Pluggable Architecture

Aly Sivji
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I’m Aly Sivji. @CaiusSivjus on

ChiPy

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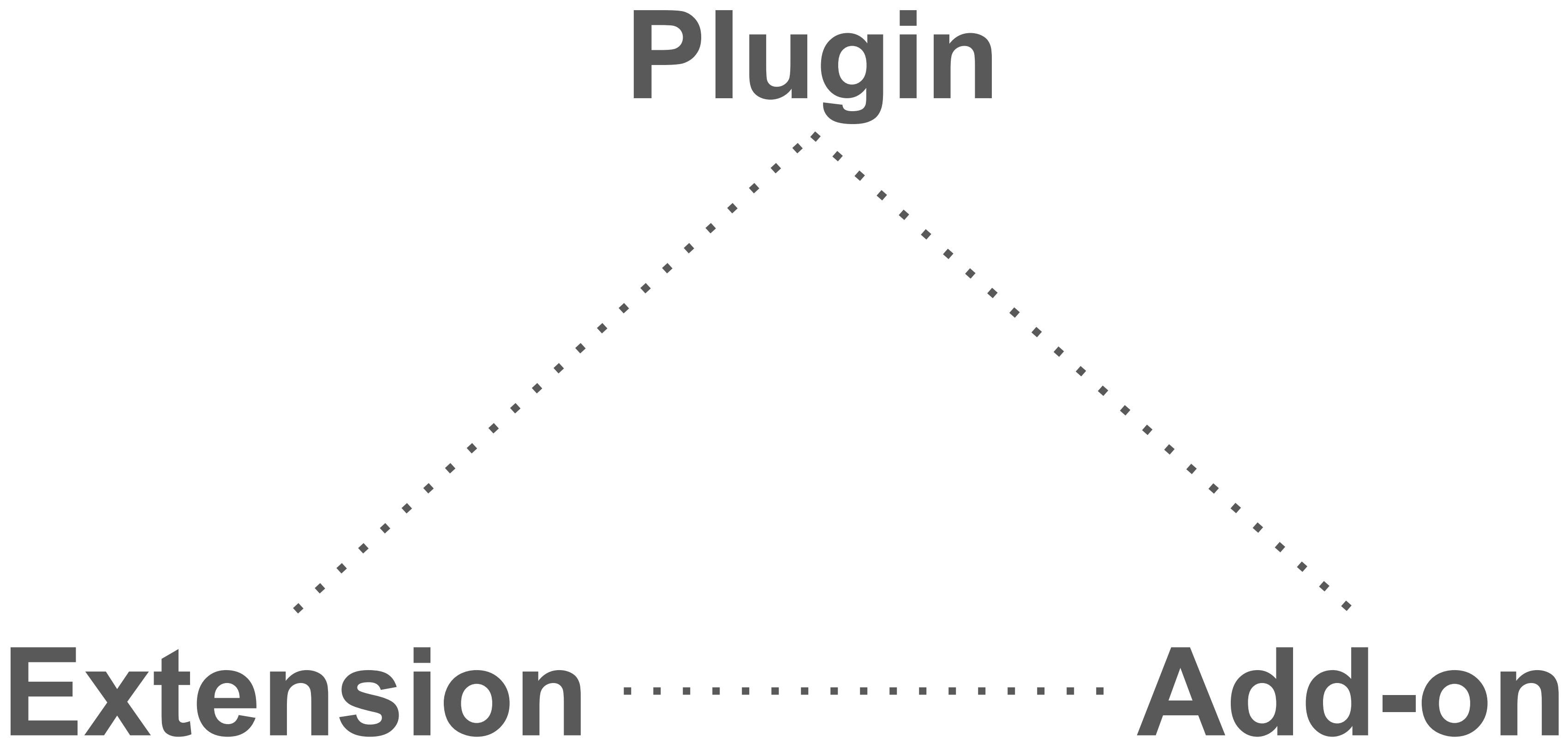
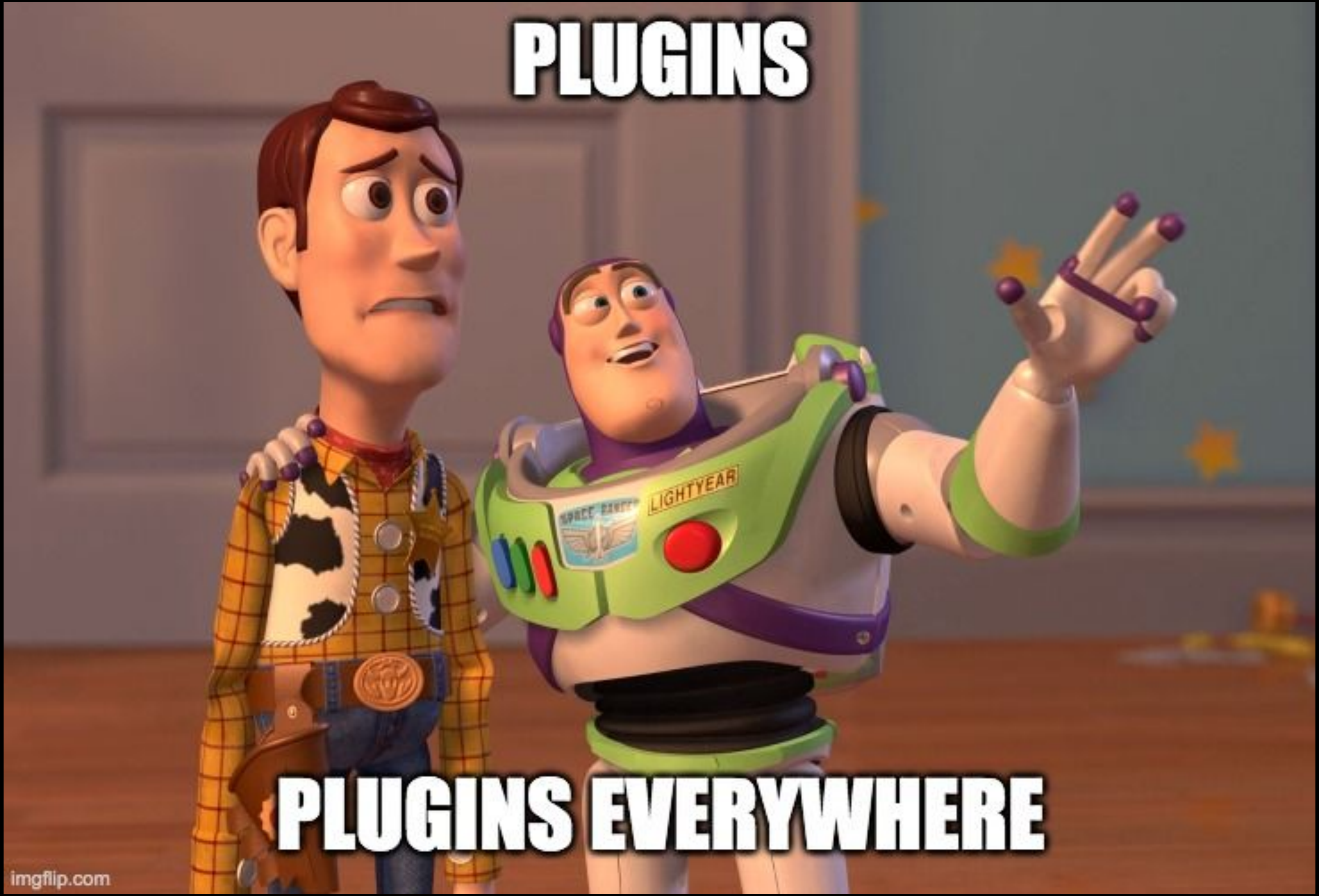
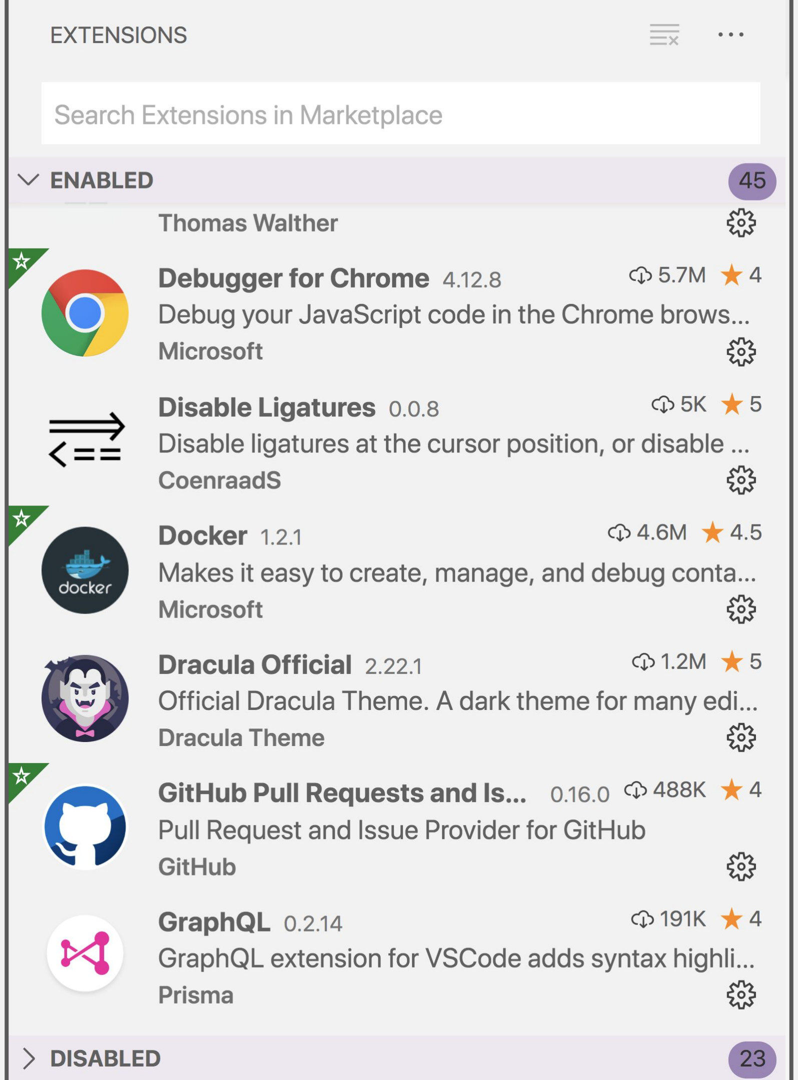
Pluggable Architecture

Plugins are software components that **extend or enhance** an existing program


Plugin
Extension
Add-on


PLUGINS
PLUGINS EVERYWHERE
LIGHTYEAR
imgflip.com



EXTENSIONS

Search Extensions in Marketplace

ENABLED 45

Thomas Walther

Debugger for Chrome 4.12.8 5.7M ★ 4
Debug your JavaScript code in the Chrome brows...
Microsoft

Disable Ligatures 0.0.8 5K ★ 5
Disable ligatures at the cursor position, or disable ...
CoenraadS

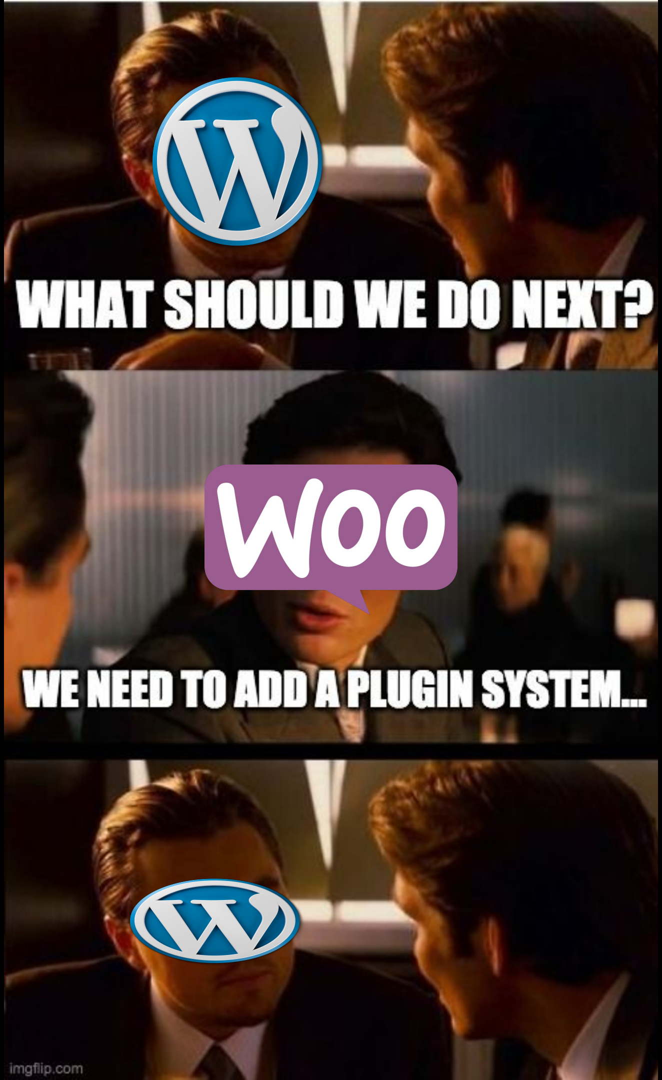
Docker 1.2.1 4.6M ★ 4.5
Makes it easy to create, manage, and debug conta...
Microsoft

Dracula Official 2.22.1 1.2M ★ 5
Official Dracula Theme. A dark theme for many edi...
Dracula Theme

GitHub Pull Requests and Is... 0.16.0 488K ★ 4
Pull Request and Issue Provider for GitHub
GitHub

GraphQL 0.2.14 191K ★ 4
GraphQL extension for VSCode adds syntax highli...
Prisma

DISABLED 23


WHAT SHOULD WE DO NEXT?
Woo
WE NEED TO ADD A PLUGIN SYSTEM...
imgflip.com

django

Flask

Benefits

Benefits

- New features are easier to develop

Benefits

- New features are easier to develop

- Separation of Concerns

Benefits

- New features are easier to develop
- Separation of Concerns
- Third-party developers can extend your app

Trade-offs

Trade-offs

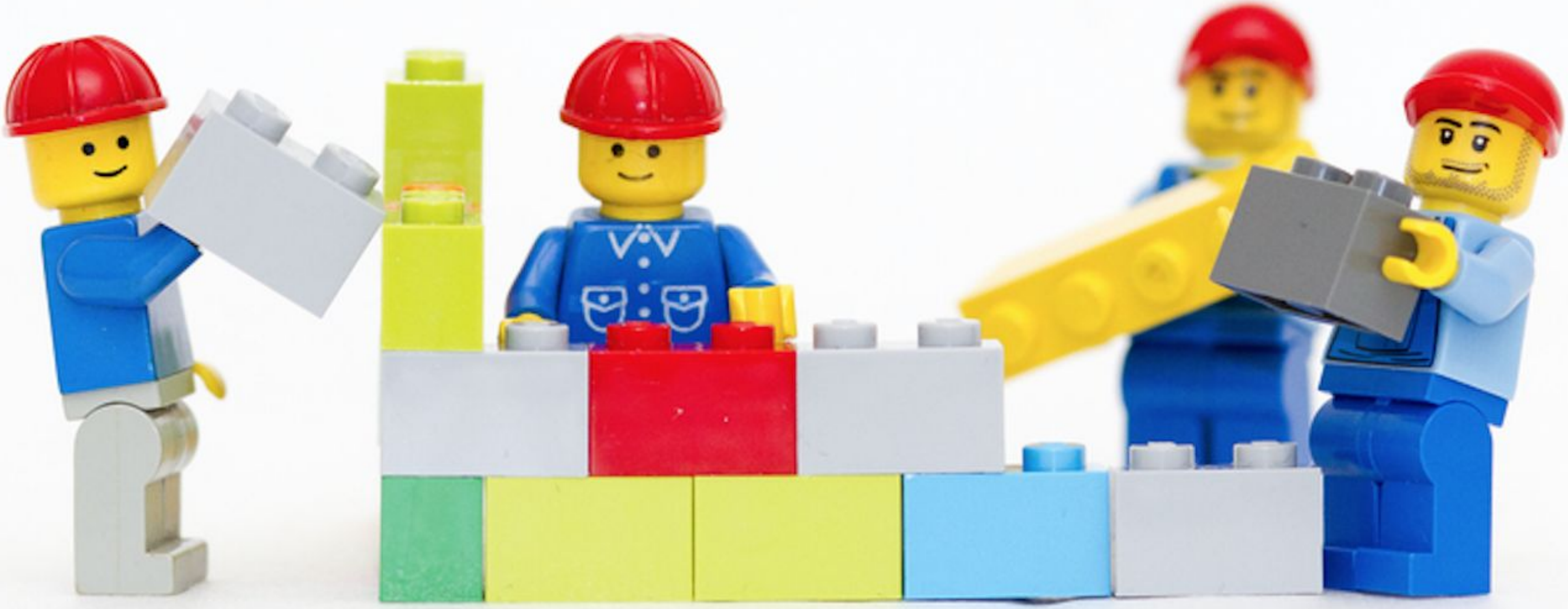
- Upfront design cost

Trade-offs

- Upfront design cost
- Additional complexity inside core application

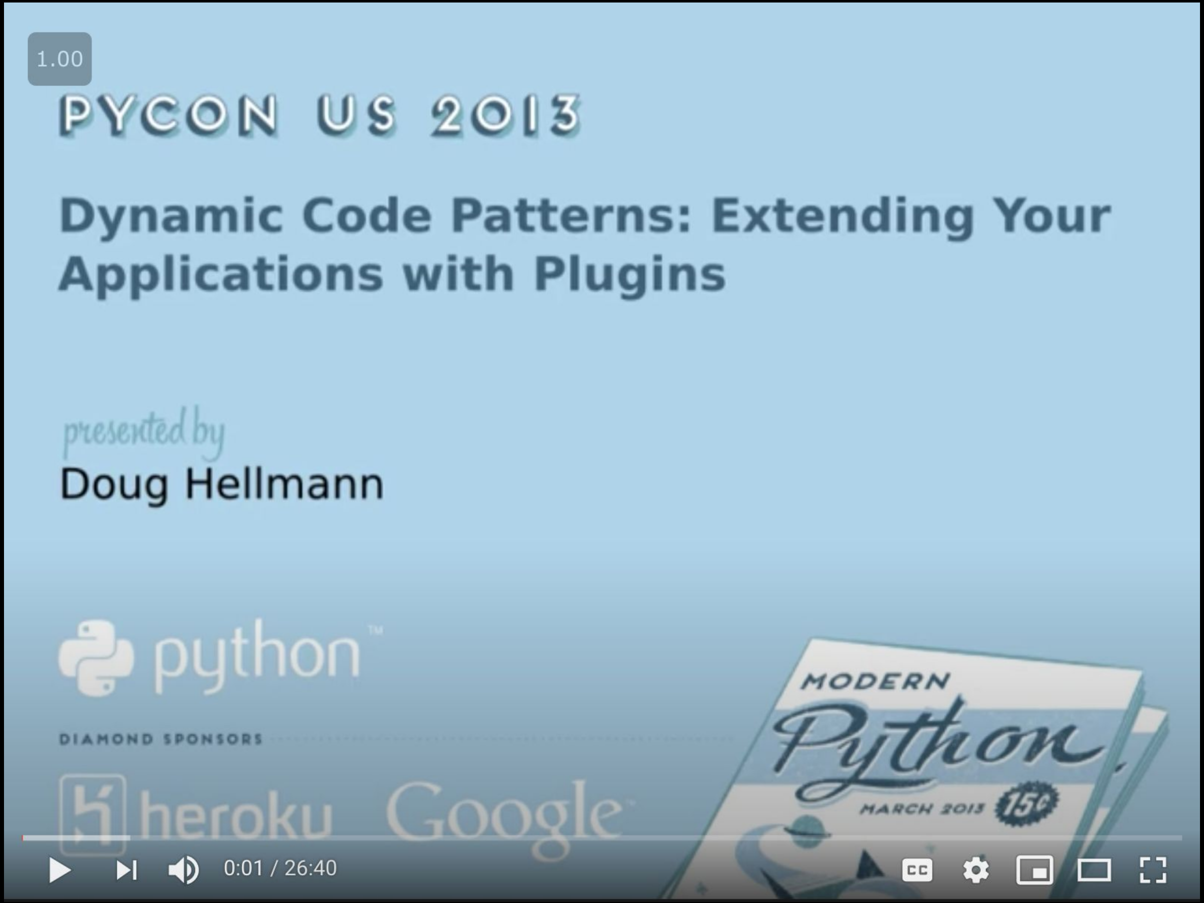
#Goals

Write a third-party plugin from scratch



To catch a fish, you have to think like a fish
I'm wet, and I don't even know it

What this talk is not...


1.00

PYCON US 2013

Dynamic Code Patterns: Extending Your Applications with Plugins

presented by

Doug Hellmann

Doug Hellman - Dynamic Code Patterns: Extending Your Applications with Plugins

Plug-in to Python

Extending your applications with plugins

Rose Judge
Open Source Engineer @ VMware

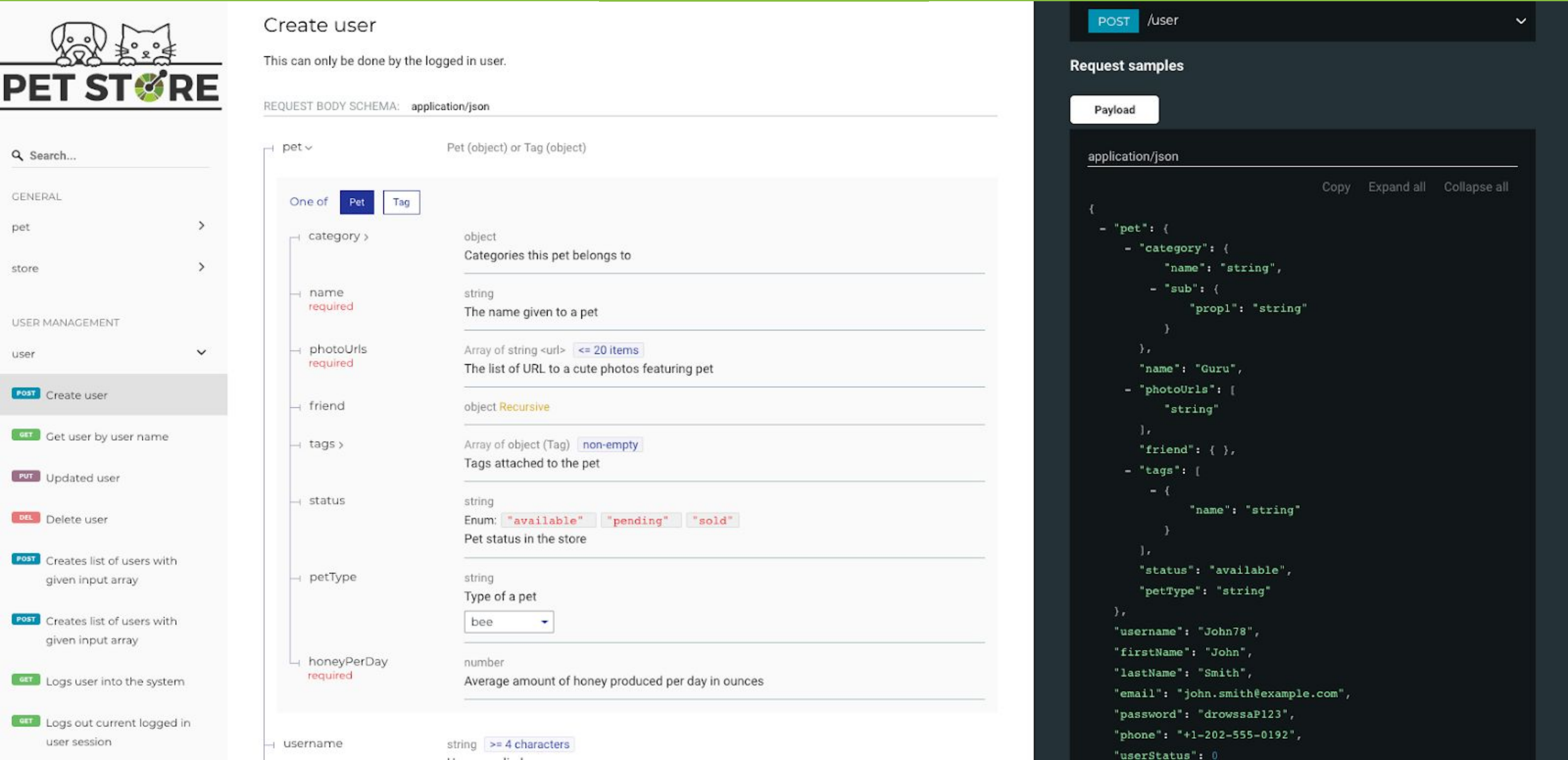
Rose Judge - Plug-in to Python: Extending your applications through the use of plugins

Motivating Example:

Generate API Documentation

swagger

swagger



PET STORE

Search...

GENERAL

pet

store

USER MANAGEMENT

user

POST Create user

GET Get user by user name

PUT Updated user

DEL Delete user

POST Creates list of users with given input array

POST Creates list of users with given input array

GET Logs user into the system

GET Logs out current logged in user session

Create user

This can only be done by the logged in user.

REQUEST BODY SCHEMA: application/json

pet — Pet (object) or Tag (object)

One of Pet Tag

category	object Categories this pet belongs to
name required	string The name given to a pet
photoUrls required	Array of string <url> <= 20 items The list of URL to a cute photos featuring pet
friend	object Recursive
tags	Array of object (Tag) non-empty Tags attached to the pet
status	string Enum: "available" "pending" "sold" Pet status in the store
petType	string Type of a pet bee
honeyPerDay required	number Average amount of honey produced per day in ounces
username	string >= 4 characters

POST /user

Request samples

Payload

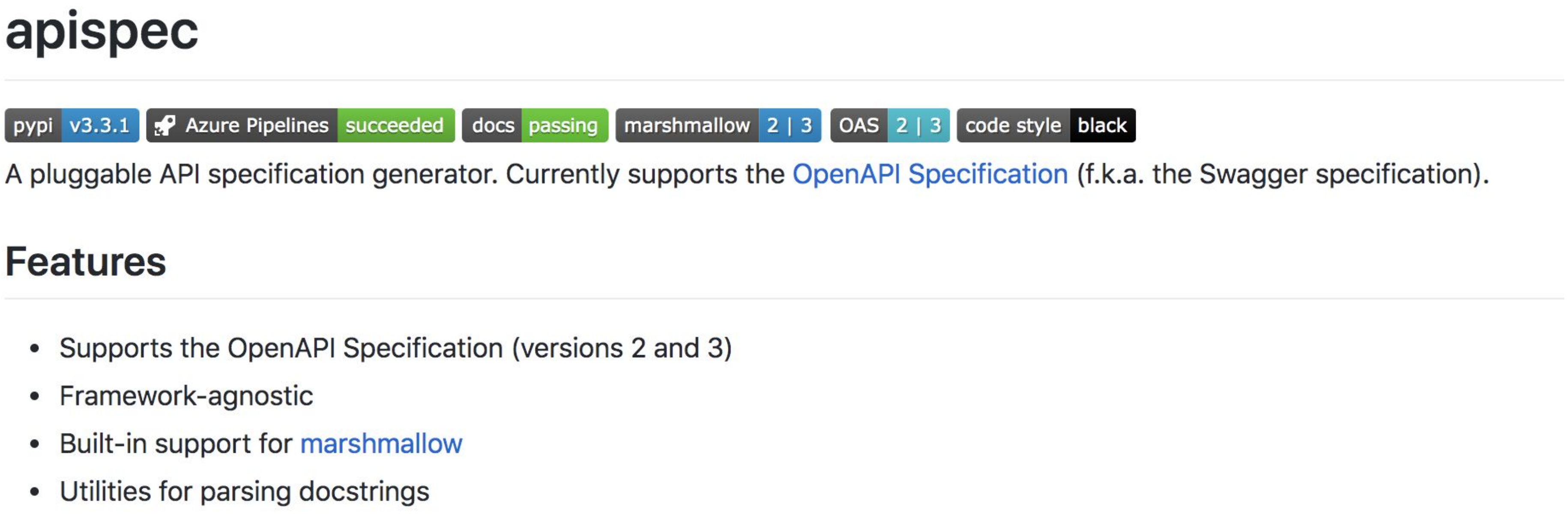
application/json

Copy Expand all Collapse all

```
{
  - "pet": {
    - "category": {
          "name": "string",
        - "sub": {
              "prop1": "string"
          }
      },
      "name": "Guru",
    - "photoUrls": [
          "string"
      ],
      "friend": { },
    - "tags": [
        - {
              "name": "string"
          }
      ],
      "status": "available",
      "petType": "string"
  },
  "username": "John78",
  "firstName": "John",
  "lastName": "Smith",
  "email": "john.smith@example.com",
  "password": "drowssaP123",
  "phone": "+1-202-555-0192",
  "userStatus": 0
```

FalconFramework.org

HELLO, IS IT ME YOU'RE LOOKING FOR?
memegenerator.net



apispec

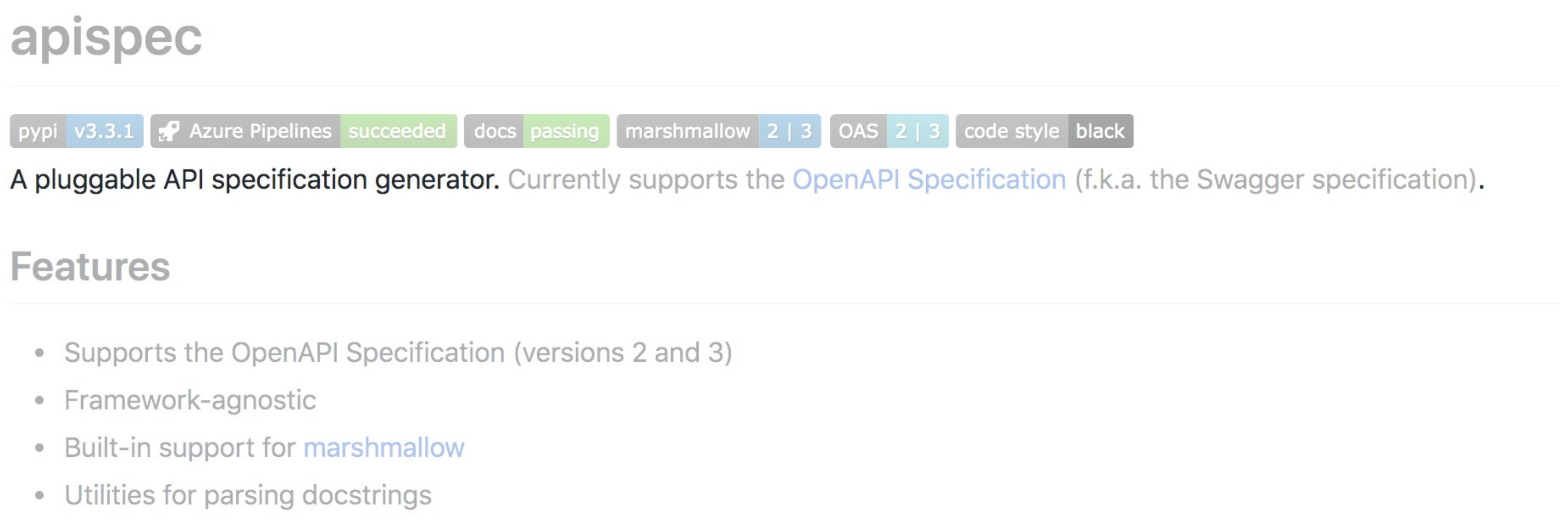
pypi v3.3.1 | Azure Pipelines succeeded | docs passing | marshmallow 2 | 3 | OAS 2 | 3 | code style black

A pluggable API specification generator. Currently supports the OpenAPI Specification (f.k.a. the Swagger specification).

Features

- Supports the OpenAPI Specification (versions 2 and 3)
- Framework-agnostic
- Built-in support for marshmallow
- Utilities for parsing docstrings

github.com/marshmallow-code/apispec



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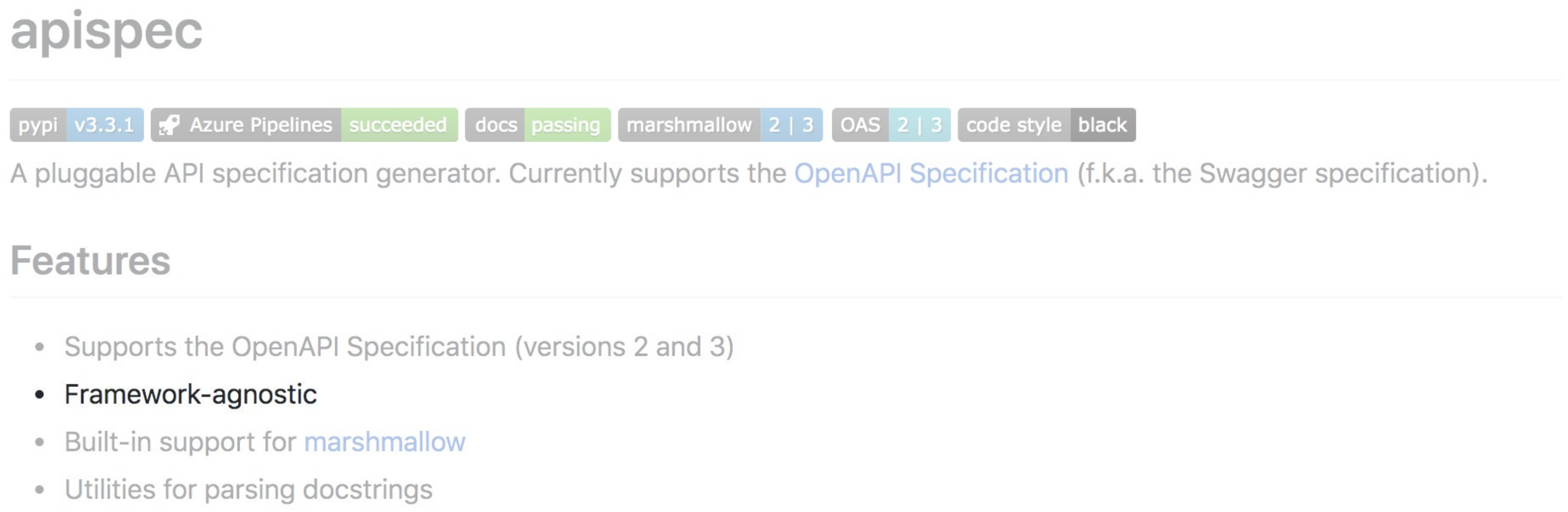

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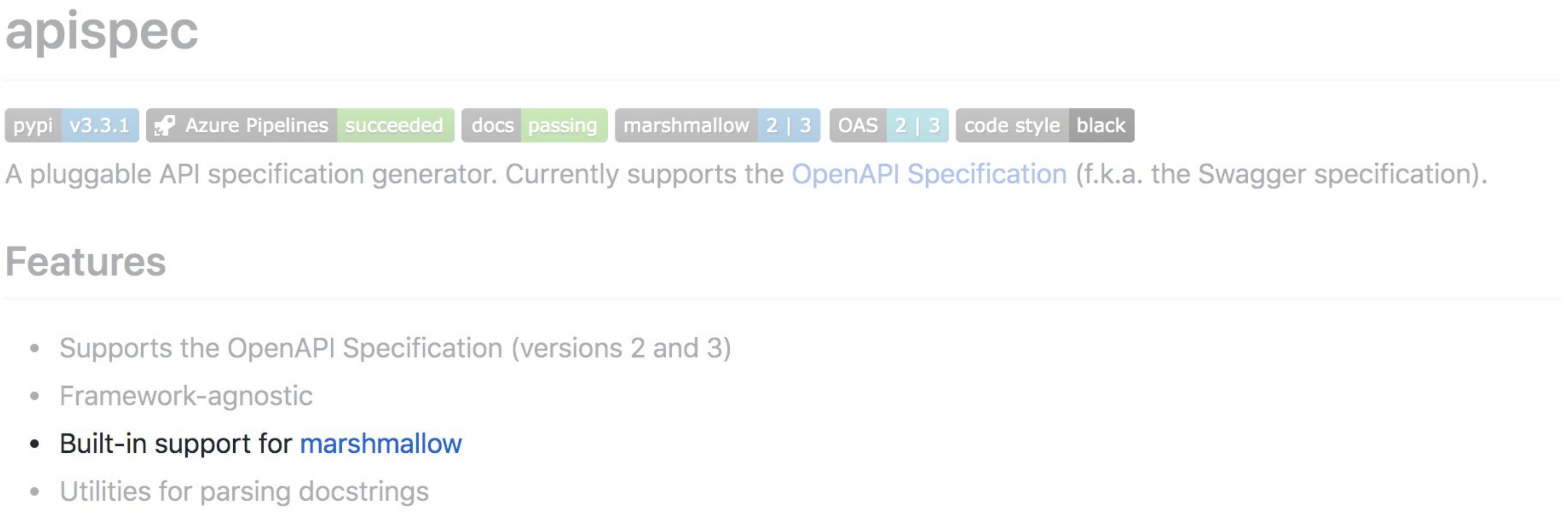

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pypi v3.3.1 | Azure Pipelines succeeded | docs passing | marshmallow 2 | 3 | OAS 2 | 3 | code style black

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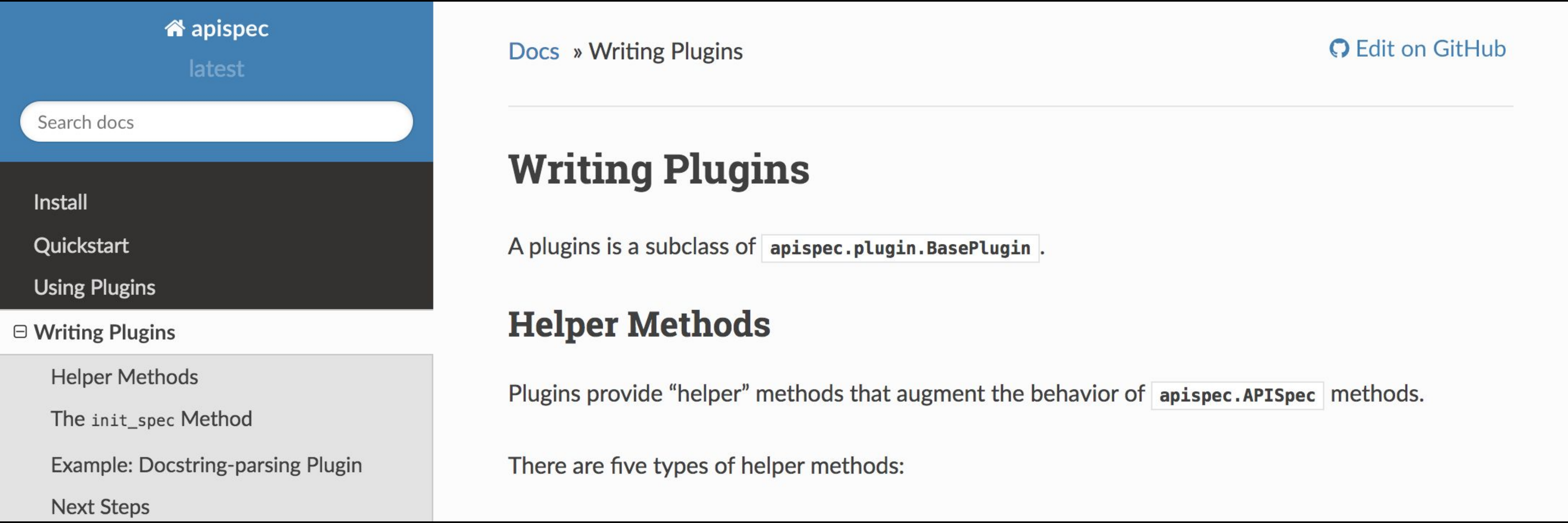

apispec
latest

Search docs

Install
Quickstart
Using Plugins
⊟ Writing Plugins
Helper Methods
The `init_spec` Method
Example: Docstring-parsing Plugin
Next Steps

Docs » Writing Plugins

Edit on GitHub

Writing Plugins

A plugins is a subclass of `apispec.plugin.BasePlugin`.

Helper Methods

Plugins provide “helper” methods that augment the behavior of `apispec.APISpec` methods.

There are five types of helper methods:

Helper Methods

Plugins provide “helper” methods that augment the behavior of `apispec.APISpec` methods.

There are five types of helper methods:

- Schema helpers
- Parameter helpers
- Response helpers
- Path helpers
- Operation helpers

Helper functions modify `apispec.APISpec` methods. For example, path helpers modify `apispec.APISpec.path`.

The `init_spec` Method

`BasePlugin` has an `init_spec` method that `APISpec` calls on each plugin at initialization with the spec object itself as parameter. It is no-op by default, but a plugin may override it to access and store useful information on the spec object.

A typical use case is conditional code depending on the OpenAPI version, which is stored as `openapi_version` on the `spec` object. See source code for apispec.ext.marshmallow.MarshmallowPlugin for an example.

Next Steps

To learn more about how to write plugins:

- Consult the Core API docs for `BasePlugin`
- View the source for an existing apispec plugin, e.g. FlaskPlugin.
- Check out some projects using apispec: https://github.com/marshmallow-code/apispec/wiki/Ecosystem

```python
class CategorySchema(Schema):
    id = fields.Int()
    name = fields.Str(required=True)

class PetSchema(Schema):
    categories = fields.List(fields.Nested(CategorySchema))
    name = fields.Str()

@app.route("/random")
def random_pet():
    """A cute furry animal endpoint.
    ---
    get:
      description: Get a random pet
      responses:
        200:
          description: Return a pet
          content:
            application/json:
              schema: PetSchema
    """
    # Hardcoded example data
    pet_data = {
        "name": "sample_pet_" + str(uuid.uuid1()),
        "categories": [{"id": 1, "name": "sample_category"}],
    }
    return PetSchema().dump(pet_data)
```

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    }
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```

```yaml
info:
  title: Swagger Petstore
  version: 1.0.0
openapi: 3.0.2
components:
  schemas:
    Category:
      properties:
        id:
          format: int32
          type: integer
        name:
          type: string
      required:
      - name
      type: object
    Pet:
      properties:
        categories:
          items:
            $ref: '#/components/schemas/Category'
          type: array
        name:
          type: string
      type: object
paths:
  /random:
    get:
      description: Get a random pet
      responses:
        '200':
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/Pet'
          description: Return a pet
```

```
class FlaskPlugin(BasePlugin):
    """APISpec plugin for Flask"""

    ...

    def path_helper(self, operations, *, view, app=None, **kwargs):
        """Path helper that allows passing a Flask view function."""

        import pdb; pdb.set_trace()

        rule = self._rule_for_view(view, app=app)
        operations.update(yaml_utils.load_operations_from_docstring(view.__doc__))
        if hasattr(view, "view_class") and issubclass(view.view_class, MethodView):
            for method in view.methods:
                if method in rule.methods:
                    method_name = method.lower()
                    method = getattr(view.view_class, method_name)
                    operations[method_name] = yaml_utils.load_yaml_from_docstring(
                    )
        return self.flaskpath2openapi(rule.rule)
```

```python
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    """APISpec plugin for Flask"""

    ...

    def path_helper(self, operations, *, view, app=None, **kwargs):
        """Path helper that allows passing a Flask view function."""

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        rule = self._rule_for_view(view, app=app)
        operations.update(yaml_utils.load_operations_from_docstring(view.__doc__))
        if hasattr(view, "view_class") and issubclass(view.view_class, MethodView):
            for method in view.methods:
                if method in rule.methods:
                    method_name = method.lower()
                    method = getattr(view.view_class, method_name)
                    operations[method_name] = yaml_utils.load_yaml_from_docstring(
                    )
        return self.flaskpath2openapi(rule.rule)
```
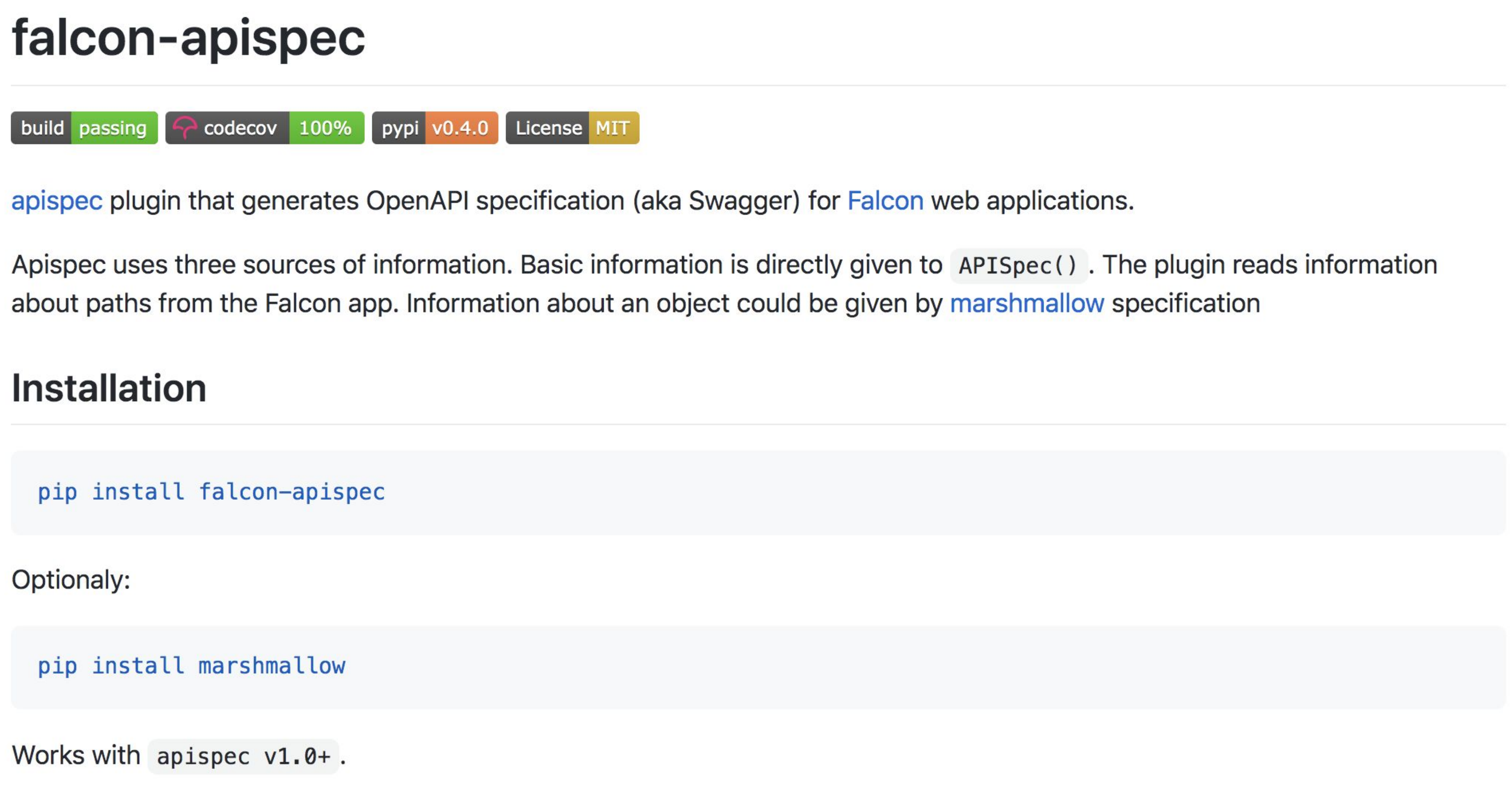

```python
app = falcon.API()

class RandomPetResource:
    def on_get(self, req, resp):
        """A cute furry animal endpoint.
        ---
        description: Get a random pet
        responses:
            200:
                description: A pet to be returned
                schema: PetSchema
        """
        pet = None
        resp.media = pet

random_pet_resource = RandomPetResource()
app.add_route("/random", random_pet_resource)
```



falcon-apispec

apispec plugin that generates OpenAPI specification (aka Swagger) for Falcon web applications.

Apispec uses three sources of information. Basic information is directly given to `APISpec()`. The plugin reads information about paths from the Falcon app. Information about an object could be given by marshmallow specification

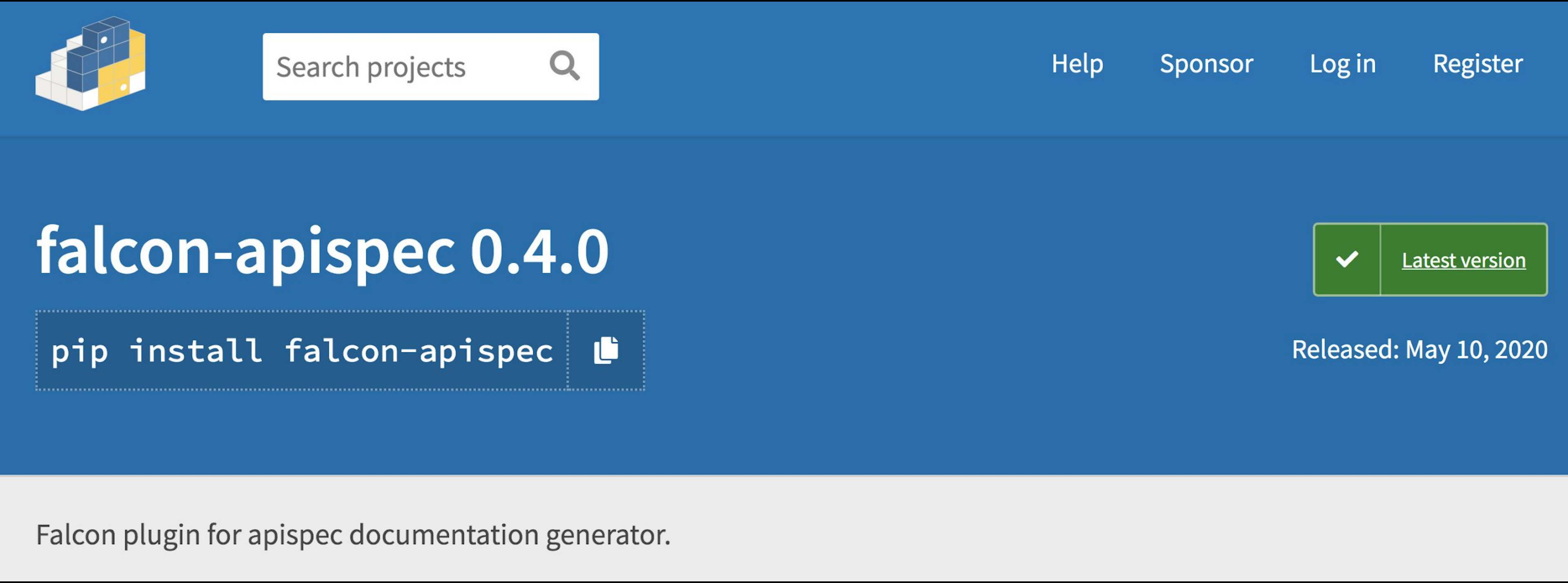
Installation

```
pip install falcon-apispec
```

Optionaly:

```
pip install marshmallow
```

Works with `apispec v1.0+`.



falcon-apispec 0.4.0

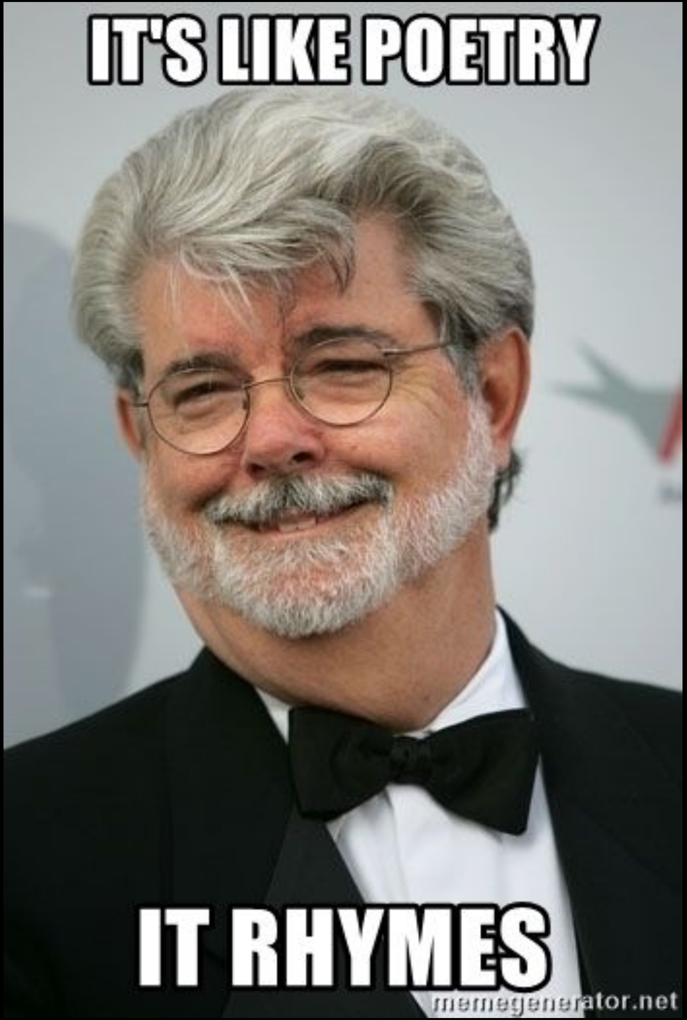
```
pip install falcon-apispec
```

Released: May 10, 2020

Falcon plugin for apispec documentation generator.

TANDEM
ARMY
GOLDEN KNIGHTS

I SEE
A PATTERN
imgflip.com


IT'S LIKE POETRY
IT RHYMES
memegenerator.net

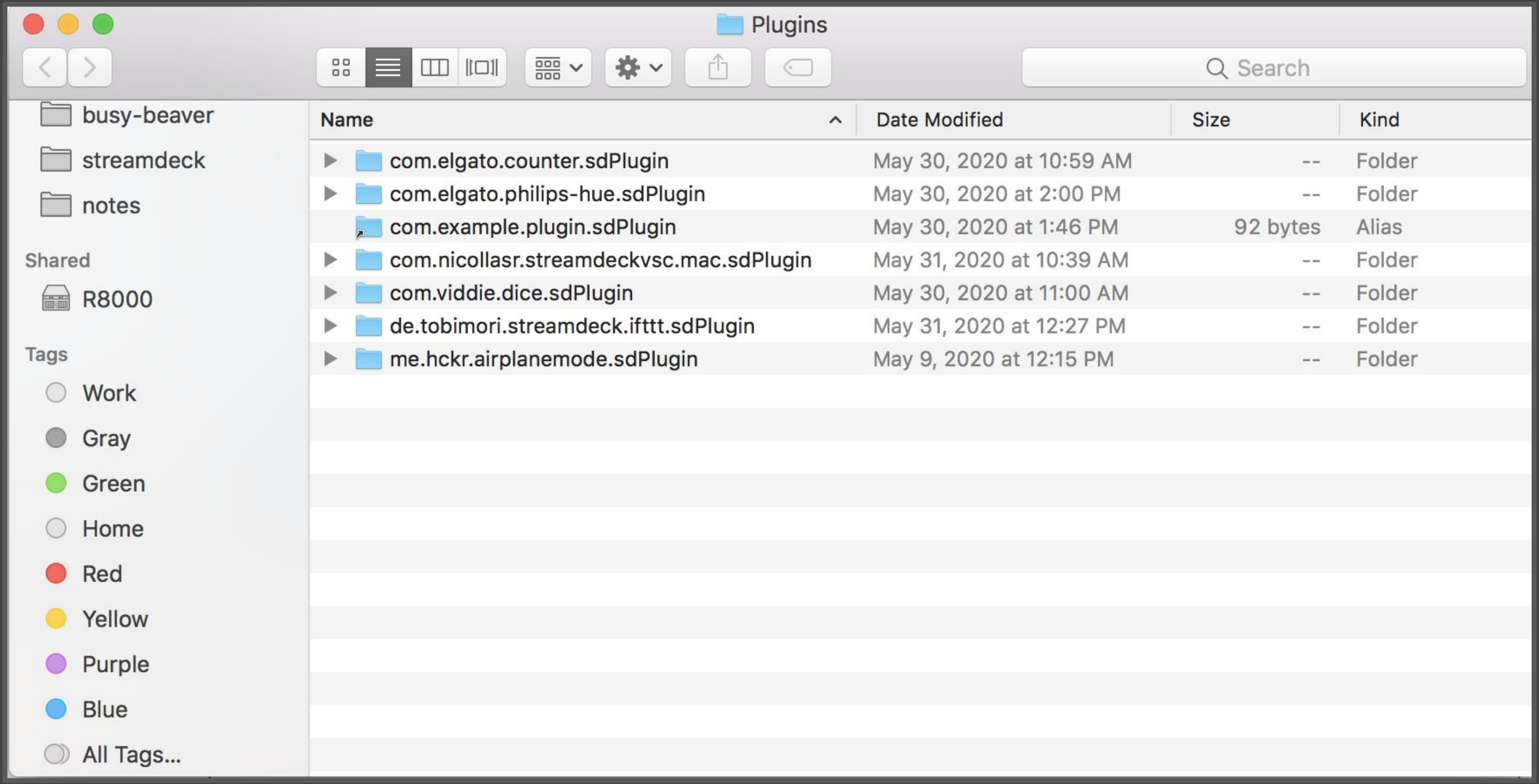
Anatomy of a Plugin System

Require host application

Communication channel between host and plugin

Register with the host application

Loaded dynamically at runtime



Name	Date Modified	Size	Kind
com.elgato.counter.sdPlugin	May 30, 2020 at 10:59 AM	--	Folder
com.elgato.philips-hue.sdPlugin	May 30, 2020 at 2:00 PM	--	Folder
com.example.plugin.sdPlugin	May 30, 2020 at 1:46 PM	92 bytes	Alias
com.nicollasr.streamdeckvsc.mac.sdPlugin	May 31, 2020 at 10:39 AM	--	Folder
com.viddie.dice.sdPlugin	May 30, 2020 at 11:00 AM	--	Folder
de.tobimori.streamdeck.ifttt.sdPlugin	May 31, 2020 at 12:27 PM	--	Folder
me.hckr.airplanemode.sdPlugin	May 9, 2020 at 12:15 PM	--	Folder

```python
MIDDLEWARE = [
    "django.middleware.security.SecurityMiddleware",
    "common.middleware.RequestUuidMiddleware",
    "django.contrib.sessions.middleware.SessionMiddleware",
    "django.middleware.common.CommonMiddleware",
    "django.middleware.csrf.CsrfViewMiddleware",
    "django.contrib.auth.middleware.AuthenticationMiddleware",
    "django.contrib.messages.middleware.MessageMiddleware",
    "django.middleware.clickjacking.XFrameOptionsMiddleware",
    "common.middleware.SuperuserCanViewDebugToolbarInProductionMiddleware",
]
```

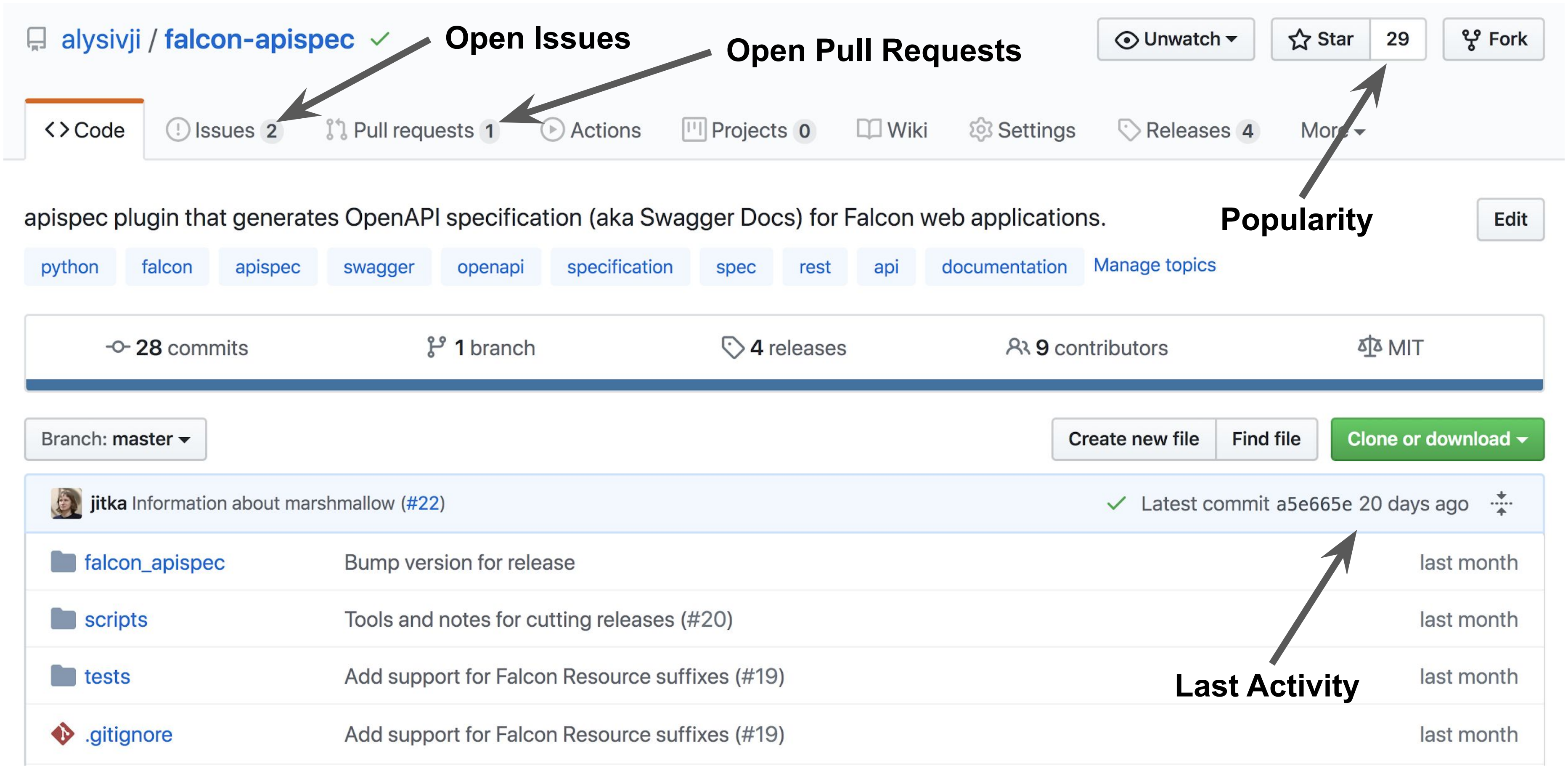
Respond when called by the host application

Designing a Plugin System

Plugin System Checklist

- ❑ Requires host application
- ❑ Communication channel between host and plugin
- ❑ Register with the host application
- ❑ Load plugins dynamically at runtime
- ❑ Respond when called upon by the host application

Case Study: **Git Stats**



alysivji / falcon-apispec

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apispec plugin that generates OpenAPI specification (aka Swagger Docs) for Falcon web applications.

Edit

python falcon apispec swagger openapi specification spec rest api documentation Manage topics

28 commits | 1 branch | 4 releases | 9 contributors | MIT

Branch: master | Create new file | Find file | Clone or download

jitka Information about marshmallow (#22) — Latest commit a5e665e 20 days ago

falcon_apispec	Bump version for release	last month
scripts	Tools and notes for cutting releases (#20)	last month
tests	Add support for Falcon Resource suffixes (#19)	last month
.gitignore	Add support for Falcon Resource suffixes (#19)	last month

```
$ python cli.py --help

usage: cli.py [-h] --url URL

Fetch statistics from Online Git Repo

optional arguments:
  -h, --help  show this help message and exit
  --url URL   URL to repository: https://addr..
```

```
$ python cli.py --url
https://github.com/alysivji/falcon-apispec
```

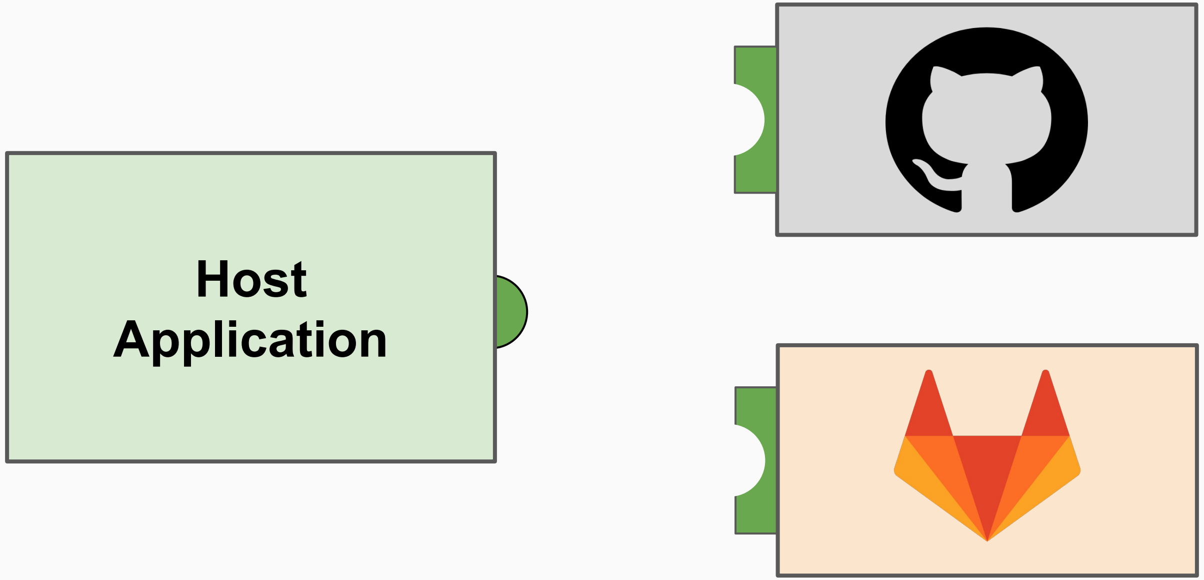
```
Description:          apispec plugin that generates
                      OpenAPI specification (aka
                      Swagger Docs) for Falcon web
                      applications.
Stars:                29
Forks:                14
Open Issues:          3
Last Activity:        2020-05-22 18:08:12+00:00
```

Git Stats MVP Requirements

- Support GitHub and GitLab upon release
  - Will have to eventually support BitBucket

- Identify provider given URL

- Use API to download statistics


Host Application

```python
class RepoDetails(NamedTuple):
    organization: str
    repo: str
```

```
>>> # https://github.com/alysivji/falcon-apispec
>>> project = RepoDetails("alysivji", "falcon-apispec")
>>> project
RepoDetails(organization='alysivji', repo='falcon-apispec')
```

```
class RepoStatistics(NamedTuple):
    id: int
    description: str
    stars: int
    forks: int
    open_issues: int
    last_activity: datetime
```

```
>>> stats = RepoStatistics(5723246, "apispec plugin for
Falcon", 29, 14, 3, yesterday)

>>> stats
RepoStatistics(id=5723246, description='apispec plugin for
Falcon', stars=29, forks=14, open_issues=3,
last_activity=datetime.datetime(2020, 6, 14, 10, 48, 1,
165391))
```

```python
url = "https://github.com/alysivji/falcon-apispec"
if "github.com" not in url.lower():
    raise ValueError("Not a valid GitHub url")

repo = url.lower().split("github.com/")[1]
project_url = f"https://api.github.com/repos/{repo}"
response = requests.get(project_url)

data = response.json()
result = RepoStatistics(
    id=data["id"],
    description=data["description"],
    stars=data["stargazers_count"],
    forks=data["forks"],
    open_issues=data["open_issues"],
    last_activity=data["pushed_at"],
)

print(result)
```

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```

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```

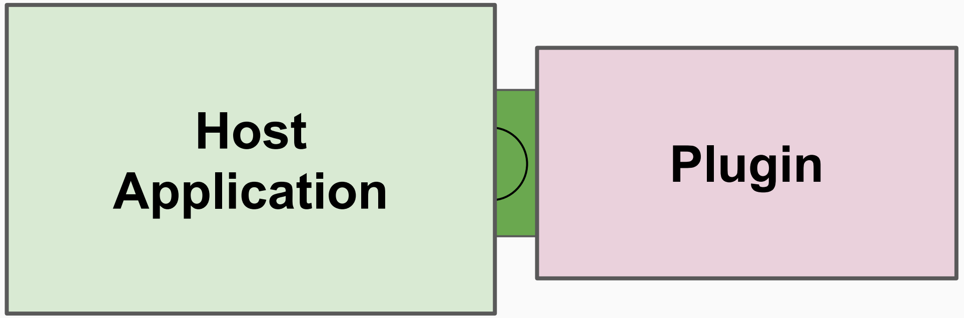
Host
Application
Plugin

```python
class BasePlugin:
```

```python
class BasePlugin:
    def __init__(self, repo):
        self.repo = repo

    def __repr__(self):
        return f"<{self.__class__.__name__}>"
```

```python
class BasePlugin:
    def __init__(self, repo):
        self.repo = repo

    def __repr__(self):
        return f"<{self.__class__.__name__}>"

    @staticmethod
    def check(domain) -> bool:
        raise NotImplementedError
```

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class BasePlugin:
    def __init__(self, repo):
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    def __repr__(self):
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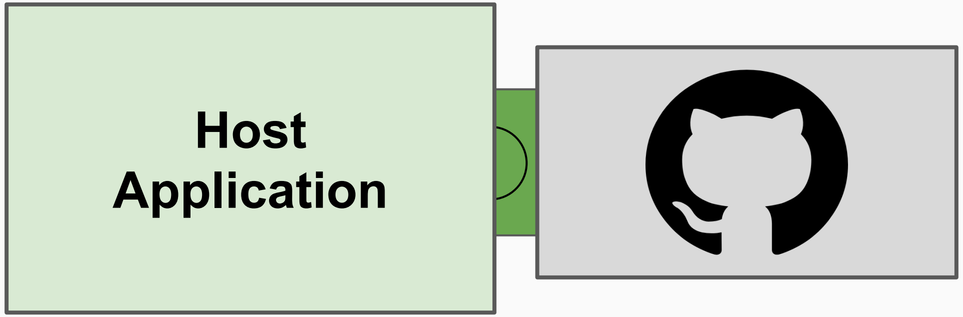
    def check(domain) -> bool:
        raise NotImplementedError

    def repo_stats(self) -> RepoStatistics:
        raise NotImplementedError
```


Host
Application

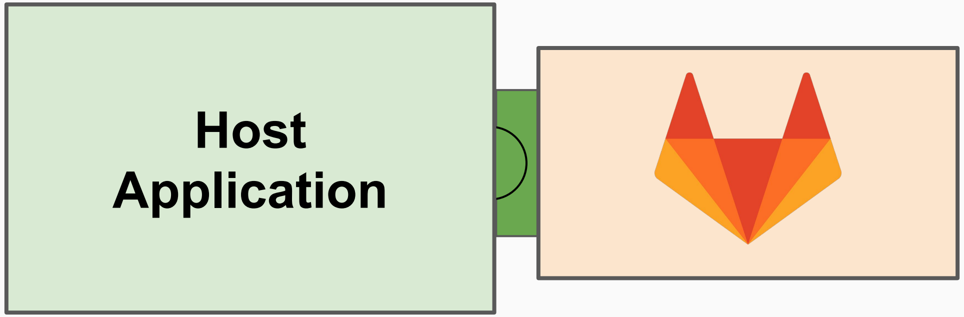
```python
class GitHubPlugin(BasePlugin):
```

```python
class GitHubPlugin(BasePlugin):
    @staticmethod
    def check(domain):
        return domain.lower() == "github.com"
```

```python
class GitHubPlugin(BasePlugin):
    @staticmethod
    def check(domain):
        return domain.lower() == "github.com"

    def repo_stats(self) -> RepoStatistics:
        project_url = f"https://api.github.com/repos/{self.repo}"
        response = requests.get(project_url)
        data = response.json()

        return RepoStatistics(
            id=data["id"],
            description=data["description"],
            stars=data["stargazers_count"],
            forks=data["forks"],
            open_issues=data["open_issues"],
            last_activity=data["pushed_at"],
        )
```


Host
Application

```python
class GitLabPlugin(BasePlugin):
```

```python
class GitLabPlugin(BasePlugin):
    @staticmethod
    def check(domain):
        return domain.lower() == "gitlab.com"
```

```python
class GitLabPlugin(BasePlugin):
    @staticmethod
    def check(domain):
        return domain.lower() == "gitlab.com"

    def repo_stats(self) -> RepoStatistics:
        encoded_repo = quote_plus(self.repo)
        project_url = f"https://gitlab.com/api/v4/projects/{encoded_repo}"
        response = requests.get(project_url)
        data = response.json()

        return RepoStatistics(
            id=data["id"],
            description=data["description"],
            stars=data["star_count"],
            forks=data["forks_count"],
            open_issues=None,
            last_activity=data["last_activity_at"],
        )
```

Host
Application

```
plugins = [GitHubPlugin, GitLabPlugin]
```

```python
plugins = [GitHubPlugin, GitLabPlugin]

class GitApiClient:
```

```python
plugins = [GitHubPlugin, GitLabPlugin]

class GitApiClient:
    def __init__(self, url):
        domain, self.repo = self._parse_url(url)
```

```python
plugins = [GitHubPlugin, GitLabPlugin]

class GitApiClient:
    def __init__(self, url):
        domain, self.repo = self._parse_url(url)







    def _parse_url(self, url):
        url_parts = urlparse(url)
        parts = url_parts.path.split("/")
        return url_parts.netloc, RepoDetails(parts[1], parts[2])
```

```python
plugins = [GitHubPlugin, GitLabPlugin]

class GitApiClient:
    def __init__(self, url):
        domain, self.repo = self._parse_url(url)
        for plugin in plugins:
            if plugin.check(domain):
                self.plugin = plugin(self.repo)
                return
        else:
            raise ValueError(f"{domain} not supported")

    def _parse_url(self, url):
        url_parts = urlparse(url)
        parts = url_parts.path.split("/")
        return url_parts.netloc, RepoDetails(parts[1], parts[2])
```

```python
plugins = [GitHubPlugin, GitLabPlugin]

class GitApiClient:
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    def _parse_url(self, url):
        url_parts = urlparse(url)
        parts = url_parts.path.split("/")
        return url_parts.netloc, RepoDetails(parts[1], parts[2])

    def get_stats(self) -> RepoStatistics:
        return self.plugin.repo_stats()
```
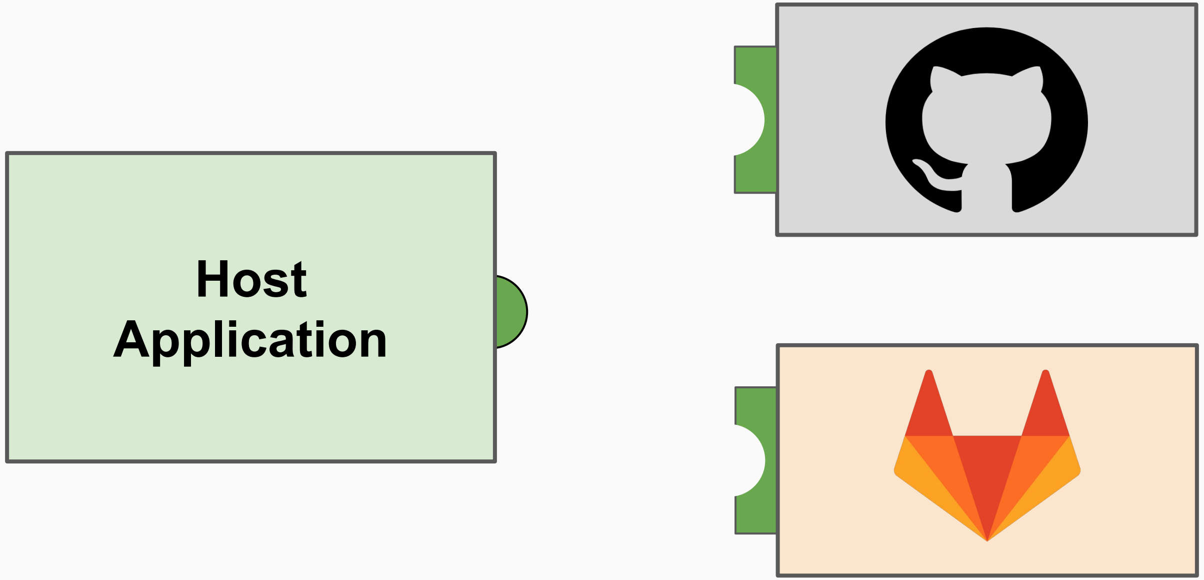
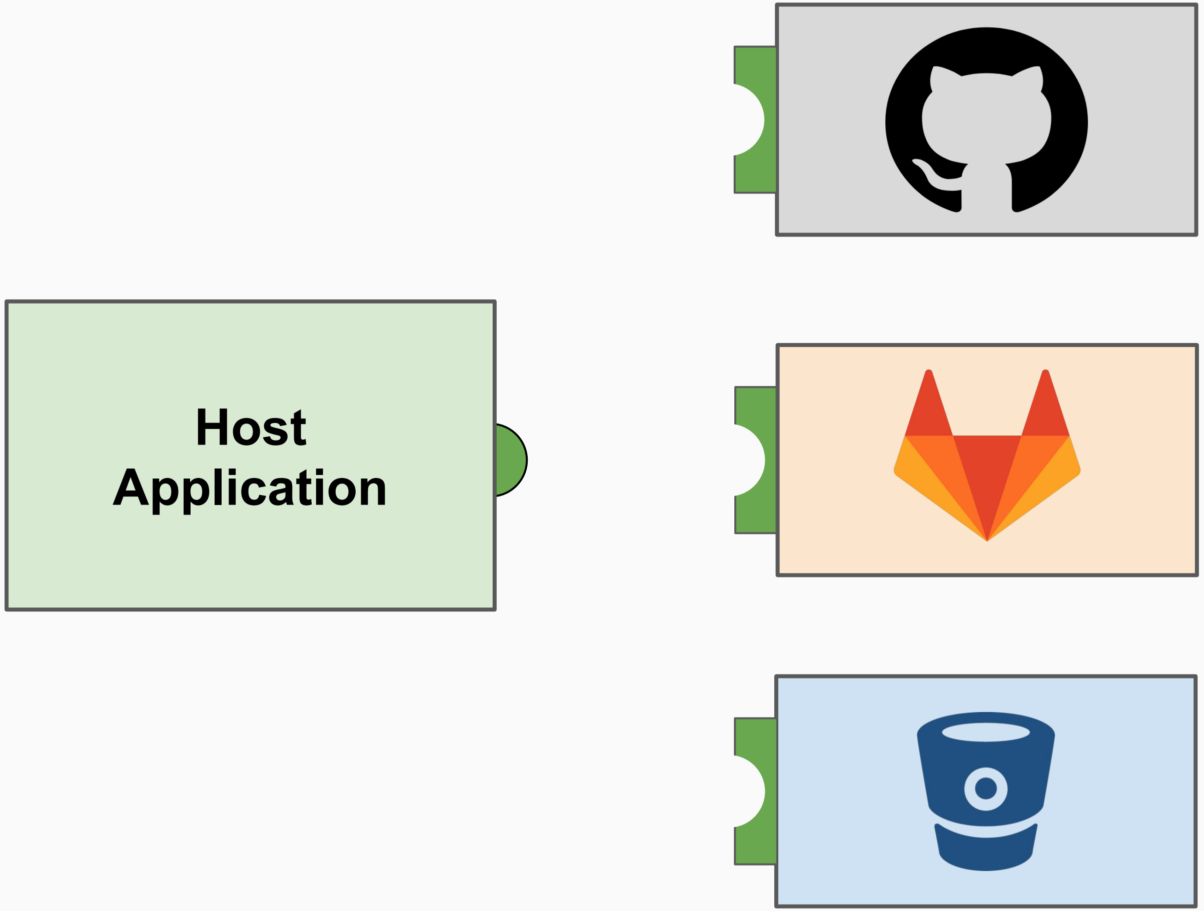

```python
url = "https://github.com/alysivji/falcon-apispec"
client = GitApiClient(url)

stats = client.get_stats()
print(stats)
```

Description:	apispec plugin that generates OpenAPI specification (aka Swagger Docs) for Falcon web applications.
Stars:	29
Forks:	14
Open Issues:	3
Last Activity:	2020-05-22 18:08:12+00:00


Host
Application


Host Application

```python
class BitBucketPlugin(BasePlugin):
    @staticmethod
    def check(domain):
        return domain.lower() == "bitbucket.org"

    def repo_stats(self) -> RepoStatistics:
        project_url = f"https://api.bitbucket.org/2.0/repositories/{self.repo}"
        response = requests.get(project_url)
        data = response.json()

        return RepoStatistics(
            id=data["uuid"],
            description=data["description"],
            stars=None,
            forks=None,
            open_issues=None,
            last_activity=parse_dt(data["updated_on"]),
        )
```

```python
plugins = [GitHubPlugin, GitLabPlugin, BitBucketPlugin]

class GitApiClient:
    def __init__(self, url):
        domain, self.repo = self._parse_url(url)
        for plugin in plugins:
            if plugin.check(domain):
                self.plugin = plugin(self.repo)
                return
        else:
            raise ValueError(f"{domain} not supported")

    def _parse_url(self, url):
        url_parts = urlparse(url)
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Recall: Plugin System Checklist

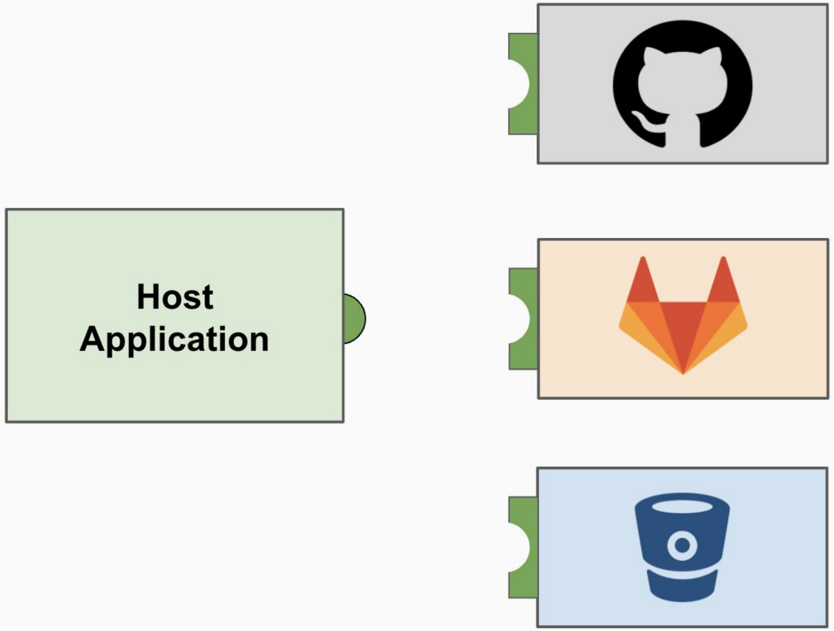
- ❏ Requires host application
- ❏ Communication channel between host and plugin
- ❏ Register with the host application
- ❏ Load plugins dynamically at runtime
- ❏ Respond when called upon by the host application

Plugin System Checklist

- ❑ Requires host application

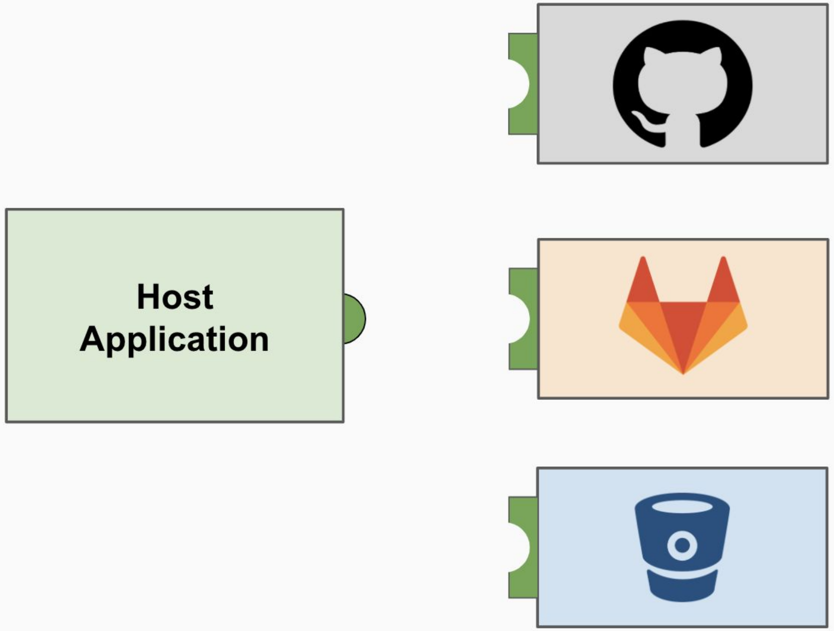
Plugin System Checklist

❑ Requires host application



Plugin System Checklist

✓ Requires host application



Plugin System Checklist

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Plugin System Checklist

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Plugin System Checklist

❑ Respond when called upon by the host application

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Plugin System Checklist

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```

Plugin System Checklist

- ✓ Requires host application
- ✓ Communication channel between host and plugin
- ✓ Register with the host application
- ✓ Load plugins dynamically at runtime
- ✓ Respond when called upon by the host application

Plugin System Checklist

- ✓ Requires host a[illegible]on
- ✓ Communicati[illegible] ch[illegible] between ho[illegible]d plugin
- ✓ Load plugi[illegible]nam[illegible]all[illegible]at r[illegible]e
- ✓ Reg[illegible]th the h[illegible]st [illegible]cati[illegible]
- ✓ Resp[illegible]nd[illegible]h[illegible]he host application

Plugin Systems in the Wild

django

Extending Django...

- Custom Model Fields
- Custom Lookups
- Custom Storage System
- Custom Cache Backend
- Custom Tags and Templates
- Custom Management Commands
- Custom Auth
- Custom User Model
- Writing Your Own Middleware
- Django Signals
  - READ THIS FIRST

Writing Reusable Applications

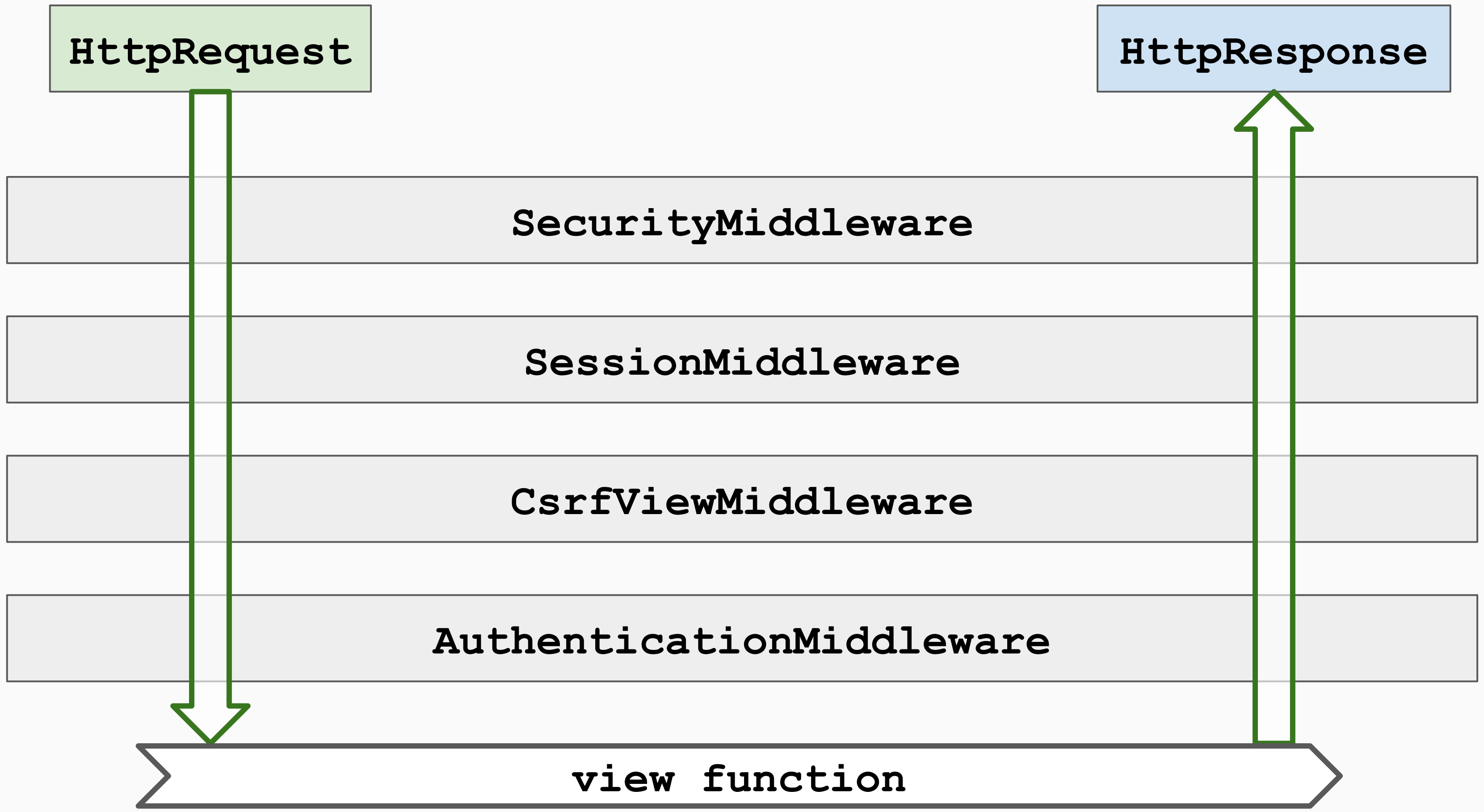
django storages

django REST framework

Writing Custom Middleware -- Django

Middleware is a framework of hooks into Django’s **request/response processing**.

```
MIDDLEWARE = [
    "django.middleware.security.SecurityMiddleware",
    "django.contrib.sessions.middleware.SessionMiddleware",
    "django.middleware.csrf.CsrfViewMiddleware",
    "django.contrib.auth.middleware.AuthenticationMiddleware",
]
```


HttpRequest
HttpResponse
SecurityMiddleware
SessionMiddleware
CsrfViewMiddleware
AuthenticationMiddleware
view function

```python
class SimpleMiddleware:
    def __init__(self, get_response):
        self.get_response = get_response
        # One-time configuration and initialization.

    def __call__(self, request):
        # Code to be executed for each request before
        # the view (and later middleware) are called.

        response = self.get_response(request)

        # Code to be executed for each request/response after
        # the view is called.

        return response
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```python
class RequestUuidMiddleware:
    """Add uuid to each request"""
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```

```python
class RequestUuidMiddleware:
    """Add uuid to each request"""

    def __init__(self, get_response):
        self.get_response = get_response

    def __call__(self, request):
        request_id = request.headers.get("X-Request-ID")
        if not request_id:
            request_id = str(uuid.uuid4())
```

```python
class RequestUuidMiddleware:
    """Add uuid to each request"""

    def __init__(self, get_response):
        self.get_response = get_response

    def __call__(self, request):
        request_id = request.headers.get("X-Request-ID")
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        if not request_id:
            request_id = str(uuid.uuid4())
        request.request_id = request_id
        response = self.get_response(request)
        return response
```

```
MIDDLEWARE = [
    "django.middleware.security.SecurityMiddleware",
    "common.middleware.RequestUuidMiddleware",
    "django.contrib.sessions.middleware.SessionMiddleware",
    "django.middleware.csrf.CsrfViewMiddleware",
    "django.contrib.auth.middleware.AuthenticationMiddleware",
]
```

```python
class TestRequestUuidMiddleware:
    def test_request_has_uuid(self, client):
        response = client.get("/healthcheck")
        request = response.wsgi_request
        assert getattr(request, "request_id") is not None

    def test_request_does_not_have_guid_field(self, client):
        response = client.get("/healthcheck")
        request = response.wsgi_request
        with pytest.raises(AttributeError):
            getattr(request, "request_guid")

    def test_request_has_request_id_header(self, client):
        headers = {"HTTP_X-Request-ID": "abc"}
        response = client.get("/healthcheck/", **headers)
        request = response.wsgi_request
        assert request.request_id == "abc"
```

Flask

Extending Flask...

- Custom Commands
- Flask Extensions
- Modular Applications with Blueprints
- Custom Middleware

Writing Custom Middleware -- Flask

WSGI middleware to wrap your Flask instances and **introduce changes** at the layer between your Flask application and your HTTP server.

```python
class RequestUuidMiddleware:
    """Add uuid to each request"""
```

```python
class RequestUuidMiddleware:
    """Add uuid to each request"""

    def __init__(self, app):
        self.app = app
```

```python
class RequestUuidMiddleware:
    """Add uuid to each request"""

    def __init__(self, app):
        self.app = app

    def __call__(self, environ, start_response):
```

```python
from werkzeug.wrappers import Request

class RequestUuidMiddleware:
    """Add uuid to each request"""

    def __init__(self, app):
        self.app = app

    def __call__(self, environ, start_response):
        request = Request(environ)
```

```python
from werkzeug.wrappers import Request

class RequestUuidMiddleware:
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    """Add uuid to each request"""

    def __init__(self, app):
        self.app = app

    def __call__(self, environ, start_response):
        request = Request(environ)
        request_id = request.headers.get("X-Request-ID")
        if not request_id:
            request_id = str(uuid.uuid4())
        environ["request_id"] = request_id
        return self.app(environ, start_response)
```

```python
from flask import Flask
from middleware import RequestUuidMiddleware

app = Flask(__name__)
app.wsgi_app = RequestUuidMiddleware(app.wsgi_app)
```

```python
@pytest.fixture(scope="session")
def app():
    app = Flask(__name__)
    app.wsgi_app = RequestUuidMiddleware(app.wsgi_app)

    @app.route('/')
    def hello_world():
        return request.environ.get("request_id")

    ctx = app.app_context()
    ctx.push()
    yield app

    ctx.pop()

@pytest.fixture(scope="session")
def client(app):
    client = app.test_client()
    yield client

def test_middleware(client):
    result = client.get("/")
    assert len(result.data) > 0

def test_middleware_with_request_id(client):
    result = client.get("/", headers={"X-Request-ID": "abc"})
    assert result.data == b"abc"
```

pytest

Extending pytest...

- Pytest Fixtures
- Hooks

pytest Fixture Model

pytest Fixture Model

- Test fixtures set up the test environment and return it to its original state

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- Fixtures are functions pytest runs before and after tests
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- Can inject fixtures into test function as input arguments
  - Searches current module then **`conftest.py`**

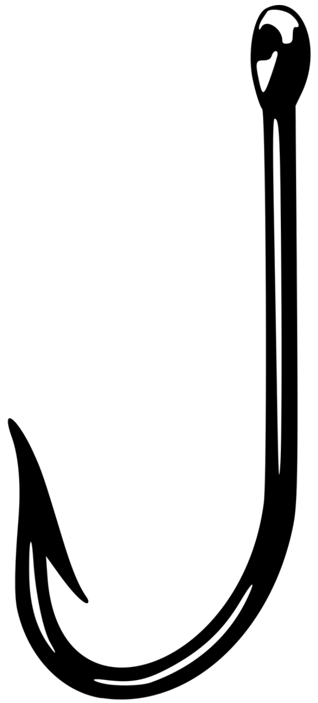
pytest Fixture Model

- Test fixtures set up the test environment and return it to its original state
- Fixtures are functions pytest runs before and after tests
  - Decorated with `@pytest.fixture`
- Can inject fixtures into test function as input arguments
  - Searches current module then `conftest.py`
- Fixture Use Cases
  - Setting up database to preconfigured state; cleaning up after tests are run
  - Monkeypatching external dependency with a known value for duration of test
  - Adding Function Arguments to pytest Fixtures aka Factories as Fixtures

```python
from my_project.app import create_app

@pytest.fixture(scope="module")
def app():
    """Session-wide test `Flask` application.

    Establish an application context before running the tests.
    """
    app = create_app(testing=True)
    ctx = app.app_context()
    ctx.push()

    yield app

    ctx.pop()

@pytest.fixture(scope="module")
def client(app):
    """Create Flask test client where we can trigger test requests to app"""
    client = app.test_client()
    yield client
```

```python
def test_ping_event(client, create_headers, subscription_payload):
    data = subscription_payload()
    headers = create_headers(data, event="ping", is_json_data=True)

    response = client.post(
      "/github/event-subscription",
      headers=headers,
      json=data
    )

    assert response.status_code == 200
```

pytest Hooks



Hook-based Plugins

- Hooks identify points where application can be extended
  - Developers need to think about this when designing their plugin system

Hook-based Plugins

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Hook-based Plugins

- Hooks identify points where application can be extended
    - Developers need to think about this when designing their plugin system

- When the host program loads, the enabled plugins are registered for the hooks they care about

- When hook is triggered, all functions registered for a hook get notified

pytest
pytest

Writing a pytest Hook Plugin

Writing a pytest Hook Plugin

- Figure out what you want to build

Writing a pytest Hook Plugin

- Figure out what you want to build
- Find hook we can use to implement desired behavior

pytest Hooks: Role Call

Bootstrapping Hooks

`pytest_load_initial_conftests`
`pytest_cmdline_parse`
`pytest_cmdline_main`

Initialization Hooks

`pytest_addoption`
`pytest_addhooks`
`pytest_configure`
`pytest_unconfigure`
`pytest_sessionstart`
`pytest_sessionfinish`
`pytest_plugin_registered`

pytest Hooks: Role Call

Test Running Hooks

pytest_runtestloop
pytest_runtest_protocol
pytest_runtest_logstart
pytest_runtest_setup
pytest_runtest_call
pytest_runtest_teardown
pytest_runtest_makereport
pytest_pyfunc_call

Collection Hooks

pytest_collection
pytest_addhooks
pytest_collect_directory
pytest_collect_file
pytest_pycollect_makemodule
pytest_pycollect_makeitem
pytest_generate_tests
pytest_make_parametrize_id
pytest_collection_modifyitems
pytest_collection_finish

pytest Hooks: Role Call

Reporting Hooks

`pytest_collectstart`
`pytest_make_collect_report`
`pytest_itemcollected`
`pytest_collectreport`
`pytest_deselected`
`pytest_report_header`
`pytest_report_collectionfinish`
`pytest_report_teststatus`
`pytest_terminal_summary`
`pytest_fixture_post_finalizer`
`pytest_fixture_setup`
`pytest_warning_captured`
`pytest_runtest_logreport`
`pytest_assertrepr_compare`
`pytest_assertion_pass`

pytest Hooks: Role Call

Debugging / Interaction hooks

`pytest_internalerror`
`pytest_keyboard_interrupt`
`pytest_exception_interact`
`pytest_enter_pdb`

TODO make picture

```python
def pytest_addoption(parser):
    parser.addoption(
        "--fast",
        action="store_true",
        default=False,
        help="Exclude tests marked as slow",
    )
```

```python
def pytest_addoption(parser):
    parser.addoption(
        "--fast",
        action="store_true",
        default=False,
        help="Exclude tests marked as slow",
    )


def pytest_collection_modifyitems(items, config):
    """Deselect tests marked as slow if --fast is set."""

    if config.option.fast is False:
        return

    selected_items = []
    deselected_items = []

    for item in items:
        if item.get_closest_marker("slow"):
            deselected_items.append(item)
        else:
            selected_items.append(item)

    config.hook.pytest_deselected(items=deselected_items)
    items[:] = selected_items
```

```
❯ pytest
========================= test session starts ==========================
platform darwin -- Python 3.8.1, pytest-5.4.2, py-1.8.1, pluggy-0.13.1
rootdir: ~/third-party-plugins/pytest-plugins, inifile: pytest.ini
collected 2 items

tests/test_main.py ..                                            [100%]

========================== 2 passed in 1.02s ===========================
```

```
if config.option.fast is False:
    return

selected_items = []
deselected_items = []

for item in items:
    if item.get_closest_marker("slow"):
        deselected_items.append(item)
    else:
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config.hook.pytest_deselected(items=deselected_items)
items[:] = selected_items
```

```
❯ pytest
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platform darwin -- Python 3.8.1, pytest-5.4.2, py-1.8.1, pluggy-0.13.1
rootdir: ~/third-party-plugins/pytest-plugins, inifile: pytest.ini
collected 2 items

tests/test_main.py ..                                            [100%]

========================== 2 passed in 1.02s ===========================
```
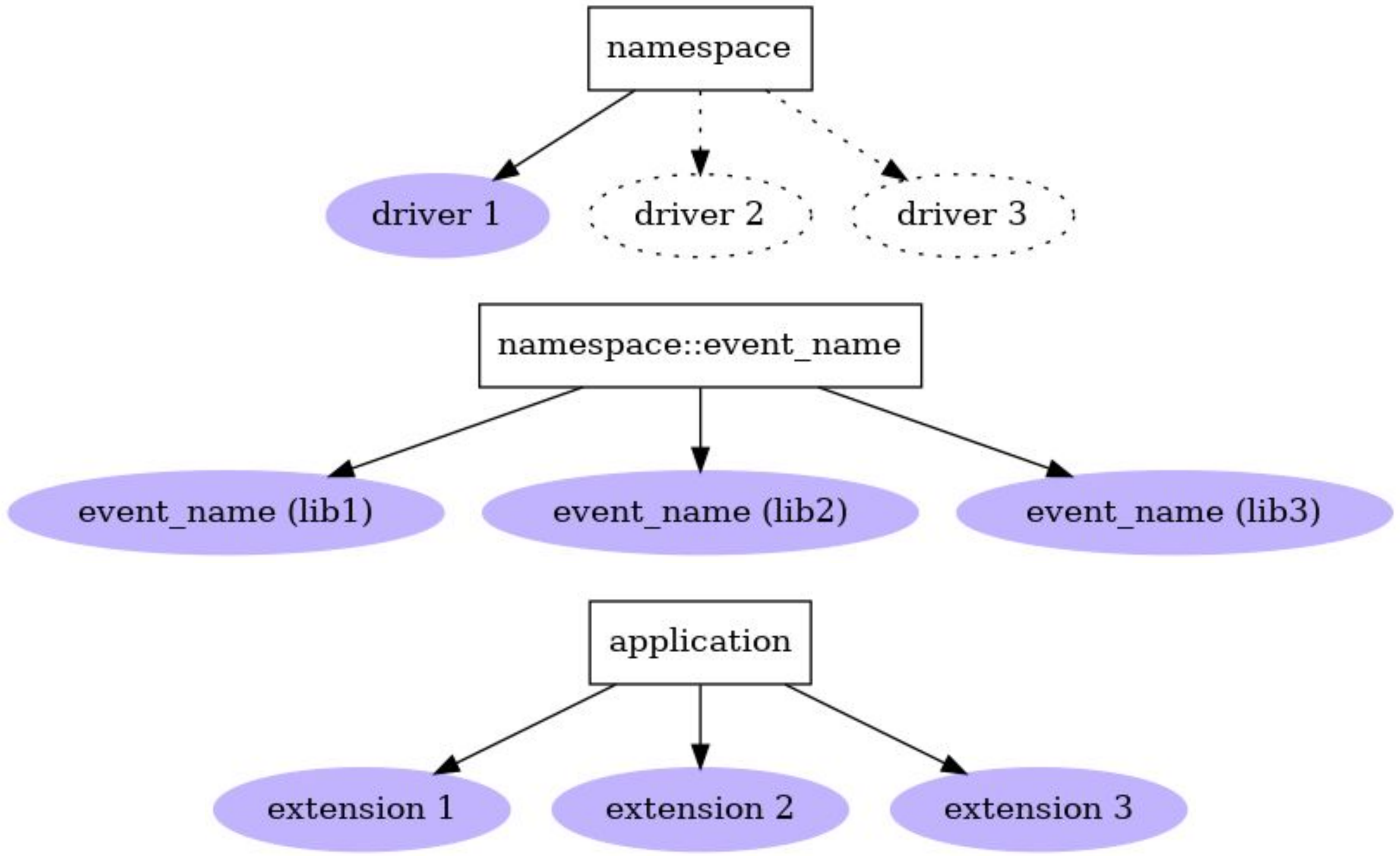
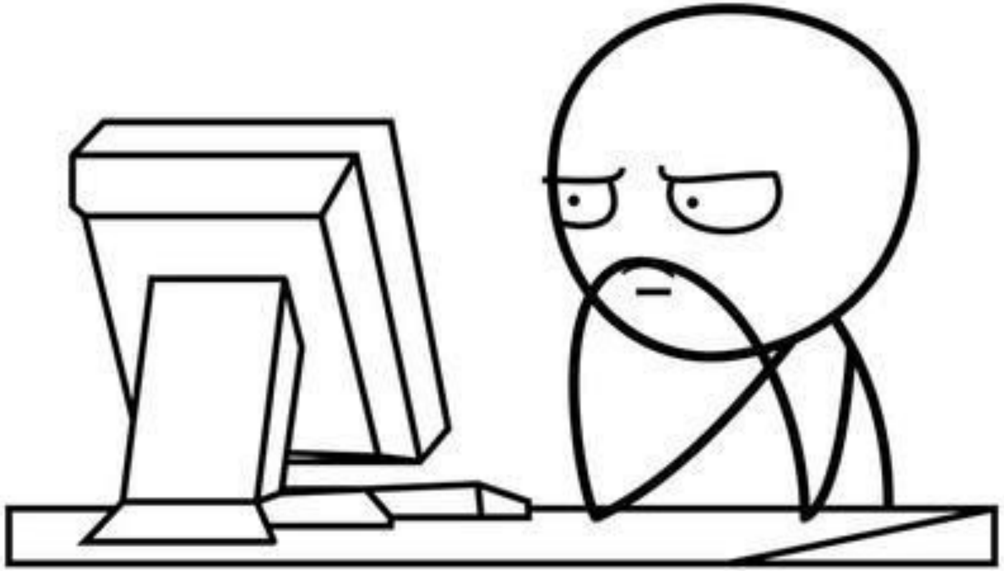

```
                 if config.option.fast is False:
                    return
```

```
❯ pytest --fast
========================= test session starts ==========================
platform darwin -- Python 3.8.1, pytest-5.4.2, py-1.8.1, pluggy-0.13.1
rootdir: ~/third-party-plugins/pytest-plugins, inifile: pytest.ini
collected 2 items / 1 deselected / 1 selected

tests/test_main.py .                                             [100%]

=================== 1 passed, 1 deselected in 0.01s ====================
```


namespace
driver 1
driver 2
driver 3
namespace::event_name
event_name (lib1)
event_name (lib2)
event_name (lib3)
application
extension 1
extension 2
extension 3

Writing Your Next Plugin



Is there a plugin system?

READ
THE DOCS

Find and copy existing plugins

Sandbox Development Environment

Add breakpoints to host application code

Add logging

CONFORMITY

Sometimes it's just easier not to fit in.

motifake.com

Testing Plugins -- Integration Tests

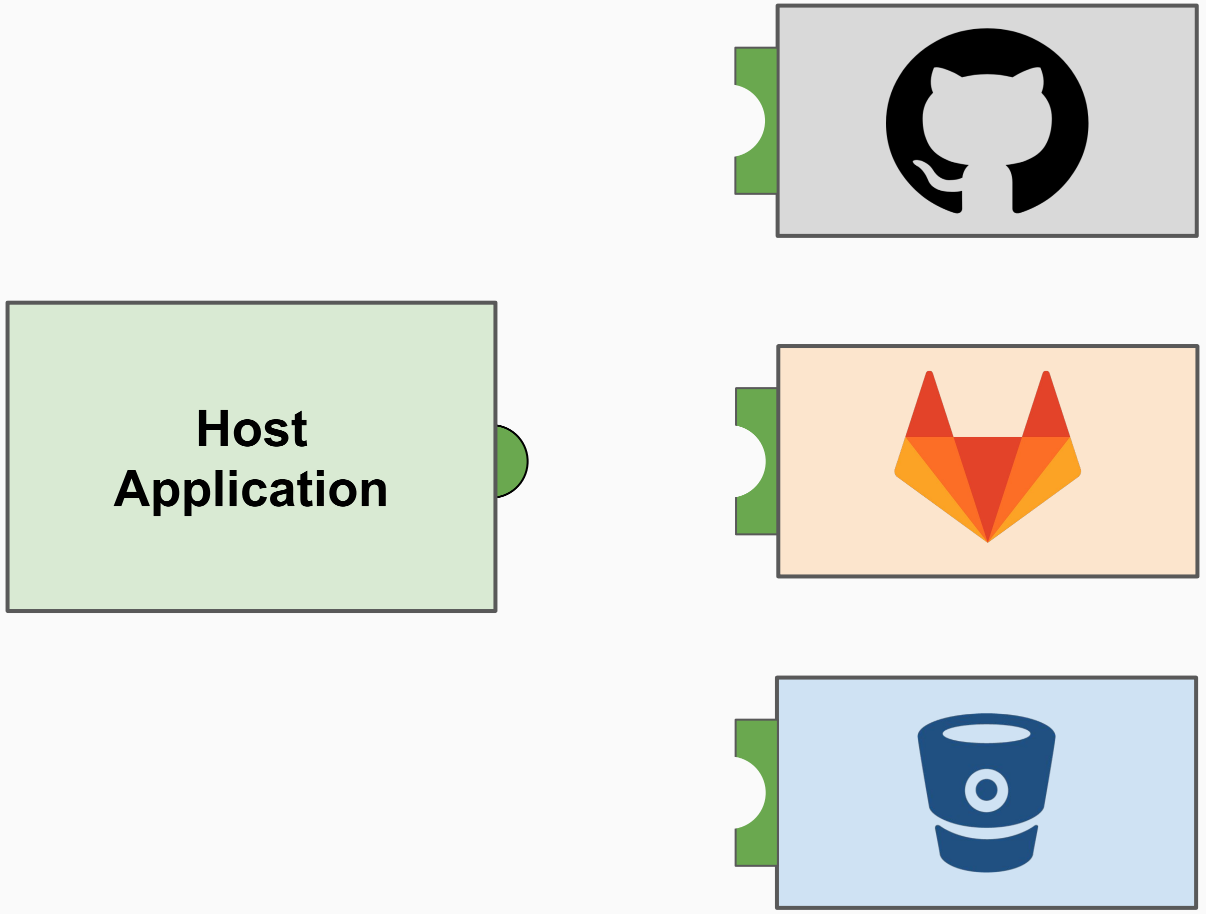
Testing Plugins -- Testing Matrix

Let’s Recap!

Plugins are software components that **extend or enhance** an existing program

Plugin System Checklist

- ❑ Requires host application
- ❑ Communication channel between host and plugin
- ❑ Register with the host application
- ❑ Load plugins dynamically at runtime
- ❑ Respond when called upon by the host application


Host Application

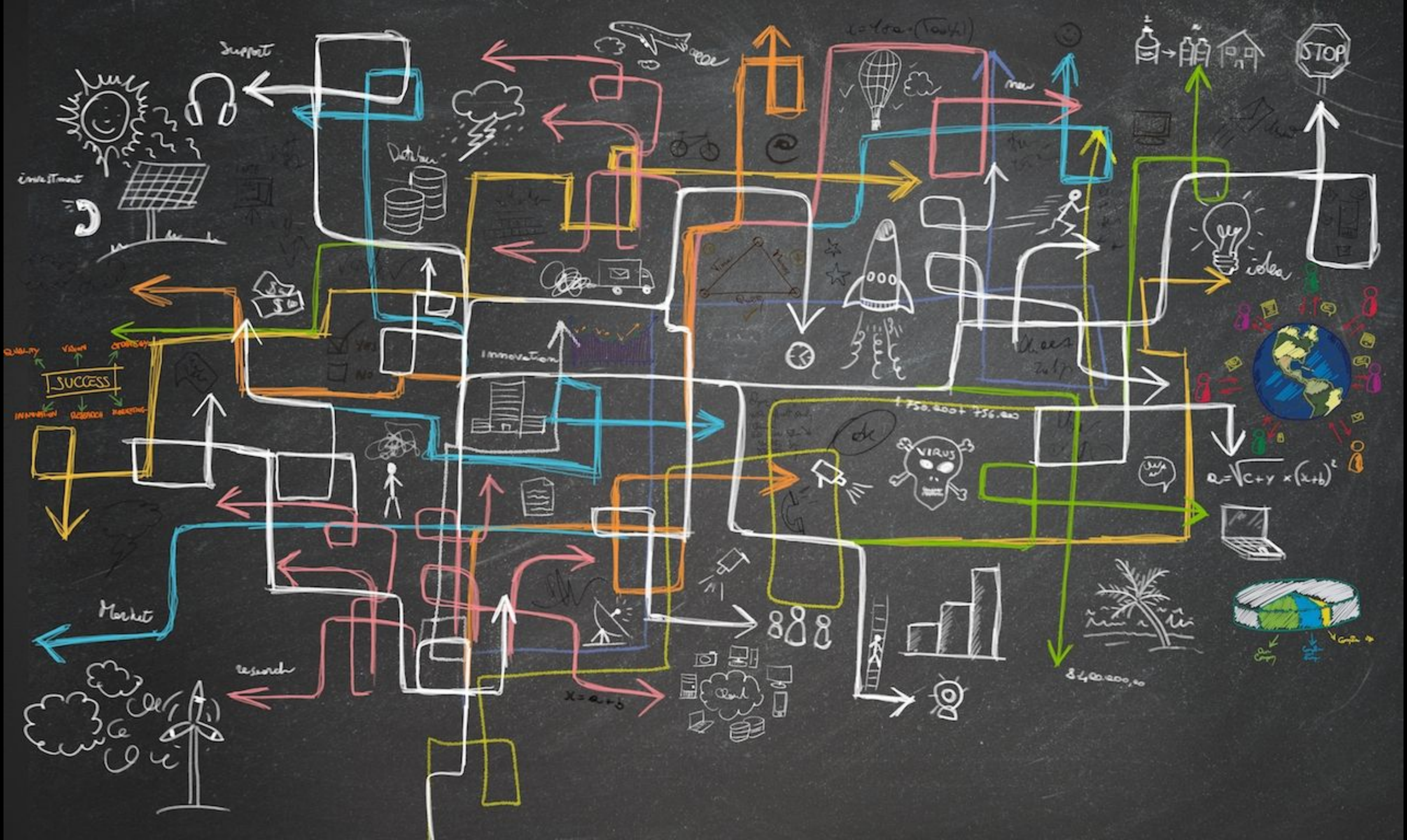
django

Flask

pytest

Tips for writing your next plugin

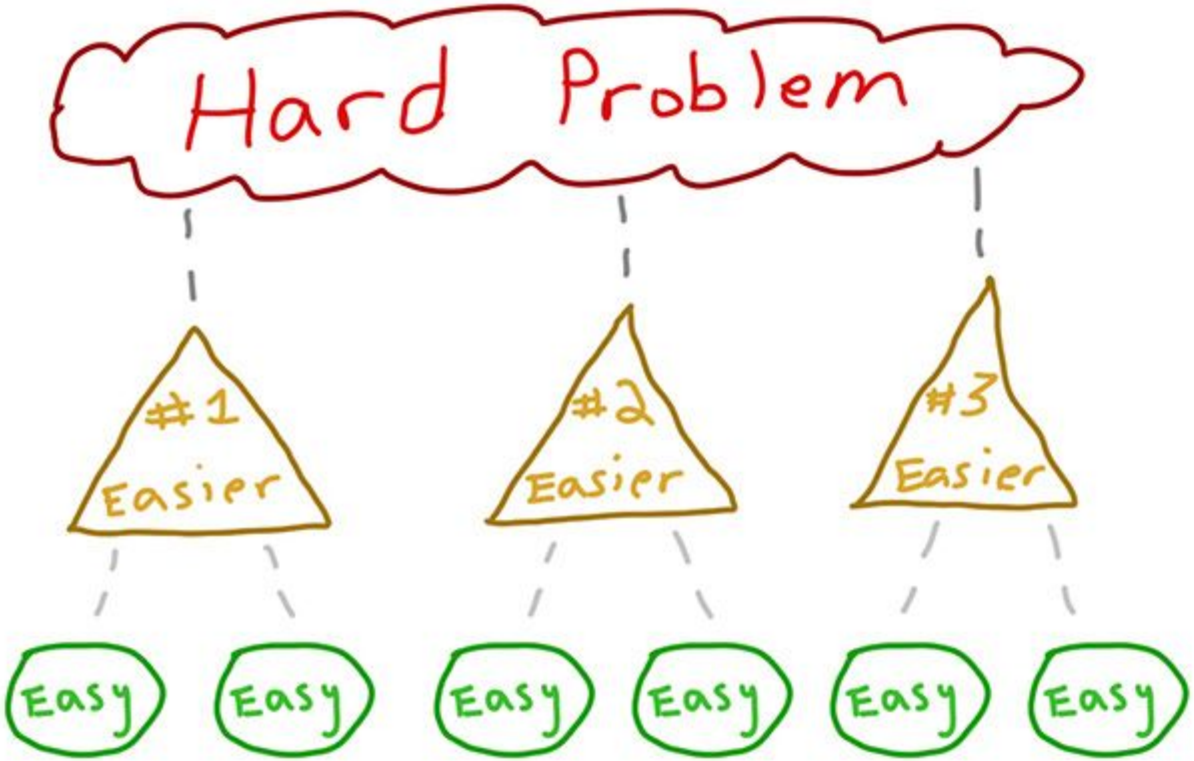
- Read the documentation
- Find and copy existing plugins
- Create a Sandbox Development Environment
- Add breakpoints in host application codebase
- Add logging
- Test using integration test
- Test all versions you plan to support


Support
investment
Database
STOP
idea
new
Innovation
QUALITY
VISION
STRATEGY
SUCCESS
INNOVATION
RESEARCH
MARKETING
YES
NO
VIRUS
1.750.000 + 756.000
Q = √C+Y × (x+b)²
Market
research
x = a + b
$400.000,00

STOP

TAKE A STEP BACK

Breathe


Hard Problem
#1 Easier
#2 Easier
#3 Easier
Easy
Easy
Easy
Easy
Easy
Easy

YOU GOT THIS
quickmeme.com

Resources -- Videos

- Darlene Wong: How to Write Pytest Plugins
- Doug Hellman: Extending Your Applications with Plugins
- Floris Bruynooghe: The hook-based plugin architecture of py.test
- Raphael Pierzina: Advanced pytest
- Rose Judge: Plug-in to Python
- Sandi Metz: Go Ahead, Make a Mess

Resources -- Websites / Blogs

- Django Docs: Index
- Flask Docs: Extension Development
- pluggy: the pytest plugin system
- pytest Docs: Writing plugins
- Omar Elgabry: Plug-in Architecture
- Stevedore Documentation

Resources -- Books

- Freeman, Eric & Robson, Elizabeth. (2004). Head First Design Patterns: A Brain-Friendly Guide. 1st ed. Sebastopol, CA: O’Reilly Media

- “Gang of Four”. (1994). Design Patterns: Elements of Reusable Object-Oriented Software. 1st ed. Boston, MA: Addison-Wesley Professional

Thank You

Github: alysivji/talks

Twitter: @CaiusSivjus

Blog: https://alysivji.github.io

Slides: https://bit.ly/write-a-plugin

Acknowledgements (Easter Egg)

- ChiPy

- AS, ES, CF, CL, TD, LG, SI, JO, RB, AS

Thank You

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Appendix

Slides below here do not fit into current form of presentation.

@CaiusSivjus

Plugin Development Tip #1

Sandbox Development Environment

Extending pytest...

Fixtures

Hooks

Extending pytest...

Fixtures

- reusable test code
- operate within test functions

Hooks

Extending pytest...

Fixtures

- reusable test code
- operate within test functions

Hooks

- customize how pytest works
- add new functionality to pytest

Ending

Like everything else in programming, once we deconstruct the problem into smaller chunks, we can reason about implementation details clearly.

We assume things are more difficult than they appear. This is especially true for problems we have not seen before.

Key Notes

- there are design patterns (strategy) we can use, but they all follow the same theme
- Aside: Design Patterns provide a blueprint
  - The design we built uses the strategy pattern
  - Strategy pattern
- break down concepts to primary parts of Object Oriented Programming
  - Design patterns make sense when you think of underlying components
- Abstract Base Classes make sense, but it’s beyond the scope of this talk
  - If you do make a plugin system, use ABCs