

Python Has Power

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Agenda

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Framework

- Application skeleton
- Abstraction, where an apps behaviour is modified by user-written code
- Defines the app structure and mechanisms
- Enforces conventions and often software design patterns



What is Django?

- Open-Source, high level web framework written in Python
- Uses the MVT (Model-View-Template) pattern, very similar to MVC
- BSD License, maintained by Django Software Foundation
- Battery-included
 - Own ORM and templating language
 - Database migrations
 - Included code for authentication and authorization, security, routing, forms, etc.

Short history of Django

- Created by web programmers of Lawrence Journal-World newspaper in 2003
- Publicly released in 2005 (BSD License)
- Transformed to Django Software Foundation in 2008
- **Current stable release: 2.2.1**
 - **Supports Python 3.6, 3.7**
 - The last version to support Python 2.7 is Django 1.11 LTS



Usage

- Great for writing big, monolithic web apps
- Pretty good at writing small API-driven apps
- Used by a lot of companies, including:
 - Instagram,
 - Pinterest,
 - Disqus,
 - OpenStack,
 - Mozilla,
 - Spotify



Project initialization

To make this workshop easy, please use python3 venv throughout our entire project

```
$ sudo apt-get install python3-venv
...
$ python3 -m venv ~/.virtualenvs/php-advanced
...

$ source ~/.virtualenvs/php-advanced/bin/activate

(phi-advanced) $ python --version
Python 3.6.7
```



Install required packages

Let's install Django and all it's basic dependencies

```
(php-advanced) $ pip install Django
Collecting Django
(...)
Successfully installed Django-2.2.1 pytz-2019.1 sqlparse-0.3.0
```

```
(php-advanced) $ pip freeze
Django==2.2.1
pkg-resources==0.0.0
pytz==2019.1
sqlparse==0.3.0
```




Setup the project

Bootstrap a django project using the tools provided with django

```
(php-advanced) $ django-admin startproject php_advanced  
(php-advanced) $
```



Project structure

```
php_advanced/  
  manage.py  
  php_advanced/  
    __init__.py  
    settings.py  
    urls.py  
    wsgi.py
```



Let's start!

Django includes a development server which we'll use throughout this workshop

```
(php-advanced) $ cd php_advanced  
(php-advanced) php_advanced $ python manage.py runserver  
Watching for file changes with StatReloader  
Performing system checks...
```

```
System check identified no issues (0 silenced).
```

```
You have 17 unapplied migration(s). Your project may not work properly until you apply the  
migrations for app(s): admin, auth, contenttypes, sessions.  
Run 'python manage.py migrate' to apply them.
```

```
Django version 2.2.1, using settings 'php_advanced.settings'  
Starting development server at http://127.0.0.1:8000/  
Quit the server with CONTROL-C.
```



Apply migrations

Let's apply the default ones, we'll get back to migrations later

```
(php-advanced) php_advanced $ python manage.py migrate
```

```
Operations to perform:
```

```
  Apply all migrations: admin, auth, contenttypes, sessions
```

```
Running migrations:
```

```
  Applying contenttypes.0001_initial... OK
```

```
  Applying auth.0001_initial... OK
```

```
  Applying admin.0001_initial... OK
```

```
...
```

```
  Applying sessions.0001_initial... OK
```

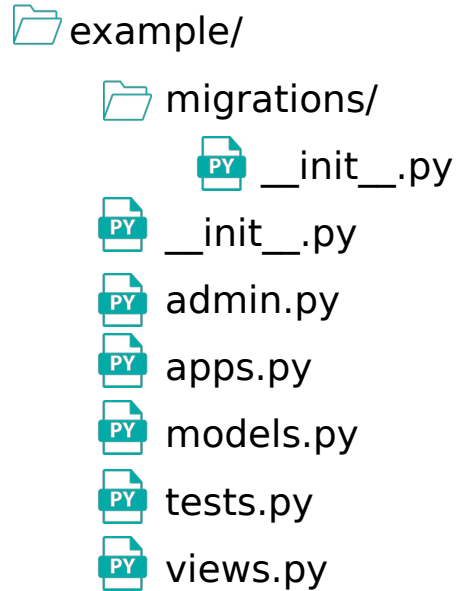


Create an application

Django project consists of smaller django apps and configurations that tie them together

```
(php-advanced) php_advanced $ python manage.py startapp example  
(php-advanced) php_advanced $
```

Default application structure



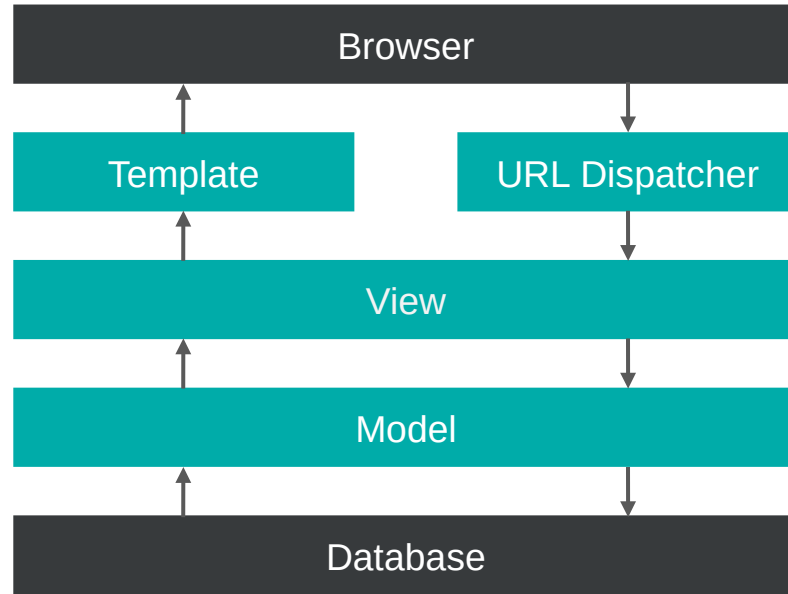


Configuring application

Django needs to know about our application, let's add it to [php_advanced/settings.py](#)

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

Django architecture (basic components)





Urls & views

URL (Uniform Resource Locator)

`http://example.com/post/123/title`

The URL consists of the **Protocol**,
Domain and **Path**.

A view function (or simply: a view) is a function that takes a **web request**, and returns a **web response**.

In its most basic form, it's a function that is pointed at by a defined URL. It should return an instance of **HttpResponse** object (or anything that inherits from it).



Writing a simple view

Let's write a simple “Hello World” view in [example/views.py](#)

```
from django.http import HttpResponse
```

```
def hello_world(request):  
    return HttpResponse('Hello World!')
```



Pointing urls at views

Let's point an url at our view in [php_advanced/urls.py](#)

```
from django.urls import path
from django.contrib import admin

from example import views as example_views

urlpatterns = [
    path('hello', example_views.hello_world),
    path('admin/', admin.site.urls),
]
```



Writing a (less) simple view

Let's write a simple “Hello {name}” view in [example/views.py](#)

```
from django.http import HttpResponse

def hello_world(request):
    return HttpResponse('Hello World!')

def hello_name(request, name):
    return HttpResponse('Hello, {name}!'.format(name))
```



Pointing (another) url at our views

Let's point an url at our view in [php_advanced/urls.py](#)

```
from django.paths import path
from django.contrib import admin

from example import views as example_views

urlpatterns = [
    path('hello', example_views.hello_world),
    path('hello/<str:name>', example_views.hello_name),
    path('admin/', admin.site.urls),
]
```



Models

A [model](#) is a single source of information about your data.

Some basic information:

- Each model is a Python class that inherits from [django.db.models.Model](#)
- Each attribute of the model represents a database field
- If done this way, Django gives you access to an automatically generated database access API



Models

Create your first model in [php_advanced/example/models.py](#)

```
from datetime import datetime
from django.db import models

class GiftList(models.Model):
    name = models.CharField(max_length=64)
    created_on = models.DateTimeField(auto_now_add=True)
    modified = models.DateTimeField(auto_now=True)
    guests = models.IntegerField()

    def __str__(self):
        return f'{self.name} for {self.guests} guests'
```



Migrations

A **migration** is a set of instructions on how to create a database schema based on a model

Create a migration file:

```
(php-advanced) php_advanced $ python manage.py makemigrations example
Migrations for 'example':
  example/migrations/0001_initial.py
    - Create model GiftList
```

and apply it to the database.

```
(php-advanced) php_advanced $ python manage.py migrate
Operations to perform:
  Apply all migrations: admin, auth, contenttypes, example, sessions
Running migrations:
  Applying example.0001_initial... OK
```




Models

Let's extend [php_advanced/example/models.py](#) by adding a new model

```
class Gift(models.Model):
    name = models.CharField(max_length=128)
    gift_list = models.ForeignKey(GiftList, on_delete=models.CASCADE)

    def __str__(self):
        return self.name
```

Model fields

`django.db.models` provides various fields, that are used to represent columns of various data types in the database:

- `models.BooleanField`
- `models.CharField`
- `models.DateTimeField`
- `models.IntegerField`
- `models.TextField`
- `models.ForeignKey`
- `models.ManyToManyField`

Migrations

Don't forget about the migration

```
(php-advanced) php_advanced $ python manage.py makemigrations example
```

```
Migrations for 'example':
```

```
example/migrations/0002_gift.py
```

```
- Create model Gift
```

```
(php-advanced) php_advanced $ python manage.py migrate
```

```
Operations to perform:
```

```
Apply all migrations: admin, auth, contenttypes, example, sessions
```

```
Running migrations:
```

```
Applying example.0002_gift... OK
```



Django admin

Django provides an automatic admin interface. It's enabled by default but you have to create an user to be able to log in.

```
(php-advanced) php_advanced $ python manage.py createsuperuser
Username (leave blank to use 'python-hero'): admin
Email address: admin@example.com
Password:
Password (again):
Superuser created successfully.
```

```
(php-advanced) php_advanced $ python manage.py runserver
```



Django admin

Where are my models? You have to register these in

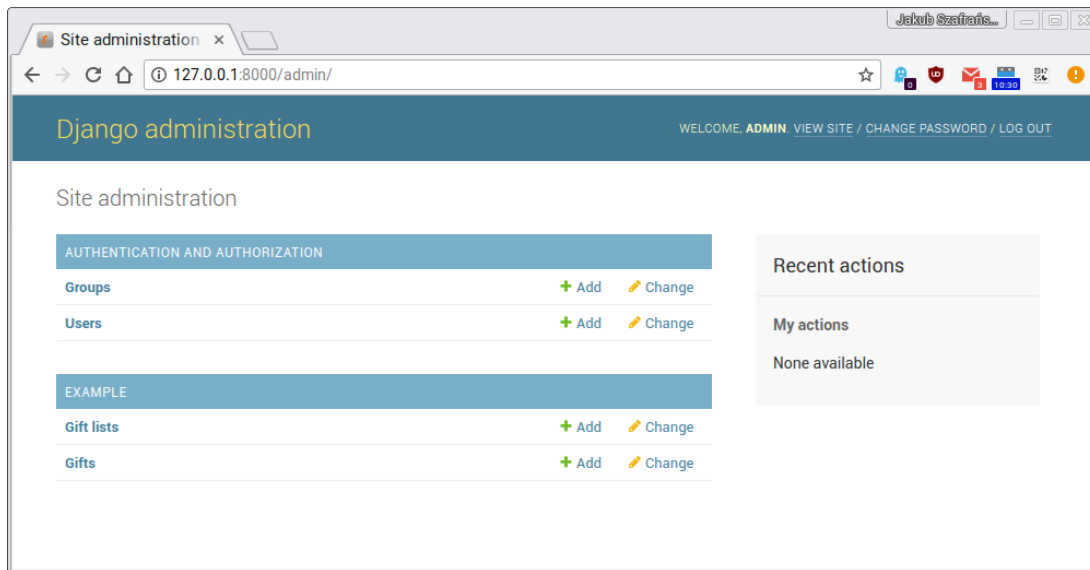
[php_advanced/example/admin.py](#)

```
from django.contrib import admin  
from example.models import GiftList, Gift
```

```
admin.site.register(GiftList)  
admin.site.register(Gift)
```

Django admin

You now should be able to log in to the admin panel at <http://127.0.0.1:8000/admin/>





Nestled forms in Django Admin

Change a little bit of code in [php_advanced/example/admin.py](#)

```
from django.contrib import admin
from example.models import GiftList, Gift

class GiftInline(admin.TabularInline):
    model = Gift
    extra = 1

class GiftListAdmin(admin.ModelAdmin):
    inlines = (GiftInline, )

admin.site.register(GiftList, GiftListAdmin)
admin.site.register(Gift)
```

ORM

Object-relational mapping is a technique used to represent object-oriented architecture to a relational database (or some other system of relational character).

Django ORM gives you access to a rich API that can be used to manipulate data stored in a relational database.



ORM

Let's try out the ORM by using django interactive shell.

First you need import our models:

```
(php-advanced) php_advanced $ python manage.py shell  
(InteractiveConsole)  
>>> from example.models import GiftList, Gift  
>>>
```



ORM

Let's create a GiftList and save it to the database:

```
(php-advanced) php_advanced $ python manage.py shell  
(InteractiveConsole)  
>>> from example.models import GiftList, Gift  
>>> gift_list = GiftList(name='Example Gift List', guests=4)  
>>> gift_list.save()  
>>>
```



ORM

The `.save()` step can be omitted if we use the `.create()` shortcut:

```
(php-advanced) php_advanced $ python manage.py shell
(InteractiveConsole)
>>> from example.models import GiftList, Gift
>>> gift_list = GiftList(name='Example Gift List', guests=4)
>>> gift_list.save()
>>> gift_list2 = GiftList.objects.create(name='Another gift list', guests=7)
>>>
```



ORM

Let's break down what has been done in the interactive shell so far. The following piece of code:

```
gift_list = GiftList(name='Example Gift List', guests=4)
gift_list.save()
```

Does two things: initializes an object, and saves it to the database. After the `save()` method has been called, the object is permanently stored to the database, and can be used by other models in the system.

Each model has a primary key, which can be accessed by the `pk` attribute. An instance will not have a primary key until it's saved to the database.



ORM

In the second case, we've done pretty much the same:

```
gift_list2 = GiftList.objects.create(name='Another gift list', guests=7)
```

We've accessed the `objects` attribute of the `GiftList` class. It's a special property, called a `Manager` - a special interface, through which database query operations are provided to the models.

Each model class has a manager, and you can create your own managers if you need to.

ORM

Let's create a few gifts, and attach them to the gift lists created:

```
(php-advanced) php_advanced $ python manage.py shell
(InteractiveConsole)
>>> from example.models import GiftList, Gift
>>> gift_list = GiftList(name='Example Gift List', guests=4)
>>> gift_list.save()
>>> gift_list2 = GiftList.objects.create(name='Another gift list', guests=7)
>>> gift1 = Gift.objects.create(name='RC Car', gift_list=gift_list)
>>> gift2 = Gift.objects.create(name='Bag of candies', gift_list=gift_list)
>>> gift3 = Gift.objects.create(name='Smartphone', gift_list=gift_list2)
>>> gift4 = Gift.objects.create(name='Game console', gift_list=gift_list2)
>>> gift5 = Gift.objects.create(name='A puppy', gift_list=gift_list2)
```



ORM

Objects can be retrieved by any field that's on the model

```
(php-advanced) php_advanced $ python manage.py shell
(InteractiveConsole)
>>> from example.models import GiftList, Gift
>>> GiftList.objects.get(name='Example Gift List')
<GiftList: Example Gift List for 4 guests>

>>> GiftList.objects.get(name='Nonexistent Gift List')
Traceback (most recent call last):
  File "<console>", line 1, in <module>
  (...)
example.models.DoesNotExist: GiftList matching query does not exist.

>>>
```



ORM

We can filter to get a list of matching objects

```
(php-advanced) php_advanced $ python manage.py shell
(InteractiveConsole)
>>> from example.models import GiftList, Gift
>>> GiftList.objects.filter(name__contains='Gift')
<QuerySet [<GiftList: Example Gift List for 4 guests>, <GiftList: Another gift list for 7 guests>]>

>>>
```




ORM

`QuerySet` is a special data type. Filters can be chained, and will be executed on the database level:

```
(php-advanced) php_advanced $ python manage.py shell
(InteractiveConsole)
>>> from example.models import GiftList, Gift
>>> GiftList.objects.filter(name__contains='Gift')
<QuerySet [<GiftList: Example Gift List for 4 guests>, <GiftList: Another gift list for 7 guests>]>

>>> GiftList.objects.filter(name__contains='Gift') \
...     .filter(name__contains='Example')
<QuerySet [<GiftList: Example Gift List for 4 guests>]>
```



ORM

QuerySets can be used to check for existence and count:

```
(php-advanced) php_advanced $ python manage.py shell
(InteractiveConsole)
>>> from example.models import GiftList, Gift
>>> qs = GiftList.objects.filter(name__contains='Gift')
>>> qs.exists()
True

>>> qs.count()
2
```



ORM

Iterating over a `QuerySet` will yield instances of the model that was retrieved

```
(php-advanced) php_advanced $ python manage.py shell  
(InteractiveConsole)
```

```
>>> from example.models import GiftList, Gift  
>>> qs = GiftList.objects.filter(name__contains='Gift')  
>>> for gl in qs:  
...     print(f'{gl.created_on} - {gl.name}')  
2017-05-09 07:37:50.611498+00:00 - Example Gift List  
2017-05-09 07:37:58.227882+00:00 - Another gift list  
  
>>> gl = GiftList.objects.filter(name__contains='Gift')[0]  
>>> print(gl.name)  
Example Gift List
```

ORM

QuerySets provide various other methods. Some of them are:

- `filter()` - as the name suggests, filters a queryset using provided criteria
- `exclude()` - used to filter-out from a queryset
- `order_by()` - used to change the ordering field of a queryset
- `delete()` - removes every object in a queryset from the database

Full api reference is available at

<https://docs.djangoproject.com/en/2.2/ref/models/querysets/>

Templates

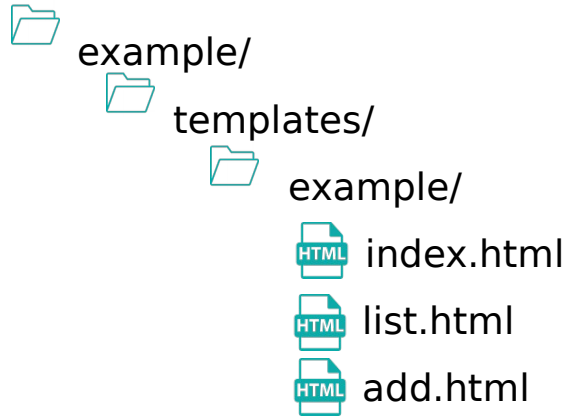
Django's [template engine](#) is a powerful mini-language (DTL) for defining user-facing layer of your application.

Let's render a simple template in [example/views.py](#)

```
from django.shortcuts import render

def hello_world(request):
    return render(request, 'example/index.html', {})
```

Template - folder structure





example/templates/example/index.html

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title>Hello world</title>
</head>
<body>
  <div>Hello world from template</div>
</body>
</html>
```



Templates - simple list view

example/templates/example/list.html

```
<h1>Python Has Power App</h1>
<h2>List of Gifts list</h2>
<ul>
  {% for gfl in gfl_entries %}
    <li>{{ gfl.name }}</li>
  {% endfor %}
</ul>
```

example/views.py

```
def simple_list_view(request):
    gfl_entries = GiftList.objects.all()
    return render(
        request,
        'example/list.html',
        {'gfl_entries': gfl_entries}
    )
```

php_advanced/urls.py

```
path('gift_list_by_func_view', example_views.simple_list_view),
```


Templates - tags and filters

[example/templates/example/list.html](#)

```
<h1>List of Gifts list {{ gfl_entries|length }}</h1>
<ul>
  {% for gfl in gfl_entries %}
    <li>{{ gfl.name|upper }} - {{ gfl.modified|date:'Y-m-d' }}</li>
  {% endfor %}
</ul>
```

[php_advanced/urls.py](#)

<https://docs.djangoproject.com/en/2.2/ref/templates/builtins/>



Templates - class based generic views

Let's build the same page in simpler way [example/views.py](#)

```
from django.views.generic import ListView
```

```
class GiftListView(ListView):  
    model = GiftList  
    template_name = 'example/list.html'  
    context_object_name = 'gfl_entries'
```

[php_advanced/urls.py](#)

```
path('gift_list_by_class_view', example_views.GiftListView.as_view(), name='list_gfl'),
```



Let's add some beauty our application

In terminal type

```
pip install django-bootstrap3
```

in `php_advanced/settings.py` add

```
INSTALLED_APPS = [  
    # ...  
    # do not remove previous apps,  
    # append this line below  
  
    'bootstrap3',  
]
```

in `example/templates/example/list.html`

```
add  
{% load bootstrap3 %}  
{% bootstrap_css %}  
  
<h1>Python Has Power App</h1>  
<div class="panel panel-default">  
    <div class="panel-heading">List of Gift List</div>  
    <div class="panel-body">  
        <ul>  
            {% for gfl in gfl_entries %}  
                <li>{{ gfl.name }}</li>  
            {% endfor %}  
        </ul>  
    </div>  
</div>
```



Extending templates

example/templates/example/

index.html

```
{% load bootstrap3 %}
{% bootstrap_css %}

<body>
  <h1>Python Has Power App</h1>

  <div class="wrapper">
    {% block content %}{% endblock %}
  </div>
</body>
```

example/templates/example/

list.html

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

{% block content %}
  <div class="panel panel-default">
    <div class="panel-heading">List of Gift List</div>
    <div class="panel-body">
      <ul>
        {% for gfl in gfl_entries %}
          <li>{{ gfl.name }}</li>
        {% endfor %}
      </ul>
    </div>
  {% endblock %}
```

Forms

We are able to build our own forms based on templates and views but it is not the best solution!

Django provides “auto” form system (similar to **Models**) which give us:

- automatic validation
- consistency of data
- automatic parsing of data types
- save time
- highly customizable
- own widgets
- less chance of confusion



Forms

Let's create our first form in [example/forms.py](#)

```
from django import forms
from example.models import GiftList

class GiftListForm(forms.ModelForm):
    class Meta:
        model = GiftList
        exclude = ('modified', )
        # fields = (...)
        # fields = '__all__'
```



Forms

We can check our form in shell

```
(php-advanced) php_advanced $ python manage.py shell  
(InteractiveConsole)
```

```
>>> from example.forms import GiftListForm  
>>> gift_list_form = GiftListForm()  
>>> print(gift_list_form)  
<tr><th><label for="id_name">Name:</label></th><td><input type="text" name="name" maxlength="64"  
required id="id_name"></td></tr>  
<tr><th><label for="id_guests">Guests:</label></th><td><input type="number" name="guests" required  
id="id_guests"></td></tr>  
  
>>> print(gift_list_form.as_p())  
<p><label for="id_name">Name:</label> <input type="text" name="name" maxlength="64" required  
id="id_name"></p>  
<p><label for="id_guests">Guests:</label> <input type="number" name="guests" required id="id_guests"></p>
```

Forms

Let's try this in practice!

To add a form we need our the knowledge we acquired today:

- form (extended ModelForm - we already have one)
- view
- template
- url



Create Form

Let's create view for form in [example/views.py](#)

```
from django.views.generic.edit import CreateView
```

```
from example.forms import GiftListForm
```

```
from example.models import GiftList
```

```
class GiftListCreateView(CreateView):  
    model = GiftList  
    form_class = GiftListForm  
    success_url = '/gift_list/add'  
    template_name = 'example/add.html'
```

Create Form

Let's create template in [example/templates/example/add.html](#)

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

```
{% block content %}
```

```
<form method="post">
```

```
    {% csrf_token %}
```

```
    {{ form }}
```

```
    <input type="submit">
```

```
</form>
```

```
{% endblock %}
```

Let's create url in [php_advanced/urls.py](#)

```
urlpatterns = [
```

```
    # add url in urls.py
```

```
    path('gift_list/add/', example_views.GiftListCreateView.as_view(), name='add_gfl'),
```

```
]
```



Edit Form

Let's create view for edit, in [example/views_forms.py](#)

```
from django.views.generic.edit import CreateView, UpdateView
from django.urls import reverse

class GiftListUpdateView(UpdateView):
    model = GiftList
    form_class = GiftListForm
    template_name = 'example/add.html'

    @property
    def success_url(self):
        return reverse('list_gfl')
```

Let's create url for edit, in [php_advanced/urls.py](#)

```
# add url in urls.py
path('gift_list/edit/<int:pk>/', example_views.GiftListUpdateView.as_view(), name='edit_gfl'),
```

Field validator

Let's create our first validator in [example/views_forms.py](#):

```
def clean_name(self):  
    name = self.cleaned_data['name']  
    if 'curse' in name.lower():  
        raise forms.ValidationError('You can not use forbidden words')  
  
    # Always return the cleaned data, whether you have changed it or not.  
    return name
```



Default field validator

```
def clean(self): # main validation function
    super(ContactForm, self).clean()
    cc_myself = self.cleaned_data.get("cc_myself")
    ...
```

```
class SlugField(CharField):
    # using defaults validators
    default_validators = [validators.validate_slug]
```

```
slug = forms.SlugField()
# is equivalent to:
slug = forms.CharField(validators=[validators.validate_slug])
```



Custom field validator

```
# our own field class
```

```
class MultiEmailField(forms.Field):  
    def to_python(self, value):  
        """Normalize data to a list of strings."""  
        # ...  
  
    def validate(self, value):  
        """Check if value consists only of valid emails."""  
        # Use the parent's handling of required fields, etc.  
        super().validate(value)  
        ...
```

Exercise time!

Using knowledge gained on the workshop, create a simple “Gift List” application:

- Ability to add/edit/delete a **Gift List**
 - A list of **Gift Lists**, an add form, an edit form, a delete view
- Ability to add/edit/remove a **Gift** to a **Gift List**
 - When viewing a **Gift List**: a list of **Gifts**, an add form, an edit form, a delete view
- Helpful links:
 - <https://docs.djangoproject.com/en/2.2/topics/http/views/>
 - <https://docs.djangoproject.com/en/2.2/topics/db/models/>
 - <https://docs.djangoproject.com/en/2.2/topics/http/urls/>
 - <https://docs.djangoproject.com/en/2.2/topics/db/queries/>

Tests

Automated testing is an extremely useful bug-killing tool for the modern Web developer. You can use a collection of tests – a test suite – to solve, or avoid, a number of problems:

- When you're writing new code, you can use tests to validate your code works as expected.
- When you're refactoring or modifying old code, you can use tests to ensure your changes haven't affected your application's behavior unexpectedly.



Flashback: simple unit test

Let's remind how a simple unit test looks like in plain Python:

```
import unittest
```

```
class SampleTestCase(unittest.TestCase):  
    def test_simple_function(self):  
        self.assertEqual(some_function(), 123)
```

Testing in Django

In Django, tests can be written in the same way, but usually you'll see usage of

`django.test.TestCase`

```
from django.test import TestCase
from example.models import Gift, GiftList
from example.forms import GiftListForm

class GiftTestCase(TestCase):
    def setUp(self):
        self.gift_list = GiftList.objects.create(name='Christmas presents', guests=4)
        self.gift = Gift.objects.create(name='RC Car', gift_list=self.gift_list)

    def test_max_length(self):
        gf = GiftListForm(data={'name': 'X' * 100})
        self.assertFalse(gf.is_valid())

    def test_initial(self):
        gf = GiftListForm(instance=self.gift_list)
        self.assertEqual(gf.initial['name'], self.gift_list.name)
```



Running tests

Classes inheriting from `django.test.TestCase` should be placed in `app/tests.py`, or in separate files like `app/tests/test_example.py`.

Test suite can be run by invoking `python manage.py test`



Running tests

Example output from running unit tests:

```
$ python manage.py test
```

```
Creating test database for alias 'default'...
```

```
-----
```

```
.....
```

```
.....
```

```
.....
```

```
Ran 427 tests in 17.409s
```

```
OK
```

```
Destroying test database for alias 'default'...
```



THANK YOU :-)

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