Unsafe Code Lab: How Modern Web Frameworks Fail

(and How to Fix Them)

Irina Iarlykanova

A Week in the Life of an AppSec Engineer

```
Flask: user_id = request.values.get('id')
```

```
ExpressJS: const userId = req.param('id')
```

```
FastAPI: def get_user(id: int):...
```

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Flask: user_id = request.values.get('id')
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ExpressJS: const userId = req.param('id')
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FastAPI: def get_user(id: int):...
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Flask: user_id = request.values.get('id')
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ExpressJS: const userId = req.param('id')
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```
FastAPI: def get_user(id: int):...
```

Same logic, same bug?

```
Flask: user_id = request.values.get('id')
```

```
ExpressJS: const userId = req.param('id')
```

```
FastAPI: def get_user(id: int):...
```

Does ?id=1&id=2 behave the same?
What about sending the id in the body and the query string?

Absolutely Not!

```
Flask: user_id = request.values.get('id')
```

```
ExpressJS: const userId = req.param('id')
```

Type confusion

```
FastAPI: def get_user(id: int):...
```

Safe by default

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SOC analyst at DIVD

You’re reviewing code in a new framework...
...where do you even start?🤔

Existing Options: CTF

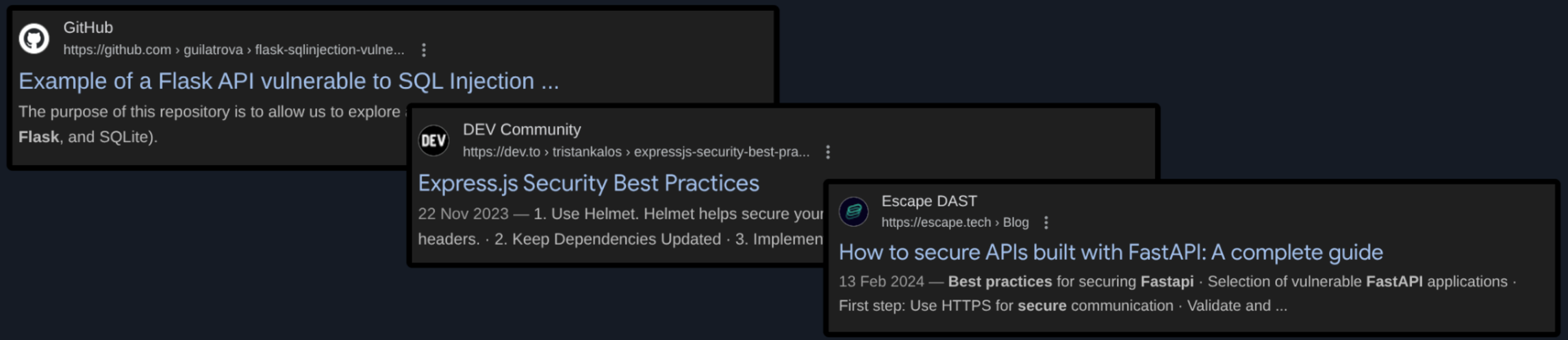
1. Learn vulnerabilities in isolation
2. Not representative
3. Unrealistic patterns
4. Rewarded for exploitation, not understanding

Existing Options: CTF

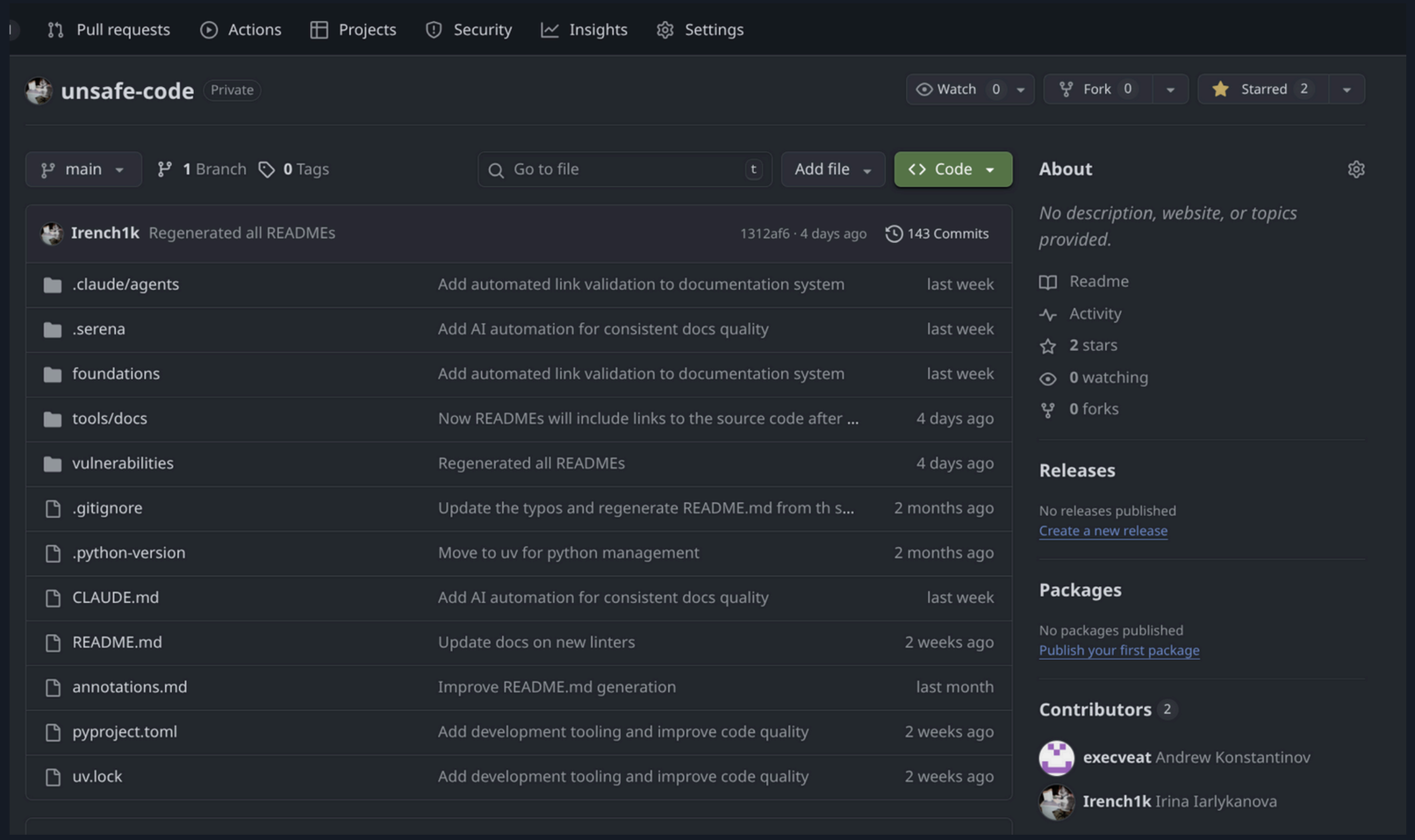
1.
2.
3.
4.

Existing Options: Blog Posts

1. One-off examples, hard to reproduce
2. Different styles, languages, versions
3. Outdated or missing fixes



Solution: Unsafe Code Lab



1. Realistic & runnable vulnerable code
2. Modern frameworks
3. Built for AppSec & Research

Case Study: Same Bug, Different Stack

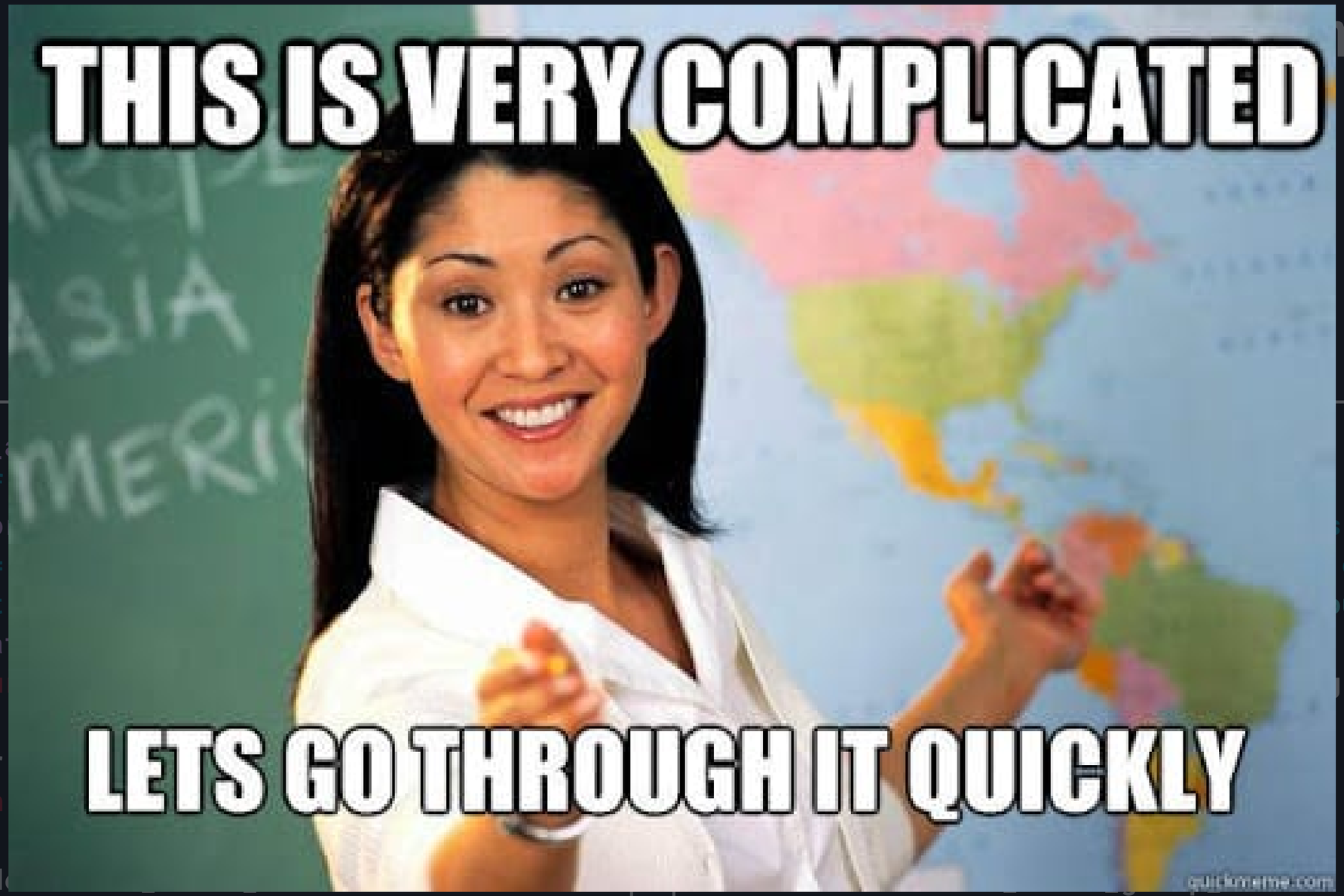
Confusion Attacks

Flask: Authorization Binding Drift # Example 1

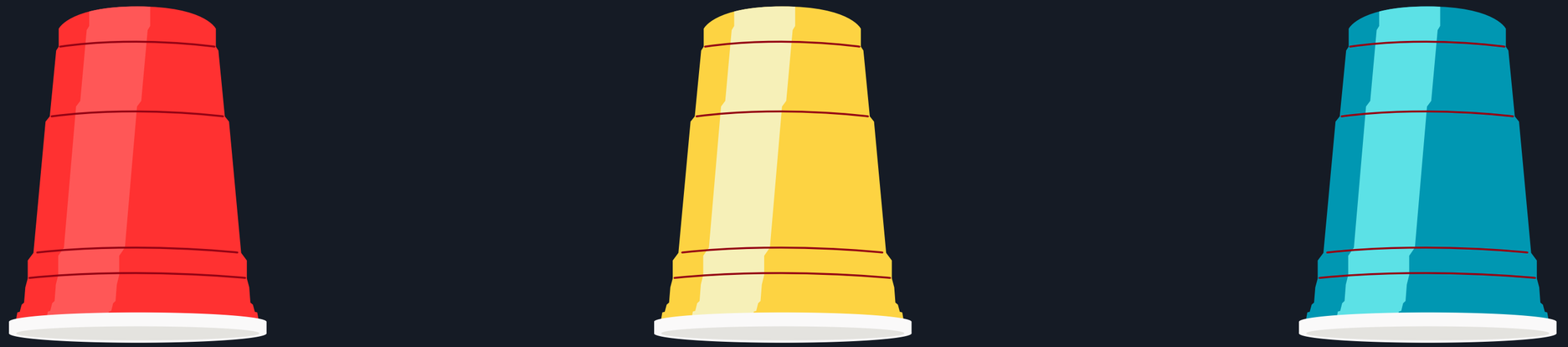
```python
@bp.get("/example3/groups/<group>/messages")
@basic_auth_v2
@check_group_membership_v2
def example3_group_messages(group):
  return get_group_messages(group)
```

```python
def basic_auth(f):
  @wraps(f)
  def decorated_basic_auth(*args, **kwargs):
    auth = request.authorization
    if not auth or not
authenticate(auth.username, auth.password):
      return response_401()

    g.user = auth.username
    return f(*args, **kwargs)

  return decorated_basic_auth
```

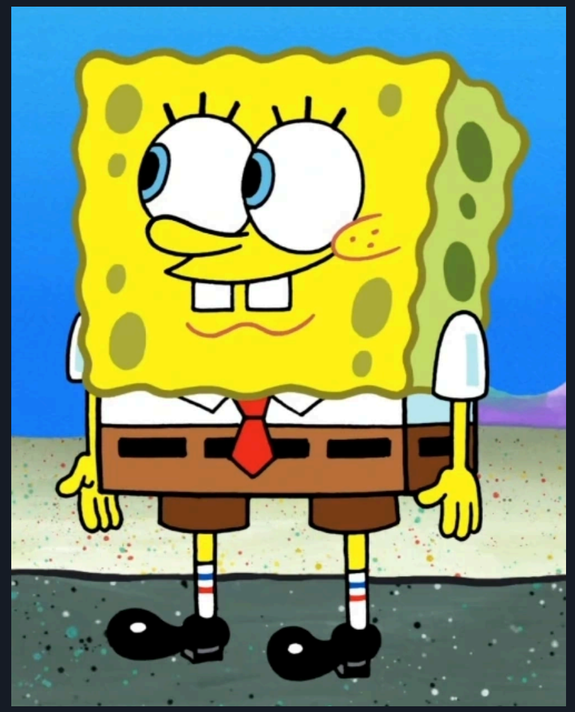
```python
def check_group_membership(f):
  @wraps(f)
  def decorated_check_group_memb(*args, **kwargs):
    group = request.args.get("group") or
            request.view_args.get("group")

    if group and not is_group_member(g.user,
group):
      return response_403()

    return f(*args, **kwargs)
  return decorated_check_group_memb
```


THIS IS VERY COMPLICATED
LETS GO THROUGH IT QUICKLY
quickmeme.com

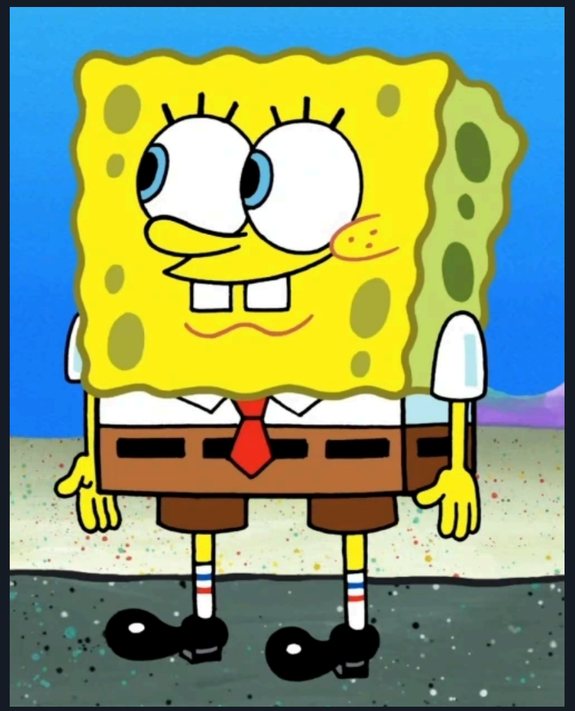
What’s source confusion?



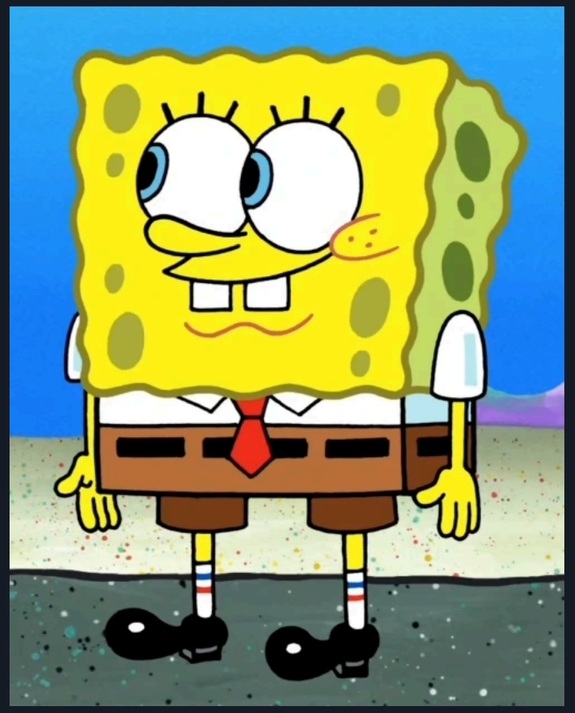
```
GET {base}/spongebob/messages
```



```
GET {base}/spongebob/messages?user=squidward
```



```
POST {base}/spongebob/messages?user=squidward
Content-Type: application/x-www-form-urlencoded

user=mr.krabs
```



Flask: Source Precedence # Example 1

```
POST /messages
Content-Type: application/x-www-form-urlencoded

user=squidward&password=clarinet123
```

```
200 OK:
Returns messages for 'squidward'
```

Flask: Source Precedence # Example 1

```
POST /messages?user=spongebob
Content-Type: application/x-www-form-urlencoded

user=squidward&password=clarinet123
```



```
200 OK:
Returns messages for 'squidward'
```

Flask: Source Precedence # Example 1.1

```
def get_parameter(key):
    return request.args.get(key) or request.form.get(key)
```

Flask: Source Precedence # Example 1.2

```
def list_messages(key):
    return messages_get(request.values.get("user"))

def authenticate_user():
    return authenticate(request.form.get("user"),
                        request.form.get("password"))
```

Flask: Source Precedence # Example 1.2

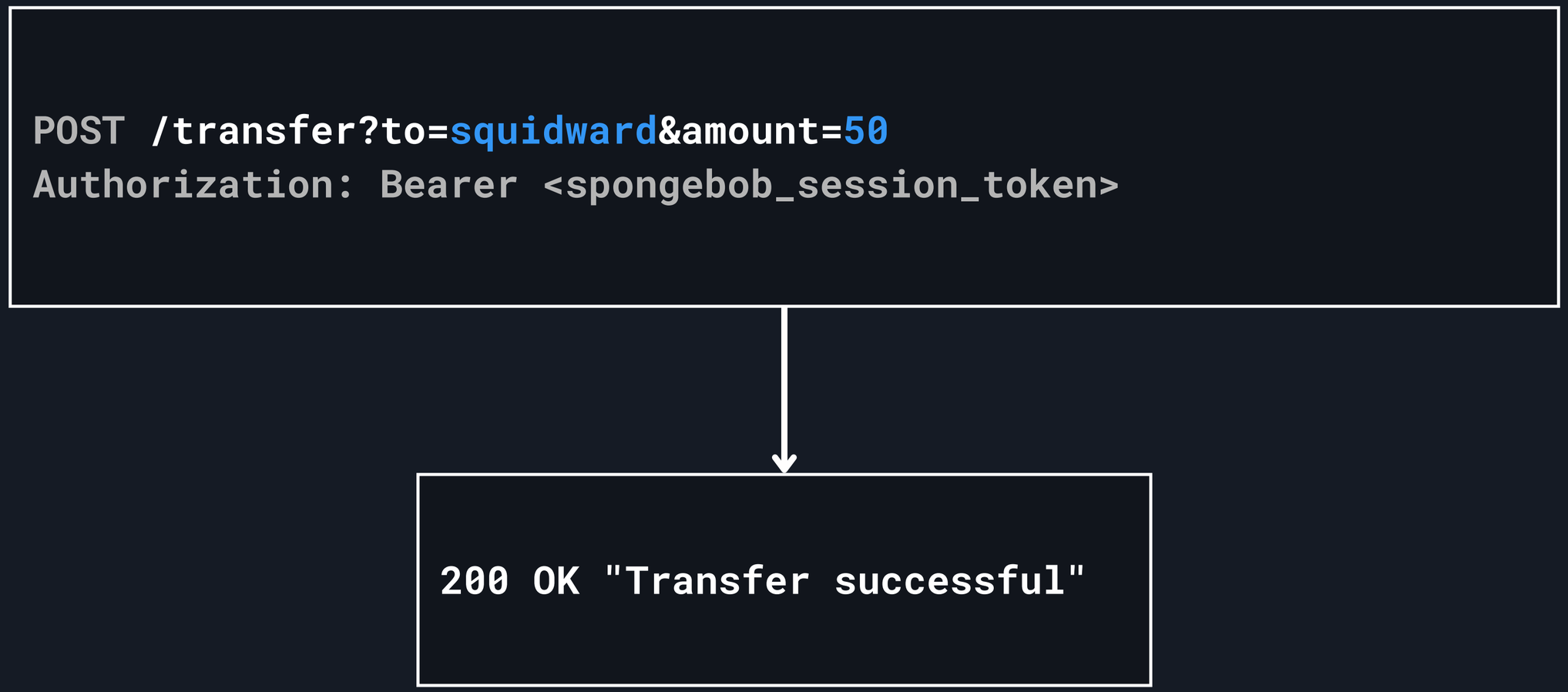
```
def list_messages(key):
    return messages_get(request.values.get("user"))

def authenticate_user():
    return authenticate(request.form.get("user"),
                        request.form.get("password"))
```

```
request.values.get("user")
```

=

```
request.args.get(key) or request.form.get(key)
```

Flask: HTTP Parameter Pollution # Example 2



Flask

ple 2

POST

Autho

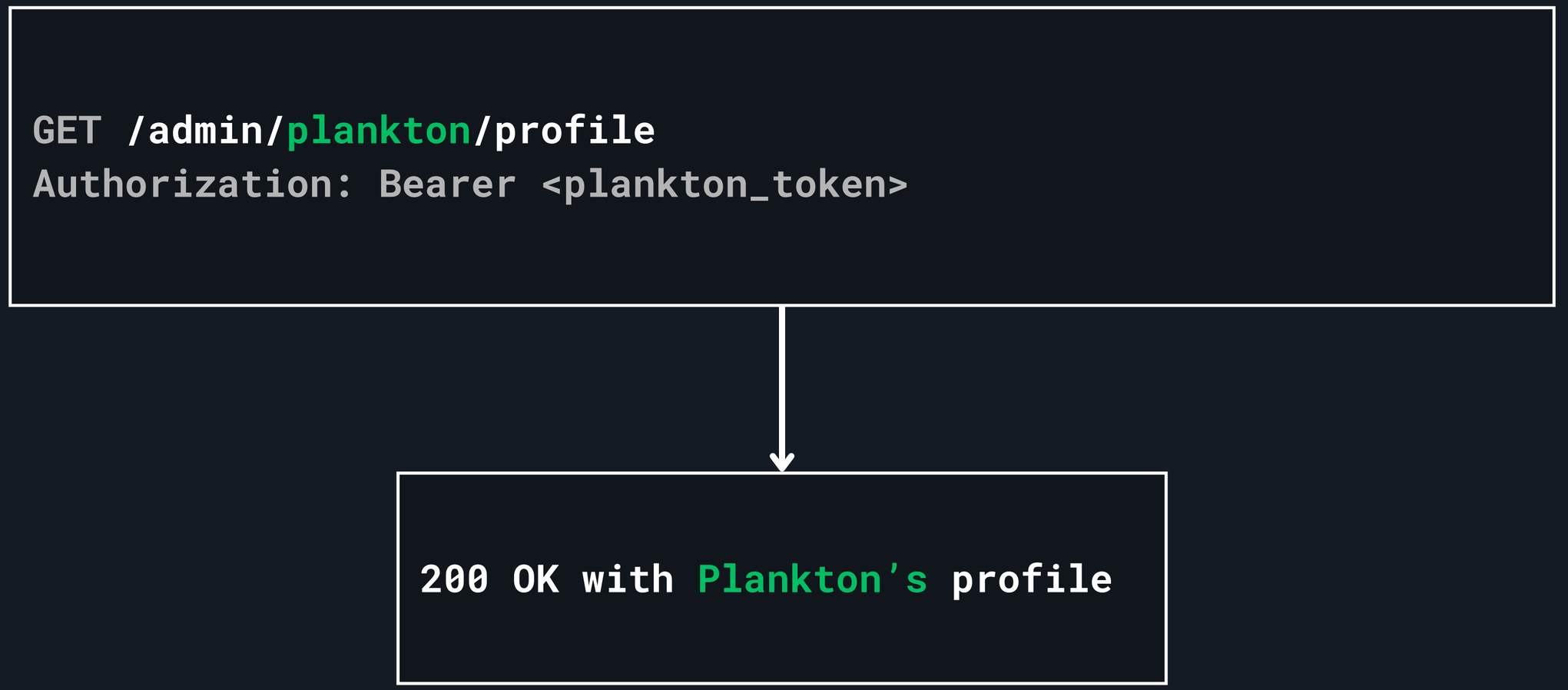
400

Bad Request

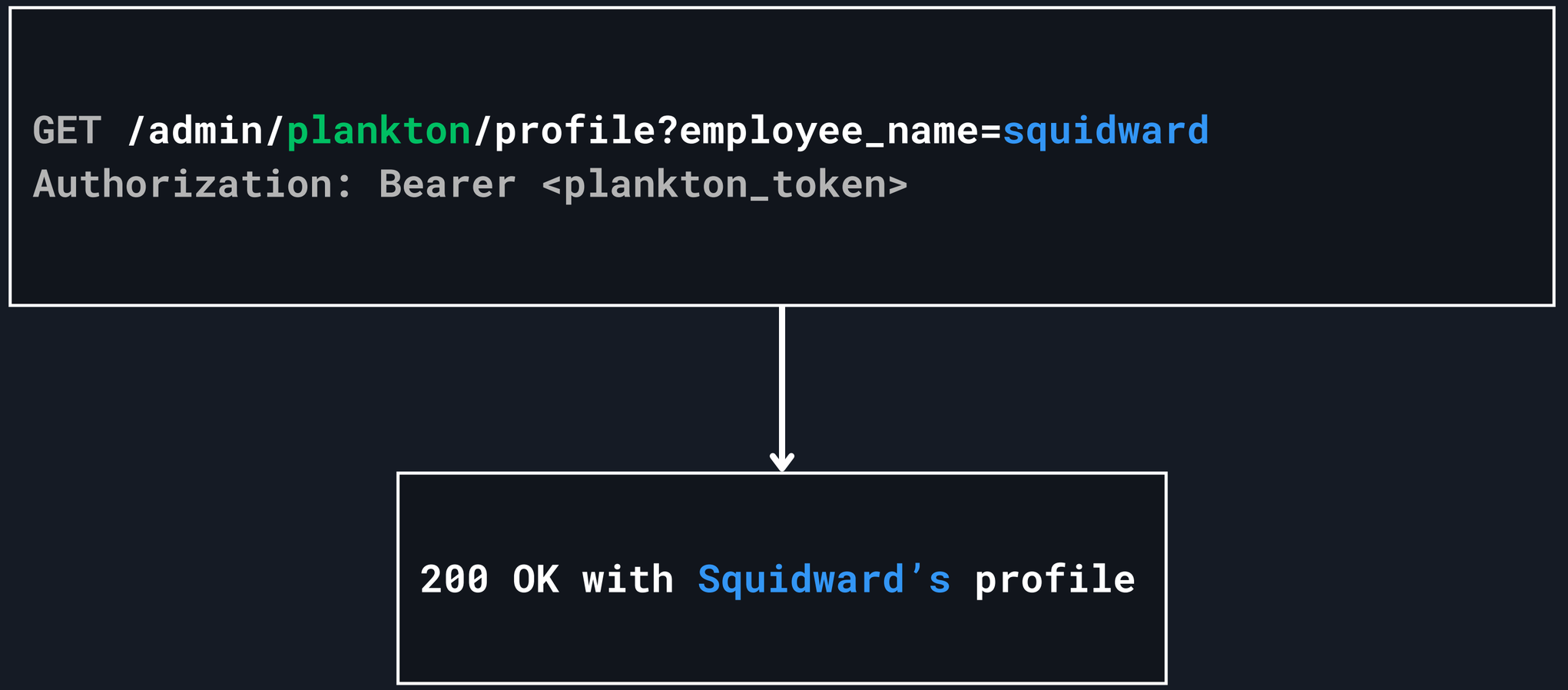
Flask: HTTP Parameter Pollution # Example 2

```
POST /transfer?to=squidward&amount=50&amount=5000
Authorization: Bearer <spongebob_session_token>
```

Flask: Source Precedence # Example 3



Flask: Source Precedence # Example 3



Flask: Authorization Binding Drift # Example 4

```python
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@basic_auth_v2
@check_group_membership_v2
def example3_group_messages(group):
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```

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def basic_auth(f):
  @wraps(f)
  def decorated_basic_auth(*args, **kwargs):
    auth = request.authorization
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authenticate(auth.username, auth.password):
      return response_401()

    g.user = auth.username
    return f(*args, **kwargs)

  return decorated_basic_auth
```

```python
def check_group_membership(f):
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            request.view_args.get("group")

    if group and not is_group_member(g.user,
group):
      return response_403()

    return f(*args, **kwargs)
  return decorated_check_group_memb
```

Flask: Authorization Binding Drift # Example 4

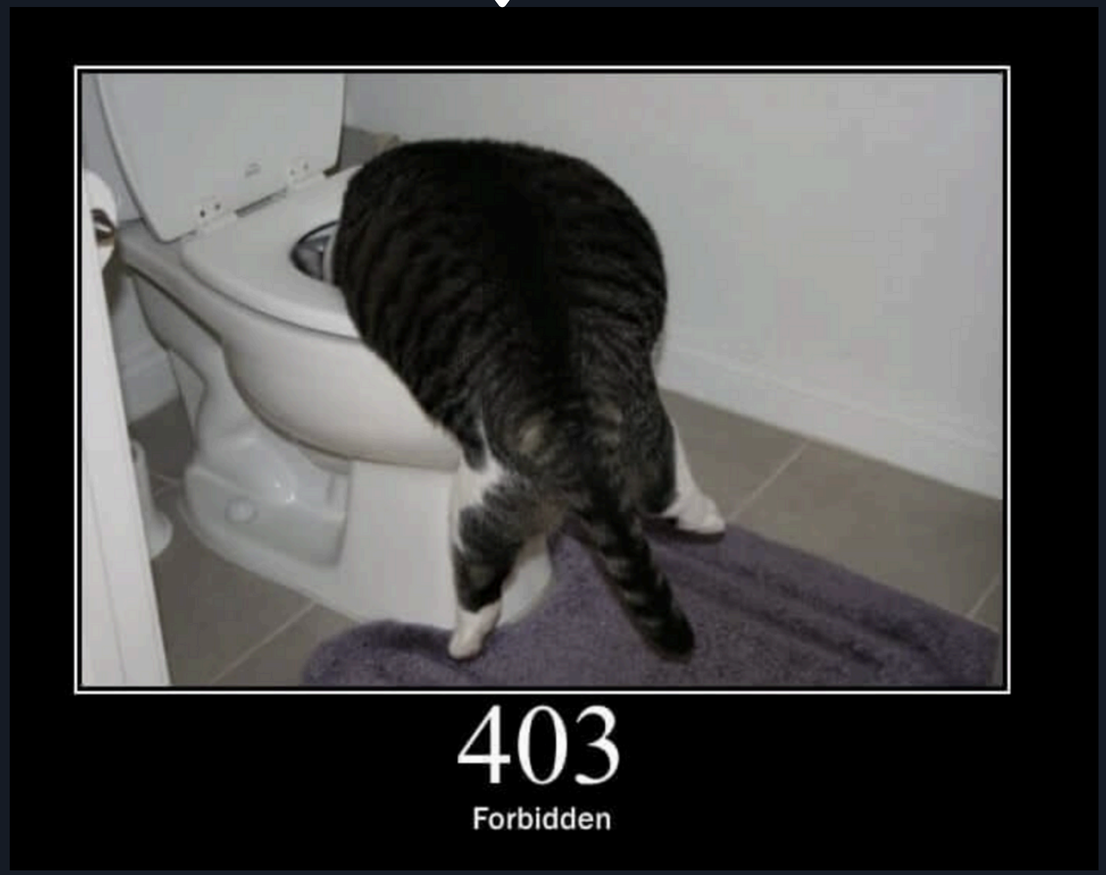
```python
@bp.get("/example3/groups/<group>/messages")
@basic_auth_v2
@check_group_membership_v2
def example3_group_messages(group):
  return get_group_messages(group)
```

`group = request.args.get("group") or request.view_args.get("group")`

```python
    auth = request.authorization
    if not auth or not
authenticate(auth.username, auth.password):
      return response_401()

    g.user = auth.username
    return f(*args, **kwargs)

  return decorated_basic_auth
```

```python
    group = request.args.get("group") or
            request.view_args.get("group")

    if group and not is_group_member(g.user,
group):
      return response_403()

    return f(*args, **kwargs)
  return decorated_check_group_memb
```

```
GET {{base}}/groups/staff@krusty-krab.sea/messages
Authorization: Basic plankton@chum-bucket.sea:burgers-are-yummy
```



```
GET {{base}}/groups/staff@krusty-krab.sea/messages?group=staff@chum-bucket.sea
Authorization: Basic plankton@chum-bucket.sea:burgers-are-yummy
```



```
200 OK:
Returns messages for 'staff@krusty-krab.sea'
```


get_group_messages(group)
GET {{base}}/groups/staff@krusty-krab.sea/messages?
group=staff@chum-bucket.sea
Authorization: Basic plankton@chum-bucket.sea:burgers-
are-yummy
is_group_member(request.args.get("group"))

So, why should I care? 🥱

CherryPy: Same Pattern, Different Syntax

```
class MessageController:
@cherrypy.expose
def messages(self, group):
        group_for_auth = cherrypy.request.params.get(“group”)
        if not is_group_member(cherrypy.request.login,
group_for_auth):
            raise cherrypy.HTTPError(403, "Forbidden")
return get_group_messages(group)
```

CherryPy: Same Pattern, Different Syntax

```
class MessageController:
@cherrypy.expose
def messages(self, group):
        group_for_auth = cherrypy.request.params.get(“group”)
        if not is_group_member(cherrypy.request.login,
group_for_auth):
            raise cherrypy.HTTPError(403, "Forbidden")
return get_group_messages(group)
```

...and more examples also found in Express.js, Ruby on Rails, and PHP...

Django & FastAPI

Django

SECURE BY DESIGN:

- Strictly separates parameter sources.
- Makes source confusion **hard to do by accident.**

FastAPI

SECURE BY DEFAULT:

- Requires explicit declaration of the parameter's source.
- A validation layer enforces this rule **before** your code ever runs.

Some tips on how to avoid Confusion Attacks

1. Be Specific
2. Be Consistent
3. Choose Wisely

Unsafe Code is more than that :)

	Flask	CherryPy	Django	FastAPI	ExpressJS
Confusion	✅	✅	✅	✅	✅
Policy Composition	✅	➡ SOON	➡ SOON	➡ SOON	➡ SOON
Trust Boundary Errors	✅	➡ SOON	➡ SOON	➡ SOON	➡ SOON
Cross-Component Semantics	✅	➡ SOON	➡ SOON	➡ SOON	➡ SOON

and more coming!

Why even bother?

1. Who should care?
2. How it can be used?
3. Can’t I just use AI?

How to contribute?

Oh, it’s so nice of you!!!:)

1. Go to our git and submit your code!!
2. Email me your questions
3. Mention us on your socials

QR code to the git repository

MANY THANKS!

 irina.iarlykanova@gmail.com

 https://github.com/Irench1k/unsafe-code/