Flask Extension Development

Flask, being a microframework, often requires some repetitive steps to get a third party library working. Many such extensions are already available on PyPI.

If you want to create your own Flask extension for something that does not exist yet, this guide to extension development will help you get your extension running in no time and to feel like users would expect your extension to behave.

Anatomy of an Extension

Extensions are all located in a package called `flask_something` where "something" is the name of the library you want to bridge. So for example if you plan to add support for a library named *simplexml* to Flask, you would name your extension's package `flask_simplexml`.

The name of the actual extension (the human readable name) however would be something like "Flask-SimpleXML". Make sure to include the name "Flask" somewhere in that name and that you check the capitalization. This is how users can then register dependencies to your extension in their `setup.py` files.

But what do extensions look like themselves? An extension has to ensure that it works with multiple Flask application instances at once. This is a requirement because many people will use patterns like the Application Factories pattern to create their application as needed to aid unittests and to support multiple configurations. Because of that it is crucial that your application supports that kind of behavior.

Most importantly the extension must be shipped with a `setup.py` file and registered on PyPI. Also the development checkout link should work so that people can easily install the development version into their virtualenv without having to download the library by hand.

Flask extensions must be licensed under a BSD, MIT or more liberal license in order to be listed in the Flask Extension Registry. Keep in mind that the Flask Extension Registry is a moderated place and libraries will be reviewed upfront if they behave as required.

"Hello Flaskext!"

So let's get started with creating such a Flask extension. The extension we want to create here will provide very basic support for SQLite3.

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First we create the following folder structure:

```
flask-sqlite3/
    flask_sqlite3.py
    LICENSE
    README
```

Here's the contents of the most important files:

setup.py

The next file that is absolutely required is the `setup.py` file which is used to install your Flask extension. The following contents are something you can work with:

```
"""
Flask-SQLite3
-------------

This is the description for that library
"""
from setuptools import setup


setup(
    name='Flask-SQLite3',
    version='1.0',
    url='http://example.com/flask-sqlite3/',
    license='BSD',
    author='Your Name',
    author_email='your-email@example.com',
    description='Very short description',
    long_description=__doc__,
    py_modules=['flask_sqlite3'],
    # if you would be using a package instead use packages instead
    # of py_modules:
    # packages=['flask_sqlite3'],
    zip_safe=False,
    include_package_data=True,
    platforms='any',
    install_requires=[
        'Flask'
    ],
    classifiers=[
        'Environment :: Web Environment',
        'Intended Audience :: Developers',
        'License :: OSI Approved :: BSD License',
        'Operating System :: OS Independent',
        'Programming Language :: Python',
        'Topic :: Internet :: WWW/HTTP :: Dynamic Content',
        'Topic :: Software Development :: Libraries :: Python Modules'
    ]
)
```

That’s a lot of code but you can really just copy/paste that from existing extensions and adapt.

flask_sqlite3.py

Now this is where your extension code goes. But how exactly should such an extension look like? What are the best practices? Continue reading for some insight.

Initializing Extensions

Many extensions will need some kind of initialization step. For example, consider an application that’s currently connecting to SQLite like the documentation suggests (Using SQLite 3 with Flask). So how does the extension know the name of the application object?

Quite simple: you pass it to it.

There are two recommended ways for an extension to initialize:

initialization functions:

> If your extension is called *helloworld* you might have a function called `init_helloworld(app[, extra_args])` that initializes the extension for that application. It could attach before / after handlers etc.

classes:

> Classes work mostly like initialization functions but can later be used to further change the behavior. For an example look at how the OAuth extension works: there is an *OAuth* object that provides some helper functions like *OAuth.remote_app* to create a reference to a remote application that uses OAuth.

What to use depends on what you have in mind. For the SQLite 3 extension we will use the class-based approach because it will provide users with an object that handles opening and closing database connections.

When designing your classes, it’s important to make them easily reusable at the module level. This means the object itself must not under any circumstances store any a
specific state and must be shareable between different applications.

The Extension Code

Here's the contents of the *flask_sqlite3.py* for copy/paste:

```
import sqlite3
from flask import current_app, _app_ctx_stack


class SQLite3(object):
    def __init__(self, app=None):
        self.app = app
        if app is not None:
            self.init_app(app)

    def init_app(self, app):
        app.config.setdefault('SQLITE3_DATABASE', ':memory:')
        app.teardown_appcontext(self.teardown)

    def connect(self):
        return sqlite3.connect(current_app.config['SQLITE3_DATABASE'])

    def teardown(self, exception):
        ctx = _app_ctx_stack.top
        if hasattr(ctx, 'sqlite3_db'):
            ctx.sqlite3_db.close()

    @property
    def connection(self):
        ctx = _app_ctx_stack.top
        if ctx is not None:
            if not hasattr(ctx, 'sqlite3_db'):
                ctx.sqlite3_db = self.connect()
            return ctx.sqlite3_db
```

So here's what these lines of code do:

1. The `__init__` method takes an optional app object and, if supplied, will call `init_app`.
2. The `init_app` method exists so that the `SQLite3` object can be instantiated without requiring an app object. This method supports the factory pattern for creating applications. The `init_app` will set the configuration for the database, defaulting to an in memory database if no configuration is supplied. In addition, the `init_app` method attaches the `teardown` handler.
3. Next, we define a `connect` method that opens a database connection.
4. Finally, we add a `connection` property that on first access opens the database connection and stores it on the context. This is also the recommended way to handling re-

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sources: fetch resources lazily the first time they are used.

Note here that we're attaching our database connection to the top application context via `_app_ctx_stack.top`. Extensions should use the top context for storing their own information with a sufficiently complex name.

So why did we decide on a class-based approach here? Because using our extension looks something like this:

```
from flask import Flask
from flask_sqlite3 import SQLite3

app = Flask(__name__)
app.config.from_pyfile('the-config.cfg')
db = SQLite3(app)
```

You can then use the database from views like this:

```
@app.route('/')
def show_all():
    cur = db.connection.cursor()
    cur.execute(...)
```

Likewise if you are outside of a request you can use the database by pushing an app context:

```
with app.app_context():
    cur = db.connection.cursor()
    cur.execute(...)
```

At the end of the `with` block the teardown handles will be executed automatically.

Additionally, the `init_app` method is used to support the factory pattern for creating apps:

```
db = SQLite3()
# Then later on.
app = create_app('the-config.cfg')
db.init_app(app)
```

Keep in mind that supporting this factory pattern for creating apps is required for approved flask extensions (described below).

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Note on `init_app`:

As you noticed, `init_app` does not assign `app` to `self`. This is intentional! Class based Flask extensions must only store the application on the object when the application was passed to the constructor. This tells the extension: I am not interested in using multiple applications.

When the extension needs to find the current application and it does not have a reference to it, it must either use the **`current_app`** context local or change the API in a way that you can pass the application explicitly.

Using _app_ctx_stack

In the example above, before every request, a `sqlite3_db` variable is assigned to `_app_ctx_stack.top`. In a view function, this variable is accessible using the `connection` property of `SQLite3`. During the teardown of a request, the `sqlite3_db` connection is closed. By using this pattern, the *same* connection to the sqlite3 database is accessible to anything that needs it for the duration of the request.

Learn from Others

This documentation only touches the bare minimum for extension development. If you want to learn more, it's a very good idea to check out existing extensions on the PyPI. If you feel lost there is still the mailinglist and the Discord server to get some ideas for nice looking APIs. Especially if you do something nobody before you did, it might be a very good idea to get some more input. This not only generates useful feedback on what people might want from an extension, but also avoids having multiple developers working in isolation on pretty much the same problem.

Remember: good API design is hard, so introduce your project on the mailing list, and let other developers give you a helping hand with designing the API.

The best Flask extensions are extensions that share common idioms for the API. And this can only work if collaboration happens early.

Approved Extensions

Flask previously had the concept of approved extensions. These came with some vetting of support and compatibility. While this list became too difficult to maintain over time, the guidelines are still relevant to all extensions maintained and developed today, a v: 1.1.x
the Flask ecosystem remain consistent and compatible.

0. An approved Flask extension requires a maintainer. In the event an extension author would like to move beyond the project, the project should find a new maintainer and transfer access to the repository, documentation, PyPI, and any other services. If no maintainer is available, give access to the Pallets core team.
1. The naming scheme is *Flask-ExtensionName* or *ExtensionName-Flask*. It must provide exactly one package or module named `flask_extension_name`.
2. The extension must be BSD or MIT licensed. It must be open source and publicly available.
3. The extension's API must have the following characteristics:
   - It must support multiple applications running in the same Python process. Use `current_app` instead of `self.app`, store configuration and state per application instance.
   - It must be possible to use the factory pattern for creating applications. Use the `ext.init_app()` pattern.
4. From a clone of the repository, an extension with its dependencies must be installable with `pip install -e .`.
5. It must ship a testing suite that can be invoked with `tox -e py` or `pytest`. If not using `tox`, the test dependencies should be specified in a `requirements.txt` file. The tests must be part of the sdist distribution.
6. The documentation must use the `flask` theme from the Official Pallets Themes. A link to the documentation or project website must be in the PyPI metadata or the readme.
7. For maximum compatibility, the extension should support the same versions of Python that Flask supports. 3.6+ is recommended as of 2020. Use `python_requires=">= 3.6"` in `setup.py` to indicate supported versions.