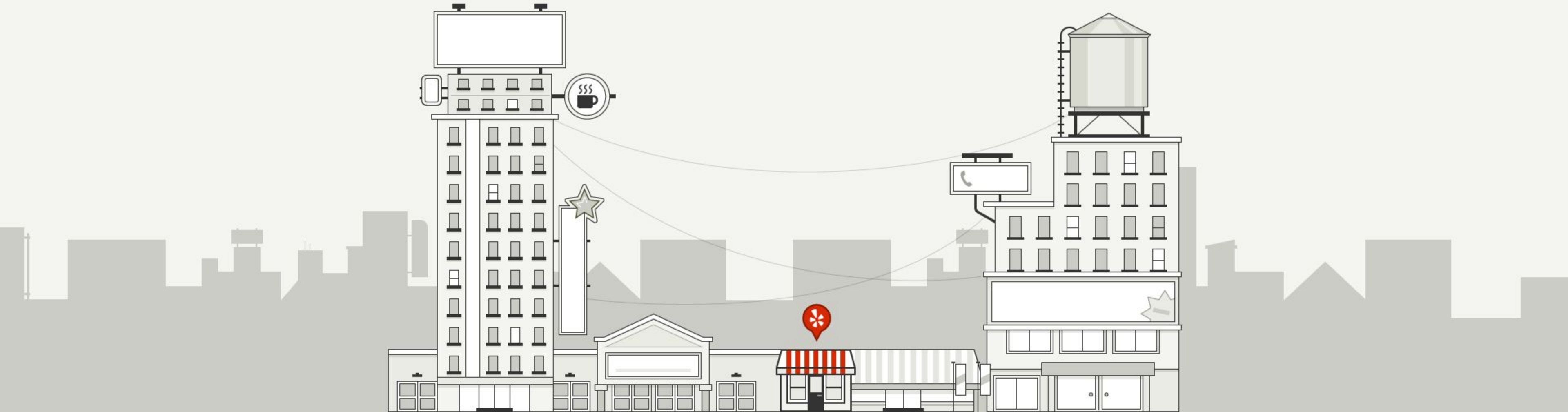
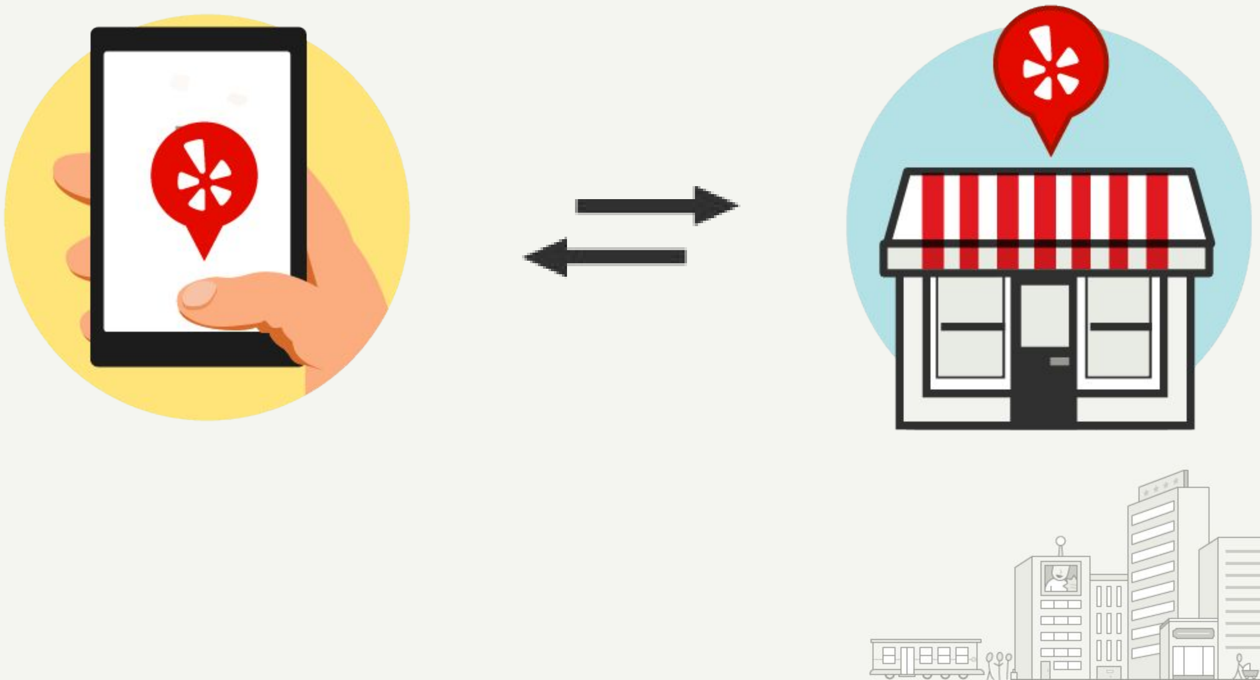
Using Swagger to tame HTTP/JSON interfaces

John Billings
billings@yelp.com



Yelp's Mission:

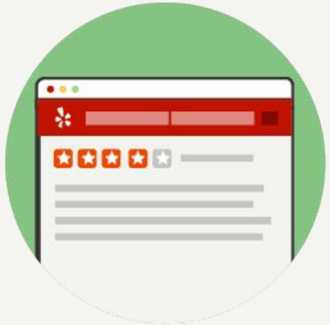
Connecting people with great local businesses.



Yelp Stats:

As of Q3 2015

89M



90M

71%

32

HTTP/JSON is amazing!

HAProxy

requests

Apache

curl

NGINX

simplejson

Varnish

jq

Pyramid

httplib

Dropwizard

http://wallakitty.deviantart.com/art/Unicorn-attack-519106761

yelp

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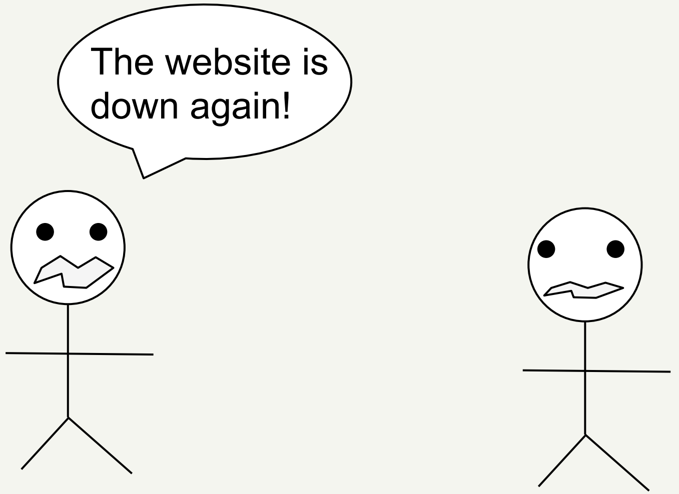
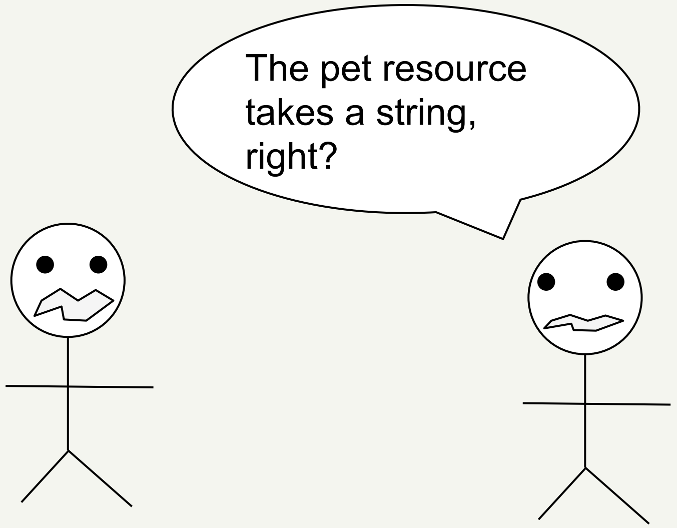
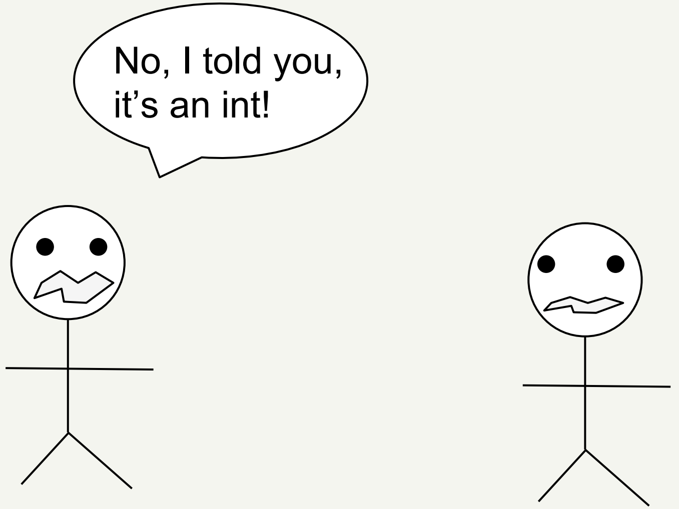
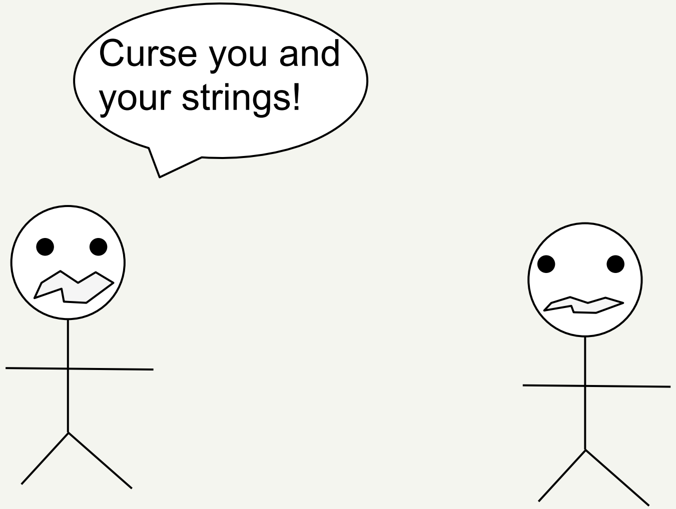
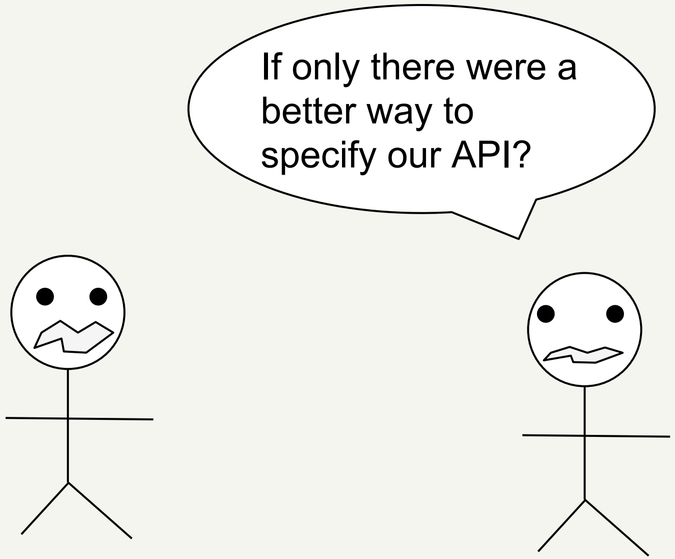

The website is down again!

%&*#! I just pushed the petstore service!

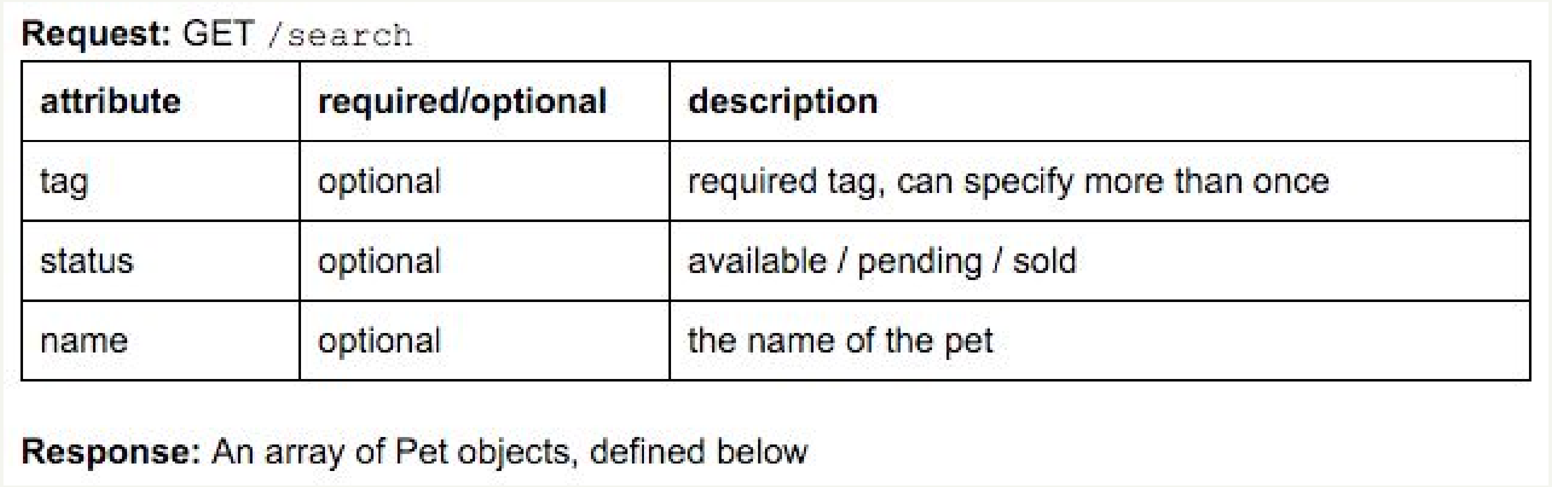

The pet resource takes a string, right?


No, I told you, it's an int!


Curse you and your strings!


If only there were a better way to specify our API?

Option 1: Write spec docs



Request: GET `/search`

attribute	required/optional	description
tag	optional	required tag, can specify more than once
status	optional	available / pending / sold
name	optional	the name of the pet

Response: An array of Pet objects, defined below

Option 1: Write spec docs

✓ It’s easy to get started
✓ People can comment if you use e.g. gdocs
✓ Approachable by non-technical individuals

✗ Implementation and spec can drift over time
✗ It’s easy to be imprecise

Option 2: Switch to Thrift / Protocol Buffers / Avro / …

```
namespace java ns
namespace py ns

typedef i32 int
service MultiplicationService
{
  int multiply(1:int n1, 2:int n2),
}
```

Option 2: Switch to Thrift / Protocol Buffers / Avro / …

✓ More efficient on the wire
✓ More efficient to decode than JSON

✗ Cannot use L7 technologies such as HTTP caching
✗ Difficult to debug on the wire
✗ Variable quality of support across languages?

Option 3: Write lots of integration tests

The tests become the de facto spec

“As a client, if I send this request to the service, then I should get back this response.”

Option 3: Write lots of integration tests

✓ You should already have (some) of these tests

✗ Final testing phase; slow to correct bugs at this stage
✗ Integration tests take a (relatively) long time to run
✗ Overall, probably only want to have a few of these?

Option 4: Write client libraries

The client library API becomes the spec for consumers

Option 4: Write client libraries

✓ Consumers don’t need to worry about wire protocol
✓ We’ve used this approach at Yelp, and it can work

✗ Lots of boilerplate
✗ Manual validation
✗ No spec for the wire protocol
✗ Still need integration tests from clientlib / service ifc

Or…

- Stick with our existing HTTP/JSON infrastructure
- Invent a machine-readable specification language to declaratively specify endpoints and return types
- Create tooling to generate client libs from specs
- Create tooling to perform server-side validation against endpoint specifications
- Create a vibrant open source community :)

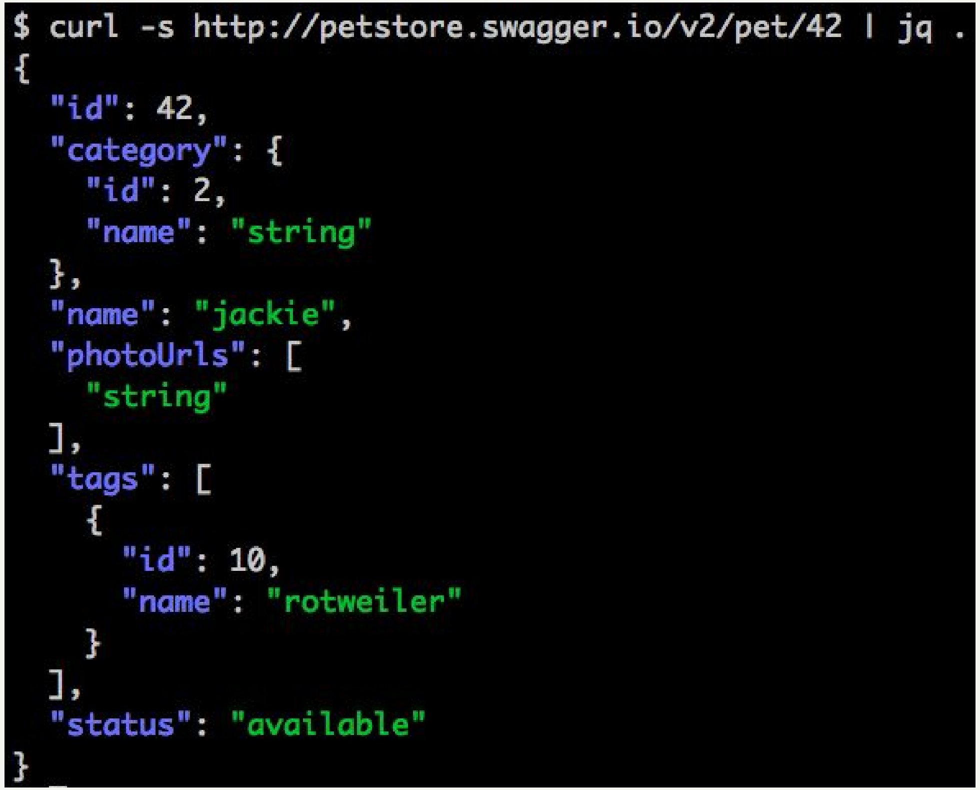
http://swagger.io/specification

A brief history of Swagger

- 2011-08-10 Version 1
- 2012-08-22 Version 1.1
- 2014-03-14 Version 1.2
  - Formal swagger specification document
- 2014-09-08 Version 2
  - Combine Resource Listings and API Declarations
- 2016-01-01 OpenAPI Specification
  - Supported by Google, Microsoft, IBM and others

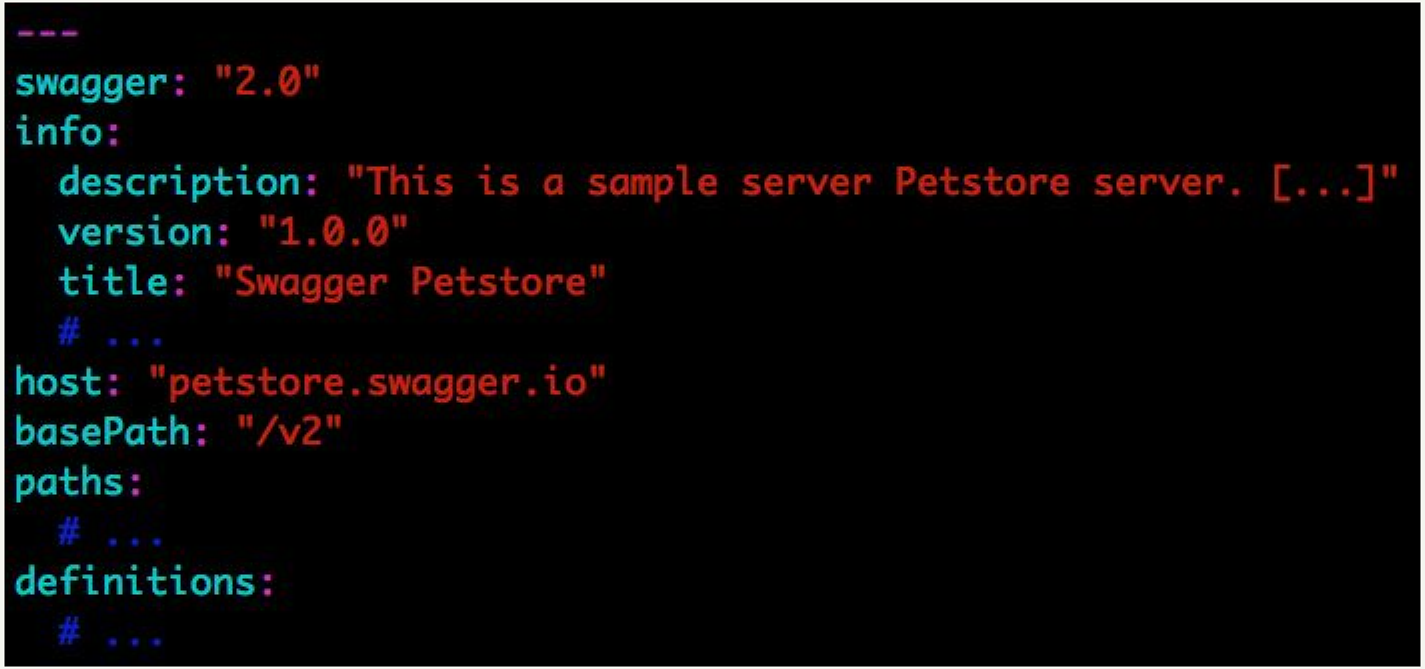
Petstore

Try this out!



```
$ curl -s http://petstore.swagger.io/v2/pet/42 | jq .
{
  "id": 42,
  "category": {
    "id": 2,
    "name": "string"
  },
  "name": "jackie",
  "photoUrls": [
    "string"
  ],
  "tags": [
    {
      "id": 10,
      "name": "rotweiler"
    }
  ],
  "status": "available"
}
```

Top-level Swagger spec



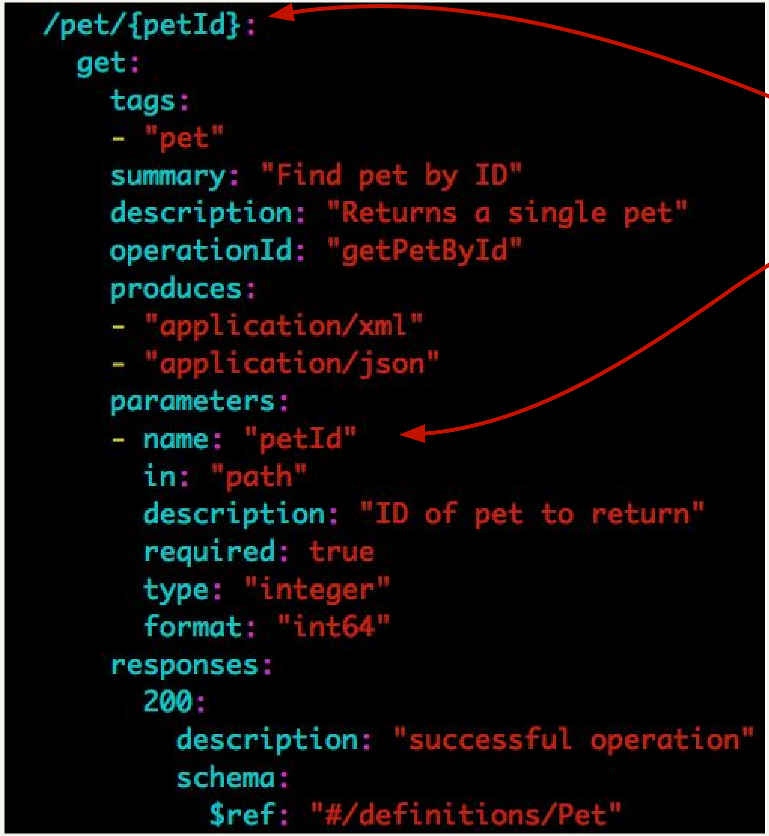
```
---
swagger: "2.0"
info:
  description: "This is a sample server Petstore server. [...]"
  version: "1.0.0"
  title: "Swagger Petstore"
  # ...
host: "petstore.swagger.io"
basePath: "/v2"
paths:
  # ...
definitions:
  # ...
```

Path objects

Definition objects

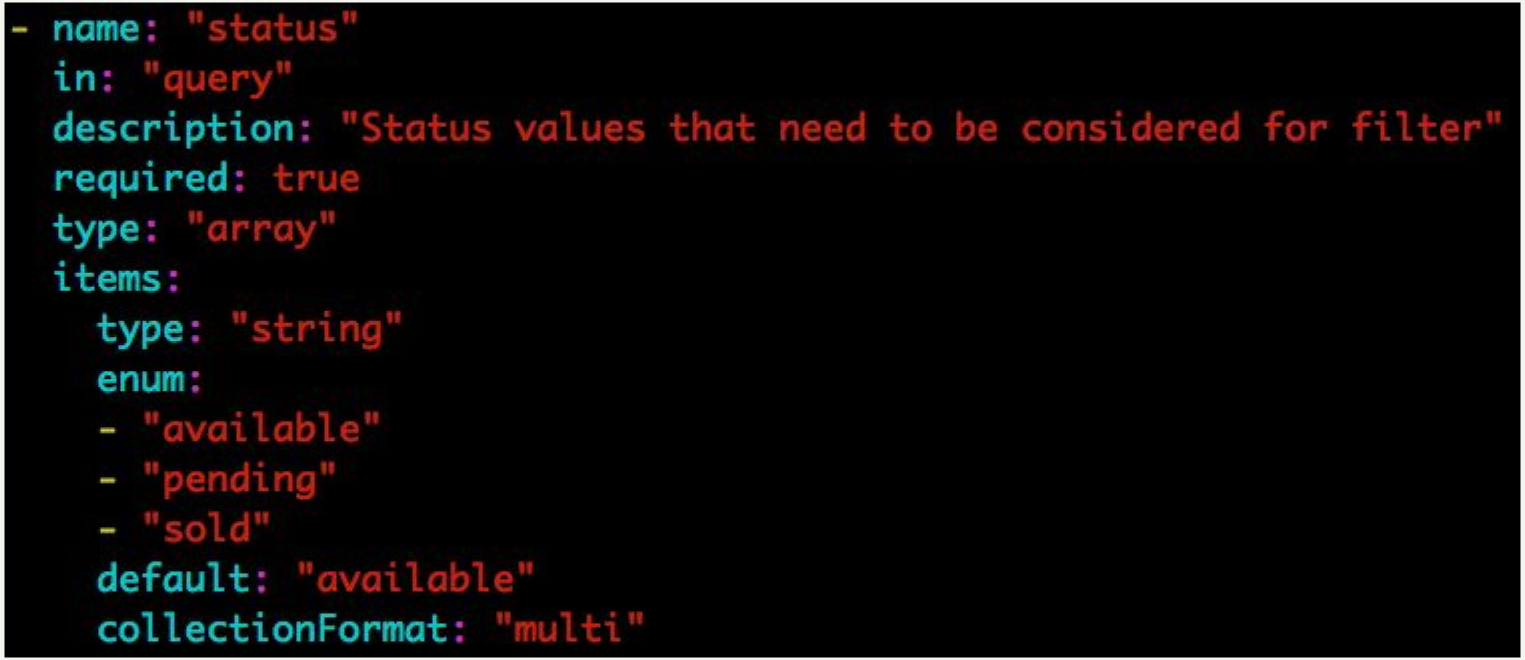
http://petstore.swagger.io/v2/swagger.yaml

Paths object



```
/pet/{petId}:
  get:
    tags:
    - "pet"
    summary: "Find pet by ID"
    description: "Returns a single pet"
    operationId: "getPetById"
    produces:
    - "application/xml"
    - "application/json"
    parameters:
    - name: "petId"
      in: "path"
      description: "ID of pet to return"
      required: true
      type: "integer"
      format: "int64"
    responses:
      200:
        description: "successful operation"
        schema:
          $ref: "#/definitions/Pet"
```

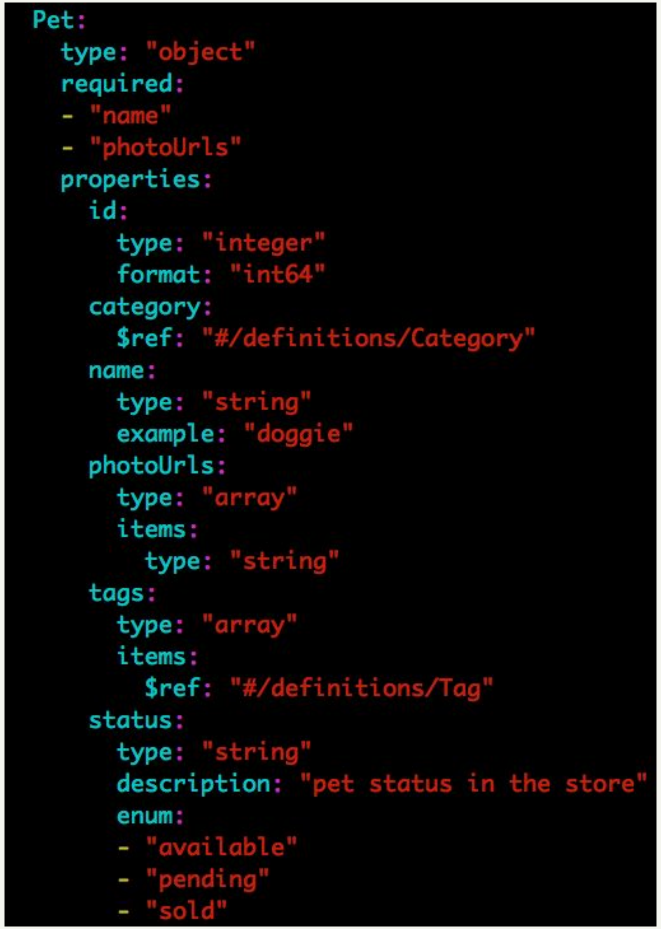
Another parameter object



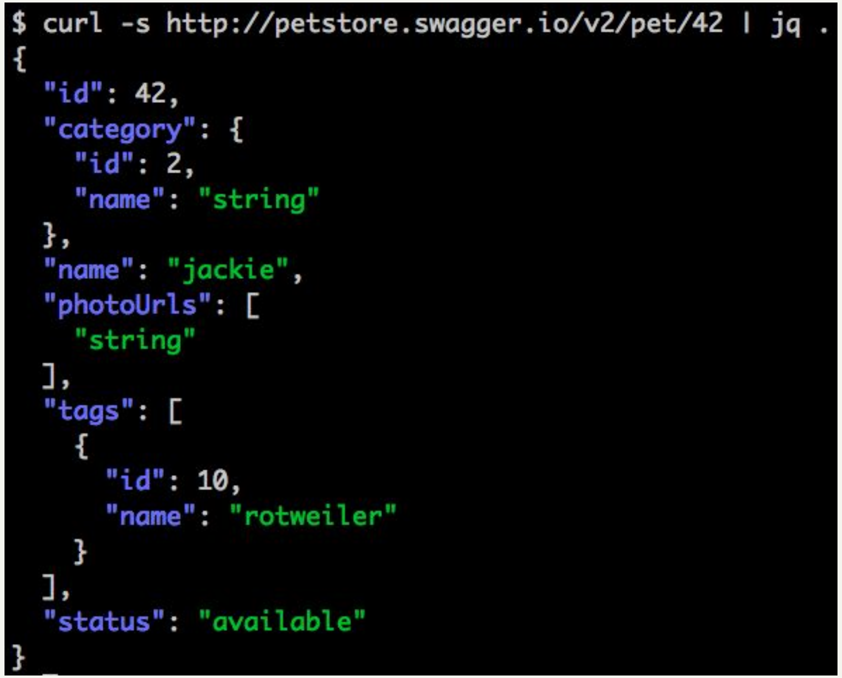
```
- name: "status"
  in: "query"
  description: "Status values that need to be considered for filter"
  required: true
  type: "array"
  items:
    type: "string"
    enum:
    - "available"
    - "pending"
    - "sold"
    default: "available"
    collectionFormat: "multi"
```

Used for `/pet/findByStatus` endpoint

Definition object



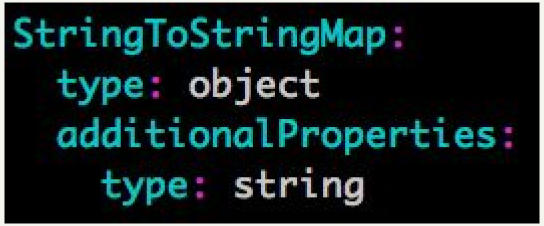
```yaml
Pet:
  type: "object"
  required:
  - "name"
  - "photoUrls"
  properties:
    id:
      type: "integer"
      format: "int64"
    category:
      $ref: "#/definitions/Category"
    name:
      type: "string"
      example: "doggie"
    photoUrls:
      type: "array"
      items:
        type: "string"
    tags:
      type: "array"
      items:
        $ref: "#/definitions/Tag"
    status:
      type: "string"
      description: "pet status in the store"
      enum:
      - "available"
      - "pending"
      - "sold"
```



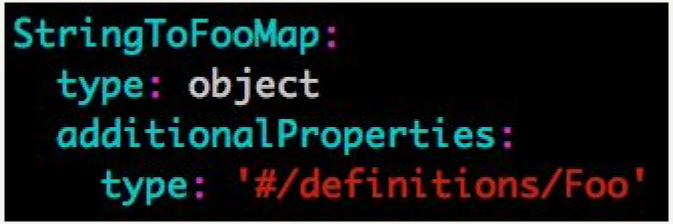
```
$ curl -s http://petstore.swagger.io/v2/pet/42 | jq .
{
  "id": 42,
  "category": {
    "id": 2,
    "name": "string"
  },
  "name": "jackie",
  "photoUrls": [
    "string"
  ],
  "tags": [
    {
      "id": 10,
      "name": "rotweiler"
    }
  ],
  "status": "available"
}
```

More definition objects: Maps

Swagger 2 only

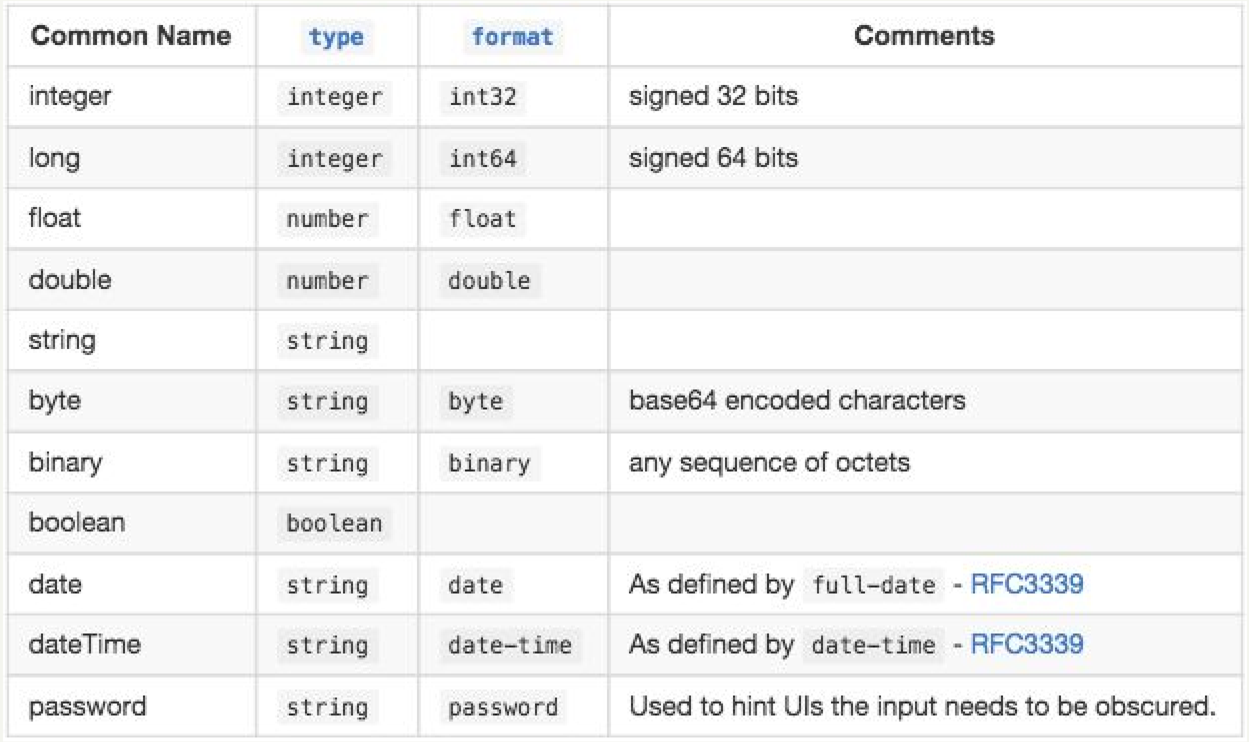


```
StringToStringMap:
  type: object
  additionalProperties:
    type: string
```



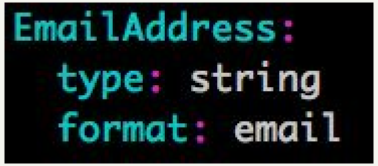
```
StringToFooMap:
  type: object
  additionalProperties:
    type: '#/definitions/Foo'
```

Datatypes and formats

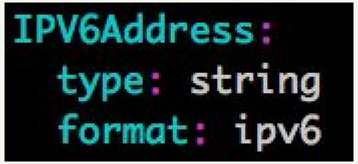


Common Name	`type`	`format`	Comments
integer	`integer`	`int32`	signed 32 bits
long	`integer`	`int64`	signed 64 bits
float	`number`	`float`	
double	`number`	`double`	
string	`string`		
byte	`string`	`byte`	base64 encoded characters
binary	`string`	`binary`	any sequence of octets
boolean	`boolean`		
date	`string`	`date`	As defined by `full-date` - RFC3339
dateTime	`string`	`date-time`	As defined by `date-time` - RFC3339
password	`string`	`password`	Used to hint UIs the input needs to be obscured.

Custom formats



```
EmailAddress:
  type: string
  format: email
```



```
IPV6Address:
  type: string
  format: ipv6
```

Ignored by Swagger, but some tooling may allow you to register your own validator

Where do Swagger specs live?

- At Yelp we check them into the service codebase
- Serve from a well-known endpoint of the service
- This minimizes distance between spec and code
- Could also store all specs in a central repo

Modifying specs

- There’s no magic here
- Swagger will not prevent you doing something bad
- You-the-programmer need to make sure that all spec changes are backwards compatible
- If you like living safely, only add new endpoints
- If you like living dangerously, change some existing endpoints or remove some endpoints :)

A brief interlude

What's the best thing about UDP jokes?

A brief interlude

What's the best thing about UDP jokes?

I don't care if you get them

A brief interlude

What's the best thing about TCP jokes?

A brief interlude

What's the best thing about TCP jokes?

I get to keep telling them until you get them

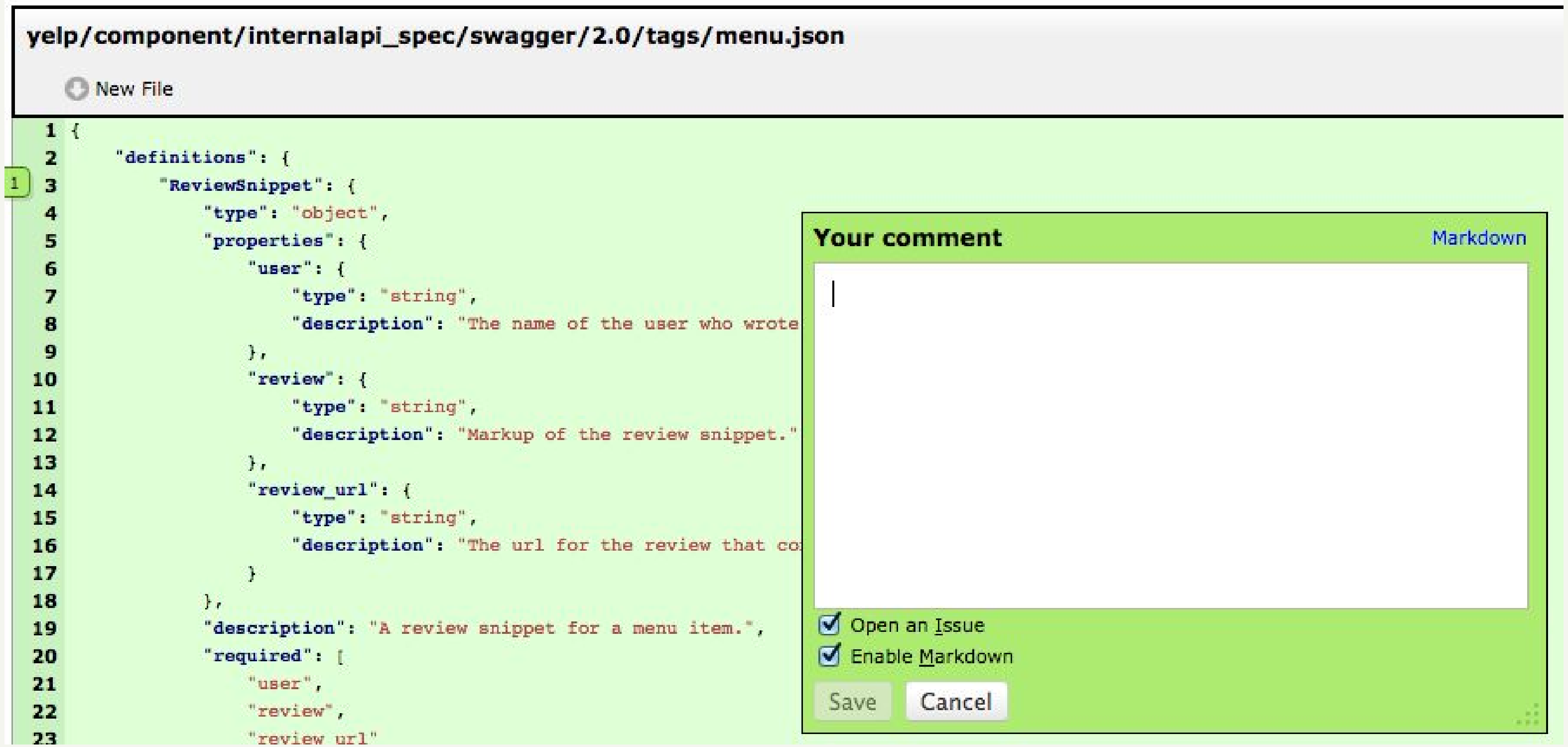
A brief interlude

What's the best thing about TCP jokes?

What can I do with a spec?

- Review an API
- Browse other specs
- Generate a client library
- Perform server-side validation
- Testing

API reviews



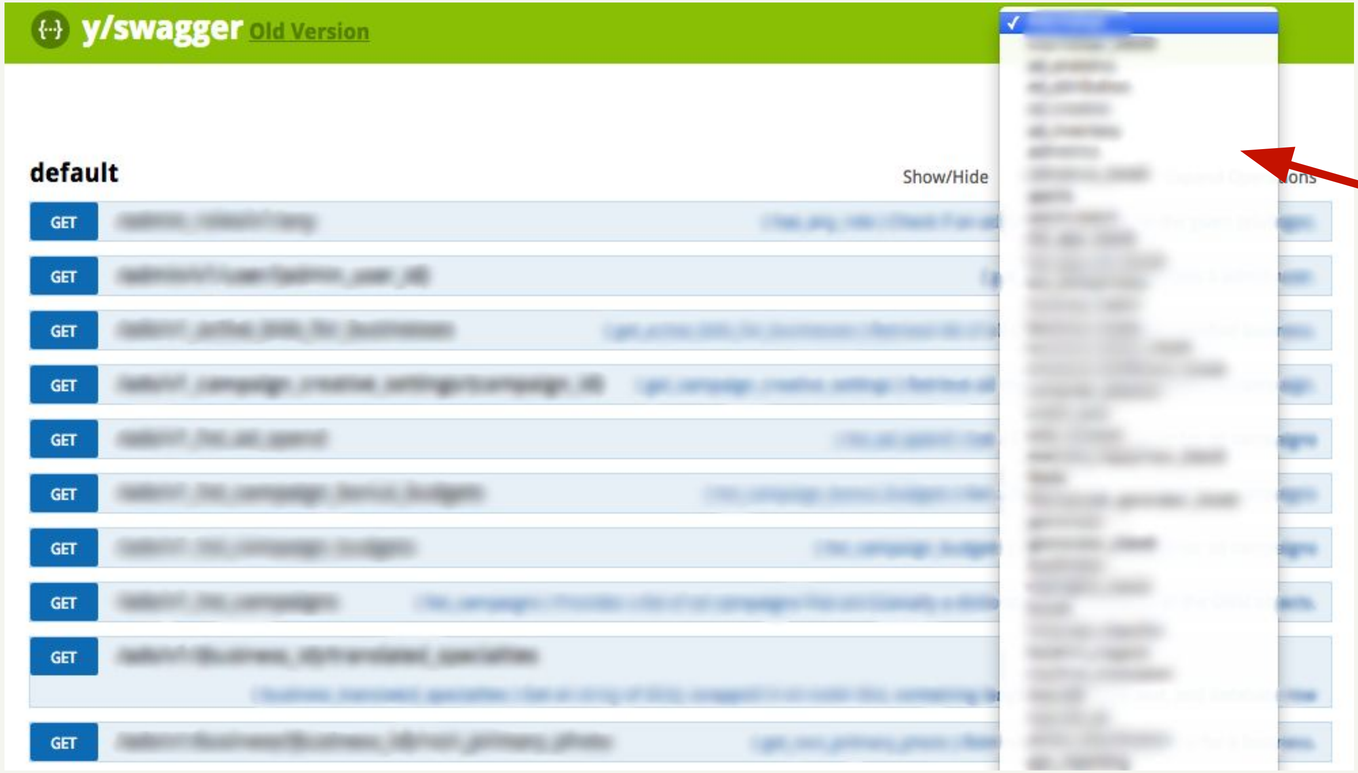
yelp/component/internalapi_spec/swagger/2.0/tags/menu.json

```
{
    "definitions": {
        "ReviewSnippet": {
            "type": "object",
            "properties": {
                "user": {
                    "type": "string",
                    "description": "The name of the user who wrote
                },
                "review": {
                    "type": "string",
                    "description": "Markup of the review snippet."
                },
                "review_url": {
                    "type": "string",
                    "description": "The url for the review that co
                }
            },
            "description": "A review snippet for a menu item.",
            "required": [
                "user",
                "review",
                "review_url"
```

[✓] Open an Issue
[✓] Enable Markdown

Browsing specs

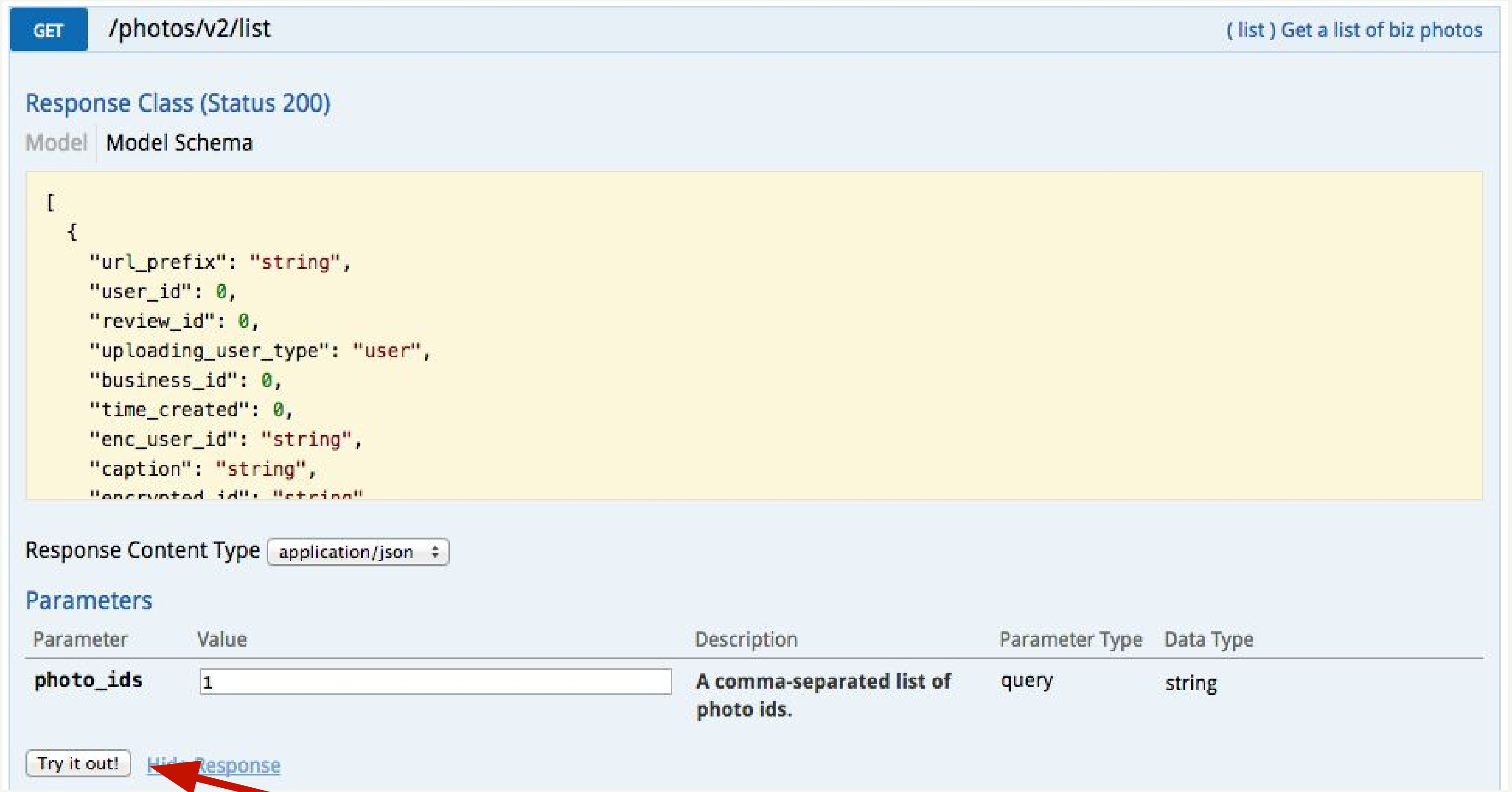
API for
selected
service



Different
services

http://swagger.io/swagger-ui/

yelp


GET /photos/v2/list

(list) Get a list of biz photos

Response Class (Status 200)

Model | Model Schema

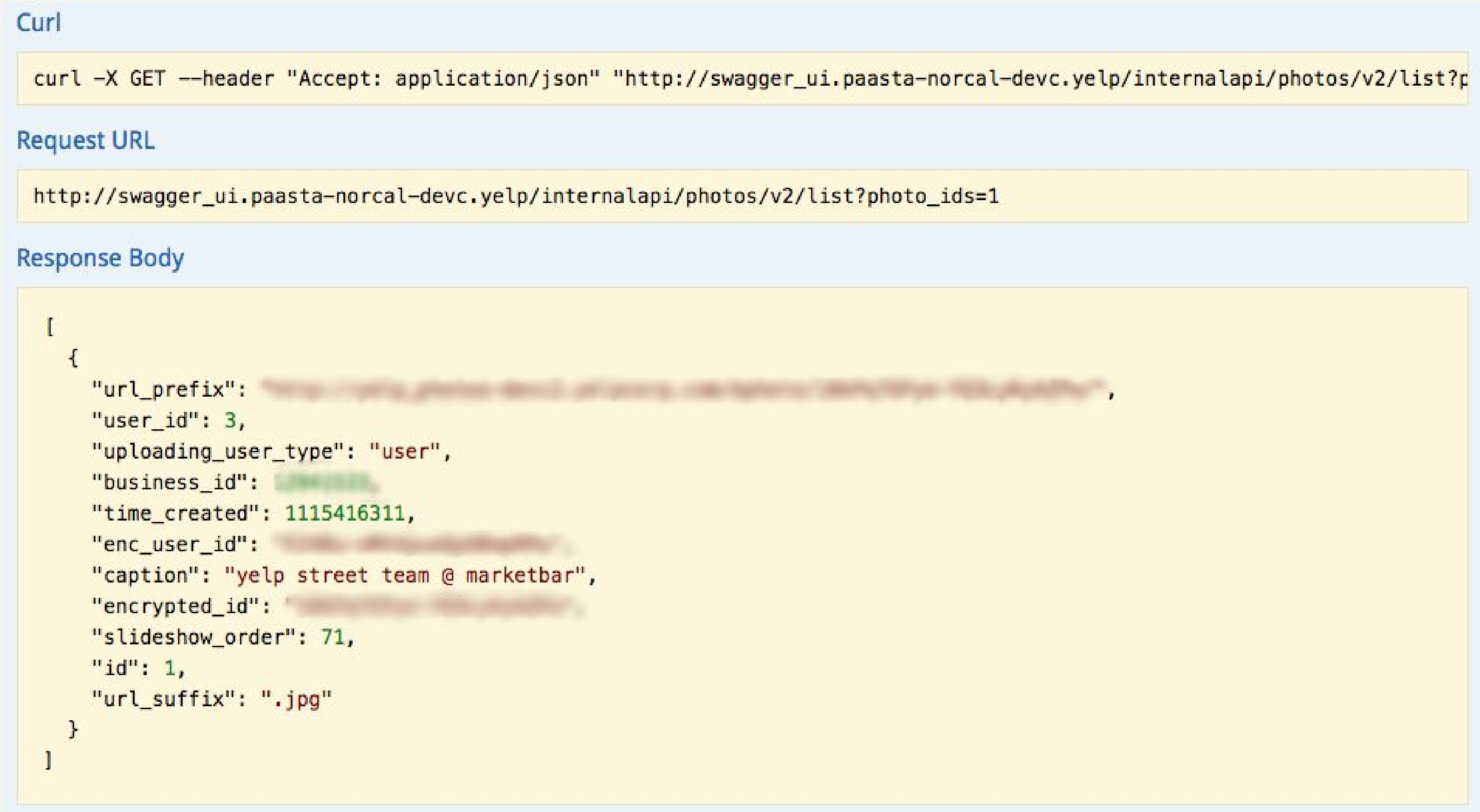
```
[
  {
    "url_prefix": "string",
    "user_id": 0,
    "review_id": 0,
    "uploading_user_type": "user",
    "business_id": 0,
    "time_created": 0,
    "enc_user_id": "string",
    "caption": "string",
    "encrypted_id": "string"
```

Response Content Type application/json

Parameters

Parameter	Value	Description	Parameter Type	Data Type
photo_ids	1	**A comma-separated list of photo ids.**	query	string

Perform a real query



Curl

```
curl -X GET --header "Accept: application/json" "http://swagger_ui.paasta-norcal-devc.yelp/internalapi/photos/v2/list?p
```

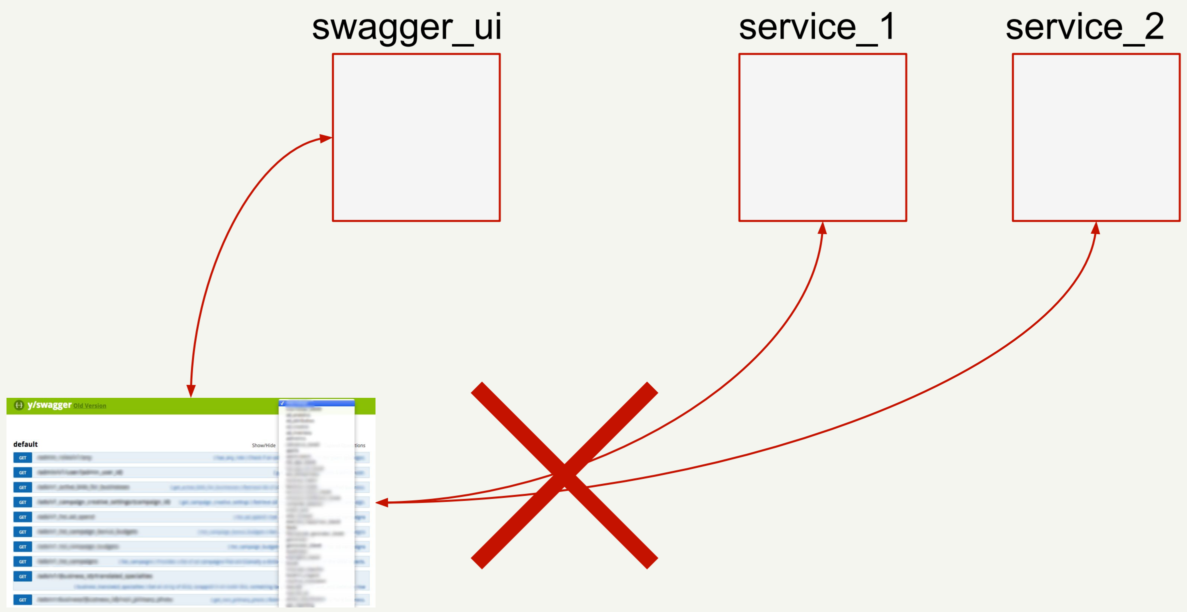
Request URL

```
http://swagger_ui.paasta-norcal-devc.yelp/internalapi/photos/v2/list?photo_ids=1
```

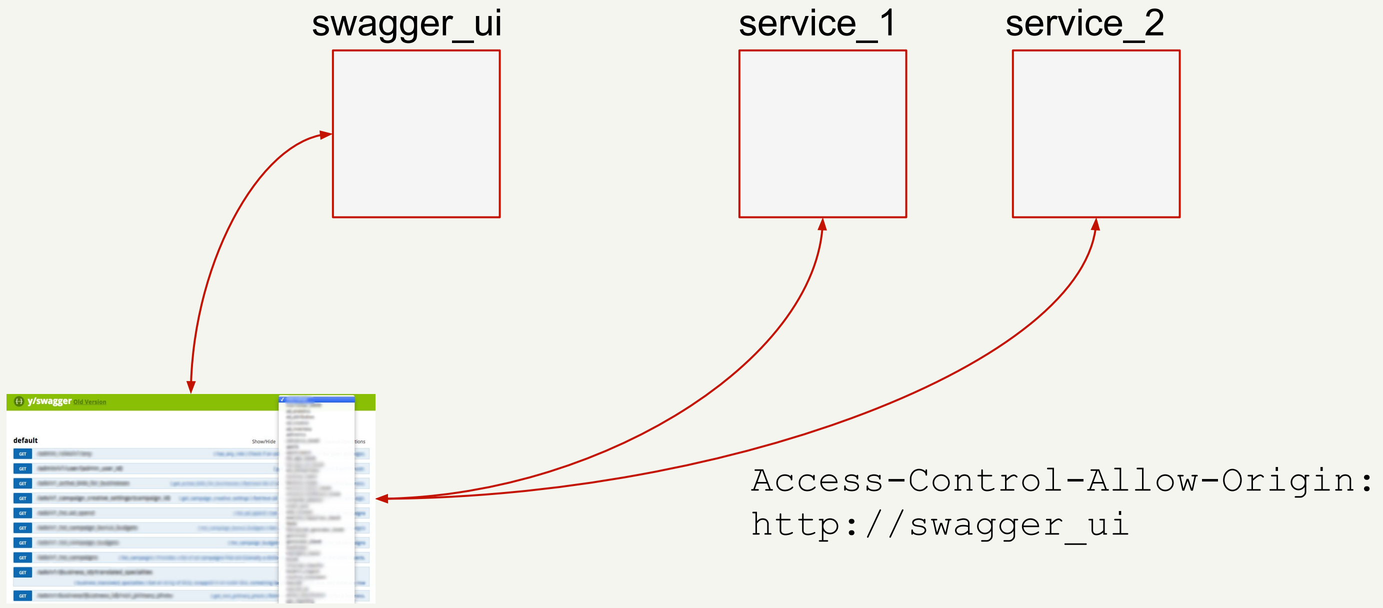
Response Body

```
[
  {
    "url_prefix": [redacted],
    "user_id": 3,
    "uploading_user_type": "user",
    "business_id": [redacted]
    "time_created": 1115416311,
    "enc_user_id": [redacted]
    "caption": "yelp street team @ marketbar",
    "encrypted_id": [redacted]
    "slideshow_order": 71,
    "id": 1,
    "url_suffix": ".jpg"
  }
]
```

Brief aside: Same-origin policy

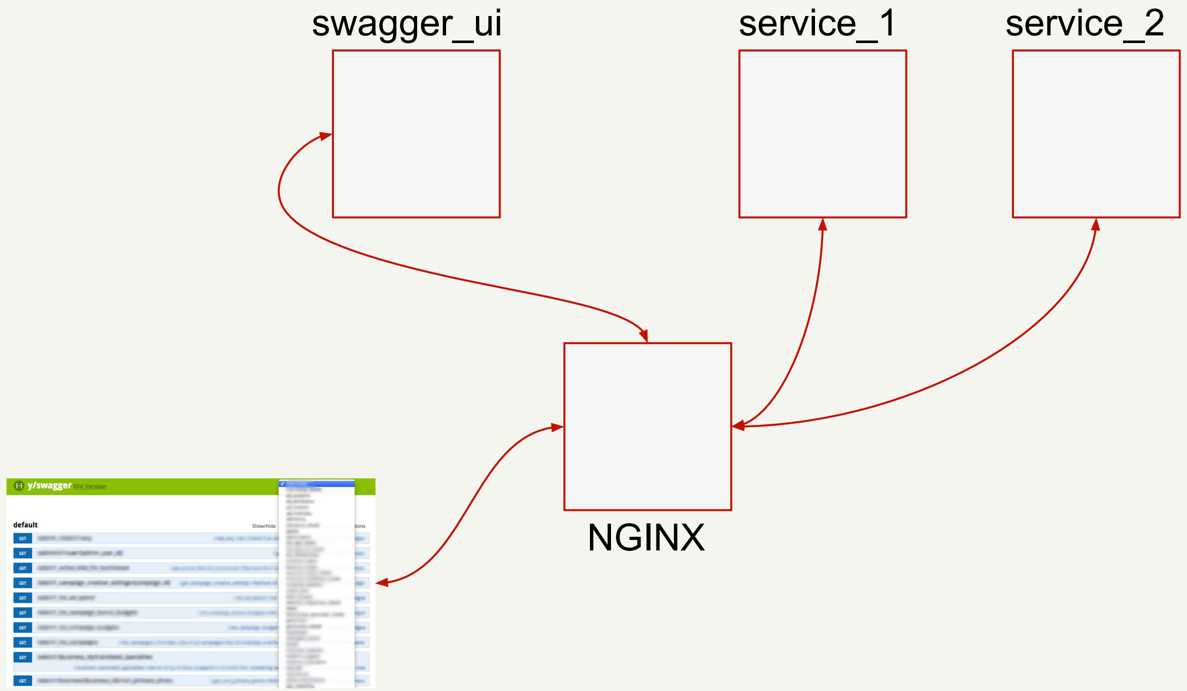


Solution using Cross-Origin Resource Sharing



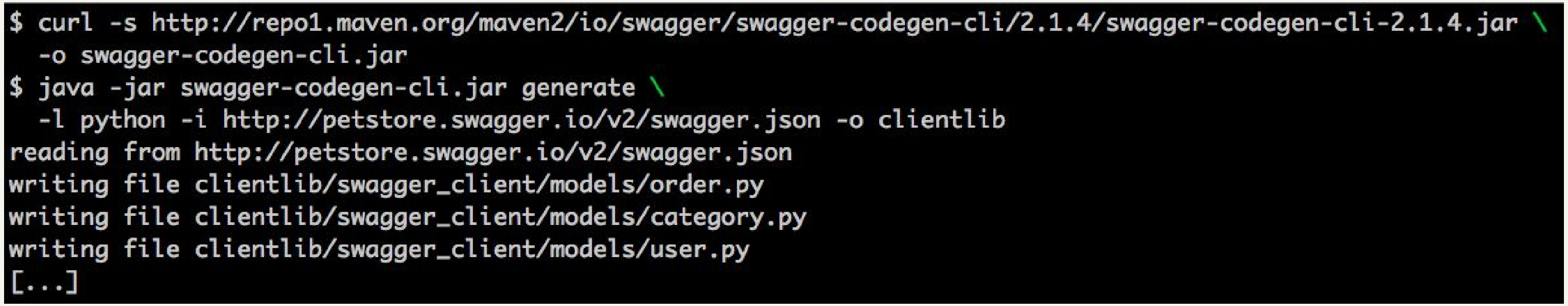
```
Access-Control-Allow-Origin:
http://swagger_ui
```

Solution using a proxy



Generating client libs

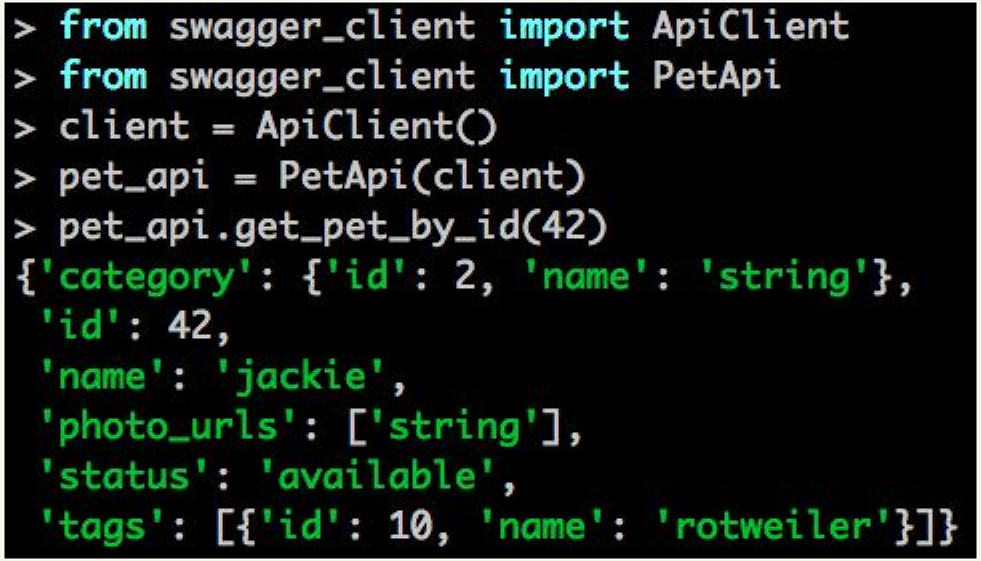
Try this out!



```
$ curl -s http://repo1.maven.org/maven2/io/swagger/swagger-codegen-cli/2.1.4/swagger-codegen-cli-2.1.4.jar \
  -o swagger-codegen-cli.jar
$ java -jar swagger-codegen-cli.jar generate \
  -l python -i http://petstore.swagger.io/v2/swagger.json -o clientlib
reading from http://petstore.swagger.io/v2/swagger.json
writing file clientlib/swagger_client/models/order.py
writing file clientlib/swagger_client/models/category.py
writing file clientlib/swagger_client/models/user.py
[...]
```

Using generated clientlibs

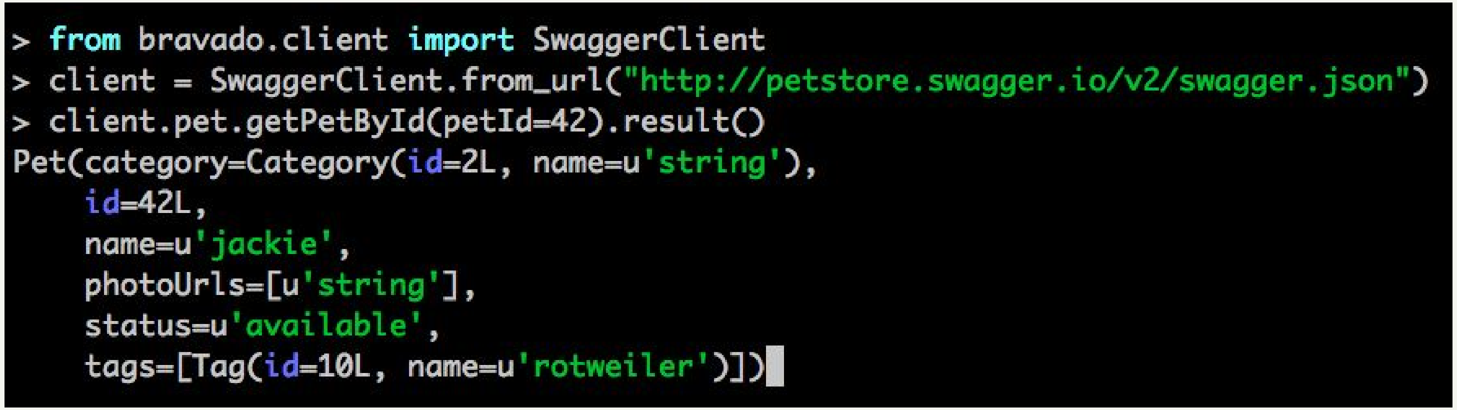
Try this out!



```
> from swagger_client import ApiClient
> from swagger_client import PetApi
> client = ApiClient()
> pet_api = PetApi(client)
> pet_api.get_pet_by_id(42)
{'category': {'id': 2, 'name': 'string'},
 'id': 42,
 'name': 'jackie',
 'photo_urls': ['string'],
 'status': 'available',
 'tags': [{'id': 10, 'name': 'rotweiler'}]}
```

Bravado: dynamic clientlibs for Python

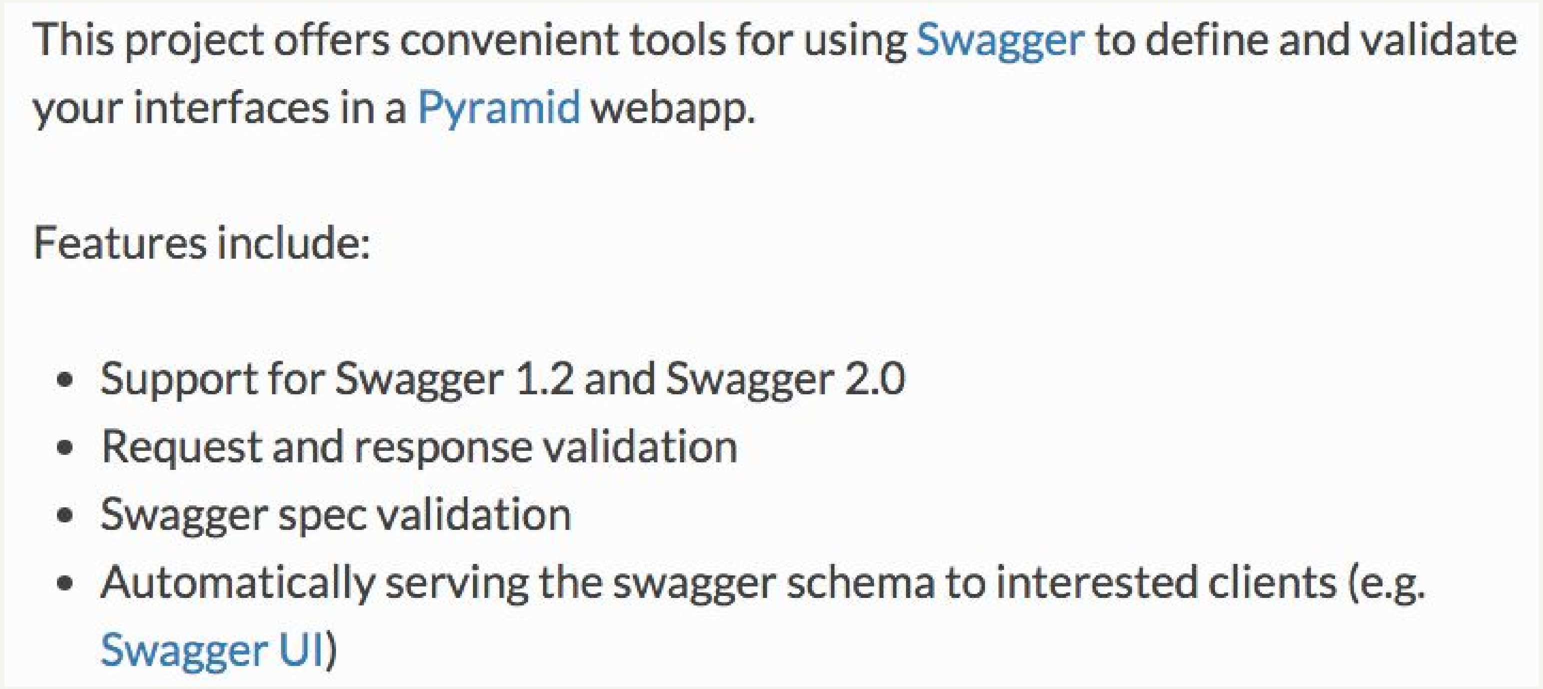
Try this out!



```
> from bravado.client import SwaggerClient
> client = SwaggerClient.from_url("http://petstore.swagger.io/v2/swagger.json")
> client.pet.getPetById(petId=42).result()
Pet(category=Category(id=2L, name=u'string'),
    id=42L,
    name=u'jackie',
    photoUrls=[u'string'],
    status=u'available',
    tags=[Tag(id=10L, name=u'rotweiler')])
```

https://github.com/Yelp/bravado

pyramid_swagger



This project offers convenient tools for using Swagger to define and validate your interfaces in a Pyramid webapp.

Features include:

- Support for Swagger 1.2 and Swagger 2.0
- Request and response validation
- Swagger spec validation
- Automatically serving the swagger schema to interested clients (e.g. Swagger UI)

https://github.com/striglia/pyramid_swagger

pyramid_swagger: usage

Matched in swagger spec

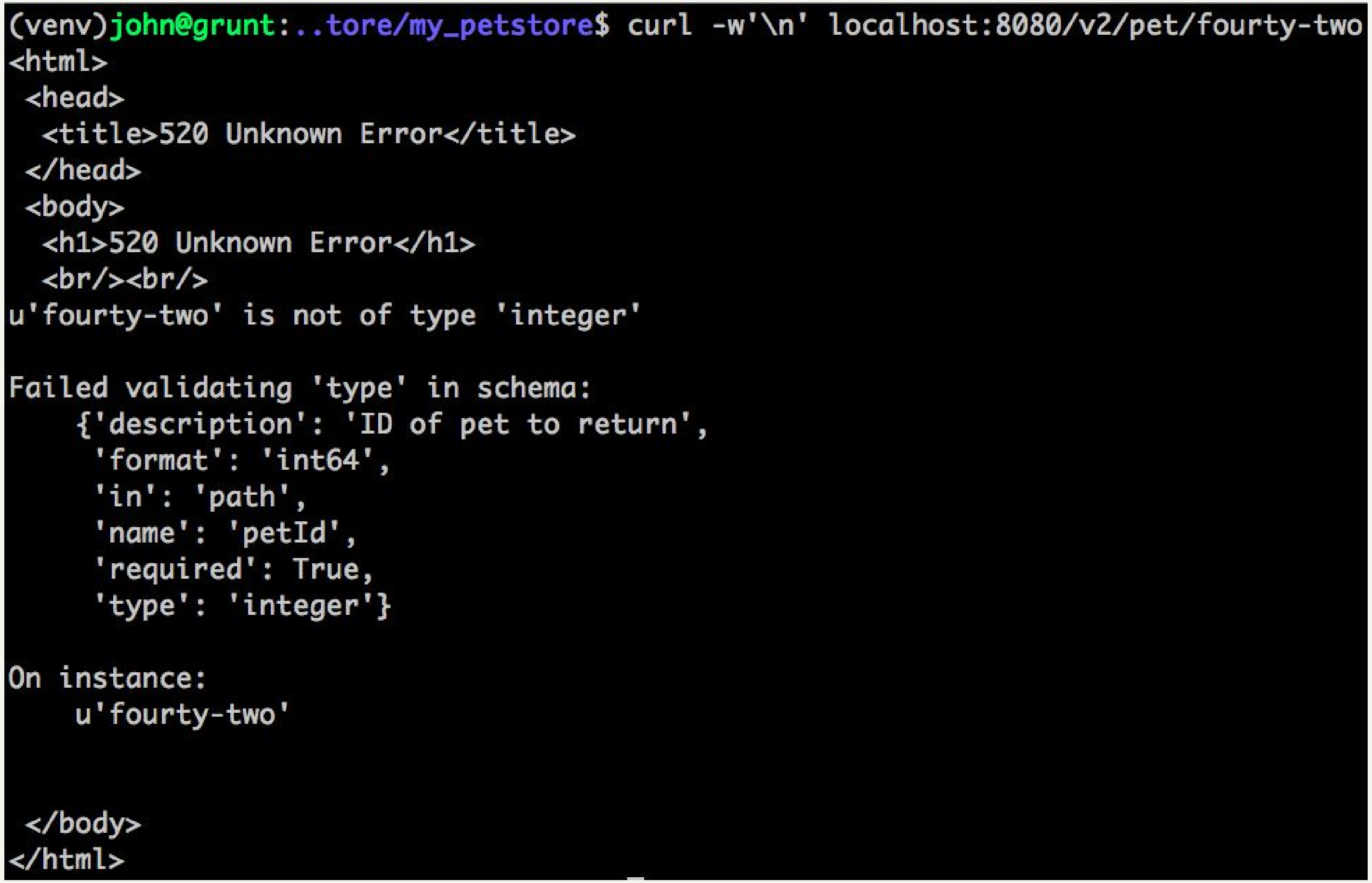
```
config.add_route('api.things.get', '/api/things', request_method='GET')
```

```
from pyramid.view import view_config

@view_config(route_name='api.things.get')
def get_things(request):
    # Returns thing_id as an int (assuming the swagger type is integer)
    thing_id = request.swagger_data['thing_id']
    ...
    return {...}
```

pyramid_swagger: custom formats

```
{
    "name": "petId",
    "in": "path",
    "description": "ID of pet to return",
    "required": true,
    "type": "string",
    "format": "base64"
}
```

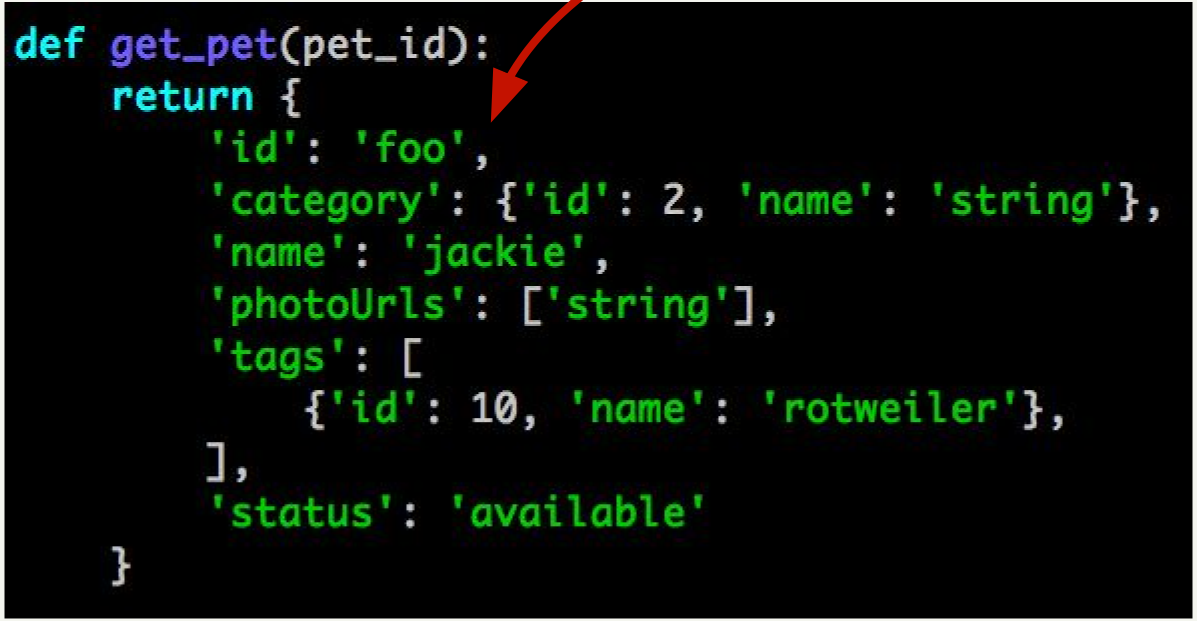
```
import base64
from pyramid_swagger.tween import SwaggerFormat
user_format = SwaggerFormat(format='base64',
                            to_wire=base64.b64encode,
                            to_python=base64.b64decode,
                            validate=base64.b64decode,
                            description='base64 conversions')
```



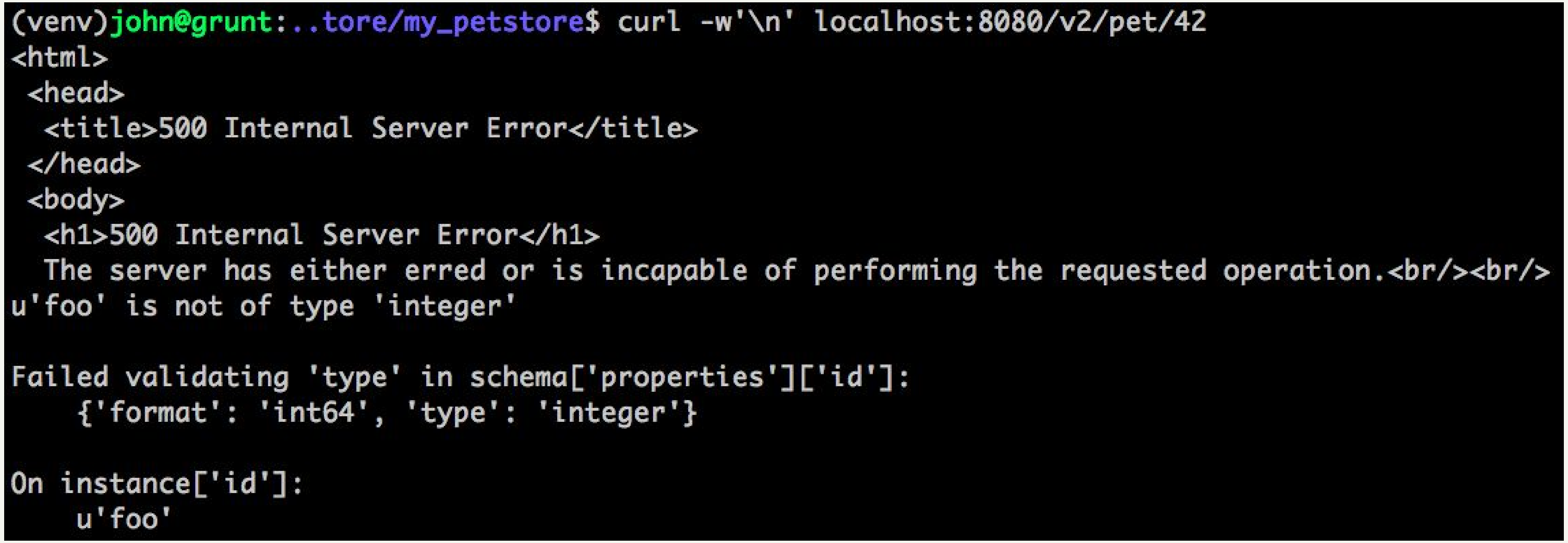
```
(venv)john@grunt:..tore/my_petstore$ curl -w'\n' localhost:8080/v2/pet/fourty-two
<html>
 <head>
  <title>520 Unknown Error</title>
 </head>
 <body>
  <h1>520 Unknown Error</h1>
  <br/><br/>
u'fourty-two' is not of type 'integer'

Failed validating 'type' in schema:
    {'description': 'ID of pet to return',
     'format': 'int64',
     'in': 'path',
     'name': 'petId',
     'required': True,
     'type': 'integer'}

On instance:
    u'fourty-two'


 </body>
</html>
```

Oops!

Oops!

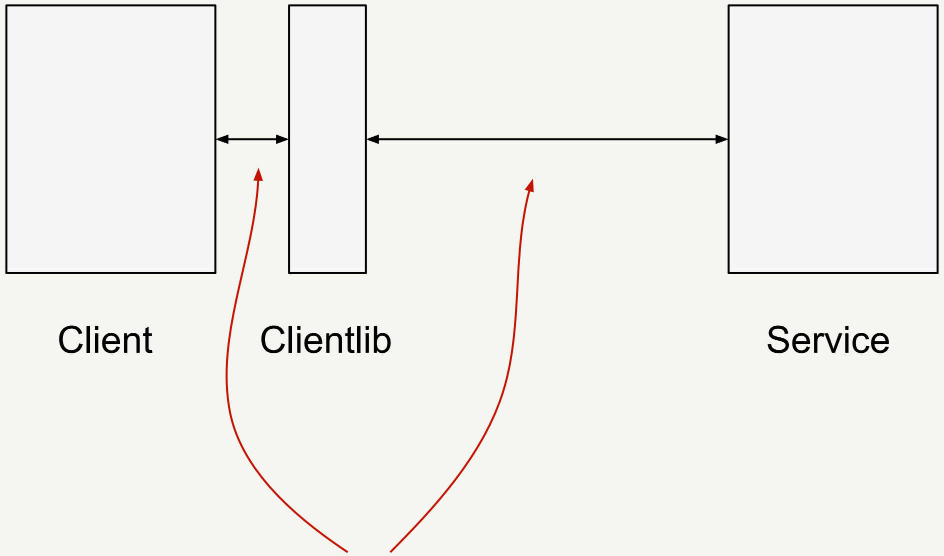


```
def get_pet(pet_id):
    return {
        'id': 'foo',
        'category': {'id': 2, 'name': 'string'},
        'name': 'jackie',
        'photoUrls': ['string'],
        'tags': [
            {'id': 10, 'name': 'rotweiler'},
        ],
        'status': 'available'
    }
```



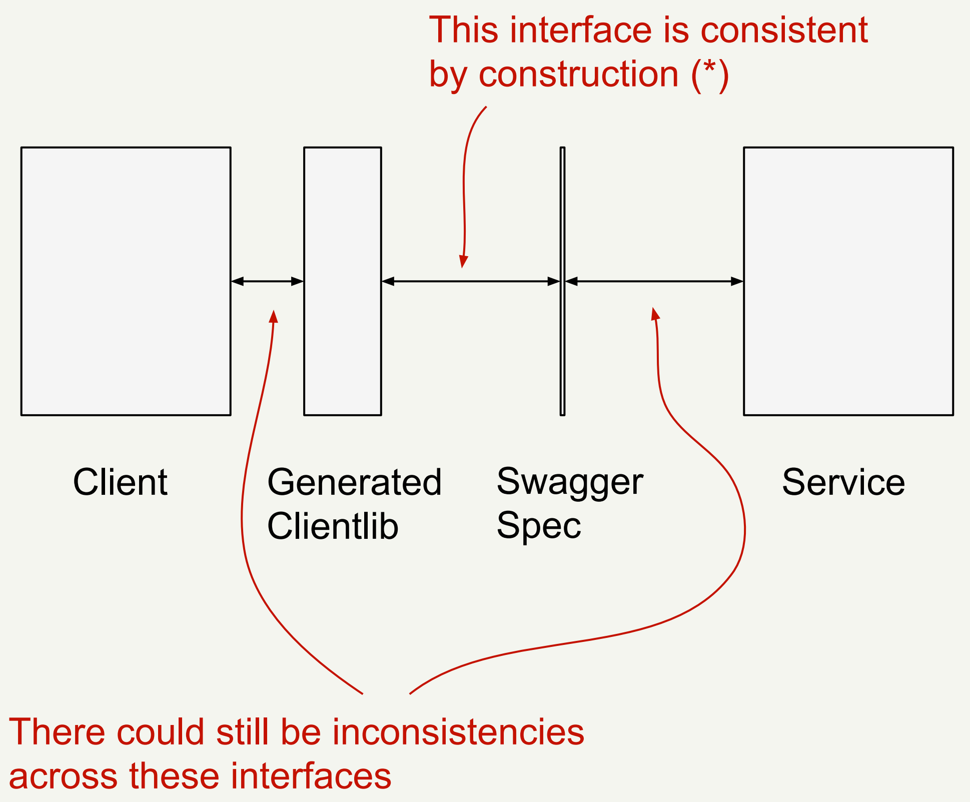
```
(venv)john@grunt:..tore/my_petstore$ curl -w'\n' localhost:8080/v2/pet/42
<html>
 <head>
  <title>500 Internal Server Error</title>
 </head>
 <body>
  <h1>500 Internal Server Error</h1>
  The server has either erred or is incapable of performing the requested operation.<br/><br/>
u'foo' is not of type 'integer'

Failed validating 'type' in schema['properties']['id']:
    {'format': 'int64', 'type': 'integer'}

On instance['id']:
    u'foo'
```

Testing without Swagger

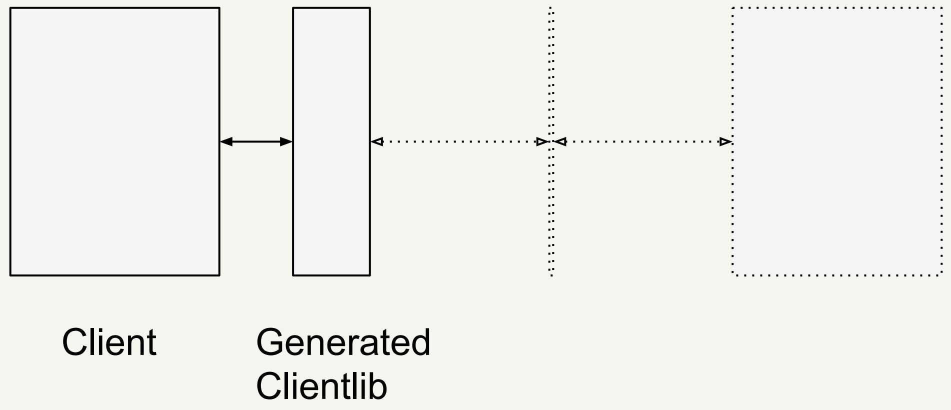


There could be inconsistencies across both of these interfaces

Testing with Swagger

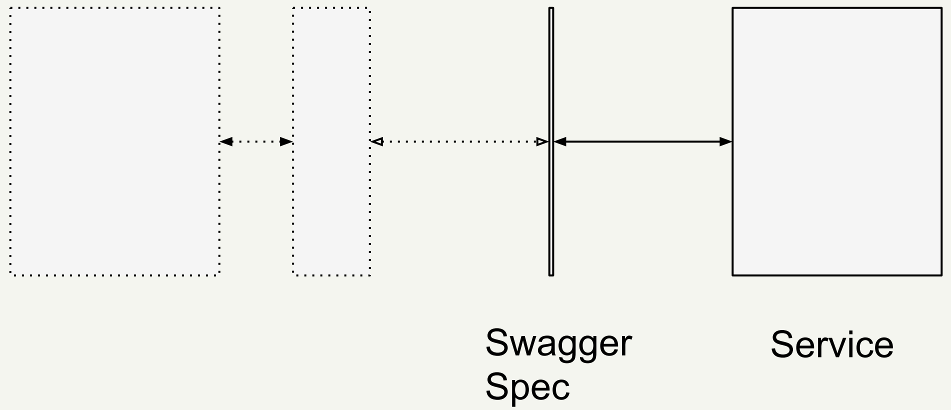

This interface is consistent by construction (*)
Client
Generated Clientlib
Swagger Spec
Service
There could still be inconsistencies across these interfaces

Testing with Swagger



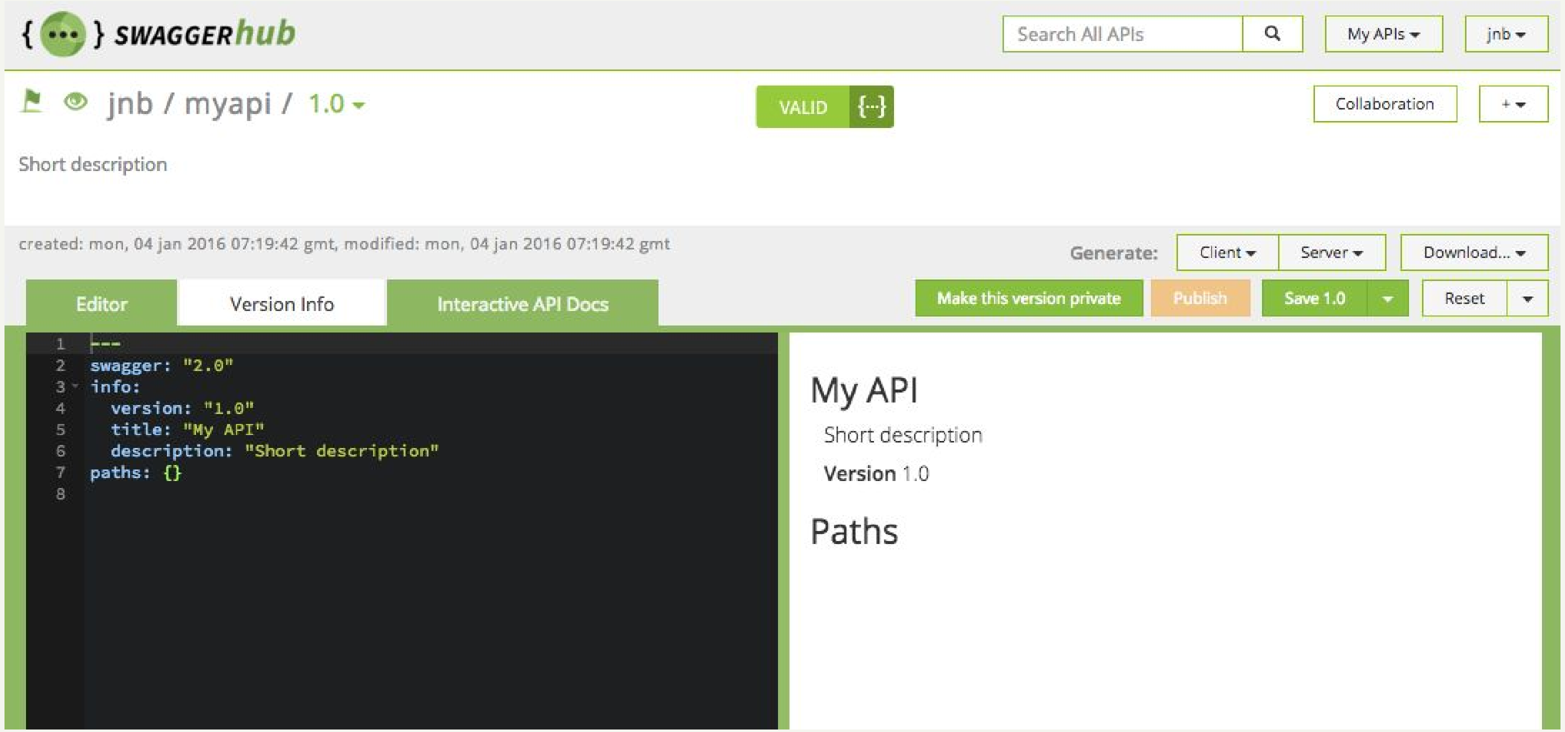
- This is a fairly standard testing problem
- Your type-checker can help here (if you have one :)
- Future work: add support for returning mock data

Testing with Swagger



- Validate your responses as part of your testing
- Fairly easy if your service already contains a validator?
- Could also use an external validator

SwaggerHub



Short description

created: mon, 04 jan 2016 07:19:42 gmt, modified: mon, 04 jan 2016 07:19:42 gmt

```yaml
---
swagger: "2.0"
info:
  version: "1.0"
  title: "My API"
  description: "Short description"
paths: {}
```

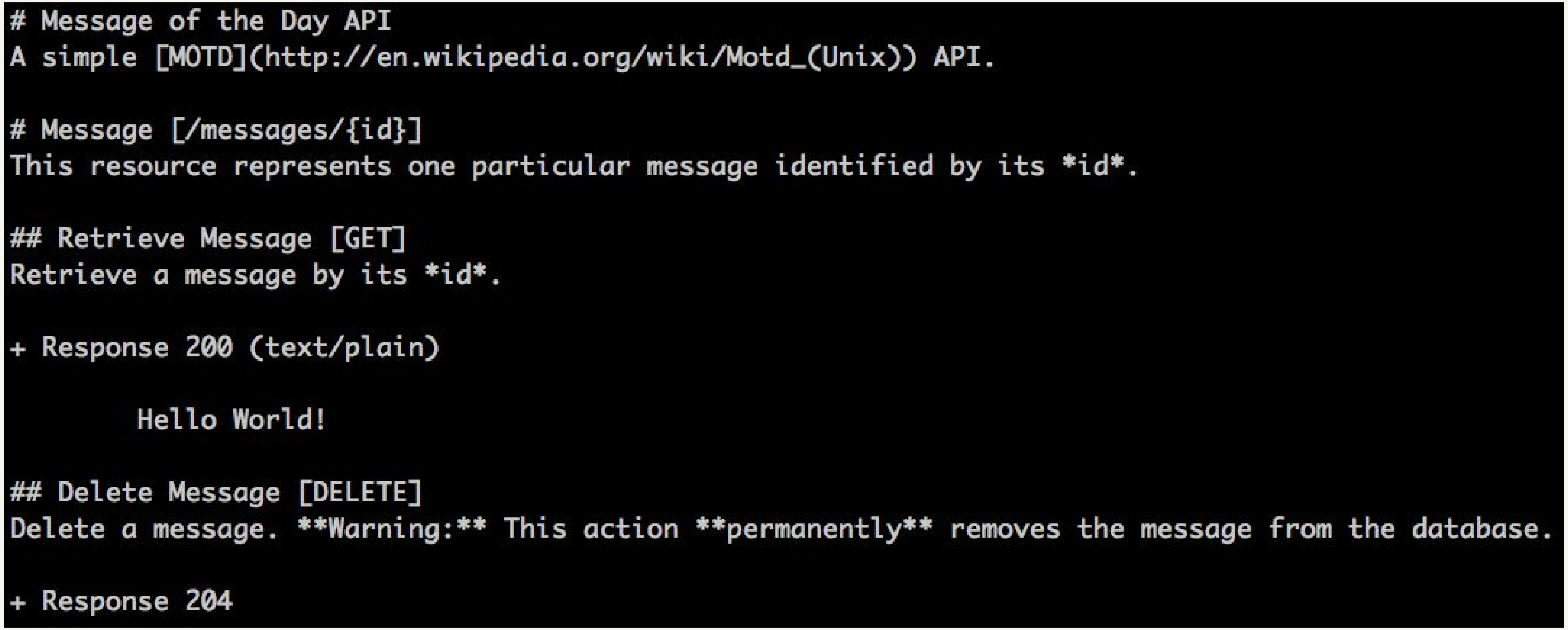
My API

Short description

Version 1.0

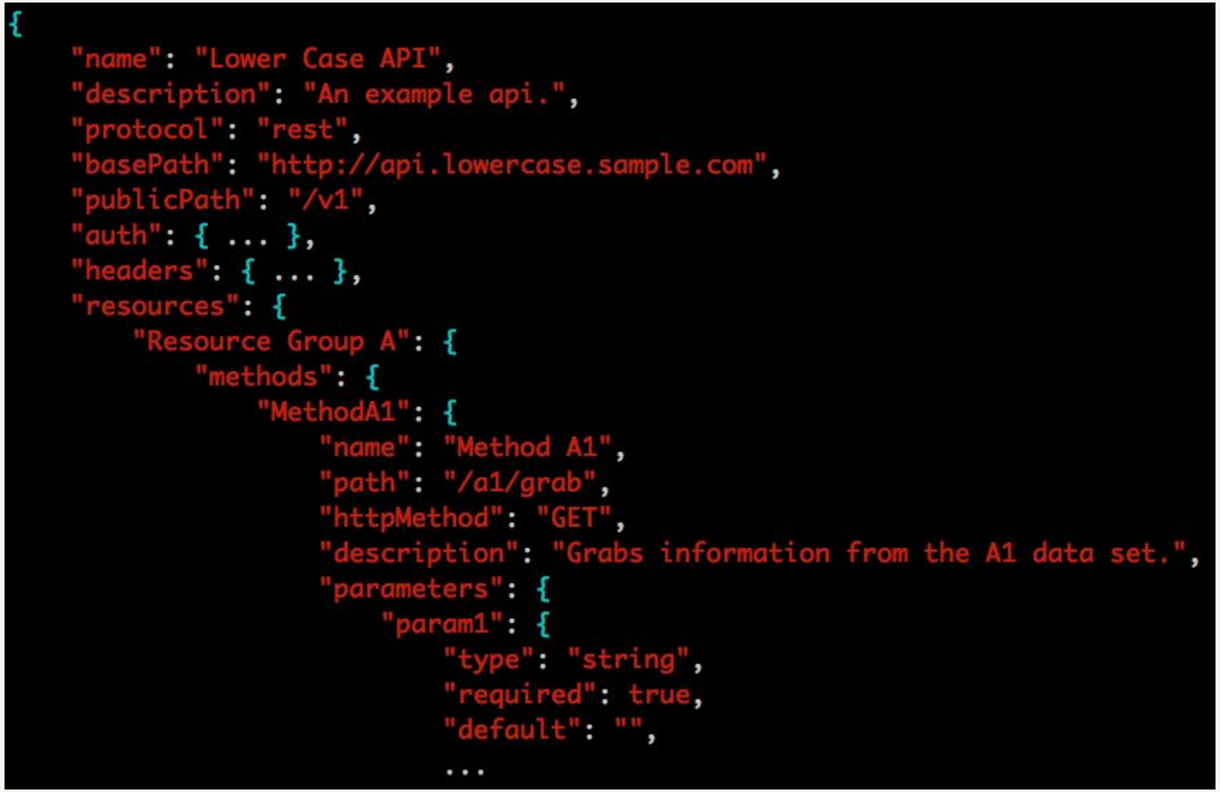
Paths

Other spec langs: API Blueprint by Apiary



```
# Message of the Day API
A simple [MOTD](http://en.wikipedia.org/wiki/Motd_(Unix)) API.

# Message [/messages/{id}]
This resource represents one particular message identified by its *id*.

## Retrieve Message [GET]
Retrieve a message by its *id*.

+ Response 200 (text/plain)

        Hello World!

## Delete Message [DELETE]
Delete a message. **Warning:** This action **permanently** removes the message from the database.

+ Response 204
```

Other spec langs: I/O Docs by Mashery



```
{
    "name": "Lower Case API",
    "description": "An example api.",
    "protocol": "rest",
    "basePath": "http://api.lowercase.sample.com",
    "publicPath": "/v1",
    "auth": { ... },
    "headers": { ... },
    "resources": {
        "Resource Group A": {
            "methods": {
                "MethodA1": {
                    "name": "Method A1",
                    "path": "/a1/grab",
                    "httpMethod": "GET",
                    "description": "Grabs information from the A1 data set.",
                    "parameters": {
                        "param1": {
                            "type": "string",
                            "required": true,
                            "default": "",
                            ...
```

Conclusions

- Swagger provides an easy way to define JSON/HTTP interfaces for new and existing services
- Once you have an interface, you get lots of tooling ‘for free’
  - Automatic generation of clientlibs for many different languages
  - Automatic validation of requests and responses

Any questions?