
Aspen

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Abstract

Aspen is a web server for highly extensible Python-based publication, application, and hybrid websites.

Introduction

Aspen is designed around the idea that there are basically two kinds of websites, publications and applications, differentiated by their organization and interface models. A *publication* website organizes information into individual pages within a hierarchical folder structure that one navigates by browsing. In an *application* website, on the other hand, data is not organized into hierarchical pages but is dealt with via a non-browsing interface such as a search box.

The HTML version of this documentation is an example of a publication website: a number of hypertext documents organized into sections. If we weren't using LaTeX (or if I knew how to use it better), the sections would probably be encoded in folders. [Gmail](#) is a pure application website, one which organizes and presents information non-hierarchically. Most websites, however, are hybrids. That is, within an overall hierarchical organization you will find both individual pages of information as well as applications such as a site search feature, or a threaded discussion forum.

Publication websites are actually a subset of application websites, of course. An application site can use any interface metaphor; a publication is an application that uses the familiar folder/page metaphor to organize and present its information. Therefore, every website is fundamentally an application.

Aspen enables the full range of websites: publications, applications, and hybrids. It uses the filesystem for the hierarchical structure of publication and hybrid websites, and provides a mechanism for including applications within that hierarchy.

An Aspen website is a collection of files, self-contained within a single directory, called the *root* of the website (cf. [Apache's DocumentRoot directive](#)). In general, URLs map directly to the filesystem. That is, given a root of:

```
/usr/local/www/example.com
```

A request for `/foo.html` would serve a file at:

```
/usr/local/www/example.com/foo.html
```

If all you want to do is serve static files, then that's most of what you need to know.

To extend an Aspen website, you use a UNIX-style userland located within a directory under the website root named `__` (that's two underscores), also called the website's *magic directory*. The existence and contents of this directory are safe from prying eyes, because Aspen will respond to any requests mapping to the magic directory with a [404 Not Found](#).

Installation

Aspen can be installed using either `distutils` or `setuptools`. That is, you can either download a tarball, unpack it, and run:

```
$ python setup.py install
```

Or you can run:

```
$ easy_install aspen
```


Tutorial

Once you have installed Aspen, here are some quick walk-throughs to get your feet wet. They are written sequentially.

3.1 "Greetings, program!"

In your home directory, make a new directory named 'aspentut'. Create a file in 'aspentut' named 'index.html', with the following contents:

```
Greetings, program!
```

At the command line in the 'aspentut' directory, type `aspen`. You should get output like this:

```
$ aspen
aspen starting on ('', 8080)
```

Now open a web browser and hit `http://localhost:8080/`. You should see "Greetings, program!" in your browser. Congratulations!

3.2 Your First Handler

Aspen uses *handlers* to process files such as your 'index.html'. Now we are going to write our own handler.

First, create a directory under 'aspentut' named '__' (that's two underscores). This is 'aspentut's *magic directory*, and it is where you configure and extend your website. Now create two directories under the magic directory: 'etc' and 'lib'. Under 'lib', create a 'python2.x' directory, where 'x' corresponds to the minor version of Python you are using. Your directory structure should now look like this:

```
aspentut
aspentut/__
aspentut/__/etc
aspentut/__/lib/python2.x
```

In '`__lib/python2.x`', create a file named 'handy.py' with the following contents:

```
def handle(environ, start_response):
    start_response('200 OK', [('Content-Type', 'text/plain')])
    return [environ['PATH_TRANSLATED']]
```

And in `__etc`, create a file named `handlers.conf` with these contents:

```
fnmatch aspen.rules:fnmatch

[handy:handle]
fnmatch *.asp
```

What we have done is we have defined a new handler, and wired it up to be used for any request for a file with the extension `.asp`. So now let's create such a file at `aspentut/handled.asp` and give it the following contents:

```
Greetings, program?
```

Restart Aspen, then hit `http://localhost:8080/handled.asp`. You should see the filesystem pathname of the file being served.

If you are familiar with the WSGI specification, you will recognize that `handy.handle` is a WSGI callable. Aspen plugins all speak WSGI. Also notice that the rules for when a certain handler is invoked are themselves extensible. The `fnmatch` rule comes with Aspen, but you can also write your own.

3.3 What You've Learned

In this brief tutorial we've introduced these key facts about Aspen:

- Aspen websites use the filesystem for site hierarchy.
- Aspen websites are configured and extended via a "magic directory."
- Aspen configuration happens through plain-text configuration files.
- Aspen extensions are WSGI callables.

Besides handlers, Aspen can be extended by wiring up arbitrary WSGI apps to certain paths, and maintaining a global WSGI middleware stack. If this all fits your style of development, then check out the reference documentation that follows for the full story.

Extending Aspen

Aspen uses Python's WSGI specification for its extension architecture. There are three categories of extension:

Category	Explanation
applications	applications are connected to directories within the site hierarchy; only one app touches any given request
handlers	handlers are tied to individual resources (i.e., files and directories) based on extensible rules; only one handler touches
middleware	one or many middleware applications may be specified; all middleware generally touches every request

All extensions are WSGI callables, connected to the above entry points with three configuration files in `'__etc/`:

- `'apps.conf'`
- `'handlers.conf'`
- `'middleware.conf'`

Where called for in these files, objects are specified in a notation derived from `setuptools'` `entry_points` feature: a dotted module name, followed by a colon and a dotted identifier naming an object within the module. This is referred to below as *colon notation*. The following example would import the `bar` object from `example.package.foo`, and use its `baz` attribute (a WSGI callable):

```
example.package.foo:bar.baz
```

The comment character for these files is `#`, and comments can be included in-line. Blank lines are ignored, as is initial and trailing whitespace per-line. Where section names are called for, they are given in brackets.

4.1 Applications: Path-based Extension

In Aspen, an *application* or *app* refers to a WSGI application that is connected to a particular directory. Apps are set up in `'__etc/apps.conf'`.

The `'__etc/apps.conf'` file contains a newline-separated list of white-space-separated path name/object name pairs. The path names refer to URL-space, and are translated literally to the filesystem. If the trailing slash is given, then requests for that directory will first be redirected to the trailing slash before being handed off to the application. If no trailing slash is given, the application will also get requests without the slash. When choosing an application to service a request, the most specific pathname matches first.

Object names are in colon notation, and they name WSGI callables. Aspen updates the `SCRIPT_NAME` and `PATH_INFO` settings in `environ` before handing off to the relevant callable. `SCRIPT_NAME` will never end with a slash, and if `PATH_INFO` is not empty, it will always begin with a slash.

Aspen will (over)write a file called 'README.aspen' in each directory mentioned in 'apps.conf', containing the relevant line from 'apps.conf'. If the directory does not exist, it is created. Aspen will also remove any obsolete 'README.aspen' files within your site tree.

4.1.1 Example apps.conf

```
/foo          example.apps:foo    # will get both /foo and /foo/  
/bar/         example.apps:bar    # /bar will redirect to /bar/  
/bar/baz      example.apps:baz    # will 'steal' some of /bar's requests
```

4.2 Handlers: Resource-based Extension

Aspen *handlers* are WSGI applications that are associated with files and directories on the filesystem according to arbitrary rules. This provides a flexible infrastructure for many different development patterns.

The '___/etc/handlers.conf' file begins with an anonymous "rules" section, which is a newline-separated list of white-space-separated rule name/object name pairs. Rule names can be any string without whitespace. Each object name (in colon notation) specifies a *rule*, a callable taking a filesystem path name and an arbitrary predicate string, and returning True or False.

Following the rule specification are sections specifying *handlers*, which as mentioned above are WSGI callables.

The name of each section specifies a handler (a WSGI callable) in colon notation. The body of each section is a newline-separated list of conditions under which this handler is to be called. Fundamentally, these conditions are made up of a rule name as defined at the beginning of the file, and an arbitrary predicate string (which can include whitespace) that is meaningful to the matching rule callable. If no predicate is given, then the rule callable will receive None for its predicate argument. Rules must be explicitly specified at the beginning of the file before being available within handler sections. After the first condition in a handler section, additional condition lines must begin with one of AND, OR, or NOT. These case-insensitive tokens specify how conditions are to be combined in evaluating whether to use this handler.

On each request, handlers are considered in the order given, and the first matching handler is used. Only one handler is used for any given request.

Note that if the file '___/etc/handlers.conf' exists at all, the defaults (see the example below) disappear, and you must respecify any of the default rules in your own file if you want them.

4.2.1 Example handlers.conf

This is Aspen's default handler configuration:

```
catch_all    aspen.rules:catch_all  
isdir        aspen.rules:isdir  
  
[aspen.handlers.autoindex:autoindex]  
  isdir                # directories get an automatic index  
  
[aspen.handlers.static:static]  
  catch_all            # anything else, serve it statically
```

4.3 Middleware: Global Extension

Aspen allows for a full WSGI middleware stack, configured via the ‘`__etc/middleware.conf`’ file. This is simply a newline-separated list of middleware factories in colon notation. Each factory (which may be a class constructor or other callable) is called with exactly one positional argument, the next middleware on the stack. The first-mentioned middleware will therefore be the outer-most in the stack (i.e., closest to the browser).

4.3.1 Example `middleware.conf`

```
example.foo:bar # closest to browser
example.baz:buz # closest to your apps/handlers
```


User Interface (UI)

Users interface with Aspen through three mechanisms: the command line, a configuration file, and the environment. Where a program parameter is set in more than one of these contexts, they take precedence in the order given here. For example, a *mode* option on the command line will override any *mode* setting in the config file or in the environment.

5.1 Command Line

Usage:

```
aspen [options] [command]
```

Aspen takes one optional positional argument, *command*, which must be one of: *start*, *status*, *stop*, *restart*, or *runfg*. The default is *runfg*, which causes Aspen to run in the foreground, sending all messages to stdout.

start, *status*, *stop*, and *restart* control Aspen as a daemon, via a pidfile. If the website root has a directory named ‘__’ (that’s two underscores; the *magic directory*), then the pidfile is at ‘__var/aspen.pid’. Otherwise, the pidfile is created in ‘/tmp’. When run as a daemon, stdout and stderr are redirected to ‘__var/aspen.log’ if ‘__’ exists, and to ‘/dev/null’ otherwise. The ‘__var’ directory will be created if it does not exist. The permission mode of the pidfile is set to 0600; likewise with the logfile, unless it is ‘/dev/null’.

The Aspen distribution includes a script in ‘etc/aspen_bash_completion’ that can be used to configure the bash shell to autocomplete from among Aspen’s arguments. See the source for more information.

Aspen’s command-line options are as follows:

Option	Description
-a/--address=address	The address to which Aspen should bind. If <i>address</i> begins with a dot or a forward slash, then it is interpreted as a relative path.
-m/--mode=mode	One of <i>debugging</i> , <i>development</i> , <i>staging</i> , or <i>production</i> . In <i>debugging</i> and <i>development</i> modes, Aspen will log to stdout.
-r/--root=root	The directory containing the website for Aspen to serve.

See Also:

[mode](#)

Aspen uses the *mode* module to model the application life-cycle. It is available to your applications at `aspen.mode`

5.2 Configuration File

This section describes the general Aspen configuration file at `'__/etc/aspen.conf'`. Additional configuration files are described in the "Extending Aspen" chapter. `'aspen.conf'` is in `'ini'`-style format per the `ConfigParser` module. Aspen responds to the following settings in the `main` section. You may define additional settings and sections that are meaningful to your application, which you may access using the `aspen.conf` object described below in the "API" chapter.

Option	Description
<i>address</i>	The address to which Aspen should bind. If <i>address</i> begins with a dot or a forward slash, then it is interpreted as an <code>AspenAddress</code> .
<i>defaults</i>	A comma-separated list of names to look for when a directory is requested. Any default resource is located immediately below the directory.
<i>mode</i>	One of <code>debugging</code> , <code>development</code> , <code>staging</code> , or <code>production</code> . In <code>debugging</code> and <code>development</code> modes, Aspen will restart itself any time the following configuration files or any module source files change on the filesystem:
<i>server_name</i>	The value to use for the <code>SERVER_NAME</code> WSGI environment setting.
<i>threads</i>	The number of threads to maintain in the request-servicing thread pool.

See Also:

[Extending Aspen](#)

Aspen three additional configuration files are described here.

[mode](#)

Aspen relies on this module to model the application life-cycle. It is available to your applications at `aspen.mode`

5.3 The Environment

Aspen incorporates the `mode` module, which uses the `PYTHONMODE` environment variable to model the application life-cycle through four deployment modes: `debugging`, `development`, `staging`, and `production`. This module is available to your applications at `aspen.mode`, and its API is documented in the "API" chapter, below.

Aspen itself adapts to the current `PYTHONMODE`. In `debugging` and `development` modes, Aspen will restart itself any time the following configuration files or any module source files change on the filesystem:

- `'apps.conf'`
- `'aspen.conf'`
- `'handlers.conf'`
- `'middleware.conf'`

See Also:

[mode](#)

Aspen relies on this module to model the application life-cycle. It is available to your applications at `aspen.mode`

Application Programming Interface (API)

Aspen parses and harmonizes all command-line, configuration file, and environment settings before it loads your plugins. This information is then available to your modules via several objects which are dynamically placed in the global `aspen` namespace before your plugins are loaded—`conf`, `configuration`, and `paths`—and via the `mode` module.

6.1 The `aspen.conf` object

The `aspen.conf` object is an instance of `aspen._configuration.ConfFile`, which subclasses the standard library's `ConfigParser.RawConfigParser` class to represent the `'__/etc/aspen.conf'` file. In addition to the `RawConfigParser` API, the object supports both attribute and key read-only access; either returns a dictionary corresponding to a section of the `'aspen.conf'` file. If the named section does not exist, an empty dictionary is returned.

Your application is free and encouraged to use the `'aspen.conf'` file for its own configuration, and to access that information via this object.

To illustrate, here is a minimal `'aspen.conf'` file:

```
[my_settings]
foo = bar
```

Such a file could support code like this:

```
import aspen

def wsgi_app(envIRON, start_response):
    my_setting = aspen.conf.my_settings.get('foo', 'default')
    start_response('200 OK', [])
    return ["My setting is %s" % my_setting]
```

See Also:

[RawConfigParser](#)

In addition to the API above, `aspen.conf` also exposes the `RawConfigParser` API.

6.2 The `aspen.configuration` object

The `aspen.configuration` object provides raw access to the parser objects used to configure your server, and a number of basic settings.

6.2.1 Parsers

The various parsers and raw settings are exposed as these members:

args

An argument list as returned by `optparse.OptionParser.parse_args`.

conf

An instance of `aspen._configuration.ConfFile`; see below.

optparser

An `optparse.OptionParser` instance.

opts

An `optparse.Values` instance per `optparse.OptionParser.parse_args`.

paths

An instance of `aspen._configuration.Paths`; see below.

6.2.2 Settings

Furthermore, `aspen.configuration` exposes specific configuration settings as these members:

address

A *(hostname, port)* tuple (for `AF_INET` and `AF_INET6` address) or string (for `AF_UNIX`) giving the address to which Aspen is bound.

command

A string giving the command line argument (*start, stop, etc.*).

daemon

A boolean indicating whether Aspen is acting as a daemon.

defaults

A tuple listing the default resource names to look for in a directory.

sockfam

One of `socket.AF_INET`, `socket.AF_INET6`, and `socket.AF_UNIX`.

threads

A non-zero positive integer; the number of threads in the server's request-handling thread pool.

All members are intended to be read-only.

See Also:

[ConfigParser](#)

The naming is not PEP 8, but the documentation is fine.

[optparse](#)

On the other hand, the documentation for `optparse` is rather, um, convoluted. Good luck!

6.3 The `aspen.mode` module

It is often valuable to maintain a distinction between various phases of an application's lifecycle. The `mode` module calls these phases *modes*, and identifies four of them, given here in conceptual life-cycle order:

Mode	Description
<code>debugging</code>	The application is being actively debugged; exceptions may trigger an interactive debugger.
<code>development</code>	The application is being actively developed; however, exceptions should not trigger interactive debugging.
<code>staging</code>	The application is deployed in a mock-production environment.
<code>production</code>	The application is in live use by its end users.

The expectation is that various aspects of the application—logging, exception handling, data sourcing—will adapt to the current mode. The mode is set in the `PYTHONMODE` environment variable. This module provides API for interacting with this variable. If `PYTHONMODE` is unset, it will be set to `development` when this module is imported.

6.3.1 Members

The module defines the following functions:

`get()`

Return the current `PYTHONMODE` setting as a lowercase string; will raise `EnvironmentError` if the (case-insensitive) setting is not one of `debugging`, `development`, `staging`, or `production`.

`set(mode)`

Given a mode, set the `PYTHONMODE` environment variable and refresh the module's boolean members. If given a bad mode, `ValueError` is raised.

`setAPI()`

Refresh the module's boolean members. Call this if you ever change `PYTHONPATH` directly in the `os.environ` mapping.

The module also defines a number of boolean attributes reflecting the current mode setting, including abbreviations and combinations. Uppercase versions of each of the following are also defined (e.g., `DEBUGGING`).

`debugging, deb`

True if `PYTHONMODE` is set to `debugging`.

`development, dev`

True if `PYTHONMODE` is set to `development`.

`staging, st`

True if `PYTHONMODE` is set to `staging`.

`production, prod`

True if `PYTHONMODE` is set to `production`.

`debugging_or_development, debdev, devdeb`

True if `PYTHONMODE` is set to `debugging` or `development`.

`staging_or_production, stprod`

True if `PYTHONMODE` is set to `staging` or `production`.

6.3.2 Example

Example usage:

```

>>> import mode
>>> mode.set('development')      # can set the mode at runtime
>>> mode.get()                   # and access the current mode
'development'
>>> mode.development             # module defines boolean constants
True
>>> mode.PRODUCTION             # uppercase versions are also defined
False
>>> mode.dev                     # as are abbreviations
True
>>> mode.DEBDEV, mode.stprod     # and combinations
(True, False)

```

See Also:

[mode](#)

The mode module is maintained as part of the lib537 library.

6.4 The aspen.paths object

The `aspen.paths` object is an instance of `aspen._configuration.Paths`; it is simply a container for various paths, all normalized and absolute:

root

the website's filesystem root

the magic directory

lib

the site's local Python library

plat

the local platform-specific Python library

If there is no magic directory, then `---`, `lib`, and `plat` are all `None`. If there is, then `lib` and `plat` are added to `sys.path`.

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