DJ4E (https://www.dj4e.com)

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Building and Loading a Data Model

Instructor 

In this assignment you will temporarily step away from building the applications and develop a data model from a file of un-normalized data and then build a script to load data in to that model. It is quite common to build a web site and then need to pre-load it with data from a file or API.

The data is a simplified extraction of the UNESCO World Heritage Sites registry. The un-normalized data is provided as both a spreadsheet and a CSV file:

CSV Version

XLS Version

The columns in the data are as follows:

```
name,description,justification,year,longitude,latitude,
area_hectares,category,state,region,iso
```

You have to have the CSV data available to run the batch script. If you are using PythonAnywhere to do your homework, you can use the `wget` command to pull in the data (see below).

Getting Started

We will do this assignment in a new Django project called `batch` so as not to disturb your other work.

```
cd ~/django_projects
django-admin startproject batch
```

Make new application under your `django_projects/batch` called `unesco` .

```
cd ~/django_projects/batch
python manage.py startapp unesco
```

You need to copy the CSV file into the `unesco` folder. If the `wget` command is available you can use it to download the file:

```
cd unesco
wget https://www.dj4e.com/assn/dj4e_load/whc-sites-2018-clean.csv
```

Also make a folder called `scripts` and add an `__init__.py` file to it. The `__init__.py` file is needed in order to store Python objects in the `scripts` folder.

```
cd ~/django_projects/batch
mkdir scripts
touch scripts/__init__.py
```

Make a copy of the `many_load.py` from this folder into your `scripts` folder:

https://github.com/csev/dj4e-samples/tree/main/scripts

Then in install `django extensions` if you have not already done so:

```
workon django4                    # or django3 (if needed)
pip install django_extensions
```

Add the following line to your `batch/batch/settings.py` :

```
INSTALLED_APPS = [
    'django.contrib.admin',
    'django.contrib.auth',
    'django.contrib.contenttypes',
...
    'django_extensions', # Add
    'unesco.apps.UnescoConfig',  # Add
]
```

At this point you should run:

```
python manage.py check
```

And make sure that your basic Django environment is configured properly.

Design a Data Model

We need to design a database model that represents this flat data across multiple tables using "third-normal form" - which basically means that columns that have vertical duplication, such as region:

```
category    state                region                    iso

Cultural    Afghanistan          Asia and the Pacific      af
Cultural    Afghanistan          Asia and the Pacific      af
Cultural    Albania              Europe and North America  al
Cultural    Albania              Europe and North America  al
Cultural    Algeria              Arab States               dz
Mixed       Algeria              Arab States               dz
Cultural    Algeria              Arab States               dz
Cultural    Algeria              Arab States               dz
```

In order to simplify the assignment, we have done the model design for you and spread the data across five tables linked together with one-to-many relationships.

The result of the database design exercise is the following `models.py` file. It uses foreign keys to link the tables together. You can add this file in `batch/unesco/models.py` :

```
from django.db import models

class Category(models.Model):
    name = models.CharField(max_length=128, default="")
    def __str__(self) :
        return self.name

class State(models.Model):
    name = models.CharField(max_length=128, default="")
    def __str__(self) :
        return self.name

class Iso(models.Model):
    name = models.CharField(max_length=128, default="")
    def __str__(self) :
        return self.name

class Region(models.Model):
    name = models.CharField(max_length=128, default="")
    def __str__(self) :
        return self.name

class Site(models.Model):
    name = models.CharField(max_length=300)
    year = models.IntegerField(null=True)
    latitude = models.FloatField(null=True)
    longitude = models.FloatField(null=True)
    description = models.TextField(null=True)
    justification = models.TextField(null=True)
    area_hectares = models.FloatField(null=True)
    category = models.ForeignKey("Category", on_delete=models.CASCADE, null=True)
    region = models.ForeignKey("Region", on_delete=models.CASCADE, null=True)
    iso = models.ForeignKey("Iso", on_delete=models.CASCADE, null=True)
    state = models.ForeignKey("State", on_delete=models.CASCADE, null=True)

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

Since we have given you the data model, in order to better understand the data model, as an exercise, please draw the model using Crow's-Foot Notation. You can use paper, or a layout tool - one way or another your diagram should have five boxes and four lines - and the each of lines should be properly labelled as a "many" or a "one" end.

Once you have put the file in `unesco/models.py` built, run `makemigrations` and `migrate` to create the database.

```
cd ~/django_projects/batch
python manage.py makemigrations
python manage.py migrate
```


Loading Data Into Your Database

Instructor 

Django has a special `runscript` capability that allows you to write a Python program to read and write the database using your Django models.

There is a simple example of how to write such a script in the `dj4e-samples` respository:

Many-to-Many / Data Model

Many-to-Many / Script

Changing the batch script

You will need to copy the `many_load.py` to `unesco/scripts/many_load.py` and then make changes to adapt it from the Membership model/data to the Site model/data. The `many_load.py` file is the sample code from the lecture on this topic - it needs a *quite a few* of changes to make it work with your `Site` data model. We outline the kinds of changes that are needed below:

(1) You need to change the name of the file that the sample script opens and reads to the file that you downloaded and installed.

(2) In the example code, before the loop to read the data is executed, we empty out the database using statements like:

```
Person.objects.all().delete()
```

For your code you will want to empty out all the models / tables with statements like:

```
Category.objects.all().delete()
```

(3) In order to create the entries in each of the lookup tables so you can point to them using foreign keys, the sample `many_load.py` code uses statements like the following:

```
p, created = Person.objects.get_or_create(email=row[0])
```

This code insures that there is a row in the Person table for the email address that was just read `row[0]`. The email address may or may not already be in the table from a previous line in the file. One way or another, by the end of this line of code `p` contains a reference to a Person stored in the database that can be used to fullfill a foreign key refernence later in the code.

Note that the "p, created" is an example of Python function returning two values using a tuple.

For your program you will create the "lookup" entries in each table (Category, Iso, State, and Region) using four statements like:

```
cat, created = Category.objects.get_or_create(name=row[7])
```

(4) In the sample code, once all the lookup objects are created, the sample code creates the Membership entry using the following code.

```
m = Membership(role=r,person=p, course=c)
m.save()
```

The line to create and save the `Membership` row is the last thing that is done so all the foreign key connections can be made because the Person, Course, and Role entries exist and are in the variables p, c, and r respectively.

(5) Your data will be more complex than the sample, You will need to deal with situations where an integer column like the `year` will be empty. The solution is to check the `year` to see if it is a valid integer and if it is not a valid integer set it to `None` which will become `NULL` (or empty) in the data base when inserted.

```
cat, created = Category.objects.get_or_create(name=row[7])

...

try:
    y = int(row[3])
except:
    y = None

...

try:
    lat = float(row[5])
except:
    lat = None

...

site = Site(name=row[0], description=row[1], year=y, ... latitude = lat, ... category=cat ...)
site.save()
```

You will need to do a try / except for each of the numeric fields that might be missing or have invalid data.

At the end you will create the Site object from the lookup objects, cleaned up column data and the string data that goes into the `Site` table.

DJ4E - Running the Script (https://www.dj4e.com/)

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Place the CSV file in the `unesco` folder and then run the script from the project folder (i.e. where the `manage.py` file resides):

```
cd ~/django_projects/batch
workon django4                          # Or django3 (if necessary)
python manage.py runscript many_load
```

Instructor

It needs to be run this way so that lines like:

```
from unesco.models import Site, Iso, ....
```

work properly.

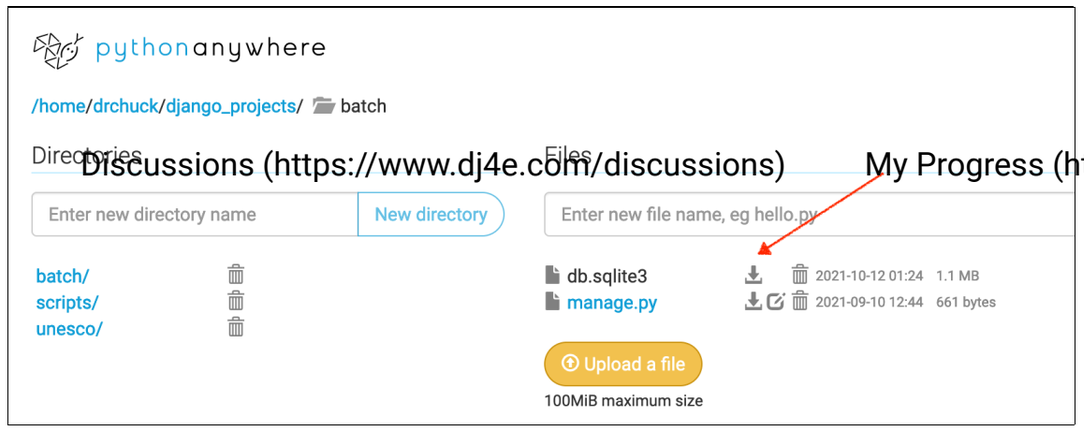
Checking Your Data By Hand

You can also hand-check your data by running a few queries on your data before turning it in to make sure the data makes it into the right tables:

```
$ sqlite3 db.sqlite3
SQLite version 3.24.0 2018-06-04 14:10:15
Enter ".help" for usage hints.
sqlite> SELECT count(id) FROM unesco_state;
163
sqlite> SELECT count(id) FROM unesco_site;
1044
sqlite> SELECT count(id) FROM unesco_state where name="India";
1
sqlite> SELECT count(id) FROM unesco_site WHERE name="Hawaii Volcanoes National Park" AND year=1987 AND area_hectares = 87940.0;
1
sqlite> SELECT COUNT(*) FROM unesco_site JOIN unesco_iso ON iso_id=unesco_iso.id WHERE unesco_site.name="Maritime Greenwich" AND unesco_iso.na
me = "gb";
1
sqlite> .quit
$
```

Upload to the Autograder

When the data passes your manual tests, you can download `db.sqlite3` from PythonAnywhere and then upload it to the autograder.



Resetting Your Database

If the autograder complains that your file is somehow too big, or you have been changing your `models.py` and your `makemigrations` is asking you how to convert existing columns, or you just want to start with a fresh database, you can run the following commands.

```
$ cd ~/django_projects/batch
$ rm db.sqlite3
$ rm */migrations/0*
$ python manage.py makemigrations
$ python manage.py migrate
$ python manage.py runscript many_load
```

Make sure you run these commands in the correct folder (i.e. `~/django_projects/batch`). You can run this process in any Django project but your database is completely reset (i.e. admin and login accounts are deleted as well). This also completely rebuilds your migrations from your latest `models.py` file(s).