CS50's Web Programming with Python and JavaScript

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Django

- Django is a much heavier weight web framework than Flask with a lot more out-of-the-box features that would've had to be built up manually and repetitively with a micro-framework like Flask.

Using Django

- Django divides all of its web applications into 'projects', composed of different parts. To start a new project, run `django-admin startproject projectname` .

Project Components

- Django creates a number of files with a new project:
  - `__init__.py` : defines the directory `projectname` as a Python 'package', a collection of multiple Python files
    - Django is built on the idea of packages. A web application can be made up of multiple packages, each serving a slightly different purpose, and Django will help manage these.
  - `manage.py` : a Python script that can be used to perform useful operations on a web application
  - `settings.py` : basic settings, like time zone, other applications installed in the project, what sort of database is used, etc.
  - `urls.py` : determines what URLs/routes can be accessed when using the web application
  - `wsgi.py` : a file that helps to deploy an application to a web server
  - `project_name/` : the directory for the project that contains all of the above files by default
- A Django project consists of one or more Django applications, or apps, which serves a particular purpose.

A Basic Application

- To create an app, inside the project directory, run `python manage.py startapp appname` . This will create a directory `appname` inside of the project directory. `appname` will contain a number of files automatically.
- Inside of `appname` , `views.py` is analogous to `application.py` for a Flask application. It contains the code that determines what the user sees at a particular route.At first, it will look like this:

```
from django.shortcuts import render

# Create your views here.
```

- All view functions should take the `request` object as an argument. Like in Flask, this object will contain information about what sort of arguments were passed in to the request, etc. A baisc view might just return an simple HTTP response.

```
from django.http import HttpResponse
from django.shortcuts import render

# Create your views here.
```

```
def index(request):
    return HttpResponse("Hello, world!")
```

- That basic view, however, does not specify what route it is at. To do so, a new `urls.py` must be created inside the `appname` directory (this is a different `urls.py` than the project-level file of the same name). Each application will often have its own routes, and these separate `urls.py` help to signal that difference in functionality, keep things organized, and make apps easily reusable in other projects. `appname/urls.py` could look like this:

```
from django.urls import path

from . import views

urlpatterns = [
    path("", views.index),
]
```

- `from . import views` imports `views.py` from the `appname` directory, so that URLs can be linked to views.
- `urlpatterns` is a list of all the URLs supported by this application.
- `""` indicates the empty route.
- When the Django project starts up, it will only check the `urls.py` at the project level. So, the final step before this basic application is actually usable, `appname/urls.py` must be linked to the project's `urls.py`, which starts off with some code in it already.

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

urlpatterns = [
    path("admin/", admin.site.urls)
]
```

- To link the new path, simply add the path to `urlpatterns`:

```
urlpatterns = [
    path("", include("appname.urls")),
    path("admin/", admin.site.urls)
]
```

  - The reason for this apparent complexity is to allow for routing amongst multiple different applications. This `urls.py` serves as the dispatch point for all those lower-level `urls.py` files.

- To run the application, run `python manage.py runserver`.

Flights Revisited

- To demonstrate Django more completely, the next example will reconstruct and expand upon the flight manager application that was originally built with Flask. The project name will be `djangoair`, and it will contain an application called `flights`.
- To start off, `flights/urls.py`:

```
from django.urls import path

from . import views

urlpatterns = [
    path("", views.index),
]
```

  - These urls should be linked to `djangoair/urls.py` in the same way as the previous example.

- `flights/views.py`:

```
from django.http import HttpResponse
from django.shortcuts import render

# Create your views here
def index(request):
    return HttpResponse("Flights")
```

- This application is now at the same point as the previous example. The next step is to add the database. Django was designed for interacting with data, so it makes it very easy to do so. `flights/models.py` looks like this right now:

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

```
# Create your models here
```

- This the file to define the classes which will define the types of data being stored in the database. The information to be contained here is very analagous to the information created with Flask-SQLAlchemy.

- A model for a flight might look like this:

```
class Flight(models.Model):
    origin = models.CharField(max_length=64)
    destination = models.CharField(max_length=64)
    duration = models.IntegerField()
```

  - Inherting `models.Model` just establishes this class as a Django model.
  - Django has a number of built-in types of fields that map to different types of data in a SQL database, for instance.
- Now, as with new URLs, the models must be linked to the Django project. In `djangoair/settings.py`, there is a list called `INSTALLED_APPS`, pre-populated with Django's installed apps. To add the `flights` app, `flights.apps.FlightsConfig` should be added to that list.

```
INSTALLED_APPS = [
    'flights.apps.FlightsConfig',
    'django.contrib.admin',
    'django.contrib.auth',
    'django.contrib.contenttypes',
    'django.contrib.sessions',
    'django.contrib.messages',
    'django.contrib.staticfiles',
]
```

- `FlightsConfig` is the class the defines the settings for the `flights` application.

Migrations

- When building a web application, very rarely will all the tables be defined will all the correct columns from the beginning. Usually, tables are built up as the application grows, and the database will be modified. It would be tedious to change both the Django model code and run the SQL commands to modify the database.
- Django's solution to this problem 'migrations'. Django automatically detects and changes to `models.py` and automatically generates the necessary SQL code to make the necessary changes.
- To create the table for managing flights inside the database, run `python manage.py makemigrations`. This will look through model files for any changes and generate a 'migration', which represents the necessary changes for the database. Running this command will create a file `migrations/0001_initial.py`:

```
# Generated by Django 2.0 on 2018-07-19 22:14

from django.db import migrations, models

class Migration(migrations.Migration):

    initial = True

    dependencies = [
    ]

    operations = [
        migrations.CreateModel(
            name='Flight',
            fields=[
                ('id', models.AutoField(auto_created=True, primary_key=True, serialize=False, verbose_name='ID')
                ('origin', models.CharField(max_length=64)),
                ('destination', models.CharField(max_length=64)),
                ('duration', models.IntegerField()),
            ],
        ),
    ]
```

  - Inside the class `Migration` is a list `operations`, which contains everything that should happen to the database. In this case, the model `Flight` should be created, with fields `id`, `origin`, `destination`, and `duration`.
  - Note that `id` was never specified in `models.py`. Django adds this column by default.
- The command `python manage.py sqlmigrate flights 0001` will produce the SQL code that actually corresponds to this migration. This command doesn't need to be run, but it is helpful in demonstrating what's actually going on. The SQL command is very similar to

This command doesn't need to be run, but it is helpful in demonstrating what's actually going on. The SQL command is very similar to what has been shown before, but it didn't need to be written. It is all generated by Django's migration system.

- To actually apply this migration to the database, run `python manage.py migrate`, which will apply the new migration as well as some default Django ones.

- The database that is actually being used here is defined in `djangoair/settings.py` in the `DATABASES` dictionary. By default, it uses a SQLite 3 (another version of SQL that uses a local file for a database) and the database file `db.sqlite3`.

Django Shell

- Django provides a shell, similar to Python's interpreter, that allows for direct modification of the database. Start the shell by running `python manage.py shell`. Inside the shell, Python commands can be run.
- To create a new flight, the following commands can be run inside the shell.

```
from flights.models import Flight

f = Flight(origin="New York", destination="London", duration=415)
f.save()

Flight.objects.all()
# Returns <QuerySet [<Flight: Flight object(1)>]>
```

  - `f.save()` is analogous to SQL's `COMMIT`.
  - A `QuerySet` is like a list, with added functionality.
- The representation of the `QuerySet` that the shell returns isn't really readable or helpful. To produce a more useful, string representation of a flight, a `__str__` function can be added to `Flight` class in `flights/models.py`.

```
def __str__(self):
    return f"{self.id} - {self.origin} to {self.destination}"
```

  - For any class, not just in Django, a `__str__` function defines what an object should like look when printed, whether to a terminal, an HTML page, etc.
- Back to the shell:

```
Flight.objects.all()
# Returns <QuerySet [<Flight: 1 - New York to London>]>

f = Flight.objects.first()

f
# Returns <Flight: 1 - New York to London>

f.origin()
# Returns 'New York'

f.id
# Returns 1

f.delete()
# Deletes the flight as expected
```

Better Models

- A more robust design for the `Flight` model would have an id field that links to a table of airports instead of just text for origins and destinations. To do so, a new `Airport` model must first be created.

```
class Airport(models.Model):
    code = models.CharField(max_length=3)
    city = models.CharField(max_length=64)

    def __str__(self):
        return f"{self.city} ({self.code})"
```

- Then, the `Flight` model can be modified appropriately, with origin and destination being `ForeignKey`s.

```
class Flight(models.Model):
    origin = models.ForeignKey(Airport, on_delete=models.CASCADE, related_name="departures")
    destination = models.ForeignKey(Airport, on_delete=models.CASCADE, related_name="arrivals")
```

  - Django models allow for specific behavior when an airport, for instance, is deleted. `on_delete=models.CASCADE` means that if an

- Django models allow for specific behavior. When an airport, for instance, is deleted. `on_delete models.CASCADE` means that if an airport is deleted, all flights with that airport as an origin or destination will be deleted as well.
- `related_name` allows for the accessing of all flights departing from or arriving at a particular airport, using the keys `deparatures` or `arrivals`.

- Note that there is no literal definitions of origin and destination as IDs, nor any actual commands for how to associate the two tables. The only things specified is that `origin` and `destination` should be `Airport`s. All of the work to make that happen is left to Django.

- To apply these changes, they must be migrated in the same fashion as before. Now, in the shell, it's a lot easier and more intuitive to create flights.

```
from flights.models import Airport, Flight

jfk = Airport(code="JFK", city="New York City")
lhr = Airport(code="LHR", city="London")
jfk.save()
lhr.save()

f = Flight(origin=jfk, destination=lhr, duration=415)
f.save()

f.origin
# Returns <Airport: New York City (JFK)>

f.origin.code
# Returns 'JFK'

jfk.departures.all()
# Returns <QuerySet [<Flight: 1 - New York City (JFK) to London (LHR)>]>
```

Rendering Templates

- Similar to Flask, in order to render an HTML template, the rendered template should be returned by the function which handles a route. For Django, that's in `flights/views.py`.

```
def index(request)
    return render(request, "flights/index.html")
```

  - The second argument to `render` is simply the path to the template to be rendered.
  - These should be stored in a path like so: `flights/templates/flights/index.html`. Note that `render` takes a path starting from the `template` folder. The apparent redudancy of this path, although not strictly necessary in this example, is good practice to avoid issues where multiples applications might have their own `index.html`.

- `index.html` can be simple for now.

```
<html>
    <head>
        <title>Flights</title>
    </head>
    <body>
        <h1>Flights</h1>
    </body>
</html>
```

- To display information about flights, Django's templating system, which is very similar to Jinja, can be used. Django passes information into a template via the `context` dictionary.

```
from .models import Flight

def index(request)
    context = {
        "flights": Flights.objects.all()
    }
    return render(request, "flights/index.html", context)
```

```
<body>
    <h1>Flights</h1>
    <ul>

        {% for flight in flights %}
            <li>
                {{ flight }}
            </li>
        {% endfor %}

    </ul>
</body>
```

Admin

- Admin is a built in Django app that makes it very easy to add or modify existing data on a web page. Note that this is a task that would require a good bit of code in Flask. This is perhaps one of the most powerful features of Django, especially when it comes to dealing with and manipulating data.
- `flights/admin.py` starts out like this.

```
from django.contrib import admin

# Register your models here.
```

- Adding the `Airport` and `Flight` models is simple.

```
from django.contrib import admin

from .models import Airpot, Flight

# Register your models here.
admin.site.register(Airport)
admin.site.register(Flight)
```

    - This allows the admin app to manipulate airports and flights.
- To access the admin site online, a user must log in. This alone is a task that would be quite tedious in Flask, but again, Django comes with this functionality built-in. The first step is to create a 'superuser' account with access to everything: `python manage.py createsuperuser` . Django will then prompt for a username, email address, and password. This data will then be entered into a users table, entirely taken care of by Django.
- The admin site is already linked by default in the project's `urls.py` at the `admin/` route. On the admin site, a user can log in and manipulate the data. The admin interface is straightforward and easily navigated. Note that this admin interface isn't meant to be used by all users of the website, but rather just content managers to dothings like populate models and add information, whearas users will view that information in a separately rendered page.

Adding More Routes

- To add more routes, for specific flight info, for example, the URLs just need to be added to `flights/urls.py` along with the corresponding view in `flights/views.py` and template in `templates/flights` .

```
urlpatterns = [
    path("", views.index),
    path("<int:flight_id>", views.flight),
]
```

    - The syntax for creating routes that accept arguments is very similar to Flask's.

```
def flight(request, flight_id):
try:
    flight = Flight.objects.get(pk=flight_id)
except Flight.DoesNotExist:
    raise Http404("Flight does not exist")
context = {
    "flight": flight,
}
```

```
    return render(request, "flights/flight.html", context)
```

- Because `flight_id` was parameter in the URL, `flight_id` gets passed to the `flight` view.
- `pk` stands for 'primary key'.

- `DoesNotExist` is a special exception built into Django models.
- `Http404` is another built-in Django feature (imported from `django.http`) that simply raises a 404 error. ``` html

Flight {{ flight.id }}

- Origin: {{ flight.origin }}
- Destination: {{ flight.destination }}

```

- `head` contents can be the same as `index.html` for now. Note the current redundancy in HTML templates.

### Template Inheritance

- Template inheritance for HTML pages works much the same way in Django as in Flask. Here's what a generic template `base.html` could look like:

```
<html>
    <head>
        <title>{% block title %}{% endblock %}</title>
    </head>
    <body>
        {% block body %}
        {% endblock %}
    </body>
</html>
```

- Now, `index.html` and `flight.html` can be simplified.

```
{% extends "flight/base.html" %}

{% block title %}
    Flights
{% endblock %}

{% body block %}
    <h1>Flights</h1>
    <uL>
        {% for flight in flights $}
            <li>
                <a href="{% for flight in flights $}
            <li>
                <a href="{% url 'flight' flight.id %}">{{ flight }}</a>
            </li>
        {% endfor %}
    </ul>
{% endblock %}
```

and

```
{% extends "flight/base.html" %}

{% block title %}
    Flight {{ flight.id }}
{% endblock %}
    <h1>Flight {{ flight.id }}</h1>
    <ul>
        <li>Origin: {{ flight.origin }}</li>
        <li>Destination: {{ flight.destination }}</li>
    </ul>
    <a href="{% url 'index' %}">Back to full listing</a>
{% block body %}
```
```

```
{% endblock %}
```

Model Relationships

- Before, with Flask and SQL, in order to link passengers to flights, there was an flight ID column in the passenger table so that each passenger can be associated with a flight. The problem with this approach is that each passenger can only be on a single flight. What is more desirable is a 'many-to-many' relationship, in which a passenger can be on multiple flights and a flight can have multiple passengers. A common paradigm for this is to implement an 'in-between table', which simply has two columns, one for a passenger ID and one for a flight ID, with as many rows as are necessary. Django allows for this, but does the work of implementing the in-between table automatically.
- The first step is to implement a passenger model in `flights/models.py`.

```
class Passenger(models.Model):
    first = models.CharField(max_length=64)
    last = models.CharField(max_length=64)
    flights = models.ManyToManyField(Flight, blank=True, related_name="passengers")

    def __str__(self):
        return f"{self.first} {self.last}"
```

  - Before, when associating two tables, `models.ForeignKey` was used. `models.ManyToManyField` allows for the desired behavior of a many-to-many relationship.
  - `blank=True` allows for a passenger to be be associated with no flights.
  - Like before, `related_name` allows for the querying of all passengers on a given flight.
- Updating the database as before, with `python manage.py makemigrations` and inspecting the SQL with `python manage.py sqlmigrate flights 0003` reveals code for creating a table `flights_passengers`, as specified, but also a table `flights_passengers_flights`, which was not specified, but is the in-betweent table that was automatically generated.
- After finishing the migration with `python manage.py migrate`, the shell can be used to try out these new models.

```
from flights.models import Flight, Passenger

f = Flight.objects.get(pk=1)
f
# Returns <Flight: 1 - New York City (JFK) to London (LHR)>

p = Passenger(first="Alice", last="Adams")
p.save()

p.flights.add(f)
p.flights.all()
# Returns <QuerySet [<Flight: 1 - New York City (JFK) to London (LHR)>]>

f.passengers.all()
# Returns <QuerySet [<Passenger: Alice Adams>]>
```

- The `flight` view and its corresponding HTML can be updated to now display passenger info.

```
def flight(request, flight_id):
    try:
        flight = Flight.objects.get(pk=flight_id)
    except Flight.DoesNotExist:
        raise Http404("Flight does not exist")
    context = {
        "flight": flight,
        "passengers": flight.passengers.all(),
    }
    return render(request, "flights/flight.html", context)
```

and

```
<h2>Passengers</h2>
<ul>
    {% for passenger in passengers %}
        <li>{{ passenger }}</li>
    {% empty %}
        <li>No passengers</li>
```

```
    {% endfor %}
</ul>
```

- `{% empty %}` executes if `passengers` is empty.

- The `Passenger` model can also be added to admin and modified on the admin application in the same was before.

User Registration

- The first step to creating a web UI for use flight registration might creating a new route, along with a corresponding view and HTML template.

```
urlpatterns = [
    path("", views.index, name="index"),
    path("<int:flight_id>", views.flight, name="flight"),
    path("<int:flight_id>/book", views.book, name="book")
]
```

```
def book(request, flight_id):
    try:
        passenger_id = int(request.POST["passenger"])
        flight = Flight.objects.get(pk=flight_id)
        passenger = Passenger.objects.get(pk=passenger_id)
    except KeyError:
        return render(request, "flights/error.html", {"message": "No selection."})
    except Flight.DoesNotExist:
        return render(request, "flights/error.html", {"message": "No flight."})
    except Passenger.DoesNotExist:
        return render(request, "flights/error.html", {"message": "No passenger."})
    passenger.flights.add(flight)
    return HttpResponseRedirect(reverse("flight", args=(flight_id,)))
```

- This code is written on the assumption that the user will submit a web form via a `POST` request with one argument being named `passenger`.
- A `KeyError` will be raised if either a `POST` request wasn't submitted or the `passenger` argument wasn't provided, leaving no data to be extracted.
- `flights/error.html` will be a new generic template to render any number of error messages.
- `HttpResponseRedirect` (imported from `django.http`) is used to send the user to their flight page after being registered for it.
- `reverse()` (imported from `django.urls`) returns the URL given the route name. Arguments can also be passed as a tuple.

- Assuming that creating a passenger is a separate process from registering a passenger for a flight, when the user goes to register for a flight, they should only be able to select from created passengers. To do so, all the 'non-passengers' on a flight should be passed into the `flight.html` template.

```
def flight(request, flight_id):
    try:
        flight = Flight.objects.get(pk=flight_id)
    except Flight.DoesNotExist:
        raise Http404("Flight does not exist")
    context = {
        "flight": flight,
        "passengers": flight.passengers.all(),
        "non_passengers": Passenger.objects.exclude(flights=flight).all()
    }
    return render(request, "flights/flight.html", context)
```

- `Passenger.objects` returns all passenger objects, which can then be filtered in a variety of ways. `exclude` removes objects with a particular property; in this case, all passengers on the current flight are excluded.

```
{% if non_passengers %}
    <h2>Add a Passenger</h2>
    <form action="{% url 'book' flight.id %}" method="post">
        <select name="passenger">
            {% for passenger in non_passengers %}
                <option value="{{ passenger.id }}">{{ passenger }}</option>
            {% endfor %}
        </select>
        <input type="submit" value="Book Flight" />
    </form>
{% else %}
    <div>No passengers to add.</div>
```

```
{% endif %}
```

- The enclosing `if` block only allows for registration if there is someone to register.

- Here, the `passenger select` element is the corresponding data that's being sent back to the `book` view, and inside `passenger` is `passenger.id`, which is what is expected.

Cross-Site Request Forgery

- Although the booking functionality looks nearly complete, when the registration form is submitted, Django will not allow the user to be redirected to their flight page, and will instead produce a 403 Forbidden error: `CSRF verification failed. Request aborted.` CSRF (Cross-Site Request Forgery) is a potential security vulnerability in forms whereby someone could forge where the form is coming from. Django is built in to protect these type of attacks. To allow for this nonetheless, a little bit of extra syntax must be added whenever dealing with a form in Django.

```
<form action="{% url 'book' flight.id %}" method="post">
    {% csrf_token %}
    <select name="passenger">
        {% for passenger in non_passengers %}
            <option value="{{ passenger.id }}">{{ passenger }}</option>
        {% endfor %}
    </select>
    <input type="submit" value="Book Flight" />
</form>
```

- When the form is submitted, a CSRF token is submitted with it to allow Django to verify that is indeed the same web application is submitting the request.

Modifying Admin

- Django's admin interface can be extended to allow for custom behavior. Returning to the flights example, here's how `flights/admin.py` could be modified.

  ```
  from django.contrib import admin

  from .models import Airport, Flight, Passenger

  # Register your models here.

  class PassengerInline(admin.StackedInline):
      model = Passenger.flights.through
      extra = 1

  class FlightAdmin(admin.ModelAdmin):
      inlines = [PassengerInline]

  class PassengerAdmin(admin.ModelAdmin):
      filter_horizontal = ("flights",)

  admin.site.register(Airport)
  admin.site.register(Flight, FlightAdmin)
  admin.site.register(Passenger, PassengerAdmin)
  ```

B

- Because the `Flights` model does not have a reference to `Passengers`, managing the flights on the admin app does not allow for the addition or removal of passengers in the same way that flights can be added or removed to a passenger. This can be solved by creating the `PassengerInline` class, which inherits from the built-in class `StackedInline` that allows for the addition of new relationships between objects. `PassengerInline` represents the place in the UI where a flight's passengers can be modified.
- `Passenger.flights.through` refers to the in-between table linking flights and passengers. By setting `model` to this in-between table, that table is associated with `PassengerInline`.
- `extra = 1` sets the number of passengers which can be edited at a time to 1.
- `FlightAdmin` is a new class which inherits from `ModelAdmin`, and contains a special set of configurations only to be used when editing passengers. These settings are applied by passing `FlightAdmin` to `admin.site.regiser.`
- `inlines` contains all additional inline modification sections for the admin page, which in this case only contains `PassengerInline`.
- `filter_horizontal` helps to manipulate what flights a passenger is on. It simply allows for an additional UI element on the admin

app to make it easy to add or remove flights that a passenger is on.

Static Files

- To use external static files, like `.css` or `.js` files, some special Django syntax has to be used. A base template with static files might look like this:

```
{% load static %}

<!DOCTYPE html>
<html>
    <head>
        <title>{% block title %}{% endblock %}</title>
        <link rel="stylesheet" href="{% static 'flights/styles.css' %}"/>
    </head>
    <body>
        {% block body %}
        {% endblock %}
    </body>
</html>
```

```
* `{% load static %}` allows for the use of static files.
* Any static file must have its `href` formattaed as `"{% static 'path/static.css' %}"`. * Inside of the application d
```

Login and Authentication

- Authentication and Authorization is a built-in app designed to handle users accounts and log-in functionality. This last example features this account system in an app called `users`. `users/urls.py` looks like this:

```
from django.urls import path

from . import views

urlpatterns = [
    path("", views.index, name="index"),
    path("login", views.login_view, name="login"),
    path("logout", views.logout_view, name="logout")
```

- `users/views.py`:

```
from django.contrib.auth import authenticate, login, logout
from django.http import HttpResponse, HttpResponseRedirect
from django.shortcuts import render
from django.urls import reverse

# Create your views here.

def index(request):
    if not request.user.is_authenticated:
        return render(request, "users/login.html", {"message": None})
    context = {
        "user": request.user
    }
    return render(request, "users/user.html", context)

def login_view(request):
    username = request.POST["username"]
    password = request.POST["password"]
    user = authenticate(request, username=username, password=password)
    if user is not None:
        login(request, user)
        return HttpResponseRedirect(reverse("index"))
    else:
        return render(request, "users/login.html", {"message": "Invalid credentials."})

def logout_view(request):
    logout(request)
    return render(request, "users/login.html", {"message": "Logged out."})
```

- `django.contrib.auth` is Django's authentication package, which contains the `User` model, along with the functions `authenticate`, `login`, and `logout`.

- `request.user.is_authenticated` is `true` if the user has logged in. If they aren't logged in, they are redirectd to the login page. If they are, the user is directed to their user page.
- `login_view` first checks that a user exists with `authenticate`, which takes the user's username and password and returns that user object.
- `login` takes a user and logs them into the authentication system.
- `logout` simply logs the user out.

- `login.html`:

```
{% block body %}
<h1>Login</h1>
{% if message %}
    <div>
        {{ message }}
    </div>
{% endif %}
<form action="{% url 'login' %}" method="post">
    {% csrf_token %}
    <input name="username" type="text"/>
    <input name="password" type="password"/>
    <input type="submit" value="Login"/>
</form>
{% endblock %}
```

- `user.html`:

```
{% block body %}
<h1>Hello, {{ user.first_name }}</h1>
<ul>
    <li>Currently logged in as: {{ user.username }}</li>
    <li><a href="{% url 'logout' %}">Logout</a></li>
</ul>
{% endblock %}
```

- The `User` contains fields such as `first_name`, `last_name`, `username`, etc., but can also be extended.
- Registering a new user entails adding a new user to the database. This can be done through the admin interface with a superuser account or using the shell:

  ```
  from django.contrib.auth.models import User

  user = User.objects.create_user("alice", "alice@something.com", "alice12345")

  user.first_name = "Alice"

  user.save()
  ```

- `create_user` takes the arguments username, e-mail, password.