Real time sweetness with Django Channels

Python Athens User Group — Thursday 13 June 2019

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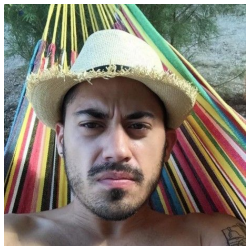
Who am I



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Co-founder of SourceLair (https://lair.io)

Co-organizer of Docker Athens User Group (https://docker.gr)

In love with Python

I love Django. Let's talk Django.

So, what did you think about Jamie Foxx’ performance?

Let's pretend this never happened.

Django

The web framework for perfectionists with deadlines.

- High level Python web framework
- End-to-end solution; handles databases, authentication, user management, HTTP and template rendering (that’s a lot)

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HTTP in Django

- Almost all business logic of the request/response cycle is being implemented in Python functions called **views**
- HTTP requests are being mapped to *views* according to the requested path in the **urls** configuration
- All these are being orchestrated in a **WSGI** entrypoint

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Example view

```
from django.shortcuts import render

def home(request):
    return render(request, "echo/index.html")
```

Example urls configuration

```
from django.urls import path

from echo import views as echo_views


urlpatterns = [
    path('', echo_views.home),
]
```

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WSGI

What the hell is WSGI ?!

WSGI

WSGI is a very rare **Sexually Transmitted Disease** exclusive to Python web developers.

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For real now...

WSGI

WSGI is the Web Server Gateway Interface.

It is a specification that describes how a web server communicates with web applications, and how web applications can be chained together to process one request.

WSGI is a Python standard described in detail in **PEP 3333**.

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Example WSGI application

```
def hello_world(environ, start_response):
    data = b"Hello, World!\n"
    start_response("200 OK", [
        ("Content-Type", "text/plain"),
    ])
    return [data]
```

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Making Django real-time

Limitations of Django for real-time use cases

1. WSGI does not support real-time
2. Real-time semantics are missing from Django

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WSGI design limitations for real-time

- Synchronous implementation
- Does not support background tasks
- Strictly supports only one protocol: HTTP (not WebSocket)

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How do we overcome the limitations of a standard?

...we create another one.

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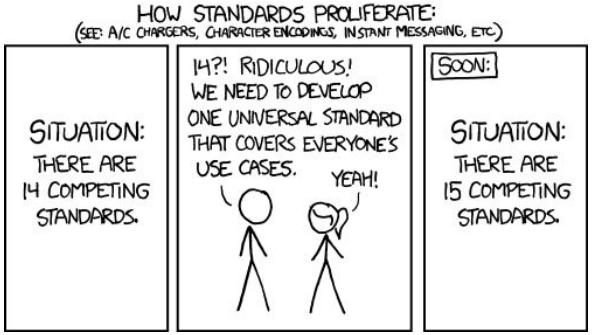

https://xkcd.com/927/

So, how did we overcome the limitations of WSGI?

With **ASGI**.

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ASGI ?!

What the hell is ASGI ?!

ASGI in a nutshell

ASGI is a another **Sexually Transmitted...**

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Enough already with these “jokes”...

ASGI in a nutshell

ASGI is the Asynchronous Server Gateway Interface.

It is a spiritual successor to WSGI, intended to provide a standard interface between async-capable Python web servers, frameworks, and applications.

The ASGI is authored by the Django team: https://github.com/django/asgiref.

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ASGI vs. WSGI

- Multiple protocols: HTTP, HTTP/2, WebSocket
- Asynchronous messaging lifecycle
- In-process background tasks

- Only HTTP
- Synchronous request/response lifecycle
- No background tasks at all

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How does ASGI work?

ASGI is a single, **asynchronous callable**, accepting three arguments:

1. **scope**: Contains details about the incoming connection
2. **send**: An awaitable that lets you send events to the client
3. **receive**: Lets you receive events from the client.

What makes ASGI special?

The design of ASGI:

1. Allows multiple incoming and outgoing events for each application

2. Allows for a background coroutine (e.g. listen for events on an external trigger, like a Redis queue)

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Example ASGI application

```
async def application(scope, receive, send):
    assert scope["type"] == "http"
    await send({
        "type": "http.response.start",
        "status": 200,
        "headers": [
            [b"content-type", b"text/plain"],
        ]
    })
    await send({
        "type": "http.response.body",
        "body": b"Hello, world!",
    })
```

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Another example ASGI application

```
async def application(scope, receive, send):
    event = await receive()
    await send({
        "type": "websocket.send",
        "text": "Hello world!"
    })
```

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Example ASGI message

```
{
    "type": "http.response.start",
    "status": 200,
    "headers": [
        ["content-type",  "text/plain"],
    ]
}
```

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What about real time semantics?

Enter Django Channels

Django Channels (or simply... Channels)

Channels is a project that takes Django and extends its abilities beyond HTTP - to handle WebSockets, chat protocols, IoT protocols, and more.

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Channels semantics for real-time use cases

1. Scopes and Events
2. Consumers
3. Multi-protocol routing

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Scopes

The **scope** is a set of details about a single incoming connection, like:

- The *path* a web request was made from
- The originating *IP address* of a WebSocket
- The *user* messaging a chatbot

The scope persists throughout the connection (HTTP → request/response cycle, WebSocket → socket lifetime)

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Events

Channels applications are instantiated once per scope.

Then, they are fed the stream of events happening within that scope to decide what to do with.

Within the lifetime of a scope the application instance will handle any events from it and persist any event data desired onto the application instance.

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Consumers

A consumer is the basic unit of Channels code.

It is being called a *consumer* as it consumes *events*.

Consumers are valid ASGI applications.

Example consumer

```
from channels.generic.websocket import AsyncJsonWebsocketConsumer

class EchoChamberConsumer(AsyncJsonWebsocketConsumer):
    async def connect(self):
        await self.accept()

    async def receive_json(self, content):
        await self.send_json(content)

    async def disconnect(self, close_code):
        await self.close()
```

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Multi protocol routing

Channels provides routing classes that allow you to combine and stack your consumers (and any other valid ASGI application) to dispatch based on what the connection is.

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Example of multi-protocol routing

```
from channels.routing import ProtocolTypeRouter, URLRouter
from django.conf.urls import url

from echo.consumers import EchoChamberConsumer

application = ProtocolTypeRouter({
    # (http->django views is added by default)
    "websocket": URLRouter([
        url(r"^echo/$", EchoChamberConsumer),
    ]),
})
```

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Running a Channels app

1. Add *ASGI_APPLICATION* to your Django settings (e.g. "myproject.routing.application")
2. Run it in development with.. *python manage.py runserver* (Channels overwrite the Django command)
3. Run it in production with *uvicorn myproject.routing:app*

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Let's get our hands dirty

Let’s create an echo chamber

1. Open a WebSocket
2. Type in a text box
3. Send the letter typed to the server using the WebSocket
4. Send the letter back to the client using the WebSocket

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github.com/parisk/echo-chamber

Okay. I lied.

import antigravity

Thank you!