource. This is because it's the *default view* (a view without a `name`) for Page resources.
- Visiting `http://localhost:6543/FrontPage/edit_page` in a browser invokes the edit view for the `FrontPage` Page resource.
- Visiting `http://localhost:6543/add_page/SomePageName` in a browser invokes the add view for a Page.
- To generate an error, visit `http://localhost:6543/add_page` which will generate an `IndexError` for the expression `request.subpath[0]`. You'll see an interactive traceback facility provided by *pyramid_debugtoolbar*.

33.6 Adding Authorization

Our application currently allows anyone with access to the server to view, edit, and add pages to our wiki. For purposes of demonstration we'll change our application to allow people whom are members of a *group* named `group:editors` to add and edit wiki pages but we'll continue allowing anyone with access to the server to view pages. Pyramid provides facilities for *authorization* and *authentication*. We'll make use of both features to provide security to our application.

We will add an *authentication policy* and an *authorization policy* to our *application registry*, add a `security.py` module and give our *root* resource an *ACL*.

Then we will add `login` and `logout` views, and modify the existing views to make them return a `logged_in` flag to the renderer and add *permission* declarations to their `view_config` decorators.

Finally, we will add a `login.pt` template and change the existing `view.pt` and `edit.pt` to show a "Logout" link when not logged in.

The source code for this tutorial stage can be browsed via http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki/src/authorization/.

33.6.1 Adding Authentication and Authorization Policies

We'll change our package's `__init__.py` file to enable an `AuthTktAuthenticationPolicy` and an `ACLAuthorizationPolicy` to enable declarative security checking. We need to import the new policies:

```
from pyramid.authentication import AuthTktAuthenticationPolicy
from pyramid.authorization import ACLAuthorizationPolicy
from tutorial.security import groupfinder
```

Then, we'll add those policies to the configuration:

```
    authn_policy = AuthTktAuthenticationPolicy(secret='sosecret',
                                               callback=groupfinder)
    authz_policy = ACLAuthorizationPolicy()
    config = Configurator(root_factory=root_factory, settings=settings,
                          authentication_policy=authn_policy,
                          authorization_policy=authz_policy)
```

Note that the creation of an `AuthTktAuthenticationPolicy` requires two arguments: `secret` and `callback`. `secret` is a string representing an encryption key used by the "authentication ticket" machinery represented by this policy: it is required. The `callback` is a reference to a `groupfinder` function in the `tutorial` package's `security.py` file. We haven't added that module yet, but we're about to.

When you're done, your `__init__.py` will look like so:

```
from pyramid.config import Configurator
from pyramid_zodbconn import get_connection

from pyramid.authentication import AuthTktAuthenticationPolicy
from pyramid.authorization import ACLAuthorizationPolicy

from tutorial.models import appmaker
from tutorial.security import groupfinder

def root_factory(request):
    conn = get_connection(request)
    return appmaker(conn.root())

def main(global_config, **settings):
    """ This function returns a WSGI application.

    It is usually called by the PasteDeploy framework during
    ``paster serve``.
    """
    authn_policy = AuthTktAuthenticationPolicy(secret='sosecret',
                                               callback=groupfinder)
    authz_policy = ACLAuthorizationPolicy()
    config = Configurator(root_factory=root_factory, settings=settings,
                          authentication_policy=authn_policy,
                          authorization_policy=authz_policy)
    config.add_static_view('static', 'tutorial:static', cache_max_age=3600)
    config.scan('tutorial')
    return config.make_wsgi_app()
```

33.6.2 Adding `security.py`

Add a `security.py` module within your package (in the same directory as `__init__.py`, `views.py`, etc.) with the following content:

```
USERS = {'editor':'editor',
         'viewer':'viewer'}
GROUPS = {'editor':['group:editors']}

def groupfinder(userid, request):
    if userid in USERS:
        return GROUPS.get(userid, [])

```

The `groupfinder` function defined here is an *authentication policy* "callback"; it is a callable that accepts a userid and a request. If the userid exists in the system, the callback will return a sequence of group identifiers (or an empty sequence if the user isn't a member of any groups). If the userid *does not* exist in the system, the callback will return `None`. In a production system, user and group data will most often come from a database, but here we use "dummy" data to represent user and groups sources. Note that the `editor` user is a member of the `group:editors` group in our dummy group data (the `GROUPS` data structure).

33.6.3 Giving Our Root Resource an ACL

We need to give our root resource object an *ACL*. This ACL will be sufficient to provide enough information to the Pyramid security machinery to challenge a user who doesn't have appropriate credentials when he attempts to invoke the `add_page` or `edit_page` views.

We need to perform some imports at module scope in our `models.py` file:

```
from pyramid.security import Allow
from pyramid.security import Everyone
```

Our root resource object is a `Wiki` instance. We'll add the following line at class scope to our `Wiki` class:

```
__acl__ = [ (Allow, Everyone, 'view'),
            (Allow, 'group:editors', 'edit') ]
```

It's only happenstance that we're assigning this ACL at class scope. An ACL can be attached to an object *instance* too; this is how "row level security" can be achieved in Pyramid applications. We actually only need *one* ACL for the entire system, however, because our security requirements are simple, so this feature is not demonstrated.

Our resulting `models.py` file will now look like so:

```
from persistent import Persistent
from persistent.mapping import PersistentMapping

from pyramid.security import Allow
from pyramid.security import Everyone

class Wiki(PersistentMapping):
    __name__ = None
    __parent__ = None
    __acl__ = [ (Allow, Everyone, 'view'),
                (Allow, 'group:editors', 'edit') ]

class Page(Persistent):
    def __init__(self, data):
        self.data = data

def appmaker(zodb_root):
    if not 'app_root' in zodb_root:
        app_root = Wiki()
        frontpage = Page('This is the front page')
        app_root['FrontPage'] = frontpage
        frontpage.__name__ = 'FrontPage'
        frontpage.__parent__ = app_root
        zodb_root['app_root'] = app_root
        import transaction
        transaction.commit()
    return zodb_root['app_root']
```

33.6.4 Adding Login and Logout Views

We'll add a `login` view which renders a login form and processes the post from the login form, checking credentials.

We'll also add a `logout` view to our application and provide a link to it. This view will clear the credentials of the logged in user and redirect back to the front page.

We'll add a different file (for presentation convenience) to add login and logout views. Add a file named `login.py` to your application (in the same directory as `views.py`) with the following content:

```
from pyramid.httpexceptions import HTTPFound

from pyramid.security import remember
```

```
from pyramid.security import forget
from pyramid.view import view_config

from tutorial.security import USERS

@view_config(context='tutorial.models.Wiki', name='login',
             renderer='templates/login.pt')
@view_config(context='pyramid.httpexceptions.HTTPForbidden',
             renderer='templates/login.pt')
def login(request):
    login_url = request.resource_url(request.context, 'login')
    referrer = request.url
    if referrer == login_url:
        referrer = '/' # never use the login form itself as came_from
    came_from = request.params.get('came_from', referrer)
    message = ''
    login = ''
    password = ''
    if 'form.submitted' in request.params:
        login = request.params['login']
        password = request.params['password']
        if USERS.get(login) == password:
            headers = remember(request, login)
            return HTTPFound(location = came_from,
                             headers = headers)
        message = 'Failed login'

    return dict(
        message = message,
        url = request.application_url + '/login',
        came_from = came_from,
        login = login,
        password = password,
        )

@view_config(context='tutorial.models.Wiki', name='logout')
def logout(request):
    headers = forget(request)
    return HTTPFound(location = request.resource_url(request.context),
                     headers = headers)

```

Note that the `login` view callable in the `login.py` file has *two* view configuration decorators. The order of these decorators is unimportant. Each just adds a different *view configuration* for the `login` view callable.

The first view configuration decorator configures the `login` view callable so it will be invoked when someone visits `/login` (when the context is a Wiki and the view name is `login`). The second decorator (with context of `pyramid.httpexceptions.HTTPForbidden`) specifies a *forbidden view*. This configures our login view to be presented to the user when Pyramid detects that a view invocation can not be authorized. Because we've configured a forbidden view, the `login` view callable will be invoked whenever one of our users tries to execute a view callable that they are not allowed to invoke as determined by the *authorization policy* in use. In our application, for example, this means that if a user has not logged in, and he tries to add or edit a Wiki page, he will be shown the login form. Before being allowed to continue on to the add or edit form, he will have to provide credentials that give him permission to add or edit via this login form.

33.6.5 Changing Existing Views

Then we need to change each of our `view_page`, `edit_page` and `add_page` views in `views.py` to pass a "logged in" parameter into its template. We'll add something like this to each view body:

```
from pyramid.security import authenticated_userid
logged_in = authenticated_userid(request)
```

We'll then change the return value of each view that has an associated `renderer` to pass the resulting `logged_in` value to the template. For example:

```
return dict(page = context,
            content = content,
            logged_in = logged_in,
            edit_url = edit_url)
```

33.6.6 Adding `permission` Declarations to our `view_config` Decorators

To protect each of our views with a particular permission, we need to pass a `permission` argument to each of our `pyramid.view.view_config` decorators. To do so, within `views.py`:

- We add `permission='view'` to the decorator attached to the `view_wiki` and `view_page` view functions. This makes the assertion that only users who possess the `view` permission against the context resource at the time of the request may invoke these views. We've granted `pyramid.security.Everyone` the view permission at the root model via its ACL, so everyone will be able to invoke the `view_wiki` and `view_page` views.

- We add `permission='edit'` to the decorator attached to the `add_page` and `edit_page` view functions. This makes the assertion that only users who possess the effective `edit` permission against the context resource at the time of the request may invoke these views. We've granted the `group:editors` principal the `edit` permission at the root model via its ACL, so only a user whom is a member of the group named `group:editors` will able to invoke the `add_page` or `edit_page` views. We've likewise given the `editor` user membership to this group via the `security.py` file by mapping him to the `group:editors` group in the `GROUPS` data structure (`GROUPS = {'editor':['group:editors']}`); the `groupfinder` function consults the `GROUPS` data structure. This means that the `editor` user can add and edit pages.

33.6.7 Adding the `login.pt` Template

Add a `login.pt` template to your templates directory. It's referred to within the login view we just added to `login.py`.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>Login - Pyramid tutorial wiki (based on TurboGears
    20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
```

```
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          <b>Login</b><br/>
          <span tal:replace="message"/>
        </div>
        <div id="right" class="app-welcome align-right"></div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <form action="${url}" method="post">
          <input type="hidden" name="came_from" value="${came_from}"/>
          <input type="text" name="login" value="${login}"/><br/>
          <input type="password" name="password"
                 value="${password}"/><br/>
          <input type="submit" name="form.submitted" value="Log In"/>
        </form>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

33.6.8 Change `view.pt` and `edit.pt`

We'll also need to change our `edit.pt` and `view.pt` templates to display a "Logout" link if someone is logged in. This link will invoke the logout view.

To do so we'll add this to both templates within the `<div id="right" class="app-welcome align-right">` div:

```
<span tal:condition="logged_in">
   <a href="${request.application_url}/logout">Logout</a>
</span>
```

33.6.9 Seeing Our Changes To `views.py` and our Templates

Our `views.py` module will look something like this when we're done:

```
from docutils.core import publish_parts
import re

from pyramid.httpexceptions import HTTPFound
from pyramid.view import view_config
from pyramid.security import authenticated_userid

from tutorial.models import Page

# regular expression used to find WikiWords
wikiwords = re.compile(r"\b([A-Z]\w+[A-Z]+\w+)")

@view_config(context='tutorial.models.Wiki', permission='view')
def view_wiki(context, request):
    return HTTPFound(location=request.resource_url(context, 'FrontPage'))

@view_config(context='tutorial.models.Page',
             renderer='templates/view.pt', permission='view')
def view_page(context, request):
    wiki = context.__parent__

    def check(match):
        word = match.group(1)
        if word in wiki:
            page = wiki[word]
            view_url = request.resource_url(page)
            return '<a href="%s">%s</a>' % (view_url, word)
        else:
            add_url = request.application_url + '/add_page/' + word
            return '<a href="%s">%s</a>' % (add_url, word)

    content = publish_parts(context.data, writer_name='html')['html_body']
    content = wikiwords.sub(check, content)
    edit_url = request.resource_url(context, 'edit_page')

    logged_in = authenticated_userid(request)

    return dict(page = context, content = content, edit_url = edit_url,
                logged_in = logged_in)

@view_config(name='add_page', context='tutorial.models.Wiki',
             renderer='templates/edit.pt',
```

```
            permission='edit')
def add_page(context, request):
    name = request.subpath[0]
    if 'form.submitted' in request.params:
        body = request.params['body']
        page = Page(body)
        page.__name__ = name
        page.__parent__ = context
        context[name] = page
        return HTTPFound(location = request.resource_url(page))
    save_url = request.resource_url(context, 'add_page', name)
    page = Page('')
    page.__name__ = name
    page.__parent__ = context

    logged_in = authenticated_userid(request)

    return dict(page = page, save_url = save_url, logged_in = logged_in)

@view_config(name='edit_page', context='tutorial.models.Page',
             renderer='templates/edit.pt',
             permission='edit')
def edit_page(context, request):
    if 'form.submitted' in request.params:
        context.data = request.params['body']
        return HTTPFound(location = request.resource_url(context))

    logged_in = authenticated_userid(request)

    return dict(page = context,
                save_url = request.resource_url(context, 'edit_page'),
                logged_in = logged_in)

```

Our `edit.pt` template will look something like this when we're done:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.__name__} - Pyramid tutorial wiki (based on
      TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
```

```
11    <link rel="shortcut icon"
12          href="${request.static_url('tutorial:static/favicon.ico')}" />
13    <link rel="stylesheet"
14          href="${request.static_url('tutorial:static/pylons.css')}"
15          type="text/css" media="screen" charset="utf-8" />
16    <!--[if lte IE 6]>
17    <link rel="stylesheet"
18          href="${request.static_url('tutorial:static/ie6.css')}"
19          type="text/css" media="screen" charset="utf-8" />
20    <![endif]-->
21  </head>
22  <body>
23    <div id="wrap">
24      <div id="top-small">
25        <div class="top-small align-center">
26          <div>
27            <img width="220" height="50" alt="pyramid"
28          src="${request.static_url('tutorial:static/pyramid-small.png')}" />
29          </div>
30        </div>
31      </div>
32      <div id="middle">
33        <div class="middle align-right">
34          <div id="left" class="app-welcome align-left">
35            Editing <b><span tal:replace="page.__name__">Page Name
36              Goes Here</span></b><br/>
37            You can return to the
38            <a href="${request.application_url}">FrontPage</a>.<br/>
39          </div>
40          <div id="right" class="app-welcome align-right">
41            <span tal:condition="logged_in">
42                <a href="${request.application_url}/logout">Logout</a>
43            </span>
44          </div>
45        </div>
46      </div>
47      <div id="bottom">
48        <div class="bottom">
49          <form action="${save_url}" method="post">
50            <textarea name="body" tal:content="page.data" rows="10"
51                      cols="60"/><br/>
52            <input type="submit" name="form.submitted" value="Save"/>
53          </form>
54        </div>
55      </div>
56    </div>
```

```
  <div id="footer">
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

Our `view.pt` template will look something like this when we're done:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.__name__} - Pyramid tutorial wiki (based on
    TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Viewing <b><span tal:replace="page.__name__">Page Name
            Goes Here</span></b><br/>
          You can return to the
```

```
38            <a href="${request.application_url}">FrontPage</a>.<br/>
39          </div>
40          <div id="right" class="app-welcome align-right">
41            <span tal:condition="logged_in">
42              <a href="${request.application_url}/logout">Logout</a>
43            </span>
44          </div>
45        </div>
46      </div>
47      <div id="bottom">
48        <div class="bottom">
49          <div tal:replace="structure content">
50            Page text goes here.
51          </div>
52          <p>
53            <a tal:attributes="href edit_url" href="">
54              Edit this page
55            </a>
56          </p>
57        </div>
58      </div>
59    </div>
60    <div id="footer">
61      <div class="footer"
62           >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
63    </div>
64  </body>
65  </html>
```

33.6.10 Viewing the Application in a Browser

We can finally examine our application in a browser. The views we'll try are as follows:

- Visiting `http://localhost:6543/` in a browser invokes the `view_wiki` view. This always redirects to the `view_page` view of the `FrontPage` page resource. It is executable by any user.

- Visiting `http://localhost:6543/FrontPage/` in a browser invokes the `view_page` view of the `FrontPage` Page resource. This is because it's the *default view* (a view without a `name`) for `Page` resources. It is executable by any user.

- Visiting `http://localhost:6543/FrontPage/edit_page` in a browser invokes the edit view for the `FrontPage` Page resource. It is executable by only the `editor` user. If a different user (or the anonymous user) invokes it, a login form will be displayed. Supplying the credentials with the username `editor`, password `editor` will show the edit page form being displayed.

- Visiting `http://localhost:6543/add_page/SomePageName` in a browser invokes the add view for a page. It is executable by only the `editor` user. If a different user (or the anonymous user) invokes it, a login form will be displayed. Supplying the credentials with the username `editor`, password `editor` will show the edit page form being displayed.

- After logging in (as a result of hitting an edit or add page and submitting the login form with the `editor` credentials), we'll see a Logout link in the upper right hand corner. When we click it, we're logged out, and redirected back to the front page.

33.7 Adding Tests

We will now add tests for the models and the views and a few functional tests in the `tests.py`. Tests ensure that an application works, and that it continues to work after some changes are made in the future.

33.7.1 Testing the Models

We write tests for the model classes and the appmaker. Changing `tests.py`, we'll write a separate test class for each model class, and we'll write a test class for the `appmaker`.

To do so, we'll retain the `tutorial.tests.ViewTests` class provided as a result of the `pyramid_zodb` project generator. We'll add three test classes: one for the `Page` model named `PageModelTests`, one for the `Wiki` model named `WikiModelTests`, and one for the appmaker named `AppmakerTests`.

33.7.2 Testing the Views

We'll modify our `tests.py` file, adding tests for each view function we added above. As a result, we'll *delete* the `ViewTests` test in the file, and add four other test classes: `ViewWikiTests`, `ViewPageTests`, `AddPageTests`, and `EditPageTests`. These test the `view_wiki`, `view_page`, `add_page`, and `edit_page` views respectively.

33.7.3 Functional tests

We test the whole application, covering security aspects that are not tested in the unit tests, like logging in, logging out, checking that the `viewer` user cannot add or edit pages, but the `editor` user can, and so on.

33.7.4 Viewing the results of all our edits to `tests.py`

Once we're done with the `tests.py` module, it will look a lot like the below:

```
import unittest

from pyramid import testing

class PageModelTests(unittest.TestCase):

    def _getTargetClass(self):
        from tutorial.models import Page
        return Page

    def _makeOne(self, data=u'some data'):
        return self._getTargetClass()(data=data)

    def test_constructor(self):
        instance = self._makeOne()
        self.assertEqual(instance.data, u'some data')

class WikiModelTests(unittest.TestCase):

    def _getTargetClass(self):
        from tutorial.models import Wiki
        return Wiki

    def _makeOne(self):
        return self._getTargetClass()()

    def test_it(self):
        wiki = self._makeOne()
        self.assertEqual(wiki.__parent__, None)
        self.assertEqual(wiki.__name__, None)

class AppmakerTests(unittest.TestCase):
    def _callFUT(self, zodb_root):
        from tutorial.models import appmaker
        return appmaker(zodb_root)

    def test_it(self):
        root = {}
        self._callFUT(root)
        self.assertEqual(root['app_root']['FrontPage'].data,
                         'This is the front page')

```

```
class ViewWikiTests(unittest.TestCase):
    def test_it(self):
        from tutorial.views import view_wiki
        context = testing.DummyResource()
        request = testing.DummyRequest()
        response = view_wiki(context, request)
        self.assertEqual(response.location, 'http://example.com/FrontPage')

class ViewPageTests(unittest.TestCase):
    def _callFUT(self, context, request):
        from tutorial.views import view_page
        return view_page(context, request)

    def test_it(self):
        wiki = testing.DummyResource()
        wiki['IDoExist'] = testing.DummyResource()
        context = testing.DummyResource(data='Hello CruelWorld IDoExist')
        context.__parent__ = wiki
        context.__name__ = 'thepage'
        request = testing.DummyRequest()
        info = self._callFUT(context, request)
        self.assertEqual(info['page'], context)
        self.assertEqual(
            info['content'],
            '<div class="document">\n'
            '<p>Hello <a href="http://example.com/add_page/CruelWorld">'
            'CruelWorld</a> '
            '<a href="http://example.com/IDoExist/">'
            'IDoExist</a>'
            '</p>\n</div>\n')
        self.assertEqual(info['edit_url'],
                         'http://example.com/thepage/edit_page')


class AddPageTests(unittest.TestCase):
    def _callFUT(self, context, request):
        from tutorial.views import add_page
        return add_page(context, request)

    def test_it_notsubmitted(self):
        context = testing.DummyResource()
        request = testing.DummyRequest()
        request.subpath = ['AnotherPage']
        info = self._callFUT(context, request)
        self.assertEqual(info['page'].data,'')
        self.assertEqual(
```

```
89              info['save_url'],
90              request.resource_url(context, 'add_page', 'AnotherPage'))
91
92      def test_it_submitted(self):
93          context = testing.DummyResource()
94          request = testing.DummyRequest({'form.submitted':True,
95                                          'body':'Hello yo!'})
96          request.subpath = ['AnotherPage']
97          self._callFUT(context, request)
98          page = context['AnotherPage']
99          self.assertEqual(page.data, 'Hello yo!')
100         self.assertEqual(page.__name__, 'AnotherPage')
101         self.assertEqual(page.__parent__, context)
102
103 class EditPageTests(unittest.TestCase):
104     def _callFUT(self, context, request):
105         from tutorial.views import edit_page
106         return edit_page(context, request)
107
108     def test_it_notsubmitted(self):
109         context = testing.DummyResource()
110         request = testing.DummyRequest()
111         info = self._callFUT(context, request)
112         self.assertEqual(info['page'], context)
113         self.assertEqual(info['save_url'],
114                          request.resource_url(context, 'edit_page'))
115
116     def test_it_submitted(self):
117         context = testing.DummyResource()
118         request = testing.DummyRequest({'form.submitted':True,
119                                         'body':'Hello yo!'})
120         response = self._callFUT(context, request)
121         self.assertEqual(response.location, 'http://example.com/')
122         self.assertEqual(context.data, 'Hello yo!')
123
124 class FunctionalTests(unittest.TestCase):
125
126     viewer_login = '/login?login=viewer&password=viewer' \
127                    '&came_from=FrontPage&form.submitted=Login'
128     viewer_wrong_login = '/login?login=viewer&password=incorrect' \
129                    '&came_from=FrontPage&form.submitted=Login'
130     editor_login = '/login?login=editor&password=editor' \
131                    '&came_from=FrontPage&form.submitted=Login'
132
133     def setUp(self):
134         import tempfile
```

```
135         import os.path
136         from tutorial import main
137         self.tmpdir = tempfile.mkdtemp()
138 
139         dbpath = os.path.join( self.tmpdir, 'test.db')
140         uri = 'file://' + dbpath
141         settings = { 'zodbconn.uri' : uri ,
142                      'pyramid.includes': ['pyramid_zodbconn', 'pyramid_tm'] }
143 
144         app = main({}, **settings)
145         self.db = app.registry.zodb_database
146         from webtest import TestApp
147         self.testapp = TestApp(app)
148 
149     def tearDown(self):
150         import shutil
151         self.db.close()
152         shutil.rmtree( self.tmpdir )
153 
154     def test_root(self):
155         res = self.testapp.get('/', status=302)
156         self.assertEqual(res.location, 'http://localhost/FrontPage')
157 
158     def test_FrontPage(self):
159         res = self.testapp.get('/FrontPage', status=200)
160         self.assertTrue('FrontPage' in res.body)
161 
162     def test_unexisting_page(self):
163         res = self.testapp.get('/SomePage', status=404)
164         self.assertTrue('Not Found' in res.body)
165 
166     def test_successful_log_in(self):
167         res = self.testapp.get( self.viewer_login, status=302)
168         self.assertEqual(res.location, 'http://localhost/FrontPage')
169 
170     def test_failed_log_in(self):
171         res = self.testapp.get( self.viewer_wrong_login, status=200)
172         self.assertTrue('login' in res.body)
173 
174     def test_logout_link_present_when_logged_in(self):
175         res = self.testapp.get( self.viewer_login, status=302)
176         res = self.testapp.get('/FrontPage', status=200)
177         self.assertTrue('Logout' in res.body)
178 
179     def test_logout_link_not_present_after_logged_out(self):
180         res = self.testapp.get( self.viewer_login, status=302)
```

```
181         res = self.testapp.get('/FrontPage', status=200)
182         res = self.testapp.get('/logout', status=302)
183         self.assertTrue('Logout' not in res.body)
184 
185     def test_anonymous_user_cannot_edit(self):
186         res = self.testapp.get('/FrontPage/edit_page', status=200)
187         self.assertTrue('Login' in res.body)
188 
189     def test_anonymous_user_cannot_add(self):
190         res = self.testapp.get('/add_page/NewPage', status=200)
191         self.assertTrue('Login' in res.body)
192 
193     def test_viewer_user_cannot_edit(self):
194         res = self.testapp.get( self.viewer_login, status=302)
195         res = self.testapp.get('/FrontPage/edit_page', status=200)
196         self.assertTrue('Login' in res.body)
197 
198     def test_viewer_user_cannot_add(self):
199         res = self.testapp.get( self.viewer_login, status=302)
200         res = self.testapp.get('/add_page/NewPage', status=200)
201         self.assertTrue('Login' in res.body)
202 
203     def test_editors_member_user_can_edit(self):
204         res = self.testapp.get( self.editor_login, status=302)
205         res = self.testapp.get('/FrontPage/edit_page', status=200)
206         self.assertTrue('Editing' in res.body)
207 
208     def test_editors_member_user_can_add(self):
209         res = self.testapp.get( self.editor_login, status=302)
210         res = self.testapp.get('/add_page/NewPage', status=200)
211         self.assertTrue('Editing' in res.body)
212 
213     def test_editors_member_user_can_view(self):
214         res = self.testapp.get( self.editor_login, status=302)
215         res = self.testapp.get('/FrontPage', status=200)
216         self.assertTrue('FrontPage' in res.body)
```

33.7.5 Running the Tests

We can run these tests by using `setup.py test` in the same way we did in *Running the Tests*. However, first we must edit our `setup.py` to include a dependency on WebTest, which we've used in our `tests.py`. Change the `requires` list in `setup.py` to include `WebTest`.

```
requires = [
    'pyramid',
    'pyramid_zodbconn',
    'pyramid_tm',
    'pyramid_debugtoolbar',
    'ZODB3',
    'docutils',
    'WebTest', # add this
    ]

```

After we've added a dependency on WebTest in `setup.py`, we need to rerun `setup.py develop` to get WebTest installed into our virtualenv. Assuming our shell's current working directory is the "tutorial" distribution directory:

On UNIX:

```
$ ../bin/python setup.py develop
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\python setup.py develop
```

Once that command has completed successfully, we can run the tests themselves:

On UNIX:

```
$ ../bin/python setup.py test -q
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\python setup.py test -q
```

The expected result looks something like:

```
.........
----------------------------------------------------------------------
Ran 23 tests in 1.653s

OK
```

33.8 Distributing Your Application

Once your application works properly, you can create a "tarball" from it by using the `setup.py sdist` command. The following commands assume your current working directory is the `tutorial` package we've created and that the parent directory of the `tutorial` package is a virtualenv representing a Pyramid environment.

On UNIX:

```
$ ../bin/python setup.py sdist
```

On Windows:

```
c:\pyramidtut> ..\Scripts\python setup.py sdist
```

The output of such a command will be something like:

```
running sdist
# .. more output ..
creating dist
tar -cf dist/tutorial-0.1.tar tutorial-0.1
gzip -f9 dist/tutorial-0.1.tar
removing 'tutorial-0.1' (and everything under it)
```

Note that this command creates a tarball in the "dist" subdirectory named `tutorial-0.1.tar.gz`. You can send this file to your friends to show them your cool new application. They should be able to install it by pointing the `easy_install` command directly at it. Or you can upload it to PyPI and share it with the rest of the world, where it can be downloaded via `easy_install` remotely like any other package people download from PyPI.

CHAPTER 34

SQLAlchemy + URL Dispatch Wiki Tutorial

This tutorial introduces a *SQLAlchemy* and *url dispatch* -based Pyramid application to a developer familiar with Python, and will be most familiar to developers who have used the *Pylons* 1.X web framework. When the tutorial is finished, the developer will have created a basic Wiki application with authentication.

For cut and paste purposes, the source code for all stages of this tutorial can be browsed at http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki2/src/.

34.1 Background

This tutorial presents a Pyramid application that uses technologies which will be familiar to someone with *Pylons* experience. It uses *SQLAlchemy* as a persistence mechanism and *url dispatch* to map URLs to code. It can also be followed by people without any prior Python web framework experience.

To code along with this tutorial, the developer will need a UNIX machine with development tools (Mac OS X with XCode, any Linux or BSD variant, etc) *or* a Windows system of any kind.

Have fun!

34.2 Installation

This tutorial assumes that Python and virtualenv are already installed and working in your system. If you need help setting this up, you should refer to the chapters on *Installing Pyramid*.

34.2.1 Preparation

Please take the following steps to prepare for the tutorial. The steps are slightly different depending on whether you're using UNIX or Windows.

Preparation, UNIX

1. Install SQLite3 and its development packages if you don't already have them installed. Usually this is via your system's package manager. For example, on a Debian Linux system, do `sudo apt-get install libsqlite3-dev`.

2. Use your Python's virtualenv to make a workspace:

```
$ path/to/my/Python-2.6/bin/virtualenv --no-site-packages pyramidtut
```

3. Switch to the `pyramidtut` directory:

```
$ cd pyramidtut
```

4. Use `easy_install` to get Pyramid and its direct dependencies installed:

```
$ bin/easy_install pyramid
```

5. Use `easy_install` to install various packages from PyPI.

```
$ bin/easy_install docutils nose coverage zope.sqlalchemy \
          SQLAlchemy pyramid_tm
```

Preparation, Windows

1. Use your Python's virtualenv to make a workspace:

```
c:\> c:\Python26\Scripts\virtualenv --no-site-packages pyramidtut
```

2. Switch to the `pyramidtut` directory:

```
c:\> cd pyramidtut
```

3. Use `easy_install` to get Pyramid and its direct dependencies installed:

```
c:\pyramidtut> Scripts\easy_install pyramid
```

4. Use `easy_install` to install various packages from PyPI.

```
c:\pyramidtut> Scripts\easy_install docutils \
         nose coverage zope.sqlalchemy SQLAlchemy pyramid_tm
```

34.2.2 Making a Project

Your next step is to create a project. Pyramid supplies a variety of scaffolds to generate sample projects. We will use the `pyramid_routesalchemy` scaffold, which generates an application that uses *SQLAlchemy* and *URL dispatch*.

The below instructions assume your current working directory is the "virtualenv" named "pyramidtut".

On UNIX:

```
$ bin/paster create -t pyramid_routesalchemy tutorial
```

On Windows:

```
c:\pyramidtut> Scripts\paster create -t pyramid_routesalchemy tutorial
```

 If you are using Windows, the `pyramid_routesalchemy` scaffold may not deal gracefully with installation into a location that contains spaces in the path. If you experience startup problems, try putting both the virtualenv and the project into directories that do not contain spaces in their paths.

34.2.3 Installing the Project in "Development Mode"

In order to do development on the project easily, you must "register" the project as a development egg in your workspace using the `setup.py develop` command. In order to do so, cd to the "tutorial" directory you created in *Making a Project*, and run the "setup.py develop" command using virtualenv Python interpreter.

On UNIX:

```
$ cd tutorial
$ ../bin/python setup.py develop
```

On Windows:

```
c:\pyramidtut> cd tutorial
c:\pyramidtut\tutorial> ..\Scripts\python setup.py develop
```

34.2.4 Running the Tests

After you've installed the project in development mode, you may run the tests for the project.

On UNIX:

```
$ ../bin/python setup.py test -q
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\python setup.py test -q
```

34.2.5 Starting the Application

Start the application.

On UNIX:

```
$ ../bin/paster serve development.ini --reload
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\paster serve development.ini --reload
```

34.2.6 Exposing Test Coverage Information

You can run the `nosetests` command to see test coverage information. This runs the tests in the same way that `setup.py test` does but provides additional "coverage" information, exposing which lines of your project are "covered" (or not covered) by the tests.

To get this functionality working, we'll need to install a couple of other packages into our `virtualenv`: `nose` and `coverage`:

On UNIX:

```
$ ../bin/easy_install nose coverage
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\easy_install nose coverage
```

Once `nose` and `coverage` are installed, we can actually run the coverage tests.

On UNIX:

```
$ ../bin/nosetests --cover-package=tutorial --cover-erase --with-coverage
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\nosetests --cover-package=tutorial ^
      --cover-erase --with-coverage
```

Looks like our package's `models` module doesn't quite have 100% test coverage.

34.2.7 Visit the Application in a Browser

In a browser, visit `http://localhost:6543/`. You will see the generated application's default page.

One thing you'll notice is the "debug toolbar" icon on right hand side of the page. You can read more about the purpose of the icon at *The Debug Toolbar*. It allows you to get information about your application while you develop.

34.2.8 Decisions the `pyramid_routesalchemy` Scaffold Has Made For You

Creating a project using the `pyramid_routesalchemy` scaffold makes the following assumptions:

- you are willing to use *SQLAlchemy* as a database access tool
- you are willing to use *url dispatch* to map URLs to code.

Pyramid supports any persistent storage mechanism (e.g. object database or filesystem files, etc). It also supports an additional mechanism to map URLs to code (*traversal*). However, for the purposes of this tutorial, we'll only be using url dispatch and SQLAlchemy.

34.3 Basic Layout

The starter files generated by the `pyramid_routesalchemy` scaffold are basic, but they provide a good orientation for the high-level patterns common to most *url dispatch* -based Pyramid projects.

The source code for this tutorial stage can be browsed at http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki2/src/basiclayout/.

34.3.1 App Startup with `__init__.py`

A directory on disk can be turned into a Python *package* by containing an `__init__.py` file. Even if empty, this marks a directory as a Python package. We use `__init__.py` both as a package marker and to contain configuration code.

The generated `development.ini` file is read by `paster` which looks for the application module in the `use` variable of the `app:main` section. The *entry point* is defined in the Setuptools configuration of this module, specifically in the `setup.py` file. For this tutorial, the *entry point* is defined as `tutorial:main` and points to a function named `main`.

First we need some imports to support later code:

```
from pyramid.config import Configurator
from sqlalchemy import engine_from_config

from tutorial.models import initialize_sql

```

Next we define the main function and create a SQLAlchemy database engine from the `sqlalchemy.` prefixed settings in the `development.ini` file's `[app:main]` section. This will be a URI (something like `sqlite://`):

```
def main(global_config, **settings):
    """ This function returns a Pyramid WSGI application.
    """
    engine = engine_from_config(settings, 'sqlalchemy.')
```

We then initialize our SQL database using SQLAlchemy, passing it the engine:

```
    initialize_sql(engine)
```

The next step is to construct a *Configurator*:

```
    config = Configurator(settings=settings)
```

`settings` is passed to the Configurator as a keyword argument with the dictionary values passed by PasteDeploy as the `**settings` argument. This will be a dictionary of settings parsed from the `.ini` file, which contains deployment-related values such as `pyramid.reload_templates`, `db_string`, etc.

We now can call `pyramid.config.Configurator.add_static_view()` with the arguments `static` (the name), and `tutorial:static` (the path):

```
    config.add_static_view('static', 'tutorial:static', cache_max_age=3600)
```

This registers a static resource view which will match any URL that starts with `/static/`. This will serve up static resources for us from within the `static` directory of our `tutorial` package, in this case, via `http://localhost:6543/static/` and below. With this declaration, we're saying that any URL that starts with `/static` should go to the static view; any remainder of its path (e.g. the `/foo` in `/static/foo`) will be used to compose a path to a static file resource, such as a CSS file.

Using the configurator we can also register a *route configuration* via the `pyramid.config.Configurator.add_route()` method that will be used when the URL is `/`:

```
    config.add_route('home', '/')
```

Since this route has a `pattern` equalling `/` it is the route that will be matched when the URL `/` is visted, e.g. `http://localhost:6543/`.

Mapping the `home` route to code is done by registering a view. You will use `pyramid.config.Configurator.add_view()` in *URL dispatch* to register views for the routes, mapping your patterns to code:

```
    config.add_view('tutorial.views.my_view', route_name='home',
                    renderer='templates/mytemplate.pt')
```

The first positional `add_view` argument `tutorial.views.my_view` is the dotted name to a *function* we write (generated by the `pyramid_routesalchemy` scaffold) that is given a `request` object and which returns a response or a dictionary. This view also names a `renderer`, which is a template which lives in the `templates` subdirectory of the package. When the `tutorial.views.my_view` view returns a dictionary, a *renderer* will use this template to create a response.

Finally, we use the `pyramid.config.Configurator.make_wsgi_app()` method to return a *WSGI* application:

```
    return config.make_wsgi_app()
```

Our final `__init__.py` file will look like this:

```
1  from pyramid.config import Configurator
2  from sqlalchemy import engine_from_config
3
4  from tutorial.models import initialize_sql
5
6  def main(global_config, **settings):
7      """ This function returns a Pyramid WSGI application.
8      """
9      engine = engine_from_config(settings, 'sqlalchemy.')
10     initialize_sql(engine)
11     config = Configurator(settings=settings)
12     config.add_static_view('static', 'tutorial:static', cache_max_age=3600)
13     config.add_route('home', '/')
14     config.add_view('tutorial.views.my_view', route_name='home',
15                     renderer='templates/mytemplate.pt')
16     return config.make_wsgi_app()
17
18
```

34.3.2 Content Models with `models.py`

In a SQLAlchemy-based application, a *model* object is an object composed by querying the SQL database which backs an application. SQLAlchemy is an "object relational mapper" (an ORM). The `models.py` file is where the `pyramid_routesalchemy` scaffold put the classes that implement our models.

Let's take a look. First, we need some imports to support later code.

```
import transaction

from sqlalchemy import Column
from sqlalchemy import Integer
from sqlalchemy import Unicode

from sqlalchemy.exc import IntegrityError
from sqlalchemy.ext.declarative import declarative_base

from sqlalchemy.orm import scoped_session
from sqlalchemy.orm import sessionmaker

from zope.sqlalchemy import ZopeTransactionExtension

```

Next we set up a SQLAlchemy "DBSession" object:

```
DBSession = scoped_session(sessionmaker(
                           extension=ZopeTransactionExtension()))
```

We also need to create a declarative `Base` object to use as a base class for our model:

```
Base = declarative_base()
```

To give a simple example of a model class, we define one named `MyModel`:

```
class MyModel(Base):
    __tablename__ = 'models'
    id = Column(Integer, primary_key=True)
    name = Column(Unicode(255), unique=True)
    value = Column(Integer)

    def __init__(self, name, value):
        self.name = name
        self.value = value
```

Our sample model has an __init__ that takes a two arguments (name, and value). It stores these values as self.name and self.value within the __init__ function itself. The MyModel class also has a __tablename__ attribute. This informs SQLAlchemy which table to use to store the data representing instances of this class.

Next we define a function named populate which adds a single model instance into our SQL storage and commits a transaction:

```
def populate():
    session = DBSession()
    model = MyModel(name=u'root',value=55)
    session.add(model)
    session.flush()
    transaction.commit()
```

The function doesn't do a lot in this case, but it's there to illustrate how an application requiring many objects to be set up could work.

Lastly we have a function named initialize_sql which receives a SQL database engine and binds it to our SQLAlchemy DBSession object. It also calls the populate function, to do initial database population. This is the initialization function that is called from __init__.py above.

```
def initialize_sql(engine):
    DBSession.configure(bind=engine)
    Base.metadata.bind = engine
    Base.metadata.create_all(engine)
    try:
        populate()
    except IntegrityError:
        transaction.abort()
```

Here is the complete source for models.py:

```
import transaction

from sqlalchemy import Column
from sqlalchemy import Integer
from sqlalchemy import Unicode

from sqlalchemy.exc import IntegrityError
from sqlalchemy.ext.declarative import declarative_base

from sqlalchemy.orm import scoped_session
```

```
from sqlalchemy.orm import sessionmaker

from zope.sqlalchemy import ZopeTransactionExtension

DBSession = scoped_session(sessionmaker(
                              extension=ZopeTransactionExtension()))
Base = declarative_base()

class MyModel(Base):
    __tablename__ = 'models'
    id = Column(Integer, primary_key=True)
    name = Column(Unicode(255), unique=True)
    value = Column(Integer)

    def __init__(self, name, value):
        self.name = name
        self.value = value

def populate():
    session = DBSession()
    model = MyModel(name=u'root',value=55)
    session.add(model)
    session.flush()
    transaction.commit()

def initialize_sql(engine):
    DBSession.configure(bind=engine)
    Base.metadata.bind = engine
    Base.metadata.create_all(engine)
    try:
        populate()
    except IntegrityError:
        transaction.abort()
```

34.4 Defining the Domain Model

The first change we'll make to our stock paster-generated application will be to define a *domain model* constructor representing a wiki page. We'll do this inside our `models.py` file.

The source code for this tutorial stage can be browsed at http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki2/src/models/.

34.4.1 Making Edits to `models.py`

There is nothing automagically special about the filename `models.py`. A project may have many models throughout its codebase in arbitrarily-named files. Files implementing models often have `model` in their filenames (or they may live in a Python subpackage of your application package named `models`) , but this is only by convention.

The first thing we want to do is remove the stock `MyModel` class from the generated `models.py` file. The `MyModel` class is only a sample and we're not going to use it.

Next, we'll remove the `sqlalchemy.Unicode` import and replace it with `sqlalchemy.Text`.

```
from sqlalchemy import Text
```

Then, we'll add a `Page` class. Because this is a SQLAlchemy application, this class should inherit from an instance of `sqlalchemy.ext.declarative.declarative_base`. Declarative SQLAlchemy models are easier to use than directly-mapped ones.

```
class Page(Base):
    """ The SQLAlchemy declarative model class for a Page object. """
    __tablename__ = 'pages'
    id = Column(Integer, primary_key=True)
    name = Column(Text, unique=True)
    data = Column(Text)

    def __init__(self, name, data):
        self.name = name
        self.data = data
```

As you can see, our `Page` class has a class level attribute `__tablename__` which equals the string `'pages'`. This means that SQLAlchemy will store our wiki data in a SQL table named `pages`. Our Page class will also have class-level attributes named `id`, `name` and `data` (all instances of `sqlalchemy.Column`). These will map to columns in the `pages` table. The `id` attribute will be the primary key in the table. The `name` attribute will be a text attribute, each value of which needs to be unique within the column. The `data` attribute is a text attribute that will hold the body of each page.

We'll also remove our `populate` function. We'll inline the populate step into `initialize_sql`, changing our `initialize_sql` function to add a FrontPage object to our database at startup time.

```
def initialize_sql(engine):
    DBSession.configure(bind=engine)
    Base.metadata.bind = engine
    Base.metadata.create_all(engine)
    try:
        transaction.begin()
        session = DBSession()
        page = Page('FrontPage', 'This is the front page')
        session.add(page)
        transaction.commit()
    except IntegrityError:
        # already created
        transaction.abort()
```

Here, we're using a slightly different binding syntax. It is otherwise largely the same as the `initialize_sql` in the paster-generated `models.py`.

Our `DBSession` assignment stays the same as the original generated `models.py`.

34.4.2 Looking at the Result of all Our Edits to `models.py`

The result of all of our edits to `models.py` will end up looking something like this:

```
import transaction

from sqlalchemy import Column
from sqlalchemy import Integer
from sqlalchemy import Text

from sqlalchemy.exc import IntegrityError
from sqlalchemy.ext.declarative import declarative_base

from sqlalchemy.orm import scoped_session
from sqlalchemy.orm import sessionmaker

from zope.sqlalchemy import ZopeTransactionExtension

DBSession = scoped_session(sessionmaker(
                           extension=ZopeTransactionExtension()))
Base = declarative_base()

class Page(Base):
```

```
    """ The SQLAlchemy declarative model class for a Page object. """
    __tablename__ = 'pages'
    id = Column(Integer, primary_key=True)
    name = Column(Text, unique=True)
    data = Column(Text)

    def __init__(self, name, data):
        self.name = name
        self.data = data

def initialize_sql(engine):
    DBSession.configure(bind=engine)
    Base.metadata.bind = engine
    Base.metadata.create_all(engine)
    try:
        transaction.begin()
        session = DBSession()
        page = Page('FrontPage', 'This is the front page')
        session.add(page)
        transaction.commit()
    except IntegrityError:
        # already created
        transaction.abort()
```

34.4.3 Viewing the Application in a Browser

We can't. At this point, our system is in a "non-runnable" state; we'll need to change view-related files in the next chapter to be able to start the application successfully. If you try to start the application, you'll wind up with a Python traceback on your console that ends with this exception:

```
ImportError: cannot import name MyModel
```

This will also happen if you attempt to run the tests.

34.5 Defining Views

A *view callable* in a *url dispatch* -based Pyramid application is typically a simple Python function that accepts a single parameter named *request*. A view callable is assumed to return a *response* object.

A Pyramid view can also be defined as callable which accepts *two* arguments: a *context* and a *request*. You'll see this two-argument pattern used in other Pyramid tutorials and applications. Either calling convention will work in any Pyramid application; the calling conventions can be used interchangeably as necessary. In *url dispatch* based applications, however, the context object is rarely used in the view body itself, so within this tutorial we define views as callables that accept only a request to avoid the visual "noise". If you do need the `context` within a view function that only takes the request as a single argument, you can obtain it via `request.context`.

The request passed to every view that is called as the result of a route match has an attribute named `matchdict` that contains the elements placed into the URL by the `pattern` of a `route` statement. For instance, if a call to `pyramid.config.Configurator.add_route()` in `__init__.py` had the pattern `{one}/{two}`, and the URL at `http://example.com/foo/bar` was invoked, matching this pattern, the `matchdict` dictionary attached to the request passed to the view would have a `'one'` key with the value `'foo'` and a `'two'` key with the value `'bar'`.

The source code for this tutorial stage can be browsed at http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki2/src/views/.

34.5.1 Declaring Dependencies in Our `setup.py` File

The view code in our application will depend on a package which is not a dependency of the original "tutorial" application. The original "tutorial" application was generated by the `paster create` command; it doesn't know about our custom application requirements. We need to add a dependency on the `docutils` package to our `tutorial` package's `setup.py` file by assigning this dependency to the `install_requires` parameter in the `setup` function.

Our resulting `setup.py` should look like so:

```
import os
import sys

from setuptools import setup, find_packages

here = os.path.abspath(os.path.dirname(__file__))
README = open(os.path.join(here, 'README.txt')).read()
CHANGES = open(os.path.join(here, 'CHANGES.txt')).read()

requires = [
    'pyramid',
    'SQLAlchemy',
    'transaction',
```

```
    'pyramid_tm',
    'pyramid_debugtoolbar',
    'zope.sqlalchemy',
    'docutils',
    ]

if sys.version_info[:3] < (2,5,0):
    requires.append('pysqlite')

setup(name='tutorial',
      version='0.0',
      description='tutorial',
      long_description=README + '\n\n' +  CHANGES,
      classifiers=[
        "Programming Language :: Python",
        "Framework :: Pylons",
        "Topic :: Internet :: WWW/HTTP",
        "Topic :: Internet :: WWW/HTTP :: WSGI :: Application",
        ],
      author='',
      author_email='',
      url='',
      keywords='web wsgi bfg pylons pyramid',
      packages=find_packages(),
      include_package_data=True,
      zip_safe=False,
      test_suite='tutorial',
      install_requires = requires,
      entry_points = """\
      [paste.app_factory]
      main = tutorial:main
      """,
      paster_plugins=['pyramid'],
      )

```

After these new dependencies are added, you will need to rerun `python setup.py develop` inside the root of the `tutorial` package to obtain and register the newly added dependency package.

34.5.2 Adding View Functions

We'll get rid of our `my_view` view function in our `views.py` file. It's only an example and isn't relevant to our application.

Then we're going to add four *view callable* functions to our `views.py` module. One view callable (named `view_wiki`) will display the wiki itself (it will answer on the root URL), another named `view_page` will display an individual page, another named `add_page` will allow a page to be added, and a final view callable named `edit_page` will allow a page to be edited. We'll describe each one briefly and show the resulting `views.py` file afterward.

 There is nothing special about the filename `views.py`. A project may have many view callables throughout its codebase in arbitrarily-named files. Files implementing view callables often have `view` in their filenames (or may live in a Python subpackage of your application package named `views`), but this is only by convention.

The `view_wiki` view function

The `view_wiki` function is the *default view* that will be called when a request is made to the root URL of our wiki. It always redirects to a URL which represents the path to our "FrontPage".

```
def view_wiki(request):
    return HTTPFound(location = request.route_url('view_page',
                                                  pagename='FrontPage'))
```

The `view_wiki` function returns an instance of the `pyramid.httpexceptions.HTTPFound` class (instances of which implement the `pyramid.interfaces.IResponse` interface like `pyramid.response.Response` does), It will use the `pyramid.request.Request.route_url()` API to construct a URL to the `FrontPage` page (e.g. `http://localhost:6543/FrontPage`), and will use it as the "location" of the HTTPFound response, forming an HTTP redirect.

The `view_page` view function

The `view_page` function will be used to show a single page of our wiki. It renders the *ReStructuredText* body of a page (stored as the `data` attribute of a Page object) as HTML. Then it substitutes an HTML anchor for each *WikiWord* reference in the rendered HTML using a compiled regular expression.

```
def view_page(request):
    pagename = request.matchdict['pagename']
    session = DBSession()
    page = session.query(Page).filter_by(name=pagename).first()
    if page is None:
        return HTTPNotFound('No such page')

    def check(match):
        word = match.group(1)
        exists = session.query(Page).filter_by(name=word).all()
        if exists:
            view_url = request.route_url('view_page', pagename=word)
            return '<a href="%s">%s</a>' % (view_url, word)
        else:
            add_url = request.route_url('add_page', pagename=word)
            return '<a href="%s">%s</a>' % (add_url, word)

    content = publish_parts(page.data, writer_name='html')['html_body']
    content = wikiwords.sub(check, content)
    edit_url = request.route_url('edit_page', pagename=pagename)
    return dict(page=page, content=content, edit_url=edit_url)
```

The curried function named `check` is used as the first argument to `wikiwords.sub`, indicating that it should be called to provide a value for each WikiWord match found in the content. If the wiki already contains a page with the matched WikiWord name, the `check` function generates a view link to be used as the substitution value and returns it. If the wiki does not already contain a page with with the matched WikiWord name, the function generates an "add" link as the substitution value and returns it.

As a result, the `content` variable is now a fully formed bit of HTML containing various view and add links for WikiWords based on the content of our current page object.

We then generate an edit URL (because it's easier to do here than in the template), and we return a dictionary with a number of arguments. The fact that this view returns a dictionary (as opposed to a *response* object) is a cue to Pyramid that it should try to use a *renderer* associated with the view configuration to render a template. In our case, the template which will be rendered will be the `templates/view.pt` template, as per the configuration put into effect in `__init__.py`.

The `add_page` view function

The `add_page` function will be invoked when a user clicks on a *WikiWord* which isn't yet represented as a page in the system. The `check` function within the `view_page` view generates URLs to this view. It also acts as a handler for the form that is generated when we want to add a page object. The `matchdict` attribute of the request passed to the `add_page` view will have the values we need to construct URLs and find model objects.

```
def add_page(request):
    name = request.matchdict['pagename']
    if 'form.submitted' in request.params:
        session = DBSession()
        body = request.params['body']
        page = Page(name, body)
        session.add(page)
        return HTTPFound(location = request.route_url('view_page',
                                                      pagename=name))
    save_url = request.route_url('add_page', pagename=name)
    page = Page('', '')
    return dict(page=page, save_url=save_url)
```

The `matchdict` will have a `'pagename'` key that matches the name of the page we'd like to add. If our add view is invoked via, e.g. `http://localhost:6543/add_page/SomeName`, the value for `'pagename'` in the `matchdict` will be `'SomeName'`.

If the view execution is *not* a result of a form submission (if the expression `'form.submitted' in request.params` is `False`), the view callable renders a template. To do so, it generates a "save url" which the template uses as the form post URL during rendering. We're lazy here, so we're trying to use the same template (`templates/edit.pt`) for the add view as well as the page edit view, so we create a dummy Page object in order to satisfy the edit form's desire to have *some* page object exposed as `page`, and Pyramid will render the template associated with this view to a response.

If the view execution *is* a result of a form submission (if the expression `'form.submitted' in request.params` is `True`), we scrape the page body from the form data, create a Page object with this page body and the name taken from `matchdict['pagename']`, and save it into the database using `session.add`. We then redirect back to the `view_page` view for the newly created page.

The `edit_page` view function

The `edit_page` function will be invoked when a user clicks the "Edit this Page" button on the view form. It renders an edit form but it also acts as the handler for the form it renders. The `matchdict` attribute of the request passed to the `edit_page` view will have a `'pagename'` key matching the name of the page the user wants to edit.

```
def edit_page(request):
    name = request.matchdict['pagename']
    session = DBSession()
    page = session.query(Page).filter_by(name=name).one()
    if 'form.submitted' in request.params:
```

```
        page.data = request.params['body']
        session.add(page)
        return HTTPFound(location = request.route_url('view_page',
                                                      pagename=name))
    return dict(
        page=page,
        save_url = request.route_url('edit_page', pagename=name),
        )
```

If the view execution is *not* a result of a form submission (if the expression `'form.submitted' in request.params` is `False`), the view simply renders the edit form, passing the page object and a `save_url` which will be used as the action of the generated form.

If the view execution *is* a result of a form submission (if the expression `'form.submitted' in request.params` is `True`), the view grabs the `body` element of the request parameters and sets it as the `data` attribute of the page object. It then redirects to the `view_page` view of the wiki page.

34.5.3 Viewing the Result of all Our Edits to `views.py`

The result of all of our edits to `views.py` will leave it looking like this:

```
import re

from docutils.core import publish_parts

from pyramid.httpexceptions import HTTPFound, HTTPNotFound

from tutorial.models import DBSession
from tutorial.models import Page

# regular expression used to find WikiWords
wikiwords = re.compile(r"\b([A-Z]\w+[A-Z]+\w+)")

def view_wiki(request):
    return HTTPFound(location = request.route_url('view_page',
                                                  pagename='FrontPage'))

def view_page(request):
    pagename = request.matchdict['pagename']
    session = DBSession()
    page = session.query(Page).filter_by(name=pagename).first()
    if page is None:
```

```
        return HTTPNotFound('No such page')

    def check(match):
        word = match.group(1)
        exists = session.query(Page).filter_by(name=word).all()
        if exists:
            view_url = request.route_url('view_page', pagename=word)
            return '<a href="%s">%s</a>' % (view_url, word)
        else:
            add_url = request.route_url('add_page', pagename=word)
            return '<a href="%s">%s</a>' % (add_url, word)

    content = publish_parts(page.data, writer_name='html')['html_body']
    content = wikiwords.sub(check, content)
    edit_url = request.route_url('edit_page', pagename=pagename)
    return dict(page=page, content=content, edit_url=edit_url)

def add_page(request):
    name = request.matchdict['pagename']
    if 'form.submitted' in request.params:
        session = DBSession()
        body = request.params['body']
        page = Page(name, body)
        session.add(page)
        return HTTPFound(location = request.route_url('view_page',
                                                      pagename=name))
    save_url = request.route_url('add_page', pagename=name)
    page = Page('', '')
    return dict(page=page, save_url=save_url)

def edit_page(request):
    name = request.matchdict['pagename']
    session = DBSession()
    page = session.query(Page).filter_by(name=name).one()
    if 'form.submitted' in request.params:
        page.data = request.params['body']
        session.add(page)
        return HTTPFound(location = request.route_url('view_page',
                                                      pagename=name))
    return dict(
        page=page,
        save_url = request.route_url('edit_page', pagename=name),
        )
```

34.5.4 Adding Templates

The views we've added all reference a *template*. Each template is a *Chameleon ZPT* template. These templates will live in the `templates` directory of our tutorial package.

The `view.pt` Template

The `view.pt` template is used for viewing a single wiki page. It is used by the `view_page` view function. It should have a div that is "structure replaced" with the `content` value provided by the view. It should also have a link on the rendered page that points at the "edit" URL (the URL which invokes the `edit_page` view for the page being viewed).

Once we're done with the `view.pt` template, it will look a lot like the below:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.name} - Pyramid tutorial wiki (based on
    TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
```

```
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Viewing <b><span tal:replace="page.name">Page Name
              Goes Here</span></b><br/>
          You can return to the
          <a href="${request.application_url}">FrontPage</a>.<br/>
        </div>
        <div id="right" class="app-welcome align-right"></div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <div tal:replace="structure content">
          Page text goes here.
        </div>
        <p>
          <a tal:attributes="href edit_url" href="">
            Edit this page
          </a>
        </p>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
        >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

The names available for our use in a template are always those that are present in the dictionary returned by the view callable. But our templates make use of a `request` object that none of our tutorial views return in their dictionary. This value appears as if "by magic". However, `request` is one of several names that are available "by default" in a template when a template renderer is used. See **.pt or *.txt: Chameleon Template Renderers* for more information about other names that are available by default in a template when a Chameleon template is used as a renderer.

The `edit.pt` Template

The `edit.pt` template is used for adding and editing a wiki page. It is used by the `add_page` and `edit_page` view functions. It should display a page containing a form that POSTs back to the "save_url" argument supplied by the view. The form should have a "body" textarea field (the page data), and a submit button that has the name "form.submitted". The textarea in the form should be filled with any existing page data when it is rendered.

Once we're done with the `edit.pt` template, it will look a lot like the below:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.name} - Pyramid tutorial wiki (based on
    TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Editing <b><span tal:replace="page.name">Page Name Goes
            Here</span></b><br/>
```

```
          You can return to the
          <a href="${request.application_url}">FrontPage</a>.<br/>
        </div>
        <div id="right" class="app-welcome align-right"></div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <form action="${save_url}" method="post">
          <textarea name="body" tal:content="page.data" rows="10"
                    cols="60"/><br/>
          <input type="submit" name="form.submitted" value="Save"/>
        </form>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

Static Assets

Our templates name a single static asset named `pylons.css`. We don't need to create this file within our package's `static` directory because it was provided at the time we created the project. This file is a little too long to replicate within the body of this guide, however it is available online.

This CSS file will be accessed via e.g. `http://localhost:6543/static/pylons.css` by virtue of the call to `add_static_view` directive we've made in the `__init__.py` file. Any number and type of static assets can be placed in this directory (or subdirectories) and are just referred to by URL or by using the convenience method `static_url` e.g. `request.static_url('{{package}}:static/foo.css')` within templates.

34.5.5 Mapping Views to URLs in `__init__.py`

The `__init__.py` file contains `pyramid.config.Configurator.add_view()` calls which serve to map routes via *url dispatch* to views. First, we'll get rid of the existing route created by the template using the name `'home'`. It's only an example and isn't relevant to our application.

We then need to add four calls to `add_route`. Note that the *ordering* of these declarations is very important. `route` declarations are matched in the order they're found in the `__init__.py` file.

1. Add a declaration which maps the pattern `/` (signifying the root URL) to the route named `view_wiki`.

2. Add a declaration which maps the pattern `/{pagename}` to the route named `view_page`. This is the regular view for a page.

3. Add a declaration which maps the pattern `/add_page/{pagename}` to the route named `add_page`. This is the add view for a new page.

4. Add a declaration which maps the pattern `/{pagename}/edit_page` to the route named `edit_page`. This is the edit view for a page.

After we've defined the routes for our application, we can register views to handle the processing and rendering that needs to happen when each route is requested.

1. Add a declaration which maps the `view_wiki` route to the view named `view_wiki` in our `views.py` file. This is the *default view* for the wiki.

2. Add a declaration which maps the `view_page` route to the view named `view_page` in our `views.py` file.

3. Add a declaration which maps the `add_page` route to the view named `add_page` in our `views.py` file.

4. Add a declaration which maps the `edit_page` route to the view named `edit_page` in our `views.py` file.

As a result of our edits, the `__init__.py` file should look something like so:

```
from pyramid.config import Configurator
from sqlalchemy import engine_from_config

from tutorial.models import initialize_sql

def main(global_config, **settings):
    """ This function returns a WSGI application.
    """
    engine = engine_from_config(settings, 'sqlalchemy.')
    initialize_sql(engine)
    config = Configurator(settings=settings)
    config.add_static_view('static', 'tutorial:static', cache_max_age=3600)
    config.add_route('view_wiki', '/')
    config.add_route('view_page', '/{pagename}')
    config.add_route('add_page', '/add_page/{pagename}')
    config.add_route('edit_page', '/{pagename}/edit_page')
```

```
17      config.add_view('tutorial.views.view_wiki', route_name='view_wiki')
18      config.add_view('tutorial.views.view_page', route_name='view_page',
19                      renderer='tutorial:templates/view.pt')
20      config.add_view('tutorial.views.add_page', route_name='add_page',
21                      renderer='tutorial:templates/edit.pt')
22      config.add_view('tutorial.views.edit_page', route_name='edit_page',
23                      renderer='tutorial:templates/edit.pt')
24      return config.make_wsgi_app()
25
```

34.5.6 Viewing the Application in a Browser

We can finally examine our application in a browser. The views we'll try are as follows:

- Visiting `http://localhost:6543` in a browser invokes the `view_wiki` view. This always redirects to the `view_page` view of the FrontPage page object.
- Visiting `http://localhost:6543/FrontPage` in a browser invokes the `view_page` view of the front page page object.
- Visiting `http://localhost:6543/FrontPage/edit_page` in a browser invokes the edit view for the front page object.
- Visiting `http://localhost:6543/add_page/SomePageName` in a browser invokes the add view for a page.

Try generating an error within the body of a view by adding code to the top of it that generates an exception (e.g. `raise Exception('Forced Exception')`). Then visit the error-raising view in a browser. You should see an interactive exception handler in the browser which allows you to examine values in a post-mortem mode.

34.6 Adding Authorization

Our application currently allows anyone with access to the server to view, edit, and add pages to our wiki. For purposes of demonstration we'll change our application to allow only people whom possess a specific username (*editor*) to add and edit wiki pages but we'll continue allowing anyone with access to the server to view pages. Pyramid provides facilities for *authorization* and *authentication*. We'll make use of both features to provide security to our application.

We will add an *authentication policy* and an *authorization policy* to our *application registry*, add a `security.py` module, create a *root factory* with an *ACL*, and add *permission* declarations to the `edit_page` and `add_page` views.

Then we will add `login` and `logout` views, and modify the existing views to make them return a `logged_in` flag to the renderer.

Finally, we will add a `login.pt` template and change the existing `view.pt` and `edit.pt` to show a "Logout" link when not logged in.

The source code for this tutorial stage can be browsed at http://github.com/Pylons/pyramid/tree/1.2-branch/docs/tutorials/wiki2/src/authorization/.

34.6.1 Changing `__init__.py` For Authorization

We're going to be making several changes to our `__init__.py` file which will help us configure an authorization policy.

Adding A Root Factory

We're going to start to use a custom *root factory* within our `__init__.py` file. The objects generated by the root factory will be used as the *context* of each request to our application. We do this to allow Pyramid declarative security to work properly. The context object generated by the root factory during a request will be decorated with security declarations. When we begin to use a custom root factory to generate our contexts, we can begin to make use of the declarative security features of Pyramid.

We'll modify our `__init__.py`, passing in a *root factory* to our *Configurator* constructor. We'll point it at a new class we create inside our `models.py` file. Add the following statements to your `models.py` file:

```
from pyramid.security import Allow
from pyramid.security import Everyone

class RootFactory(object):
    __acl__ = [ (Allow, Everyone, 'view'),
                (Allow, 'group:editors', 'edit') ]
    def __init__(self, request):
        pass
```

The `RootFactory` class we've just added will be used by Pyramid to construct a `context` object. The context is attached to the request object passed to our view callables as the `context` attribute.

The context object generated by our root factory will possess an `__acl__` attribute that allows `pyramid.security.Everyone` (a special principal) to view all pages, while allowing only a *principal* named `group:editors` to edit and add pages. The `__acl__` attribute attached to a context is interpreted specially by Pyramid as an access control list during view callable execution. See *Assigning ACLs to your Resource Objects* for more information about what an *ACL* represents.

We'll pass the `RootFactory` we created in the step above in as the `root_factory` argument to a *Configurator*.

Configuring an Authorization Policy

For any Pyramid application to perform authorization, we need to add a `security.py` module (we'll do that shortly) and we'll need to change our `__init__.py` file to add an *authentication policy* and an *authorization policy* which uses the `security.py` file for a *callback*.

We'll change our `__init__.py` file to enable an `AuthTktAuthenticationPolicy` and an `ACLAuthorizationPolicy` to enable declarative security checking. We need to import the new policies:

```
from pyramid.authentication import AuthTktAuthenticationPolicy
from pyramid.authorization import ACLAuthorizationPolicy
from tutorial.security import groupfinder
```

Then, we'll add those policies to the configuration:

```
    authn_policy = AuthTktAuthenticationPolicy(
        'sosecret', callback=groupfinder)
    authz_policy = ACLAuthorizationPolicy()
    config = Configurator(settings=settings,
                          root_factory='tutorial.models.RootFactory',
                          authentication_policy=authn_policy,
                          authorization_policy=authz_policy)
```

Note that that the `pyramid.authentication.AuthTktAuthenticationPolicy` constructor accepts two arguments: `secret` and `callback`. `secret` is a string representing an encryption key used by the "authentication ticket" machinery represented by this policy: it is required. The `callback` is a `groupfinder` function in the current directory's `security.py` file. We haven't added that module yet, but we're about to.

We'll also change `__init__.py`, adding a call to `pyramid.config.Configurator.add_view()` that points at our `login` *view callable*. This is also known as a *forbidden view*:

```
    config.add_route('login', '/login')
    config.add_view('tutorial.login.login',
                    context='pyramid.httpexceptions.HTTPForbidden',
                    renderer='tutorial:templates/login.pt')
```

A forbidden view configures our newly created login view to show up when Pyramid detects that a view invocation can not be authorized.

A `logout` *view callable* will allow users to log out later:

```
    config.add_route('logout', '/logout')
    config.add_view('tutorial.login.logout', route_name='logout')
```

We'll also add `permission` arguments with the value `edit` to the `edit_page` and `add_page` views. This indicates that the view callables which these views reference cannot be invoked without the authenticated user possessing the `edit` permission with respect to the current context.

```
    config.add_view('tutorial.views.add_page', route_name='add_page',
                    renderer='tutorial:templates/edit.pt', permission='edit')
    config.add_view('tutorial.views.edit_page', route_name='edit_page',
                    renderer='tutorial:templates/edit.pt', permission='edit')
```

Adding these `permission` arguments causes Pyramid to make the assertion that only users who possess the effective `edit` permission at the time of the request may invoke those two views. We've granted the `group:editors` principal the `edit` permission at the root model via its ACL, so only the a user whom is a member of the group named `group:editors` will able to invoke the views associated with the `add_page` or `edit_page` routes.

Viewing Your Changes

When we're done configuring a root factory, adding an authorization policy, and adding views, your application's `__init__.py` will look like this:

```
from pyramid.config import Configurator
from pyramid.authentication import AuthTktAuthenticationPolicy
from pyramid.authorization import ACLAuthorizationPolicy

from sqlalchemy import engine_from_config

```

```
from tutorial.models import initialize_sql
from tutorial.security import groupfinder

def main(global_config, **settings):
    """ This function returns a WSGI application.
    """
    engine = engine_from_config(settings, 'sqlalchemy.')
    initialize_sql(engine)
    authn_policy = AuthTktAuthenticationPolicy(
        'sosecret', callback=groupfinder)
    authz_policy = ACLAuthorizationPolicy()
    config = Configurator(settings=settings,
                          root_factory='tutorial.models.RootFactory',
                          authentication_policy=authn_policy,
                          authorization_policy=authz_policy)
    config.add_static_view('static', 'tutorial:static', cache_max_age=3600)

    config.add_route('view_wiki', '/')
    config.add_route('login', '/login')
    config.add_route('logout', '/logout')
    config.add_route('view_page', '/{pagename}')
    config.add_route('add_page', '/add_page/{pagename}')
    config.add_route('edit_page', '/{pagename}/edit_page')

    config.add_view('tutorial.views.view_wiki', route_name='view_wiki')
    config.add_view('tutorial.login.login', route_name='login',
                    renderer='tutorial:templates/login.pt')
    config.add_view('tutorial.login.logout', route_name='logout')
    config.add_view('tutorial.views.view_page', route_name='view_page',
                    renderer='tutorial:templates/view.pt')
    config.add_view('tutorial.views.add_page', route_name='add_page',
                    renderer='tutorial:templates/edit.pt', permission='edit')
    config.add_view('tutorial.views.edit_page', route_name='edit_page',
                    renderer='tutorial:templates/edit.pt', permission='edit')
    config.add_view('tutorial.login.login',
                    context='pyramid.httpexceptions.HTTPForbidden',
                    renderer='tutorial:templates/login.pt')
    return config.make_wsgi_app()

```

34.6.2 Adding `security.py`

Add a `security.py` module within your package (in the same directory as `__init__.py`, `views.py`, etc.) with the following content:

```
USERS = {'editor':'editor',
         'viewer':'viewer'}
GROUPS = {'editor':['group:editors']}

def groupfinder(userid, request):
    if userid in USERS:
        return GROUPS.get(userid, [])

```

The `groupfinder` function defined here is an *authentication policy* "callback"; it is a callable that accepts a userid and a request. If the userid exists in the system, the callback will return a sequence of group identifiers (or an empty sequence if the user isn't a member of any groups). If the userid *does not* exist in the system, the callback will return `None`. In a production system, user and group data will most often come from a database, but here we use "dummy" data to represent user and groups sources. Note that the `editor` user is a member of the `group:editors` group in our dummy group data (the `GROUPS` data structure).

We've given the `editor` user membership to the `group:editors` by mapping him to this group in the `GROUPS` data structure (`GROUPS = {'editor':['group:editors']}`). Since the `groupfinder` function consults the `GROUPS` data structure, this will mean that, as a result of the ACL attached to the root returned by the root factory, and the permission associated with the `add_page` and `edit_page` views, the `editor` user should be able to add and edit pages.

34.6.3 Adding Login and Logout Views

We'll add a `login` view callable which renders a login form and processes the post from the login form, checking credentials.

We'll also add a `logout` view callable to our application and provide a link to it. This view will clear the credentials of the logged in user and redirect back to the front page.

We'll add a different file (for presentation convenience) to add login and the logout view callables. Add a file named `login.py` to your application (in the same directory as `views.py`) with the following content:

```
from pyramid.httpexceptions import HTTPFound
from pyramid.security import remember
from pyramid.security import forget

from tutorial.security import USERS

```

```
def login(request):
    login_url = request.route_url('login')
    referrer = request.url
    if referrer == login_url:
        referrer = '/' # never use the login form itself as came_from
    came_from = request.params.get('came_from', referrer)
    message = ''
    login = ''
    password = ''
    if 'form.submitted' in request.params:
        login = request.params['login']
        password = request.params['password']
        if USERS.get(login) == password:
            headers = remember(request, login)
            return HTTPFound(location = came_from,
                             headers = headers)
        message = 'Failed login'

    return dict(
        message = message,
        url = request.application_url + '/login',
        came_from = came_from,
        login = login,
        password = password,
        )

def logout(request):
    headers = forget(request)
    return HTTPFound(location = request.route_url('view_wiki'),
                     headers = headers)

```

34.6.4 Changing Existing Views

Then we need to change each of our `view_page`, `edit_page` and `add_page` views in `views.py` to pass a "logged in" parameter to its template. We'll add something like this to each view body:

```
from pyramid.security import authenticated_userid
logged_in = authenticated_userid(request)
```

We'll then change the return value of these views to pass the *resulting 'logged_in'* value to the template, e.g.:

```
return dict(page = page,
            content = content,
            logged_in = logged_in,
            edit_url = edit_url)
```

34.6.5 Adding the `login.pt` Template

Add a `login.pt` template to your templates directory. It's referred to within the login view we just added to `login.py`.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>Login - Pyramid tutorial wiki (based on TurboGears
    20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
```

```
        <div id="left" class="app-welcome align-left">
          <b>Login</b><br/>
          <span tal:replace="message"/>
        </div>
        <div id="right" class="app-welcome align-right"></div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <form action="${url}" method="post">
          <input type="hidden" name="came_from" value="${came_from}"/>
          <input type="text" name="login" value="${login}"/><br/>
          <input type="password" name="password"
                 value="${password}"/><br/>
          <input type="submit" name="form.submitted" value="Log In"/>
        </form>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

34.6.6 Change `view.pt` and `edit.pt`

We'll also need to change our `edit.pt` and `view.pt` templates to display a "Logout" link if someone is logged in. This link will invoke the logout view.

To do so we'll add this to both templates within the `<div id="right" class="app-welcome align-right">` div:

```
<span tal:condition="logged_in">
   <a href="${request.application_url}/logout">Logout</a>
</span>
```

34.6.7 Seeing Our Changes To `views.py` and our Templates

Our `views.py` module will look something like this when we're done:

```
import re

from docutils.core import publish_parts

from pyramid.httpexceptions import HTTPFound, HTTPNotFound
from pyramid.security import authenticated_userid

from tutorial.models import DBSession
from tutorial.models import Page

# regular expression used to find WikiWords
wikiwords = re.compile(r"\b([A-Z]\w+[A-Z]+\w+)")

def view_wiki(request):
    return HTTPFound(location = request.route_url('view_page',
                                                  pagename='FrontPage'))

def view_page(request):
    pagename = request.matchdict['pagename']
    session = DBSession()
    page = session.query(Page).filter_by(name=pagename).first()
    if page is None:
        return HTTPNotFound('No such page')

    def check(match):
        word = match.group(1)
        exists = session.query(Page).filter_by(name=word).all()
        if exists:
            view_url = request.route_url('view_page', pagename=word)
            return '<a href="%s">%s</a>' % (view_url, word)
        else:
            add_url = request.route_url('add_page', pagename=word)
            return '<a href="%s">%s</a>' % (add_url, word)

    content = publish_parts(page.data, writer_name='html')['html_body']
    content = wikiwords.sub(check, content)
    edit_url = request.route_url('edit_page', pagename=pagename)
    logged_in = authenticated_userid(request)
    return dict(page=page, content=content, edit_url=edit_url,
                logged_in=logged_in)

def add_page(request):
    name = request.matchdict['pagename']
    if 'form.submitted' in request.params:
        session = DBSession()
        body = request.params['body']
```

```
        page = Page(name, body)
        session.add(page)
        return HTTPFound(location = request.route_url('view_page',
                                                      pagename=name))
    save_url = request.route_url('add_page', pagename=name)
    page = Page('', '')
    logged_in = authenticated_userid(request)
    return dict(page=page, save_url=save_url, logged_in=logged_in)

def edit_page(request):
    name = request.matchdict['pagename']
    session = DBSession()
    page = session.query(Page).filter_by(name=name).one()
    if 'form.submitted' in request.params:
        page.data = request.params['body']
        session.add(page)
        return HTTPFound(location = request.route_url('view_page',
                                                      pagename=name))

    logged_in = authenticated_userid(request)
    return dict(
        page=page,
        save_url = request.route_url('edit_page', pagename=name),
        logged_in = logged_in,
        )
```

Our `edit.pt` template will look something like this when we're done:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.name} - Pyramid tutorial wiki (based on
    TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
```

```
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Editing <b><span tal:replace="page.name">Page Name
            Goes Here</span></b><br/>
          You can return to the
          <a href="${request.application_url}">FrontPage</a>.<br/>
        </div>
        <div id="right" class="app-welcome align-right">
          <span tal:condition="logged_in">
              <a href="${request.application_url}/logout">Logout</a>
          </span>
        </div>
      </div>
    </div>
    <div id="bottom">
      <div class="bottom">
        <form action="${save_url}" method="post">
          <textarea name="body" tal:content="page.data" rows="10"
                    cols="60"/><br/>
          <input type="submit" name="form.submitted" value="Save"/>
        </form>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
         >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

Our `view.pt` template will look something like this when we're done:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en"
      xmlns:tal="http://xml.zope.org/namespaces/tal">
<head>
  <title>${page.name} - Pyramid tutorial wiki (based on
    TurboGears 20-Minute Wiki)</title>
  <meta http-equiv="Content-Type" content="text/html;charset=UTF-8"/>
  <meta name="keywords" content="python web application" />
  <meta name="description" content="pyramid web application" />
  <link rel="shortcut icon"
        href="${request.static_url('tutorial:static/favicon.ico')}" />
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/pylons.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <!--[if lte IE 6]>
  <link rel="stylesheet"
        href="${request.static_url('tutorial:static/ie6.css')}"
        type="text/css" media="screen" charset="utf-8" />
  <![endif]-->
</head>
<body>
  <div id="wrap">
    <div id="top-small">
      <div class="top-small align-center">
        <div>
          <img width="220" height="50" alt="pyramid"
        src="${request.static_url('tutorial:static/pyramid-small.png')}" />
        </div>
      </div>
    </div>
    <div id="middle">
      <div class="middle align-right">
        <div id="left" class="app-welcome align-left">
          Viewing <b><span tal:replace="page.name">Page Name
            Goes Here</span></b><br/>
          You can return to the
          <a href="${request.application_url}">FrontPage</a>.<br/>
        </div>
        <div id="right" class="app-welcome align-right">
          <span tal:condition="logged_in">
            <a href="${request.application_url}/logout">Logout</a>
          </span>
        </div>
      </div>
    </div>
```

```
    <div id="bottom">
      <div class="bottom">
        <div tal:replace="structure content">
          Page text goes here.
        </div>
        <p>
          <a tal:attributes="href edit_url" href="">
            Edit this page
          </a>
        </p>
      </div>
    </div>
  </div>
  <div id="footer">
    <div class="footer"
        >&copy; Copyright 2008-2011, Agendaless Consulting.</div>
  </div>
</body>
</html>
```

34.6.8 Viewing the Application in a Browser

We can finally examine our application in a browser. The views we'll try are as follows:

- Visiting `http://localhost:6543/` in a browser invokes the `view_wiki` view. This always redirects to the `view_page` view of the FrontPage page object. It is executable by any user.

- Visiting `http://localhost:6543/FrontPage` in a browser invokes the `view_page` view of the FrontPage page object.

- Visiting `http://localhost:6543/FrontPage/edit_page` in a browser invokes the edit view for the FrontPage object. It is executable by only the `editor` user. If a different user (or the anonymous user) invokes it, a login form will be displayed. Supplying the credentials with the username `editor`, password `editor` will display the edit page form.

- Visiting `http://localhost:6543/add_page/SomePageName` in a browser invokes the add view for a page. It is executable by only the `editor` user. If a different user (or the anonymous user) invokes it, a login form will be displayed. Supplying the credentials with the username `editor`, password `editor` will display the edit page form.

- After logging in (as a result of hitting an edit or add page and submitting the login form with the `editor` credentials), we'll see a Logout link in the upper right hand corner. When we click it, we're logged out, and redirected back to the front page.

34.7 Adding Tests

We will now add tests for the models and the views and a few functional tests in the `tests.py`. Tests ensure that an application works, and that it continues to work after some changes are made in the future.

34.7.1 Testing the Models

We write a test class for the model class `Page` and another test class for the `initialize_sql` function.

To do so, we'll retain the `tutorial.tests.ViewTests` class provided as a result of the `pyramid_routesalchemy` project generator. We'll add two test classes: one for the `Page` model named `PageModelTests`, one for the `initialize_sql` function named `InitializeSqlTests`.

34.7.2 Testing the Views

We'll modify our `tests.py` file, adding tests for each view function we added above. As a result, we'll *delete* the `ViewTests` test in the file, and add four other test classes: `ViewWikiTests`, `ViewPageTests`, `AddPageTests`, and `EditPageTests`. These test the `view_wiki`, `view_page`, `add_page`, and `edit_page` views respectively.

34.7.3 Functional tests

We test the whole application, covering security aspects that are not tested in the unit tests, like logging in, logging out, checking that the `viewer` user cannot add or edit pages, but the `editor` user can, and so on.

34.7.4 Viewing the results of all our edits to `tests.py`

Once we're done with the `tests.py` module, it will look a lot like the below:

```
import unittest

from pyramid import testing


def _initTestingDB():
    from tutorial.models import DBSession
    from tutorial.models import Base
    from sqlalchemy import create_engine
    engine = create_engine('sqlite:///:memory:')
    DBSession.configure(bind=engine)
    Base.metadata.bind = engine
    Base.metadata.create_all(engine)
    return DBSession

def _registerRoutes(config):
    config.add_route('view_page', '{pagename}')
    config.add_route('edit_page', '{pagename}/edit_page')
    config.add_route('add_page', 'add_page/{pagename}')


class PageModelTests(unittest.TestCase):

    def setUp(self):
        self.session = _initTestingDB()

    def tearDown(self):
        self.session.remove()

    def _getTargetClass(self):
        from tutorial.models import Page
        return Page

    def _makeOne(self, name='SomeName', data='some data'):
        return self._getTargetClass()(name, data)

    def test_constructor(self):
        instance = self._makeOne()
        self.assertEqual(instance.name, 'SomeName')
        self.assertEqual(instance.data, 'some data')

class InitializeSqlTests(unittest.TestCase):

    def setUp(self):
        from tutorial.models import DBSession
        DBSession.remove()
```

```
47
48      def tearDown(self):
49          from tutorial.models import DBSession
50          DBSession.remove()
51
52      def _callFUT(self, engine):
53          from tutorial.models import initialize_sql
54          return initialize_sql(engine)
55
56      def test_it(self):
57          from sqlalchemy import create_engine
58          engine = create_engine('sqlite:///:memory:')
59          self._callFUT(engine)
60          from tutorial.models import DBSession, Page
61          self.assertEqual(DBSession.query(Page).one().data,
62              'This is the front page')
63
64  class ViewWikiTests(unittest.TestCase):
65      def setUp(self):
66          self.config = testing.setUp()
67
68      def tearDown(self):
69          testing.tearDown()
70
71      def _callFUT(self, request):
72          from tutorial.views import view_wiki
73          return view_wiki(request)
74
75      def test_it(self):
76          _registerRoutes(self.config)
77          request = testing.DummyRequest()
78          response = self._callFUT(request)
79          self.assertEqual(response.location, 'http://example.com/FrontPage')
80
81  class ViewPageTests(unittest.TestCase):
82      def setUp(self):
83          self.session = _initTestingDB()
84          self.config = testing.setUp()
85
86      def tearDown(self):
87          self.session.remove()
88          testing.tearDown()
89
90      def _callFUT(self, request):
91          from tutorial.views import view_page
92          return view_page(request)
```

```
93
94      def test_it(self):
95          from tutorial.models import Page
96          request = testing.DummyRequest()
97          request.matchdict['pagename'] = 'IDoExist'
98          page = Page('IDoExist', 'Hello CruelWorld IDoExist')
99          self.session.add(page)
100         _registerRoutes(self.config)
101         info = self._callFUT(request)
102         self.assertEqual(info['page'], page)
103         self.assertEqual(
104             info['content'],
105             '<div class="document">\n'
106             '<p>Hello <a href="http://example.com/add_page/CruelWorld">'
107             'CruelWorld</a> '
108             '<a href="http://example.com/IDoExist">'
109             'IDoExist</a>'
110             '</p>\n</div>\n')
111         self.assertEqual(info['edit_url'],
112             'http://example.com/IDoExist/edit_page')
113
114 class AddPageTests(unittest.TestCase):
115     def setUp(self):
116         self.session = _initTestingDB()
117         self.config = testing.setUp()
118
119     def tearDown(self):
120         self.session.remove()
121         testing.tearDown()
122
123     def _callFUT(self, request):
124         from tutorial.views import add_page
125         return add_page(request)
126
127     def test_it_notsubmitted(self):
128         _registerRoutes(self.config)
129         request = testing.DummyRequest()
130         request.matchdict = {'pagename':'AnotherPage'}
131         info = self._callFUT(request)
132         self.assertEqual(info['page'].data,'')
133         self.assertEqual(info['save_url'],
134                          'http://example.com/add_page/AnotherPage')
135
136     def test_it_submitted(self):
137         from tutorial.models import Page
138         _registerRoutes(self.config)
```

```
        request = testing.DummyRequest({'form.submitted':True,
                                        'body':'Hello yo!'})
        request.matchdict = {'pagename':'AnotherPage'}
        self._callFUT(request)
        page = self.session.query(Page).filter_by(name='AnotherPage').one()
        self.assertEqual(page.data, 'Hello yo!')

class EditPageTests(unittest.TestCase):
    def setUp(self):
        self.session = _initTestingDB()
        self.config = testing.setUp()

    def tearDown(self):
        self.session.remove()
        testing.tearDown()

    def _callFUT(self, request):
        from tutorial.views import edit_page
        return edit_page(request)

    def test_it_notsubmitted(self):
        from tutorial.models import Page
        _registerRoutes(self.config)
        request = testing.DummyRequest()
        request.matchdict = {'pagename':'abc'}
        page = Page('abc', 'hello')
        self.session.add(page)
        info = self._callFUT(request)
        self.assertEqual(info['page'], page)
        self.assertEqual(info['save_url'],
            'http://example.com/abc/edit_page')

    def test_it_submitted(self):
        from tutorial.models import Page
        _registerRoutes(self.config)
        request = testing.DummyRequest({'form.submitted':True,
            'body':'Hello yo!'})
        request.matchdict = {'pagename':'abc'}
        page = Page('abc', 'hello')
        self.session.add(page)
        response = self._callFUT(request)
        self.assertEqual(response.location, 'http://example.com/abc')
        self.assertEqual(page.data, 'Hello yo!')

class FunctionalTests(unittest.TestCase):

```

```
185     viewer_login = '/login?login=viewer&password=viewer' \
186                    '&came_from=FrontPage&form.submitted=Login'
187     viewer_wrong_login = '/login?login=viewer&password=incorrect' \
188                    '&came_from=FrontPage&form.submitted=Login'
189     editor_login = '/login?login=editor&password=editor' \
190                    '&came_from=FrontPage&form.submitted=Login'
191 
192     def setUp(self):
193         from tutorial import main
194         settings = { 'sqlalchemy.url': 'sqlite:///:memory:'}
195         app = main({}, **settings)
196         from webtest import TestApp
197         self.testapp = TestApp(app)
198 
199     def tearDown(self):
200         del self.testapp
201         from tutorial.models import DBSession
202         DBSession.remove()
203 
204     def test_root(self):
205         res = self.testapp.get('/', status=302)
206         self.assertEqual(res.location, 'http://localhost/FrontPage')
207 
208     def test_FrontPage(self):
209         res = self.testapp.get('/FrontPage', status=200)
210         self.assertTrue('FrontPage' in res.body)
211 
212     def test_unexisting_page(self):
213         self.testapp.get('/SomePage', status=404)
214 
215     def test_successful_log_in(self):
216         res = self.testapp.get(self.viewer_login, status=302)
217         self.assertEqual(res.location, 'http://localhost/FrontPage')
218 
219     def test_failed_log_in(self):
220         res = self.testapp.get(self.viewer_wrong_login, status=200)
221         self.assertTrue('login' in res.body)
222 
223     def test_logout_link_present_when_logged_in(self):
224         self.testapp.get(self.viewer_login, status=302)
225         res = self.testapp.get('/FrontPage', status=200)
226         self.assertTrue('Logout' in res.body)
227 
228     def test_logout_link_not_present_after_logged_out(self):
229         self.testapp.get(self.viewer_login, status=302)
230         self.testapp.get('/FrontPage', status=200)
```

```
231         res = self.testapp.get('/logout', status=302)
232         self.assertTrue('Logout' not in res.body)
233 
234     def test_anonymous_user_cannot_edit(self):
235         res = self.testapp.get('/FrontPage/edit_page', status=200)
236         self.assertTrue('Login' in res.body)
237 
238     def test_anonymous_user_cannot_add(self):
239         res = self.testapp.get('/add_page/NewPage', status=200)
240         self.assertTrue('Login' in res.body)
241 
242     def test_viewer_user_cannot_edit(self):
243         self.testapp.get(self.viewer_login, status=302)
244         res = self.testapp.get('/FrontPage/edit_page', status=200)
245         self.assertTrue('Login' in res.body)
246 
247     def test_viewer_user_cannot_add(self):
248         self.testapp.get(self.viewer_login, status=302)
249         res = self.testapp.get('/add_page/NewPage', status=200)
250         self.assertTrue('Login' in res.body)
251 
252     def test_editors_member_user_can_edit(self):
253         self.testapp.get(self.editor_login, status=302)
254         res = self.testapp.get('/FrontPage/edit_page', status=200)
255         self.assertTrue('Editing' in res.body)
256 
257     def test_editors_member_user_can_add(self):
258         self.testapp.get(self.editor_login, status=302)
259         res = self.testapp.get('/add_page/NewPage', status=200)
260         self.assertTrue('Editing' in res.body)
261 
262     def test_editors_member_user_can_view(self):
263         self.testapp.get(self.editor_login, status=302)
264         res = self.testapp.get('/FrontPage', status=200)
265         self.assertTrue('FrontPage' in res.body)
```

34.7.5 Running the Tests

We can run these tests by using `setup.py test` in the same way we did in *Running the Tests*. However, first we must edit our `setup.py` to include a dependency on WebTest, which we've used in our `tests.py`. Change the `requires` list in `setup.py` to include `WebTest`.

```
requires = [
    'pyramid',
    'SQLAlchemy',
    'transaction',
    'pyramid_tm',
    'pyramid_debugtoolbar',
    'zope.sqlalchemy',
    'docutils',
    'WebTest', # add this
    ]
```

After we've added a dependency on WebTest in `setup.py`, we need to rerun `setup.py develop` to get WebTest installed into our virtualenv. Assuming our shell's current working directory is the "tutorial" distribution directory:

On UNIX:

```
$ ../bin/python setup.py develop
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\python setup.py develop
```

Once that command has completed successfully, we can run the tests themselves:

On UNIX:

```
$ ../bin/python setup.py test -q
```

On Windows:

```
c:\pyramidtut\tutorial> ..\Scripts\python setup.py test -q
```

The expected result looks something like:

```
......................
----------------------------------------------------------------------
Ran 22 tests in 2.700s

OK
```

34.8 Distributing Your Application

Once your application works properly, you can create a "tarball" from it by using the `setup.py sdist` command. The following commands assume your current working directory is the `tutorial` package we've created and that the parent directory of the `tutorial` package is a virtualenv representing a Pyramid environment.

On UNIX:

```
$ ../bin/python setup.py sdist
```

On Windows:

```
c:\pyramidtut> ..\Scripts\python setup.py sdist
```

The output of such a command will be something like:

```
running sdist
# ... more output ...
creating dist
tar -cf dist/tutorial-0.1.tar tutorial-0.1
gzip -f9 dist/tutorial-0.1.tar
removing 'tutorial-0.1' (and everything under it)
```

Note that this command creates a tarball in the "dist" subdirectory named `tutorial-0.1.tar.gz`. You can send this file to your friends to show them your cool new application. They should be able to install it by pointing the `easy_install` command directly at it. Or you can upload it to PyPI and share it with the rest of the world, where it can be downloaded via `easy_install` remotely like any other package people download from PyPI.

CHAPTER 35

Converting a repoze.bfg Application to Pyramid

Prior iterations of Pyramid were released as a package named repoze.bfg. repoze.bfg users are encouraged to upgrade their deployments to Pyramid, as, after the first final release of Pyramid, further feature development on repoze.bfg will cease.

Most existing repoze.bfg applications can be converted to a Pyramid application in a completely automated fashion. However, if your application depends on packages which are not "core" parts of repoze.bfg but which nonetheless have repoze.bfg in their names (e.g. repoze.bfg.skins, repoze.bfg.traversalwrapper, repoze.bfg.jinja2), you will need to find an analogue for each. For example, by the time you read this, there will be a pyramid_jinja2 package, which can be used instead of repoze.bfg.jinja2. If an analogue does not seem to exist for a repoze.bfg add-on package that your application uses, please email the Pylons-devel maillist; we'll convert the package to a Pyramid analogue for you.

Here's how to convert a repoze.bfg application to a Pyramid application:

1. Ensure that your application works under repoze.bfg *version 1.3 or better*. See http://docs.repoze.org/bfg/1.3/narr/install.html for repoze.bfg 1.3 installation instructions. If your application has an automated test suite, run it while your application is using repoze.bfg 1.3+. Otherwise, test it manually. It is only safe to proceed to the next step once your application works under repoze.bfg 1.3+.

   If your application has a proper set of dependencies, and a standard automated test suite, you might test your repoze.bfg application against repoze.bfg 1.3 like so:

   ```
   $ bfgenv/bin/python setup.py test
   ```

bfgenv above will be the virtualenv into which you've installed repoze.bfg 1.3.

2. Install Pyramid into a *separate* virtualenv as per the instructions in *Installing Pyramid*. The Pyramid virtualenv should be separate from the one you've used to install repoze.bfg. A quick way to do this:

```
$ cd ~
$ virtualenv --no-site-packages pyramidenv
$ cd pyramidenv
$ bin/easy_install pyramid
```

3. Put a *copy* of your repoze.bfg application into a temporary location (perhaps by checking a fresh copy of the application out of a version control repository). For example:

```
$ cd /tmp
$ svn co http://my.server/my/bfg/application/trunk bfgapp
```

4. Use the bfg2pyramid script present in the bin directory of the Pyramid virtualenv to convert all repoze.bfg Python import statements into compatible Pyramid import statements. bfg2pyramid will also fix ZCML directive usages of common repoze.bfg directives. You invoke bfg2pyramid by passing it the *path* of the copy of your application. The path passed should contain a "setup.py" file, representing your repoze.bfg application's setup script. bfg2pyramid will change the copy of the application *in place*.

```
$ ~/pyramidenv/bfg2pyramid /tmp/bfgapp
```

bfg2pyramid will convert the following repoze.bfg application aspects to Pyramid compatible analogues:

- Python import statements naming repoze.bfg APIs will be converted to Pyramid compatible import statements. Every Python file beneath the top-level path will be visited and converted recursively, except Python files which live in directories which start with a . (dot).
- Each ZCML file found (recursively) within the path will have the default xmlns attribute attached to the configure tag changed from http://namespaces.repoze.org/bfg to http://pylonshq.com/pyramid. Every ZCML file beneath the top-level path (files ending with .zcml) will be visited and converted recursively, except ZCML files which live in directories which start with a . (dot).
- ZCML files which contain directives that have attributes which name a repoze.bfg API module or attribute of an API module (e.g. context="repoze.bfg.exceptions.NotFound") will be converted to Pyramid compatible ZCML attributes (e.g. context="pyramid.exceptions.NotFound). Every ZCML file beneath the top-level path (files ending with .zcml) will be visited and converted recursively, except ZCML files which live in directories which start with a . (dot).

5. Edit the `setup.py` file of the application you've just converted (if you've been using the example paths, this will be `/tmp/bfgapp/setup.py`) to depend on the `pyramid` distribution instead the of `repoze.bfg` distribution in its `install_requires` list. If you used a scaffold to create the `repoze.bfg` application, you can do so by changing the `requires` line near the top of the `setup.py` file. The original may look like this:

   ```
   requires = ['repoze.bfg', ... other dependencies ...]
   ```

   Edit the `setup.py` so it has:

   ```
   requires = ['pyramid', ... other dependencies ...]
   ```

   All other install-requires and tests-requires dependencies save for the one on `repoze.bfg` can remain the same.

6. Convert any `install_requires` dependencies your application has on other add-on packages which have `repoze.bfg` in their names to Pyramid compatible analogues (e.g. `repoze.bfg.jinja2` should be replaced with `pyramid_jinja2`). You may need to adjust configuration options and/or imports in your `repoze.bfg` application after replacing these add-ons. Read the documentation of the Pyramid add-on package for information.

7. *Only if you use ZCML and add-ons which use ZCML*: The default `xmlns` of the `configure` tag in ZCML has changed. The `bfg2pyramid` script effects the default namespace change (it changes the `configure` tag default `xmlns` from `http://namespaces.repoze.org/bfg` to `http://pylonshq.com/pyramid`).

   This means that uses of add-ons which define ZCML directives in the `http://namespaces.repoze.org/bfg` namespace will begin to "fail" (they're actually not really failing, but your ZCML assumes that they will always be used within a `configure` tag which names the `http://namespaces.repoze.org/bfg` namespace as its default `xmlns`). Symptom: when you attempt to start the application, an error such as `ConfigurationError: ('Unknown directive', u'http://namespaces.repoze.org/bfg', u'workflow')` is printed to the console and the application fails to start. In such a case, either add an `xmlns="http://namespaces.repoze.org/bfg"` attribute to each tag which causes a failure, or define a namespace alias in the configure tag and prefix each failing tag. For example, change this "failing" tag instance:

   ```
   <configure xmlns="http://pylonshq.com/pyramid">
       <failingtag attr="foo"/>
   </configure>
   ```

To this, which will begin to succeed:

```
<configure xmlns="http://pylonshq.com/pyramid"
           xmlns:bfg="http://namespaces.repoze.org/bfg">
    <bfg:failingtag attr="foo"/>
</configure>
```

You will also need to add the pyramid_zcml package to your setup.py install_requires list. In Pyramid, ZCML configuration became an optional add-on supported by the pyramid_zcml package.

8. Retest your application using Pyramid. This might be as easy as:

```
$ cd /tmp/bfgapp
$ ~/pyramidenv/bin/python setup.py test
```

9. Fix any test failures.

10. Fix any code which generates deprecation warnings.

11. Start using the converted version of your application. Celebrate.

Two terminological changes have been made to Pyramid which make its documentation and newer APIs different than those of repoze.bfg. The concept that BFG called model is called resource in Pyramid and the concept that BFG called resource is called asset in Pyramid. Various APIs have changed as a result (although all have backwards compatible shims). Additionally, the environment variables that influenced server behavior which used to be prefixed with BFG_ (such as BFG_DEBUG_NOTFOUND) must now be prefixed with PYRAMID_.

CHAPTER 36

Running Pyramid on Google's App Engine

It is possible to run a Pyramid application on Google's App Engine. Content from this tutorial was contributed by YoungKing, based on the "appengine-monkey" tutorial for Pylons. This tutorial is written in terms of using the command line on a UNIX system; it should be possible to perform similar actions on a Windows system.

1. Download Google's App Engine SDK and install it on your system.

2. Use Subversion to check out the source code for `appengine-monkey`.

   ```
   $ svn co http://appengine-monkey.googlecode.com/svn/trunk/ \
       appengine-monkey
   ```

3. Use `appengine_homedir.py` script in `appengine-monkey` to create a *virtualenv* for your application.

   ```
   $ export GAE_PATH=/usr/local/google_appengine
   $ python2.5 /path/to/appengine-monkey/appengine-homedir.py --gae \
     $GAE_PATH pyramidapp
   ```

   Note that `$GAE_PATH` should be the path where you have unpacked the App Engine SDK. (On Mac OS X at least, `/usr/local/google_appengine` is indeed where the installer puts it).

   This will set up an environment in `pyramidapp/`, with some tools installed in `pyramidapp/bin`. There will also be a directory `pyramidapp/app/` which is the directory you will upload to appengine.

4. Install Pyramid into the virtualenv

```
$ cd pyramidapp/
$ bin/easy_install pyramid
```

This will install Pyramid in the environment.

5. Create your application

   We'll use the standard way to create a Pyramid application, but we'll have to move some files around when we are done. The below commands assume your current working directory is the `pyramidapp` virtualenv directory you created in the third step above:

```
$ cd app
$ rm -rf pyramidapp
$ bin/paster create -t pyramid_starter pyramidapp
$ mv pyramidapp aside
$ mv aside/pyramidapp .
$ rm -rf aside
```

6. Edit `config.py`

   Edit the `APP_NAME` and `APP_ARGS` settings within `config.py`. The `APP_NAME` must be `pyramidapp:main`, and the APP_ARGS must be `({},)`. Any other settings in `config.py` should remain the same.

```
APP_NAME = 'pyramidapp:main'
APP_ARGS = ({},)
```

7. Edit `runner.py`

   To prevent errors for `import site`, add this code stanza before `import site` in app/runner.py:

```
import sys
sys.path = [path for path in sys.path if 'site-packages' not in path]
import site
```

You will also need to comment out the line that starts with `assert sys.path` in the file.

```
# comment the sys.path assertion out
# assert sys.path[:len(cur_sys_path)] == cur_sys_path, (
#   "addsitedir() caused entries to be prepended to sys.path")
```

For GAE development environment 1.3.0 or better, you will also need the following somewhere near the top of the `runner.py` file to fix a compatibility issue with `appengine-monkey`:

```
import os
os.mkdir = None
```

8. Run the application. `dev_appserver.py` is typically installed by the SDK in the global path but you need to be sure to run it with Python 2.5 (or whatever version of Python your GAE SDK expects).

```
$ cd ../..
$ python2.5 /usr/local/bin/dev_appserver.py pyramidapp/app/
```

Startup success looks something like this:

```
[chrism@vitaminf pyramid_gae]$ python2.5 \
              /usr/local/bin/dev_appserver.py \
              pyramidapp/app/
INFO     2009-05-03 22:23:13,887 appengine_rpc.py:157] # ... more...
Running application pyramidapp on port 8080: http://localhost:8080
```

You may need to run "Make Symlinks" from the Google App Engine Launcher GUI application if your system doesn't already have the `dev_appserver.py` script sitting around somewhere.

9. Hack on your pyramid application, using a normal run, debug, restart process. For tips on how to use the `pdb` module within Google App Engine, see this blog post. In particular, you can create a function like so and call it to drop your console into a pdb trace:

```
def set_trace():
    import pdb, sys
    debugger = pdb.Pdb(stdin=sys.__stdin__,
        stdout=sys.__stdout__)
    debugger.set_trace(sys._getframe().f_back)
```

10. Sign up for a GAE account and create an application. You'll need a mobile phone to accept an SMS in order to receive authorization.

11. Edit the application's ID in `app.yaml` to match the application name you created during GAE account setup.

```
application: mycoolpyramidapp
```

12. Upload the application

```
$ python2.5 /usr/local/bin/appcfg.py update pyramidapp/app
```

You almost certainly won't hit the 3000-file GAE file number limit when invoking this command. If you do, however, it will look like so:

```
HTTPError: HTTP Error 400: Bad Request
Rolling back the update.
Error 400: --- begin server output ---
Max number of files and blobs is 3000.
--- end server output ---
```

If you do experience this error, you will be able to get around this by zipping libraries. You can use `pip` to create zipfiles from packages. See *Zipping Files Via Pip* for more information about this.

A successful upload looks like so:

```
[chrism@vitaminf pyramidapp]$ python2.5 /usr/local/bin/appcfg.py \
                              update ../pyramidapp/app/
Scanning files on local disk.
Scanned 500 files.
# ... more output ...
Will check again in 16 seconds.
Checking if new version is ready to serve.
Closing update: new version is ready to start serving.
Uploading index definitions.
```

13. Visit `http://<yourapp>.appspot.com` in a browser.

36.1 Zipping Files Via Pip

If you hit the Google App Engine 3000-file limit, you may need to create zipfile archives out of some distributions installed in your application's virtualenv.

First, see which packages are available for zipping:

```
$ bin/pip zip -l
```

This shows your zipped packages (by default, none) and your unzipped packages. You can zip a package like so:

```
$ bin/pip zip pytz-2009g-py2.5.egg
```

Note that it requires the whole egg file name. For a Pyramid app, the following packages are good candidates to be zipped.

- Chameleon
- zope.i18n

Once the zipping procedure is finished you can try uploading again.

CHAPTER 37

Running a Pyramid Application under `mod_wsgi`

mod_wsgi is an Apache module developed by Graham Dumpleton. It allows *WSGI* programs to be served using the Apache web server.

This guide will outline broad steps that can be used to get a Pyramid application running under Apache via `mod_wsgi`. This particular tutorial was developed under Apple's Mac OS X platform (Snow Leopard, on a 32-bit Mac), but the instructions should be largely the same for all systems, delta specific path information for commands and files.

 Unfortunately these instructions almost certainly won't work for deploying a Pyramid application on a Windows system using `mod_wsgi`. If you have experience with Pyramid and `mod_wsgi` on Windows systems, please help us document this experience by submitting documentation to the Pylons-devel maillist.

1. The tutorial assumes you have Apache already installed on your system. If you do not, install Apache 2.X for your platform in whatever manner makes sense.

2. Once you have Apache installed, install `mod_wsgi`. Use the (excellent) installation instructions for your platform into your system's Apache installation.

3. Install *virtualenv* into the Python which mod_wsgi will run using the `easy_install` program.

   ```
   $ sudo /usr/bin/easy_install-2.6 virtualenv
   ```

   This command may need to be performed as the root user.

4. Create a *virtualenv* which we'll use to install our application.

```
$ cd ~
$ mkdir modwsgi
$ cd modwsgi
$ /usr/local/bin/virtualenv --no-site-packages env
```

5. Install Pyramid into the newly created virtualenv:

```
$ cd ~/modwsgi/env
$ bin/easy_install pyramid
```

6. Create and install your Pyramid application. For the purposes of this tutorial, we'll just be using the `pyramid_starter` application as a baseline application. Substitute your existing Pyramid application as necessary if you already have one.

```
$ cd ~/modwsgi/env
$ bin/paster create -t pyramid_starter myapp
$ cd myapp
$ ../bin/python setup.py install
```

7. Within the virtualenv directory (`~/modwsgi/env`), create a script named `pyramid.wsgi`. Give it these contents:

```
from pyramid.paster import get_app
application = get_app(
  '/Users/chrism/modwsgi/env/myapp/production.ini', 'main')
```

   The first argument to `get_app` is the project Paste configuration file name. It's best to use the `production.ini` file provided by your scaffold, as it contains settings appropriate for production. The second is the name of the section within the .ini file that should be loaded by `mod_wsgi`. The assignment to the name `application` is important: mod_wsgi requires finding such an assignment when it opens the file.

8. Make the `pyramid.wsgi` script executable.

```
$ cd ~/modwsgi/env
$ chmod 755 pyramid.wsgi
```

9. Edit your Apache configuration and add some stuff. I happened to create a file named `/etc/apache2/other/modwsgi.conf` on my own system while installing Apache, so this stuff went in there.

```
# Use only 1 Python sub-interpreter.  Multiple sub-interpreters
# play badly with C extensions.
WSGIApplicationGroup %{GLOBAL}
WSGIPassAuthorization On
WSGIDaemonProcess pyramid user=chrism group=staff threads=4 \
   python-path=/Users/chrism/modwsgi/env/lib/python2.6/site-packages
WSGIScriptAlias /myapp /Users/chrism/modwsgi/env/pyramid.wsgi

<Directory /Users/chrism/modwsgi/env>
  WSGIProcessGroup pyramid
  Order allow,deny
  Allow from all
</Directory>
```

10. Restart Apache

```
$ sudo /usr/sbin/apachectl restart
```

11. Visit `http://localhost/myapp` in a browser. You should see the sample application rendered in your browser.

mod_wsgi has many knobs and a great variety of deployment modes. This is just one representation of how you might use it to serve up a Pyramid application. See the mod_wsgi configuration documentation for more in-depth configuration information.

Part III

API Reference

CHAPTER 38

pyramid.authorization

CHAPTER 39

pyramid.authentication

39.1 Authentication Policies

39.2 Helper Classes

CHAPTER 40

pyramid.chameleon_text

These APIs will will work against template files which contain simple `${Genshi}` - style replacement markers.

The API of `pyramid.chameleon_text` is identical to that of `pyramid.chameleon_zpt`; only its import location is different. If you need to import an API functions from this module as well as the `pyramid.chameleon_zpt` module within the same view file, use the `as` feature of the Python import statement, e.g.:

```
from pyramid.chameleon_zpt import render_template as zpt_render
from pyramid.chameleon_text import render_template as text_render
```

CHAPTER 41

pyramid.chameleon_zpt

These APIs will work against files which supply template text which matches the *ZPT* specification.

The API of `pyramid.chameleon_zpt` is identical to that of `pyramid.chameleon_text`; only its import location is different. If you need to import an API functions from this module as well as the `pyramid.chameleon_text` module within the same view file, use the `as` feature of the Python import statement, e.g.:

```
from pyramid.chameleon_zpt import render_template as zpt_render
from pyramid.chameleon_text import render_template as text_render
```

CHAPTER 42

pyramid.config

CHAPTER 43

pyramid.events

43.1 Functions

43.2 Event Types

See *Using Events* for more information about how to register code which subscribes to these events.

CHAPTER 44

pyramid.exceptions

CHAPTER 45

pyramid.httpexceptions

CHAPTER 46

pyramid.i18n

See *Internationalization and Localization* for more information about using Pyramid internationalization and localization services within an application.

CHAPTER 47

pyramid.interfaces

47.1 Event-Related Interfaces

47.2 Other Interfaces

CHAPTER 48

pyramid.location

CHAPTER 49

pyramid.paster

CHAPTER 50

pyramid.registry

CHAPTER 51

pyramid.renderers

null_renderer

An object that can be used in advanced integration cases as input to the view configuration `renderer=` argument. When the null renderer is used as a view renderer argument, Pyramid avoids converting the view callable result into a Response object. This is useful if you want to reuse the view configuration and lookup machinery outside the context of its use by the Pyramid router (e.g. the package named `pyramid_rpc` does this).

CHAPTER 52

pyramid.request

For information about the API of a *multidict* structure (such as that used as `request.GET`, `request.POST`, and `request.params`), see `pyramid.interfaces.IMultiDict`.

CHAPTER 53

pyramid.response

53.1 Functions

CHAPTER 54

pyramid.scripting

CHAPTER 55

pyramid.security

55.1 Authentication API Functions

55.2 Authorization API Functions

55.3 Constants

Everyone
The special principal id named 'Everyone'. This principal id is granted to all requests. Its actual value is the string 'system.Everyone'.

Authenticated
The special principal id named 'Authenticated'. This principal id is granted to all requests which contain any other non-Everyone principal id (according to the *authentication policy*). Its actual value is the string 'system.Authenticated'.

ALL_PERMISSIONS
An object that can be used as the `permission` member of an ACE which matches all permissions unconditionally. For example, an ACE that uses `ALL_PERMISSIONS` might be composed like so: `('Deny', 'system.Everyone', ALL_PERMISSIONS)`.

DENY_ALL
A convenience shorthand ACE that defines `('Deny', 'system.Everyone', ALL_PERMISSIONS)`. This is often used as the last ACE in an ACL in systems that use an "inheriting" security policy, representing the concept "don't inherit any other ACEs".

NO_PERMISSION_REQUIRED
A special permission which indicates that the view should always be executable by entirely anonymous users, regardless of the default permission, bypassing any *authorization policy* that may be in effect. Its actual value is the string '__no_permission_required__'.

55.4 Return Values

Allow
: The ACE "action" (the first element in an ACE e.g. `(Allow, Everyone, 'read')` that means allow access. A sequence of ACEs makes up an ACL. It is a string, and it's actual value is "Allow".

Deny
: The ACE "action" (the first element in an ACE e.g. `(Deny, 'george', 'read')` that means deny access. A sequence of ACEs makes up an ACL. It is a string, and it's actual value is "Deny".

CHAPTER 56

pyramid.settings

CHAPTER 57

pyramid.testing

CHAPTER 58

pyramid.threadlocal

CHAPTER 59

pyramid.traversal

CHAPTER 60

pyramid.url

CHAPTER 61

pyramid.view

CHAPTER 62

pyramid.wsgi

Part IV

Glossary and Index

Glossary

ACE An *access control entry*. An access control entry is one element in an *ACL*. An access control entry is a three-tuple that describes three things: an *action* (one of either `Allow` or `Deny`), a *principal* (a string describing a user or group), and a *permission*. For example the ACE, `(Allow, 'bob', 'read')` is a member of an ACL that indicates that the principal `bob` is allowed the permission `read` against the resource the ACL is attached to.

ACL An *access control list*. An ACL is a sequence of *ACE* tuples. An ACL is attached to a resource instance. An example of an ACL is `[ (Allow, 'bob', 'read'), (Deny, 'fred', 'write')]`. If an ACL is attached to a resource instance, and that resource is findable via the context resource, it will be consulted any active security policy to determine wither a particular request can be fulfilled given the *authentication* information in the request.

Agendaless Consulting A consulting organization formed by Paul Everitt, Tres Seaver, and Chris McDonough. See also http://agendaless.com .

Akhet Akhet is a Pyramid-based development environment which provides a Pylons-esque scaffold which sports support for *view handler* application development, *SQLAlchemy* support, *Mako* templating by default, and other Pylons-like features. See http://docs.pylonsproject.org/projects/akhet/dev/index.html for more information.

application registry A registry of configuration information consulted by Pyramid while servicing an application. An application registry maps resource types to views, as well as housing other application-specific component registrations. Every Pyramid application has one (and only one) application registry.

asset Any file contained within a Python *package* which is *not* a Python source code file.

asset specification A colon-delimited identifier for an *asset*. The colon separates a Python *package* name from a package subpath. For example, the asset specification `my.package:static/baz.css` identifies the file named `baz.css` in the `static` subdirectory of the `my.package` Python *package*. See *Understanding Asset Specifications* for more info.

authentication The act of determining that the credentials a user presents during a particular request are "good". Authentication in Pyramid is performed via an *authentication policy*.

authentication policy An authentication policy in Pyramid terms is a bit of code which has an API which determines the current *principal* (or principals) associated with a request.

authorization The act of determining whether a user can perform a specific action. In pyramid terms, this means determining whether, for a given resource, any *principal* (or principals) associated with the request have the requisite *permission* to allow the request to continue. Authorization in Pyramid is performed via its *authorization policy*.

authorization policy An authorization policy in Pyramid terms is a bit of code which has an API which determines whether or not the principals associated with the request can perform an action associated with a permission, based on the information found on the *context* resource.

Babel A collection of tools for internationalizing Python applications. Pyramid does not depend on Babel to operate, but if Babel is installed, additional locale functionality becomes available to your application.

Chameleon chameleon is an attribute language template compiler which supports both the *ZPT* and *Genshi* templating specifications. It is written and maintained by Malthe Borch. It has several extensions, such as the ability to use bracketed (Genshi-style) `${name}` syntax, even within ZPT. It is also much faster than the reference implementations of both ZPT and Genshi. Pyramid offers Chameleon templating out of the box in ZPT and text flavors.

configuration declaration An individual method call made to an instance of a Pyramid *Configurator* object which performs an arbitrary action, such as registering a *view configuration* (via the `add_view()` method of the configurator) or *route configuration* (via the `add_route()` method of the configurator). A set of configuration declarations is also implied by the *configuration decoration* detected by a *scan* of code in a package.

configuration decoration Metadata implying one or more *configuration declaration* invocations. Often set by configuration Python *decorator* attributes, such as `pyramid.view.view_config`, aka `@view_config`.

configurator An object used to do *configuration declaration* within an application. The most common configurator is an instance of the `pyramid.config.Configurator` class.

context A resource in the resource tree that is found during *traversal* or *URL dispatch* based on URL data; if it's found via traversal, it's usually a *resource* object that is part of a resource tree; if it's found via *URL dispatch*, it's an object manufactured on behalf of the route's "factory". A context resource becomes the subject of a *view*, and often has security information attached to it. See the *Traversal* chapter and the *URL Dispatch* chapter for more information about how a URL is resolved to a context resource.

CPython The C implementation of the Python language. This is the reference implementation that most people refer to as simply "Python"; *Jython*, Google's App Engine, and PyPy are examples of non-C based Python implementations.

declarative configuration The configuration mode in which you use the combination of *configuration decoration* and a *scan* to configure your Pyramid application.

decorator A wrapper around a Python function or class which accepts the function or class as its first argument and which returns an arbitrary object. Pyramid provides several decorators, used for configuration and return value modification purposes. See also PEP 318.

Default Locale Name The *locale name* used by an application when no explicit locale name is set. See *Localization-Related Deployment Settings*.

default permission A *permission* which is registered as the default for an entire application. When a default permission is in effect, every *view configuration* registered with the system will be effectively amended with a `permission` argument that will require that the executing user possess the default permission in order to successfully execute the associated *view callable* See also *Setting a Default Permission*.

Default view The default view of a *resource* is the view invoked when the *view name* is the empty string (`''`). This is the case when *traversal* exhausts the path elements in the PATH_INFO of a request before it returns a *context* resource.

Deployment settings Deployment settings are settings passed to the *Configurator* as a `settings` argument. These are later accessible via a `request.registry.settings` dictionary in views or as `config.registry.settings` in configuration code. Deployment settings can be used as global application values.

distribution (Setuptools/distutils terminology). A file representing an installable library or application. Distributions are usually files that have the suffix of `.egg`, `.tar.gz`, or `.zip`. Distributions are the target of Setuptools commands such as `easy_install`.

distutils The standard system for packaging and distributing Python packages. See http://docs.python.org/distutils/index.html for more information. *setuptools* is actually an *extension* of the Distutils.

Django A full-featured Python web framework.

domain model Persistent data related to your application. For example, data stored in a relational database. In some applications, the *resource tree* acts as the domain model.

dotted Python name A reference to a Python object by name using a string, in the form `path.to.modulename:attributename`. Often used in Paste and setuptools configurations. A variant is used in dotted names within configurator method arguments that name objects (such as the "add_view" method's "view" and "context" attributes): the colon (`:`) is not used; in its place is a dot.

entry point A *setuptools* indirection, defined within a setuptools *distribution* setup.py. It is usually a name which refers to a function somewhere in a package which is held by the distribution.

event An object broadcast to zero or more *subscriber* callables during normal Pyramid system operations during the lifetime of an application. Application code can subscribe to these events by using the subscriber functionality described in *Using Events*.

exception response A *response* that is generated as the result of a raised exception being caught by an *exception view*.

Exception view An exception view is a *view callable* which may be invoked by Pyramid when an exception is raised during request processing. See *Custom Exception Views* for more information.

finished callback A user-defined callback executed by the *router* unconditionally at the very end of request processing . See *Using Finished Callbacks*.

Forbidden view An *exception view* invoked by Pyramid when the developer explicitly raises a `pyramid.httpexceptions.HTTPForbidden` exception from within *view* code or *root factory* code, or when the *view configuration* and *authorization policy* found for a request disallows a particular view invocation. Pyramid provides a default implementation of a forbidden view; it can be overridden. See *Changing the Forbidden View*.

Genshi An XML templating language by Christopher Lenz.

Gettext The GNU gettext library, used by the Pyramid translation machinery.

Google App Engine Google App Engine (aka "GAE") is a Python application hosting service offered by Google. Pyramid runs on GAE.

Grok A web framework based on Zope 3.

HTTP Exception The set of exception classes defined in `pyramid.httpexceptions`. These can be used to generate responses with various status codes when raised or returned from a *view callable*. See also *HTTP Exceptions*.

imperative configuration The configuration mode in which you use Python to call methods on a *Configurator* in order to add each *configuration declaration* required by your application.

interface A Zope interface object. In Pyramid, an interface may be attached to a *resource* object or a *request* object in order to identify that the object is "of a type". Interfaces are used internally by Pyramid to perform view lookups and other policy lookups. The ability to make use of an interface is exposed to an application programmers during *view configuration* via the `context` argument, the `request_type` argument and the `containment` argument. Interfaces are also exposed to application developers when they make use of the *event* system. Fundamentally, Pyramid programmers can think of an interface as something that they can attach to an object that stamps it with a "type" unrelated to its underlying Python type. Interfaces can also be used to describe the behavior of an object (its methods and attributes), but unless they choose to, Pyramid programmers do not need to understand or use this feature of interfaces.

Internationalization The act of creating software with a user interface that can potentially be displayed in more than one language or cultural context. Often shortened to "i18n" (because the word "internationalization" is I, 18 letters, then N). See also: *Localization*.

Jinja2 A text templating language by Armin Ronacher.

jQuery A popular Javascript library.

JSON JavaScript Object Notation is a data serialization format.

Jython A Python implementation written for the Java Virtual Machine.

lineage An ordered sequence of objects based on a "*location* -aware" resource. The lineage of any given *resource* is composed of itself, its parent, its parent's parent, and so on. The order of the sequence is resource-first, then the parent of the resource, then its parent's parent, and so on. The parent of a resource in a lineage is available as its `__parent__` attribute.

Lingua A package by Wichert Akkerman which provides *Babel* message extractors for Python source files and Chameleon ZPT template files.

Locale Name A string like `en`, `en_US`, `de`, or `de_AT` which uniquely identifies a particular locale.

Locale Negotiator An object supplying a policy determining which *locale name* best represents a given *request*. It is used by the `pyramid.i18n.get_locale_name()`, and `pyramid.i18n.negotiate_locale_name()` functions, and indirectly by `pyramid.i18n.get_localizer()`. The `pyramid.i18n.default_locale_negotiator()` function is an example of a locale negotiator.

Localization The process of displaying the user interface of an internationalized application in a particular language or cultural context. Often shortened to "l10" (because the word "localization" is L, 10 letters, then N). See also: *Internationalization*.

Localizer An instance of the class `pyramid.i18n.Localizer` which provides translation and pluralization services to an application. It is retrieved via the `pyramid.i18n.get_localizer()` function.

location The path to an object in a *resource tree*. See *Location-Aware Resources* for more information about how to make a resource object *location-aware*.

Mako Mako is a template language language which refines the familiar ideas of componentized layout and inheritance using Python with Python scoping and calling semantics.

matchdict The dictionary attached to the *request* object as `request.matchdict` when a *URL dispatch* route has been matched. Its keys are names as identified within the route pattern; its values are the values matched by each pattern name.

Message Catalog A *gettext* `.mo` file containing translations.

Message Identifier A string used as a translation lookup key during localization. The `msgid` argument to a *translation string* is a message identifier. Message identifiers are also present in a *message catalog*.

METAL Macro Expansion for TAL, a part of *ZPT* which makes it possible to share common look and feel between templates.

middleware *Middleware* is a *WSGI* concept. It is a WSGI component that acts both as a server and an application. Interesting uses for middleware exist, such as caching, content-transport encoding, and other functions. See WSGI.org or PyPI to find middleware for your application.

mod_wsgi mod_wsgi is an Apache module developed by Graham Dumpleton. It allows *WSGI* applications (such as applications developed using Pyramid) to be served using the Apache web server.

module A Python source file; a file on the filesystem that typically ends with the extension `.py` or `.pyc`. Modules often live in a *package*.

multidict An ordered dictionary that can have multiple values for each key. Adds the methods `getall`, `getone`, `mixed`, `add` and `dict_of_lists` to the normal dictionary interface. See *Multidict* and `pyramid.interfaces.IMultiDict`.

Not Found view An *exception view* invoked by Pyramid when the developer explicitly raises a `pyramid.httpexceptions.HTTPNotFound` exception from within *view* code or *root factory* code, or when the current request doesn't match any *view configuration*. Pyramid provides a default implementation of a not found view; it can be overridden. See *Changing the Not Found View*.

package A directory on disk which contains an `__init__.py` file, making it recognizable to Python as a location which can be `import` -ed. A package exists to contain *module* files.

Paste Paste is a WSGI development and deployment system developed by Ian Bicking.

PasteDeploy PasteDeploy is a library used by Pyramid which makes it possible to configure *WSGI* components together declaratively within an `.ini` file. It was developed by Ian Bicking as part of *Paste*.

permission A string or unicode object that represents an action being taken against a *context* resource. A permission is associated with a view name and a resource type by the developer. Resources are decorated with security declarations (e.g. an *ACL*), which reference these tokens also. Permissions are used by the active security policy to match the view permission against the resources's statements about which permissions are granted to which principal in a context in order to answer the question "is this user allowed to do this". Examples of permissions: `read`, or `view_blog_entries`.

pipeline The *Paste* term for a single configuration of a WSGI server, a WSGI application, with a set of middleware in-between.

pkg_resources A module which ships with *setuptools* that provides an API for addressing "asset files" within a Python *package*. Asset files are static files, template files, etc; basically anything non-Python-source that lives in a Python package can be considered a asset file. See also PkgResources

predicate A test which returns `True` or `False`. Two different types of predicates exist in Pyramid: a *view predicate* and a *route predicate*. View predicates are attached to *view configuration* and route predicates are attached to *route configuration*.

pregenerator A pregenerator is a function associated by a developer with a *route*. It is called by `route_url()` in order to adjust the set of arguments passed to it by the user for special purposes. It will influence the URL returned by `route_url()`. See `pyramid.interfaces.IRoutePregenerator` for more information.

principal A *principal* is a string or unicode object representing a userid or a group id. It is provided by an *authentication policy*. For example, if a user had the user id "bob", and Bob was part of two groups named "group foo" and "group bar", the request might have information attached to it that would indicate that Bob was represented by three principals: "bob", "group foo" and "group bar".

project (Setuptools/distutils terminology). A directory on disk which contains a `setup.py` file and one or more Python packages. The `setup.py` file contains code that allows the package(s) to be installed, distributed, and tested.

Pylons A lightweight Python web framework and a predecessor of Pyramid.

PyPI The Python Package Index, a collection of software available for Python.

PyPy PyPy is an "alternative implementation of the Python language":http://pypy.org/

Pyramid Cookbook An additional documentation resource for Pyramid which presents topical, practical usages of Pyramid available via http://docs.pylonsproject.org/ .

pyramid_debugtoolbar A Pyramid add on which displays a helpful debug toolbar "on top of" HTML pages rendered by your application, displaying request, routing, and database information. `pyramid_debugtoolbar` is configured into the `development.ini` of all applications which use a Pyramid *scaffold*. For more information, see http://docs.pylonsproject.org/projects/pyramid_debugtoolbar/dev/ .

pyramid_exclog A package which logs Pyramid application exception (error) information to a standard Python logger. This add-on is most useful when used in production applications, because the logger can be configured to log to a file, to UNIX syslog, to the Windows Event Log, or even to email. See its documentation.

pyramid_handlers An add-on package which allows Pyramid users to create classes that are analogues of Pylons 1 "controllers". See http://docs.pylonsproject.org/projects/pyramid_handlers/dev/ .

pyramid_jinja2 *Jinja2* templating system bindings for Pyramid, documented at http://docs.pylonsproject.org/projects/pyramid_jinja2/dev/ . This package also includes a scaffold named `pyramid_jinja2_starter`, which creates an application package based on the Jinja2 templating system.

pyramid_zcml An add-on package to Pyramid which allows applications to be configured via *ZCML*. It is available on *PyPI*. If you use `pyramid_zcml`, you can use ZCML as an alternative to *imperative configuration* or *configuration decoration*.

Python The programming language in which Pyramid is written.

renderer A serializer that can be referred to via *view configuration* which converts a non-*Response* return values from a *view* into a string (and ultimately a response). Using a renderer can make writing views that require templating or other serialization less tedious. See *Writing View Callables Which Use a Renderer* for more information.

renderer factory A factory which creates a *renderer*. See *Adding and Changing Renderers* for more information.

renderer globals Values injected as names into a renderer based on application policy. See *Adding Renderer Globals (Deprecated)* for more information.

Repoze "Repoze" is essentially a "brand" of software developed by Agendaless Consulting and a set of contributors. The term has no special intrinsic meaning. The project's website has more information. The software developed "under the brand" is available in a Subversion repository. Pyramid was originally known as `repoze.bfg`.

repoze.catalog An indexing and search facility (fielded and full-text) based on zope.index. See the documentation for more information.

repoze.lemonade Zope2 CMF-like data structures and helper facilities for CA-and-ZODB-based applications useful within Pyramid applications.

repoze.who Authentication middleware for *WSGI* applications. It can be used by Pyramid to provide authentication information.

repoze.workflow Barebones workflow for Python apps . It can be used by Pyramid to form a workflow system.

request An object that represents an HTTP request, usually an instance of the `pyramid.request.Request` class. See *Request and Response Objects* (narrative) and *pyramid.request* (API documentation) for information about request objects.

request factory An object which, provided a *WSGI* environment as a single positional argument, returns a Pyramid-compatible request.

request type An attribute of a *request* that allows for specialization of view invocation based on arbitrary categorization. The every *request* object that Pyramid generates and manipulates has one or more *interface* objects attached to it. The default interface attached to a request object is `pyramid.interfaces.IRequest`.

resource An object representing a node in the *resource tree* of an application. If `traversal` is used, a resource is an element in the resource tree traversed by the system. When traversal is used, a resource becomes the *context* of a *view*. If `url dispatch` is used, a single resource is generated for each request and is used as the context resource of a view.

Resource Location The act of locating a *context* resource given a *request*. *Traversal* and *URL dispatch* are the resource location subsystems used by Pyramid.

resource tree A nested set of dictionary-like objects, each of which is a *resource*. The act of *traversal* uses the resource tree to find a *context* resource.

response An object returned by a *view callable* that represents response data returned to the requesting user agent. It must implements the `pyramid.interfaces.IResponse` interface. A response object is typically an instance of the `pyramid.response.Response` class or a subclass such as `pyramid.httpexceptions.HTTPFound`. See *Request and Response Objects* for information about response objects.

response adapter A callable which accepts an arbitrary object and "converts" it to a `pyramid.response.Response` object. See *Changing How Pyramid Treats View Responses* for more information.

response callback A user-defined callback executed by the *router* at a point after a *response* object is successfully created. See *Using Response Callbacks*.

reStructuredText A plain text format that is the defacto standard for descriptive text shipped in *distribution* files, and Python docstrings. This documentation is authored in ReStructuredText format.

root The object at which *traversal* begins when Pyramid searches for a *context* resource (for *URL Dispatch*, the root is *always* the context resource unless the `traverse=` argument is used in route configuration).

root factory The "root factory" of a Pyramid application is called on every request sent to the application. The root factory returns the traversal root of an application. It is conventionally named `get_root`. An application may supply a root factory to Pyramid during the construction of a *Configurator*. If a root factory is not supplied, the application uses a default root object. Use of the default root object is useful in application which use *URL dispatch* for all URL-to-view code mappings.

route A single pattern matched by the *url dispatch* subsystem, which generally resolves to a *root factory* (and then ultimately a *view*). See also *url dispatch*.

route configuration Route configuration is the act of associating request parameters with a particular *route* using pattern matching and *route predicate* statements. See *URL Dispatch* for more information about route configuration.

route predicate An argument to a *route configuration* which implies a value that evaluates to `True` or `False` for a given *request*. All predicates attached to a *route configuration* must evaluate to `True` for the associated route to "match" the current request. If a route does not match the current request, the next route (in definition order) is attempted.

router The *WSGI* application created when you start a Pyramid application. The router intercepts requests, invokes traversal and/or URL dispatch, calls view functions, and returns responses to the WSGI server on behalf of your Pyramid application.

Routes A system by Ben Bangert which parses URLs and compares them against a number of user defined mappings. The URL pattern matching syntax in Pyramid is inspired by the Routes syntax (which was inspired by Ruby On Rails pattern syntax).

routes mapper An object which compares path information from a request to an ordered set of route patterns. See *URL Dispatch*.

scaffold A project template that helps users get started writing a Pyramid application quickly. Scaffolds are usually used via the `paster create` command.

scan The term used by Pyramid to define the process of importing and examining all code in a Python package or module for *configuration decoration*.

session A namespace that is valid for some period of continual activity that can be used to represent a user's interaction with a web application.

session factory A callable, which, when called with a single argument named `request` (a *request* object), returns a *session* object.

setuptools Setuptools builds on Python's `distutils` to provide easier building, distribution, and installation of libraries and applications.

SQLAlchemy SQLAlchemy is an object relational mapper used in tutorials within this documentation.

subpath A list of element "left over" after the *router* has performed a successful traversal to a view. The subpath is a sequence of strings, e.g. `['left', 'over', 'names']`. Within Pyramid applications that use URL dispatch rather than traversal, you can use `*subpath` in the route pattern to influence the subpath. See *Using *subpath in a Route Pattern* for more information.

subscriber A callable which receives an *event*. A callable becomes a subscriber via *imperative configuration* or via *configuration decoration*. See *Using Events* for more information.

template A file with replaceable parts that is capable of representing some text, XML, or HTML when rendered.

thread local A thread-local variable is one which is essentially a global variable in terms of how it is accessed and treated, however, each thread used by the application may have a different value for this same "global" variable. Pyramid uses a small number of thread local variables, as described in *Thread Locals*. See also the threading.local documentation for more information.

Translation Directory A translation directory is a *gettext* translation directory. It contains language folders, which themselves contain `LC_MESSAGES` folders, which contain `.mo` files. Each `.mo` file represents a set of translations for a language in a *translation domain*. The name of the `.mo` file (minus the .mo extension) is the translation domain name.

Translation Domain A string representing the "context" in which a translation was made. For example the word "java" might be translated differently if the translation domain is "programming-languages" than would be if the translation domain was "coffee". A translation domain is represnted by a collection of `.mo` files within one or more *translation directory* directories.

Translation String An instance of `pyramid.i18n.TranslationString`, which is a class that behaves like a Unicode string, but has several extra attributes such as `domain`, `msgid`, and `mapping` for use during translation. Translation strings are usually created by hand within software, but are sometimes created on the behalf of the system for automatic template translation. For more information, see *Internationalization and Localization*.

Translator A callable which receives a *translation string* and returns a translated Unicode object for the purposes of internationalization. A *localizer* supplies a translator to a Pyramid application accessible via its `translate` method.

traversal The act of descending "up" a tree of resource objects from a root resource in order to find a *context* resource. The Pyramid *router* performs traversal of resource objects when a *root factory* is specified. See the *Traversal* chapter for more information. Traversal can be performed *instead* of *URL dispatch* or can be combined *with* URL dispatch. See *Combining Traversal and URL Dispatch* for more information about combining traversal and URL dispatch (advanced).

tween A bit of code that sits between the Pyramid router's main request handling function and the upstream WSGI component that uses Pyramid as its 'app'. The word "tween" is a contraction of "between". A tween may be used by Pyramid framework extensions, to provide, for example, Pyramid-specific view timing support, bookkeeping code that examines exceptions before they are returned to the upstream WSGI application, or a variety of other features. Tweens behave a bit like *WSGI* 'middleware' but they have the benefit of running in a context in which they have access to the Pyramid *application registry* as well as the Pyramid rendering machinery. See *Registering "Tweens"*.

URL dispatch An alternative to *traversal* as a mechanism for locating a *context* resource for a *view*. When you use a *route* in your Pyramid application via a *route configuration*, you are using URL dispatch. See the *URL Dispatch* for more information.

Venusian Venusian is a library which allows framework authors to defer decorator actions. Instead of taking actions when a function (or class) decorator is executed at import time, the action usually taken by the decorator is deferred until a separate "scan" phase. Pyramid relies on Venusian to provide a basis for its *scan* feature.

view Common vernacular for a *view callable*.

view callable A "view callable" is a callable Python object which is associated with a *view configuration*; it returns a *response* object . A view callable accepts a single argument: `request`, which will be an instance of a *request* object. An alternate calling convention allows a view to be defined as a callable which accepts a pair of arguments: `context` and `request`: this calling convention is useful for traversal-based applications in which a *context* is always very important. A view callable is the primary mechanism by which a developer writes user interface code within Pyramid. See *Views* for more information about Pyramid view callables.

view configuration View configuration is the act of associating a *view callable* with configuration information. This configuration information helps map a given *request* to a particular view callable and it can influence the response of a view callable. Pyramid views can be configured via *imperative configuration*, or by a special `@view_config` decorator coupled with a *scan*. See *View Configuration* for more information about view configuration.

View handler A view handler ties together `pyramid.config.Configurator.add_route()` and `pyramid.config.Configurator.add_view()` to make it more convenient to register a collection of views as a single class when using *url dispatch*. View handlers ship as part of the *pyramid_handlers* add-on package.

View Lookup The act of finding and invoking the "best" *view callable* given a *request* and a *context* resource.

view mapper A view mapper is a class which implements the `pyramid.interfaces.IViewMapperFactory` interface, which performs view argument and return value mapping. This is a plug point for extension builders, not normally used by "civilians".

view name The "URL name" of a view, e.g `index.html`. If a view is configured without a name, its name is considered to be the empty string (which implies the *default view*).

view predicate An argument to a *view configuration* which evaluates to `True` or `False` for a given *request*. All predicates attached to a view configuration must evaluate to true for the associated view to be considered as a possible callable for a given request.

virtual root A resource object representing the "virtual" root of a request; this is typically the physical root object (the object returned by the application root factory) unless *Virtual Hosting* is in use.

virtualenv An isolated Python environment. Allows you to control which packages are used on a particular project by cloning your main Python. virtualenv was created by Ian Bicking.

WebOb WebOb is a WSGI request/response library created by Ian Bicking.

WebTest WebTest is a package which can help you write functional tests for your WSGI application.

WSGI Web Server Gateway Interface. This is a Python standard for connecting web applications to web servers, similar to the concept of Java Servlets. Pyramid requires that your application be served as a WSGI application.

ZCML Zope Configuration Markup Language, an XML dialect used by Zope and *pyramid_zcml* for configuration tasks.

ZEO Zope Enterprise Objects allows multiple simultaneous processes to access a single *ZODB* database.

ZODB Zope Object Database, a persistent Python object store.

Zope The Z Object Publishing Framework, a full-featured Python web framework.

Zope Component Architecture The Zope Component Architecture (aka ZCA) is a system which allows for application pluggability and complex dispatching based on objects which implement an *interface*. Pyramid uses the ZCA "under the hood" to perform view dispatching and other application configuration tasks.

ZPT The Zope Page Template templating language.

Symbols

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