Cardiff University
School of Computer Science & Informatics

Flask 2:
Making Blogging Website Dynamic

Lab Objectives

Objectives of this lab are to carry on developing our **Blogging website**, by:

- creating and setting up a **database**;
- adding **individual pages** for blog posts, which are accessed from the home page;

PRELIMINARIES

- As before, this exercise is not assessed, but you should complete all tasks.
- **NB:** It is advisable to do all the work with your virtual environment **activated**.
- Review the **RELIMINARIES** section in Flask 1 instructions - these are relevant to this lab too.

Useful resources	
Snapshots demonstrating code at various points of lab tasks completion:	https://git.cardiff.ac.uk/scmne/flask-labs
Flask Website:	https://flask.palletsprojects.com/en/2.2.x/
Flask Quickstart:	https://flask.palletsprojects.com/en/2.2.x/quickstart/
Flask Tutorial:	https://flask.palletsprojects.com/en/2.2.x/tutorial/
SQLAlchemy Quick Start:	https://flask-sqlalchemy.palletsprojects.com/en/2.x/quickstart/
Also see the 'Useful Resources' section in Flask 1 lab.	

Initial Setup

1. Make sure you have the virtual environment active.

DATABASE (DB)

To add dynamic content and to store our data, we need to set up a database. For this project, we will be using **SQLite** (1), and **Flask-SQLAlchemy** (2) to manage connection to the db (3).

DB SCHEMA

The schema for the db we will be creating in this lab is:

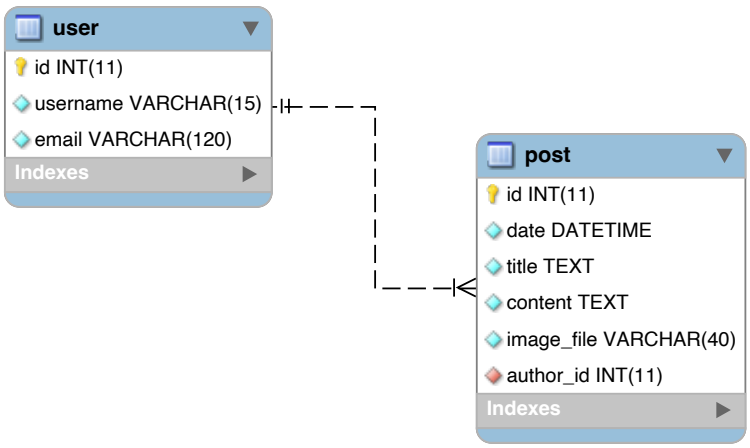

Figure 1: Initial db schema for Blogging website

(1) https://www.sqlite.org/index.html
(2) https://flask-sqlalchemy.palletsprojects.com/en/2.x/
(3) Alternatively, we could use Python's built-in support for SQLite in the `sqlite3` module https://docs.python.org/3.9/library/sqlite3.html. However, this is beyond the scope for these labs, and presents an opportunity for independent learning.

CREATING DB: using GUI

In this section, we will create a db for our Blogging website, using a GUI, namely, **DB Browser for SQLite** [4].

(**NB:** Alternatively, we could create the same database using 'non-GUI', code/CLI method. This is covered at the end of this document in **"Appendix A. 'Non-GUI' Method to create the database"**, but is optional.)

2. Start DB Browser for SQLite.
3. Click on `New Database` button and create a new db named `blog.db` in the ~~root~~ **app** dir of your Blogging website project, i.e. `blog` dir.
4. Create `user` table, based on the schema in Fig. 1.

   (a) Edit `Name` and `Type` columns by double clicking in the appropriate field. There are some 'pre-installed' data types available in the drop down menu - if the one you need is not available you can type these in the field.

   (b) Make sure to select `id` as Primary Key (`PK`).

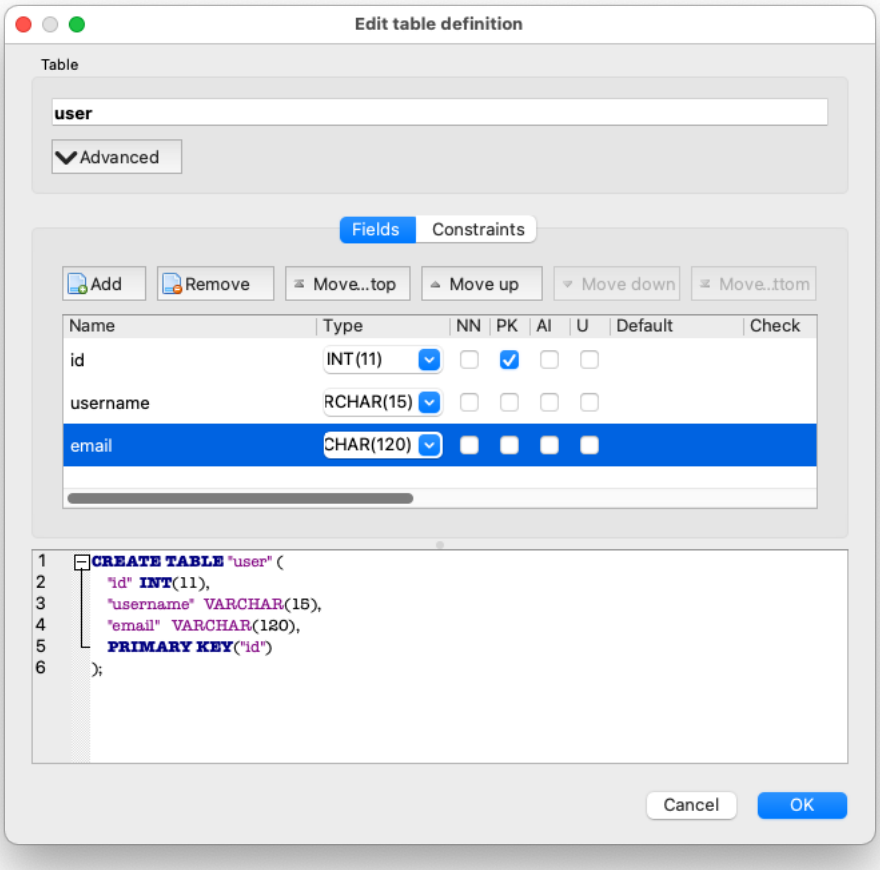

Figure 2: Creation of `user` table

(4) https://sqlitebrowser.org/

(c) Set `UNIQUE` constraint for `username` and `email` (Fig. 3), by selecting relevant checkboxes in `U` column:

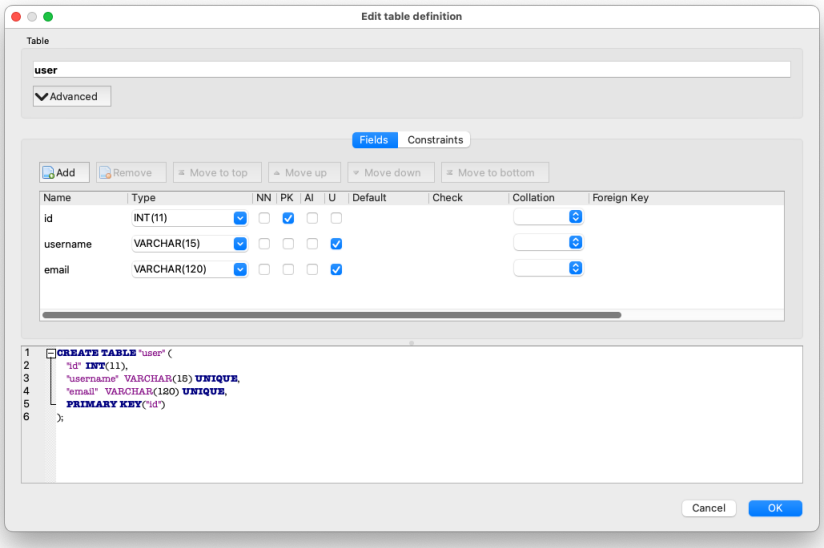

Figure 3: Setting other constraints in `user` table

5. Create `post` table in a similar manner, and make `id` to be the primary key:

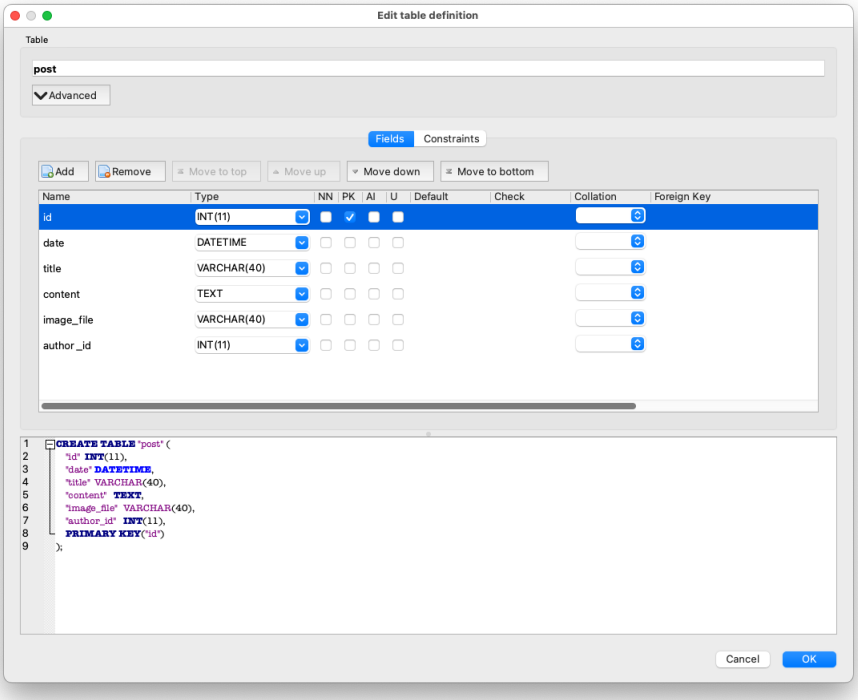

Figure 4: Creation of `post` table

6. Still editing `post` table, set up the foreign key:

(a) Double click the **Foreign Key** column against **author_id**, and select **user** and **id**. The table should now be updated as shown in Fig. 5.

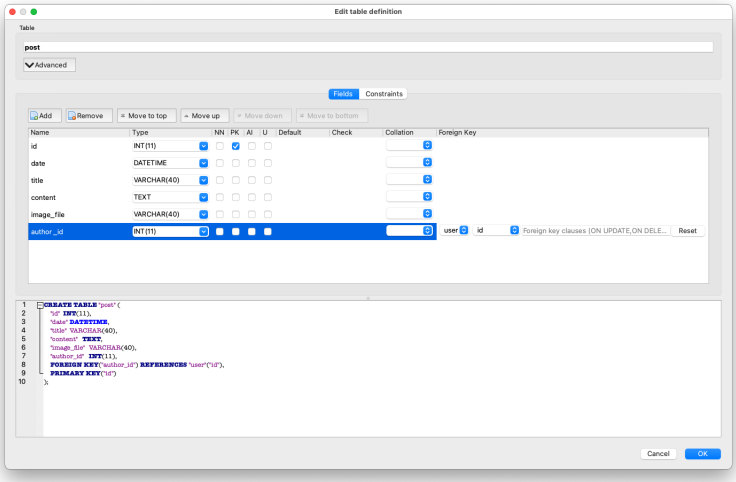

Figure 5: Setting Foreign Key constraint in **post** table

(b) Select **Constraints** tab to check the foreign key constraint has been added to the table (Fig. 6):

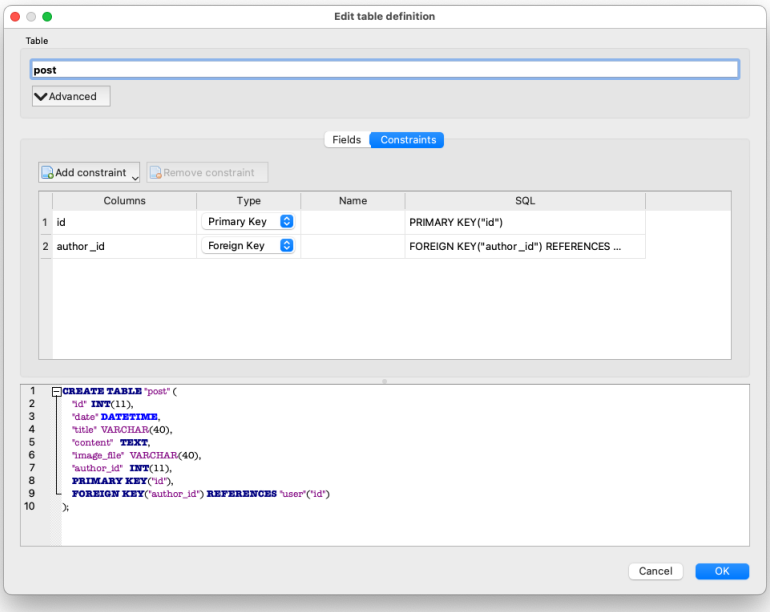

Figure 6: Foreign Key Constraint in **post** table

(c) Set , **date**, **title**, **content** and **image_file** attributes to be **NOT NULL** (Fig. 7):

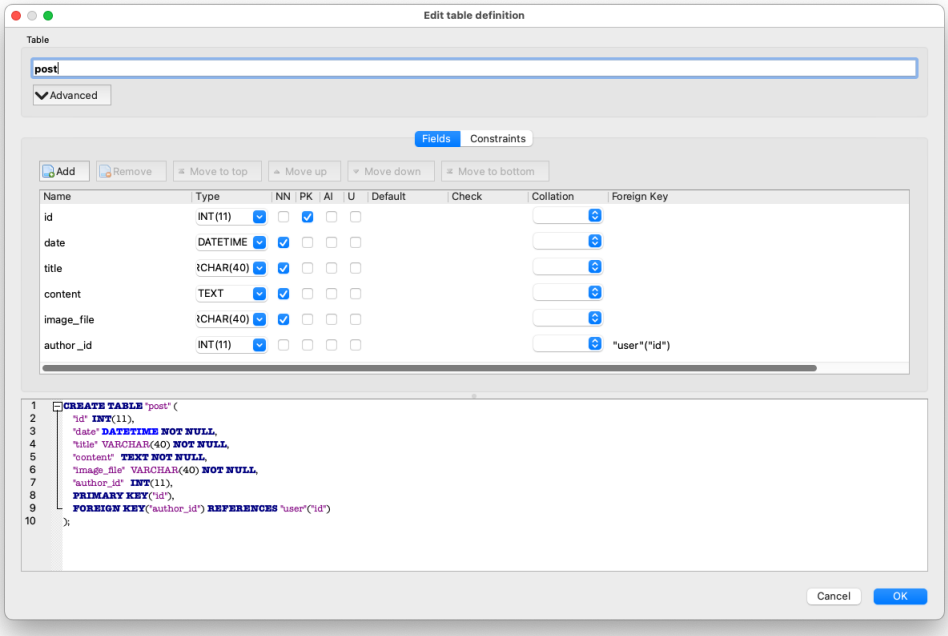

Figure 7: NOT NULL Constraints in `post` table

7. **NB: UPD 1.2:** Select the primary keys, i.e. `id` attribute in both tables to be auto incremented. Alternatively, you can manually add a unique `id` for each record in each table when you start populating your db with data (e.g. when you run SQL `INSERT` commands).

DB MANAGEMENT

Having created the two tables, we can now start populating these with data. We will be using `sqlite3` shell (CLI) to complete the necessary tasks:

8. Firstly, make sure you are in the dir where the `blog.db` is located (e.g. in this lab it's `blog` folder),

9. and then use the following commands:

```
# to start the shell
$ sqlite3
 ...
# check you are in blog dir:
sqlite> .databases
main: PATH_TO_PROJECT_DIR/blog/blog.db r/w
 ...
# use the db:
sqlite> .open blog.db
 ...
# check the tables are present in the db by listing them all:
sqlite> .tables
post  user
  ...
 # describe the tables (db schema):
 sqlite> .schema
```

which should return an output similar to [5]:

```
CREATE TABLE IF NOT EXISTS "post" (
        "id" INT(11),
        "date" DATETIME NOT NULL,
        "title" VARCHAR(40) NOT NULL,
        "content" TEXT NOT NULL,
        "image_file" VARCHAR(40) NOT NULL,
        "author_id" INT(11),
        PRIMARY KEY("id"),
        FOREIGN KEY("author_id") REFERENCES "user"("id")
);
CREATE TABLE IF NOT EXISTS "user" (
        "id" INT(11),
        "username" VARCHAR(15) UNIQUE,
        "email" VARCHAR(120) UNIQUE,
        PRIMARY KEY("id")

);
```

(5) The output you receive depends on your db implementation, e.g. chosen datatypes and constraints)

Populating DB with Data

We can now start populating the db with data.

NB: for the tasks in this section, we will be using `sqlite3` command line interface (CLI). You may use other tools, e.g. an SQLite browser.

10. Make sure you have switch to `blog` dir (where our db is located), and have connected to the db (see Task 9 in the previous section).

11. Populate tables with some data:

    (a) Insert into `user` table:

```
sqlite> INSERT INTO user (username,email) VALUES ('johnsmith','john@smith.com');

sqlite> INSERT INTO user (username,email) VALUES ('janedoe','jane@doe.com');
```

    (b) and into `post` table:

```
sqlite> INSERT INTO post (date,title,content,image_file,author_id)
        ->  VALUES (datetime('now'),'Test post','This is a test post','default.jpg',1);

sqlite> INSERT INTO post (date,title,content,image_file,author_id)
        ->  VALUES (datetime('now'),'Second post','This is the second post','default.jpg',2);
```

    ****
    NB: Data can also be imported in bulk, by using:

```
sqlite> .mode csv
sqlite>.import <FILE> <TABLE>
  -- e.g. '.import c:/flask/project/app/users.csv user'
```

    ****

12. Check the records were successfully inserted into your db. You should get the following output:

```
 sqlite> SELECT * FROM user;
1|johnsmith|john@smith.com
2|janedoe|jane@doe.com

sqlite> SELECT * FROM post;
|2022-11-24 18:21:09|Test post|This is a test post|default.jpg|1
|2022-11-24 18:21:26|Second post|This is the second post|default.jpg|2
```

    ****
    NB: If you run into problems and need to delete data or tables, use the following commands:

```
-- to truncate table (i.e. delete all data from the table but not the table itself):
```

```
sqlite> DELETE FROM <TABLE>;
   -- e.g.
      sqlite> DELETE FROM post;

-- to delete a table (i.e. both, data and table):
sqlite> DROP TABLE <TABLE>;
```

Further comments:

- You can only drop one table at a time.
- The database can be deleted by removing `*.db` file. However, make sure you keep a backup if case you need it.

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DATABASE CONNECTION

13. Check you have **`Flask-SQLAlchemy`** installed and working, and if necessary install it using `pip`: (6)

    ```
    > pip install Flask-SQLAlchemy
    ```

14. Open `__init__.py`, and add DB import and other configurations settings we need to be able to access SQLite database:

    ```
    ...
    import os
    from flask_sqlalchemy import SQLAlchemy
    ...

    basedir = os.path.abspath(os.path.dirname(__file__))

    app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///' +
    ↪  os.path.join(basedir, 'blog.db')

    db = SQLAlchemy(app)
    ...
    ```

(6) **NB**: If you are getting an error message when you use pip to install a python package, you might need to use `--user` option, i.e. `pip install --user <PACKAGE>`.

BLOG POSTS

To be able to show all the posts on our home page, we need to modify `routes.py` and `home.html`:

15. In `routes.py` modify the routing for `home()`:

```
...
def home():
  posts = Post.query.all()
  return render_template('home.html', posts=posts)
...
```

You also need to:

- add imports of: `db` (from `blog`), as well as `User` and `Post` from `blog.models`;
- make sure you have `models.py` in `blog` directory (see Task 27 later on in the document; or copy this file from GitLab's repository).

NB: If in doubt, see the example code provided on GitLab.

16. In `home.html` replace

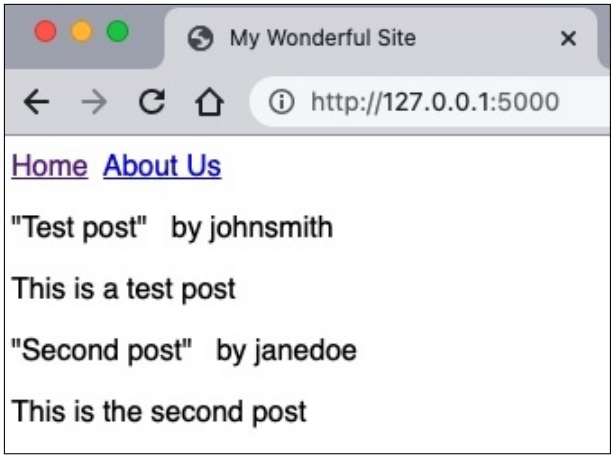
```
...
<h1>Hello, World!</h1>
...
```

with:

```
...
{% for post in posts %}
  <p>"{{ post.title }}"  
        by {{ post.user.username }}</p>
  <p>{{ post.content }}</p>
{% endfor %}
...
```

This tells the server to display all the posts, titles and users, using a `for` loop.

17. Go to the home page and check the home page now displays the data we added to the database, i.e.:



Note: This example does not have any styling - if you applied styling in the previous lab, the content on your page will be displayed differently.

NB: You might need to restart the server for the changes to take effect.

18. Insert few more records in your db and check everything works as intended.

INDIVIDUAL POST PAGES

In our online Blog, each individual post is accessed by using dynamic URLs in the form of `post/<post_id>`, e.g. for the first post in our database with the URL is `post/1`.

To enable our website visitors to access each post's page, we need to:
- create a new `post.html` template,
- and then update `home.html` and `routes.py`.

19. In `blog/templates` dir, create an empty `post.html`, make sure it inherits all the elements of our site's layout (i.e. navigation, etc.), i.e.:

    (a) In `{% block content %}` section of the page, specify that we want the page to display each post's image, content, titles and author (similar to what we did previously in `home.html` page).

```
...
<img src="{{ url_for('static', filename='img/' + post.image_file) }}">
<p>"{{ post.title }}"   Author: {{ post.user.username }}</p>
<p>{{ post.content }}</p>
...
```

20. In `home.html`, update the template in such a way that when the user clicks on a post's title that post's individual page is displayed. This is accomplished by using `a href`, e.g.:

```
...
<a href="{{ url_for('post', post_id=post.id) }}">
...
```

21. Now, we need to update `routes.py` to tell the server where to redirect to `post.html` when the user clicks on the post's title:

```
...
@app.route("/post/<int:post_id>")
def post(post_id):
    post = Post.query.get_or_404(post_id)
    return render_template('post.html', title=post.title, post=post)
```

22. Create `img` subdirectory in the `static` dir. Find a suitable image, name it '`default.jpg`' and put `img`, i.e.:

```
./PROJECT_DIR
|
+---blog
    |
    +---static
        |
        \---img
                default.jpg
```

23. Go to your website to test it works by clicking on a post's title to check that it redirects to that post's page. (*Hint: you might need to restart the server.)*

24. Update `home.html` to also enable the user to click on a post's image to redirect to that post's page.

25. Insert few more records in the db to check everything works as intended.

Further Styling

26. Continue working on further modification of your website to implement a '*look and feel*' you would like it to have, and improve usability, e.g. by adding the top navigation bar accessible from each page.

Appendix A. 'Non-GUI' Method to create the database.

Follow these instructions to learn how to create the database for our Blogging website using alternative, 'non-GUI' method via coding and CLI commands. This is **optional**, but you might find it useful as this method is (arguably) more efficient, and it helps you learn Flask at a more advanced level.

27. Create `models.py` in the `blog` dir, and define two models for `Post` and `User` db tables. Make sure you understand what each line of the code means.

```
from datetime import datetime
from blog import db

class Post(db.Model):
    id = db.Column(db.Integer, primary_key=True)
    date = db.Column(db.DateTime, nullable=False, default=datetime.utcnow)
    title = db.Column(db.Text, nullable=False)
    content = db.Column(db.Text, nullable=False)
    image_file = db.Column(db.String(40), nullable=False, default='default.jpg')
    author_id = db.Column(db.Integer, db.ForeignKey('user.id'), nullable=False)

    def __repr__(self):
        return f"Post('{self.date}', '{self.title}', '{self.content}')"

class User(db.Model):
    id = db.Column(db.Integer, primary_key=True)
    username = db.Column(db.String(15), unique=True, nullable=False)
    email = db.Column(db.String(120), unique=True, nullable=False)
    post = db.relationship('Post', backref='user', lazy=True)

    def __repr__(self):
        return f"User('{self.username}', '{self.email}')"
```

28. Open `routes.py` and add an import for the models

```
...
from blog.models import User, Post
...
```

29. To create DB from models, go to the python shell:

```
> python
>>> from blog import db
>>> db.create_all()
```

30. A db `blog.db` is now created in the app dir, i.e. `blog`.
31. Complete the tasks in **"DB MANAGEMENT"** and **"Populating DB with Data"** sections.

NB: if you get am empty set ('`[]`'), i.e. no tables were created, check you completed Task 28.