Getting Started with Django Channels

by Real Python 57 Comments advanced databases django web-dev

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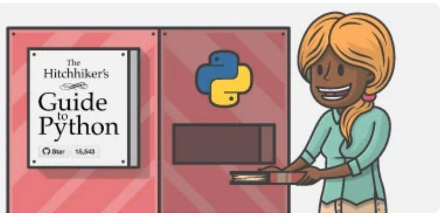


In this tutorial, we will use Django Channels to create a real-time application that updates a list of users as they log in and out.

With WebSockets (via Django Channels) managing the communication between the client and the server, whenever a user is authenticated, an event will be broadcasted to every other connected user. Each user's screen will change automatically, without them having to reload their browsers.

> **NOTE:** We recommend that you have some experience with Django before beginning this tutorial. Also, you should be familiar with the concept of WebSockets.

Our application uses:

- Python (v3.6.0)
- Django (v1.10.5)
- Django Channels (v1.0.3)
- Redis (v3.2.8)

Objectives

By the end of this tutorial, you will be ab

1. Add Web sockets support to a Djan
2. Set up a simple connection betwee
3. Implement basic user authenticati
4. Leverage Django Signals to take ac

Getting Started

First, create a new virtual environment to isolate our project's dependencies:

Shell

```
$ mkdir django-example-channels
$ cd django-example-channels
$ python3.6 -m venv env
$ source env/bin/activate
(env)$
```

Install Django, Django Channels, and ASGI Redis, and then create a new Django project and app:

Shell

```
(env)$ pip install django==1.10.5 channels==1.0.2 asgi_redis==1.0.0
(env)$ django-admin.py startproject example_channels
(env)$ cd example_channels
(env)$ python manage.py startapp example
(env)$ python manage.py migrate
```

NOTE: During the course of this tutorial, we will create a variety of different files and folders. Please refer to the folder structure from the project's repository if you get stuck.

Next, download and install Redis. If you're on a Mac, we recommend using Homebrew:

Shell

```
$ brew install redis
```

Start the Redis server in a new terminal window and make sure that it is running on its default port, 6379. The port number will be important when we tell Django how to communicate with Redis.

Complete the setup by updating `INSTALLED_APPS` in the project's *settings.py* file:

Python

```
INSTALLED_APPS = [
    'django.contrib.admin',
    'django.contrib.auth',
    'django.contrib.contenttypes',
    'django.contrib.sessions',
    'django.contrib.messages',
    'django.contrib.staticfiles',
    'channels',
    'example',
]
```

Then Configure the `CHANNEL_LAYERS` by s

Python

```
CHANNEL_LAYERS = {
    'default': {
        'BACKEND': 'asgi_redis.Redis
        'CONFIG': {
            'hosts': [('localhost',
        },
        'ROUTING': 'example_channels
    }
}
```

This uses a Redis backend which is also needed in production.

WebSockets 101

Normally, Django uses HTTP to communicate between the client and server:

1. The client sends an HTTP request to the server.
2. Django parses the request, extracts a URL, and then matches it to a view.
3. The view processes the request and returns an HTTP response to the client.

Unlike HTTP, the WebSockets protocol allows bi-directional communication, meaning that the server can push data to the client without being prompted by the user. With HTTP, only the client that made a request receives a response. With WebSockets, the server can communicate with multiple clients simultaneously. As we will see later on in this tutorial, we send WebSockets messages using the `ws://` prefix, as opposed to `http://`.

NOTE: Before diving in, quickly review the Channels Concepts documentation.

Consumers and Groups

Let's create our first consumer, which handle the basic connections between the client and the server. Create a new file called *example_channels/example/consumers.py*:

Python

```
from channels import Group


def ws_connect(message):
    Group('users').add(message.reply_channel)


def ws_disconnect(message):
    Group('users').discard(message.reply_channel)
```

Consumers are the counterpart to Django views. Any user connecting to our app will be added to the “users” group and will receive messages sent by the server. When the client disconnects from our app, the channel is removed from the group, and the user will stop receiving messages.

Next, let’s set up routes, which work in almost the same manner as Django URL configuration, by adding the following code to a new file called *example_channels/routing.py*:

Python

```python
from channels.routing import route
from example.consumers import ws_connect, ws_disconnect


channel_routing = [
    route('websocket.connect', ws_cc
    route('websocket.disconnect', ws
]
```

So, we defined `channel_routing` instead consumer functions to WebSockets.

Templates

Let’s write up some HTML that can communicate with our server via a WebSocket. Create a “templates” folder within “example” and then add an “example” folder within “templates” - “example_channels/example/templates/example”.

Add a *_base.html* file:

HTML

```html
<!doctype html>
<html lang="en">
<head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, user-scalable=no, initial-scale=1.0, maximum-scale=1.0,
  <meta http-equiv="X-UA-Compatible" content="ie=edge">
  <link href="//maxcdn.bootstrapcdn.com/bootstrap/3.3.7/css/bootstrap.min.css" rel="stylesheet">
  <title>Example Channels</title>
</head>
<body>
  <div class="container">
    <br>
    {% block content %}{% endblock content %}
  </div>
  <script src="//code.jquery.com/jquery-3.1.1.min.js"></script>
  {% block script %}{% endblock script %}
</body>
</html>
```

And *user_list.html*:

HTML

```html
{% extends 'example/_base.html' %}

{% block content %}{% endblock content %}

{% block script %}
  <script>
    var socket = new WebSocket('ws://' + window.location.host + '/users/');

    socket.onopen = function open() {
      console.log('WebSockets connection created.');
    };

    if (socket.readyState == WebSock
      socket.onopen();
    }
  </script>
{% endblock script %}
```

Now, when the client successfully opens
message print to the console.

Views

Set up a supporting Django view to render our template within *example_channels/example/views.py*:

Python

```python
from django.shortcuts import render


def user_list(request):
    return render(request, 'example/user_list.html')
```

Add the URL to *example_channels/example/urls.py*:

Python

```python
from django.conf.urls import url
from example.views import user_list


urlpatterns = [
    url(r'^$', user_list, name='user_list'),
]
```

Update the project URL as well in *example_channels/example_channels/urls.py*:

Python

```python
from django.conf.urls import include, url
from django.contrib import admin

urlpatterns = [
    url(r'^admin/', admin.site.urls),
    url(r'^', include('example.urls', namespace='example')),
]
```

Test

Ready to test?

Shell

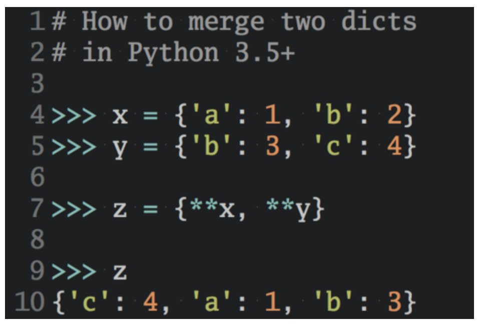
```
(env)$ python manage.py runserver
```

NOTE: You can alternatively run `python manage.py runserver --noworker` and `python manage.py runworker` in two different terminals to test the interface and worker servers as two separate processes. Both methods work!

When you visit http://localhost:8000/, you should see the connection message print to the terminal:

Shell

```
[2017/02/19 23:24:57] HTTP GET / 200
[2017/02/19 23:24:58] WebSocket HAND
[2017/02/19 23:25:03] WebSocket DISC
```



```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

User Authentication

Now that we have proven that we can o
We want a user to be able to log into ou
group. First, we need a way for users to create accounts and log in. Begin by creating a simple login page that will allow a user to authenticate with a username and password.

Create a new file called *log_in.html* within “example_channels/example/templates/example”:

HTML

```
{% extends 'example/_base.html' %}

{% block content %}
  <form action="{% url 'example:log_in' %}" method="post">
    {% csrf_token %}
    {% for field in form %}
      <div>
        {{ field.label_tag }}
        {{ field }}
      </div>
    {% endfor %}
    <button type="submit">Log in</button>
  </form>
  <p>Don't have an account? <a href="{% url 'example:sign_up' %}">Sign up!</a></p>
{% endblock content %}
```

Next, update *example_channels/example/views.py* like so:

Python

```
from django.contrib.auth import login, logout
from django.contrib.auth.forms import AuthenticationForm
from django.core.urlresolvers import reverse
from django.shortcuts import render, redirect


def user_list(request):
    return render(request, 'example/user_list.html')


def log_in(request):
    form = AuthenticationForm()
    if request.method == 'POST':
        form = AuthenticationForm(da
        if form.is_valid():
            login(request, form.get_
            return redirect(reverse(
        else:
            print(form.errors)
    return render(request, 'example/


def log_out(request):
    logout(request)
    return redirect(reverse('example:log_in'))
```

Django comes with forms that support common authentication functionality. We can use the `AuthenticationForm` to handle user login. This form checks the supplied username and password, then returns a `User` object if a validated user is found. We log in the validated user and redirect them to our homepage. A user should also have to ability to log out of the application, so we create a logout view that provides that functionality and then takes the user back to the login screen.

Then update *example_channels/example/urls.py*:

Python

```
from django.conf.urls import url
from example.views import log_in, log_out, user_list


urlpatterns = [
    url(r'^log_in/$', log_in, name='log_in'),
    url(r'^log_out/$', log_out, name='log_out'),
    url(r'^$', user_list, name='user_list')
]
```

We also need a way to create new users. Create a sign-up page in the same manner as the login by adding a new file called *sign_up.html* to "example_channels/example/templates/example":

HTML

```
{% extends 'example/_base.html' %}

{% block content %}
  <form action="{% url 'example:sign_up' %}" method="post">
    {% csrf_token %}
    {% for field in form %}
      <div>
        {{ field.label_tag }}
        {{ field }}
      </div>
    {% endfor %}
    <button type="submit">Sign up</button>
    <p>Already have an account? <a href="{% url 'example:log_in' %}">Log in!</a></p>
  </form>
{% endblock content %}
```

Notice that the login page has a link to the sign-up page, ar

Add the following function to the views:

Python

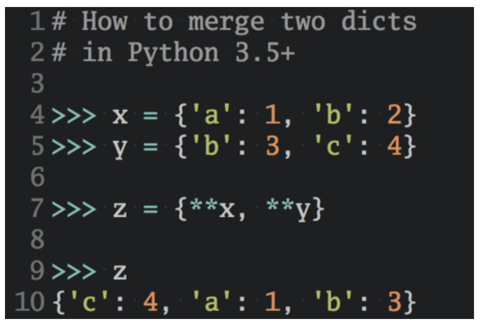
```python
def sign_up(request):
    form = UserCreationForm()
    if request.method == 'POST':
        form = UserCreationForm(data=request.POST)
        if form.is_valid():
            form.save()
            return redirect(reverse('example:log_in'))
        else:
            print(form.errors)
    return render(request, 'example/
```

We use another built-in form for user cre

Make sure to import the form:

Python

```python
from django.contrib.auth.forms impor
```



```python
# How to merge two dicts
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>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

Update *example_channels/example/urls.py* again:

Python

```python
from django.conf.urls import url
from example.views import log_in, log_out, sign_up, user_list


urlpatterns = [
    url(r'^log_in/$', log_in, name='log_in'),
    url(r'^log_out/$', log_out, name='log_out'),
    url(r'^sign_up/$', sign_up, name='sign_up'),
    url(r'^$', user_list, name='user_list')
]
```

At this point, we need to create a user. Run the server and visit `http://localhost:8000/sign_up/` in your browser. Fill in the form with a valid username and password and submit it to create our first user.

> **NOTE:** Try using `michael` as the username and `johnson123` as the password.

The `sign_up` view redirects us to the `log_in` view, and from there we can authenticate our newly created user.

After we log in, we can test our new authentication views.

Use the sign up form to create several new users in preparation for the next section.

Login Alerts

We have basic user authentication working, but we still need to display a list of users and we need the server to tell the group when a user logs in and out. We need to edit our consumer functions so that they send a message right after a client connects and right before a client disconnects. The message data will include the user's username and connection status.

Update *example_channels/example/consumers.py* like so:

Python

```python
import json
from channels import Group
from channels.auth import channel_session_user, channel_session_user_from_http


@channel_session_user_from_http
def ws_connect(message):
    Group('users').add(message.reply_channel)
    Group('users').send({
        'text': json.dumps({
            'username': message.user
            'is_logged_in': True
        })
    })


@channel_session_user
def ws_disconnect(message):
    Group('users').send({
        'text': json.dumps({
            'username': message.user
            'is_logged_in': False
        })
    })
    Group('users').discard(message.reply_channel)
```

Notice that we have added decorators to the functions to get the user from the Django session. Also, all messages must be JSON-serializable, so we dump our data into a JSON string.

Next, update *example_channels/example/templates/example/user_list.html*:

HTML

```
{% extends 'example/_base.html' %}

{% block content %}
  <a href="{% url 'example:log_out' %}">Log out</a>
  <br>
  <ul>
    {% for user in users %}
      <!-- NOTE: We escape HTML to prevent XSS attacks. -->
      <li data-username="{{ user.username|escape }}">
        {{ user.username|escape }}: {{ user.status|default:'Offline' }}
      </li>
    {% endfor %}
  </ul>
{% endblock content %}

{% block script %}
  <script>
    var socket = new WebSocket('ws:/

    socket.onopen = function open()
      console.log('WebSockets connec
    };

    socket.onmessage = function message(event) {
      var data = JSON.parse(event.data);
      // NOTE: We escape JavaScript to prevent XSS attacks.
      var username = encodeURI(data['username']);
      var user = $('li').filter(function () {
        return $(this).data('username') == username;
      });

      if (data['is_logged_in']) {
        user.html(username + ': Online');
      }
      else {
        user.html(username + ': Offline');
      }
    };

    if (socket.readyState == WebSocket.OPEN) {
      socket.onopen();
    }
  </script>
{% endblock script %}
```

On our homepage, we expand our user list to display a list of users. We store each user's username as a data attribute to make it easy to find the user item in the DOM. We also add an event listener to our WebSocket that can handle messages from the server. When we receive a message, we parse the JSON data, find the `<li>` element for the given user, and update that user's status.

Django does not track whether a user is logged in, so we need to create a simple model to do that for us. Create a `LoggedInUser` model with a one-to-one connection to our `User` model in *example_channels/example/models.py*:

Python

```
from django.conf import settings
from django.db import models


class LoggedInUser(models.Model):
    user = models.OneToOneField(
        settings.AUTH_USER_MODEL, related_name='logged_in_user')
```

Our app will create a `LoggedInUser` instance when a user logs in, and the app will delete the instance when the user logs out.

Make the schema migration and then migrate our database to apply the changes.

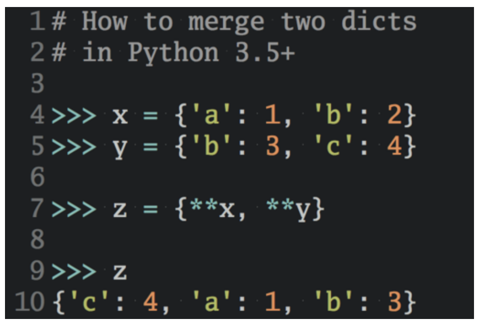
Shell

```
(env)$ python manage.py makemigrations
(env)$ python manage.py migrate
```

Next, update our user list view, in *example_channels/example/views.py*, to retrieve a list of users to render:

Python

```
from django.contrib.auth import get_user_model, login, logout
from django.contrib.auth.decorators import login_required
from django.contrib.auth.forms impor
from django.core.urlresolvers import
from django.shortcuts import render,


User = get_user_model()


@login_required(login_url='/log_in/'
def user_list(request):
    """
    NOTE: This is fine for demonstra
    refactored before we deploy this
    Imagine how 100,000 users loggi
    the performance of this code!
    """
    users = User.objects.select_related('logged_in_user')
    for user in users:
        user.status = 'Online' if hasattr(user, 'logged_in_user') else 'Offline'
    return render(request, 'example/user_list.html', {'users': users})


def log_in(request):
    form = AuthenticationForm()
    if request.method == 'POST':
        form = AuthenticationForm(data=request.POST)
        if form.is_valid():
            login(request, form.get_user())
            return redirect(reverse('example:user_list'))
        else:
            print(form.errors)
    return render(request, 'example/log_in.html', {'form': form})


@login_required(login_url='/log_in/')
def log_out(request):
    logout(request)
    return redirect(reverse('example:log_in'))


def sign_up(request):
    form = UserCreationForm()
    if request.method == 'POST':
        form = UserCreationForm(data=request.POST)
        if form.is_valid():
            form.save()
            return redirect(reverse('example:log_in'))
        else:
            print(form.errors)
    return render(request, 'example/sign_up.html', {'form': form})
```



```
# How to merge two dicts
# in Python 3.5+

>>> x = {'a': 1, 'b': 2}
>>> y = {'b': 3, 'c': 4}

>>> z = {**x, **y}

>>> z
{'c': 4, 'a': 1, 'b': 3}
```

If a user has an associated `LoggedInUser`, then we record the user's status as "Online", and if not, the user is "Offline". We also add a `@login_required` decorator to both our user list and log out views to restrict access only to registered users.

Add the imports as well:

Python

```python
from django.contrib.auth import get_user_model, login, logout
from django.contrib.auth.decorators import login_required
```

At this point, users can log in and out, which will trigger the server to send messages to the client, but we have no way of knowing which users are logged in when the user first logs in. The user only sees updates when another user's status changes. This is where the `LoggedInUser` comes into play, but we need a way to create a `LoggedInUser` instance when a user logs in, and then delete it when that user logs out.

The Django library includes a feature kn
Applications can listen for those notifica
(`user_logged_in` and `user_logged_out`) tc

Within "example_channels/example", ac

Python

```python
from django.contrib.auth import user
from django.dispatch import receiver
from example.models import LoggedInL


@receiver(user_logged_in)
def on_user_login(sender, **kwargs):
    LoggedInUser.objects.get_or_create(user=kwargs.get('user'))


@receiver(user_logged_out)
def on_user_logout(sender, **kwargs):
    LoggedInUser.objects.filter(user=kwargs.get('user')).delete()
```

We have to make the signals available in our app configuration, *example_channels/example/apps.py*:

Python

```python
from django.apps import AppConfig


class ExampleConfig(AppConfig):
    name = 'example'

    def ready(self):
        import example.signals
```

Update *example_channels/example/__init__.py* as well:

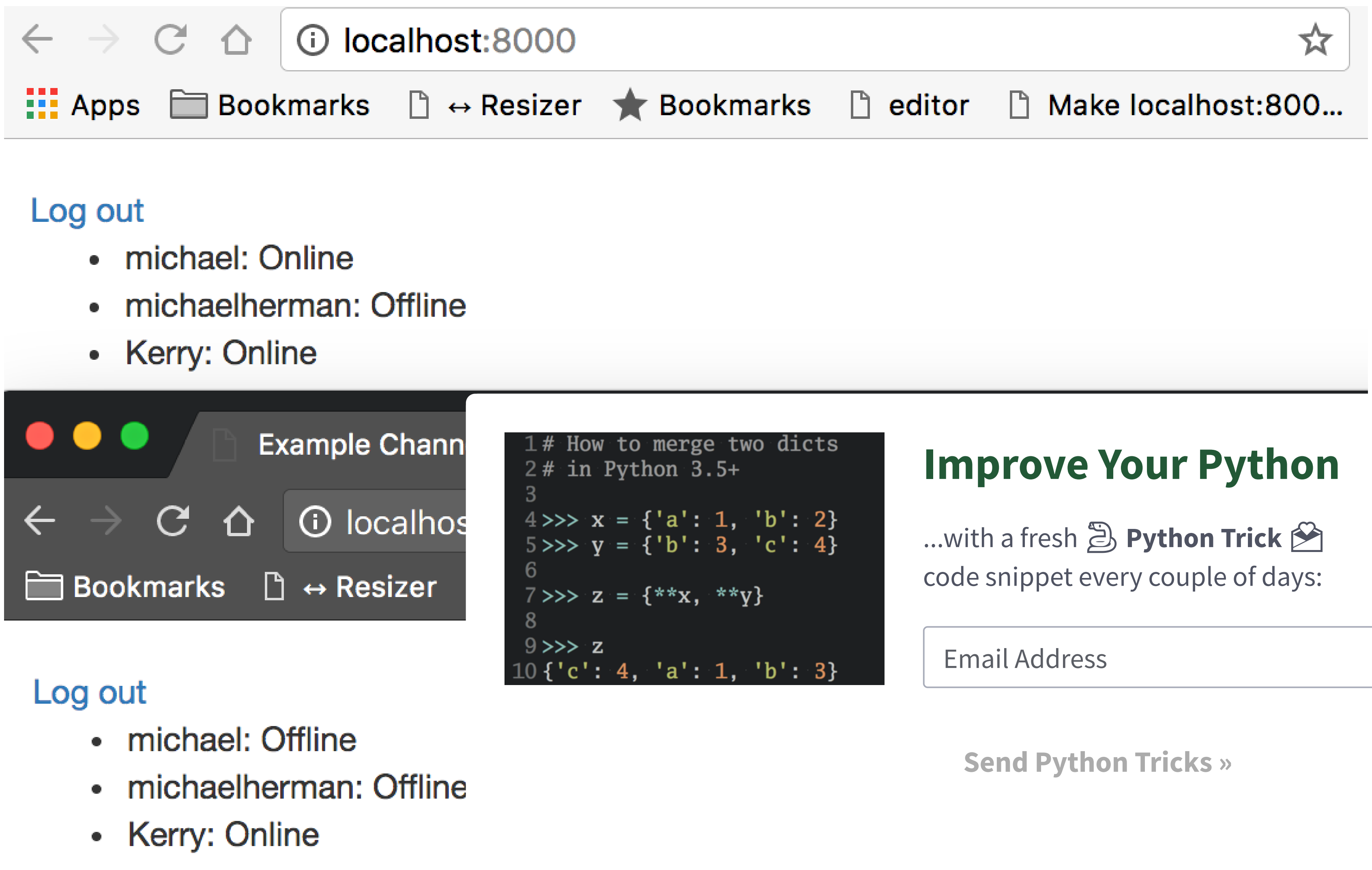
Python

```python
default_app_config = 'example.apps.ExampleConfig'
```

Sanity Check

Now we are finished coding and are ready to connect to our server with multiple users to test our app.

Run the Django server, log in as a user, and visit the homepage. We should see a list of all of the users in our app, each with a status of "Offline". Next, open a new Incognito window and log in as a different user and watch both screens. Right when we log in, the regular browser updates the user status to "Online". From our Incognito window, we see that the user logged in also has a status of "Online". We can test the WebSockets by logging in and out on our different devices with various users.



Log out

- michael: Online
- michaelherman: Offline
- Kerry: Online

Log out

- michael: Offline
- michaelherman: Offline
- Kerry: Online

Observing the developer console on the client and the server activity in our terminal, we can confirm that WebSocket connections are being formed when a user logs in and destroyed when a user logs out.

Shell

```
[2017/02/20 00:15:23] HTTP POST /log_in/ 302 [0.07, 127.0.0.1:55393]
[2017/02/20 00:15:23] HTTP GET / 200 [0.04, 127.0.0.1:55393]
[2017/02/20 00:15:23] WebSocket HANDSHAKING /users/ [127.0.0.1:55414]
[2017/02/20 00:15:23] WebSocket CONNECT /users/ [127.0.0.1:55414]
[2017/02/20 00:15:25] HTTP GET /log_out/ 302 [0.01, 127.0.0.1:55393]
[2017/02/20 00:15:26] HTTP GET /log_in/ 200 [0.02, 127.0.0.1:55393]
[2017/02/20 00:15:26] WebSocket DISCONNECT /users/ [127.0.0.1:55414]
```

NOTE: You could also use ngrok to expose the local server to the internet securely. Doing this will allow you to hit the local server from various devices such as your phone or tablet.

Closing Thoughts

We covered a lot in this tutorial - Django Channels, WebSockets, user authentication, signals, and some front-end development. The main take away is this: Channels extends the functionality of a traditional Django app by letting us push messages from the server to groups of users via WebSockets.

This is powerful stuff!

Think of some of the applications. We can create chat rooms, multiplayer games, and collaborative apps that allow users to communicate in real time. Even mundane tasks are improved with WebSockets. For example, instead of periodically polling the server to see if a long-running task has completed, the server can push a status update to the client when it finishes.

This tutorial just scratches the surface of what we can do with Django Channels, too. Explore the Django Channels documentation and see what else you can create.

Grab the final code from the django-example-channels repo. Cheers!

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# How to merge two dicts
# in Python 3.5+

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>>> y = {'b': 3, 'c': 4}

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```

Email Address

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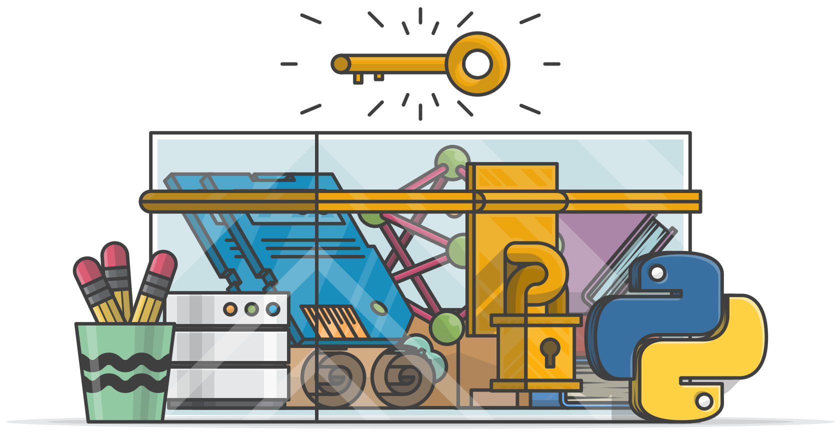

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