Fundamentals of Database Technologies
Coursework assignment 2

Normalisation and connecting to a database using a web app

Technical reports are a key part of a data scientist or business analyst's skills and, in the form of project writeups, grant proposals or analytics reports, can make or break your career. In this assignment, you will discuss database normalisation and create a web app backed by an SQL database.

Formatting criteria **(10 marks)**

- You should submit a single PDF file.
- The report should include an introduction (which gives general background to your report, and gives an overview of what the report covers) and a conclusion (which summarises what you have achieved, and any problems you overcame).
- Each section in your report (including the introduction, the conclusion, and your response to each question) should have a section heading (e.g. **Question 1**) in a larger or bold font and on a separate line.
- Paragraphs of appropriate length should be used to divide your work into coherent sections. Paragraphs should be separated by a blank line or first-line indent (not both) and only a paragraph which follows directly on from another should have a first-line indent.
- If including screenshots, you should crop them to show just the area of the screen you are interested in. Consider making windows smaller before screenshotting them. However, you should not distort the aspect ratio. If your file is larger than 8 MB (the upload limit), you should resize screenshots to reduce their resolution.
- Do not copy parts of the question text into your report.
- Indented lists, nested lists and bullet lists should be avoided. While these are often automatically inserted, they waste space and distract the reader. Lists should be reserved for information which is inherently list-like in nature, e.g. formatting criteria. Your work should be written up using coherent paragraphs of text.
- Do not use the Imperial College logo. College regulations explicitly prohibit the use of the logo on student work (since you do not represent the College).
- Do not capitalise anything except for proper nouns (names of people, tools, etc). In particular, don't capitalise terminology (server, client, etc).

Assignment overview

SQL databases are used to store and manage the data used by web apps. In this assignment, you will create a simple web app using the Flask server in Python and connect it to your local database server, using an object relational mapper (ORM).

You will need to refer to online documentation, Web searching, and sources such as Stack Overflow to do research for this assignment.

If you experience any difficulties, refer to a tutorial on developing a Flask app.

There is also some **sample code** available (see the Files section on Insendi). If you are stuck, you can run the sample code, then **check for differences** between your code and the working sample app (using the **bridge method** - see the document on this method).

If you are still stuck after trying these approaches, please post on EdStem with a **detailed description** of your issue and the error you encountered, including code and/or screenshots.

You **must** use your local database server to avoid damage to the course server.

Introduction **(2 marks)**

Write an introduction to your report, giving context and background to the reader, and explaining the work described in your report.

Question 1 **(6 marks)**

Note: in this question, "describe a table" means to state its name and column names and to give a brief explanation of what the entities in the table are. It is not necessary to show actual table rows or discuss datatypes.

a) Define the following terms, giving an example in each case: functional dependency, candidate key, primary key.

b) Describe a table which is not in first normal form, and explain why. Describe some problems this could cause. Then state what modifications you would have to make to put this table in first normal form.

c) Describe a table which is in first normal form, but not in second normal form, and explain why. Describe some problems this could cause. Then state what modifications you would have to make to put this table in second normal form.

d) Describe a table which is in second normal form, but not in third normal form, and explain why. Describe some problems this could cause. Then state what modifications you would have to make to put this table in third normal form.

Question 2 **(5 marks)**

Create a new database on your local Postgres server, then create a new table there with at least four columns and five rows (you will need to issue the CREATE DATABASE, CREATE TABLE and at least one INSERT statement). Modify your app so that it connects to this new database. Create a new page in your app which lists all the information in this table.

Explain what you did in this step in your own words, and include a screenshot.

Question 3 **(5 marks)**

a) Check whether Flask is installed. If it is not, install Flask using **pip**. If you get stuck, check some examples or try **conda** instead of **pip**.

Explain what you did in this step in your own words, and include a screenshot.

b) Create a folder called **server**. In this folder, save the following as a Python file called **app.py**:

```
from flask import Flask
app = Flask(__name__)

@app.route('/')
def hello_world():
    return 'Hello, World!'
```

Then run this file using the **flask run** command on the command line. You may need to set an environment variable using set or export to get this to work.

The Flask server is now serving a web page. Visit this page in your browser.

Explain what you did in this step in your own words, and include a screenshot.

c) While developing, when we make a change to the code, we want to easily see it in the browser when the page is refreshed.

With the Flask server still running, change ‘Hello, World!’ to something else. Refresh the web page. Is the new value shown?

Configure your Flask environment to automatically reload the code when you change it. (Hint: look up the **FLASK_DEBUG** environment variable).

Explain what you did in this step in your own words, and include a screenshot.

d) To show web pages, Flask uses templates. A template is a file containing hypertext markup language (HTML) code which will eventually be rendered as a web page.

Research how to add a template to your Flask app, then add a simple HTML page.

Explain what you did in this step in your own words, and include a screenshot. Show also all your code.

Question 4 **(5 marks)**

a) Drawing on tutorials and the Flask sample code made available, add Flask-SQLAlchemy to your app. Add a database model for the database table you created previously, then use a template to create a page listing all the rows in this table.

Explain what you did in this step in your own words, and include a screenshot of the app running in the browser. Show also the relevant new code.

b) Modify the page you just created so that Flask-SQLAlchemy is also used to display the number of rows in the table (research the `.count()` function in SQLAlchemy).

Explain what you did in this step in your own words, and include a screenshot. Show also the relevant new code.

Question 5 **(5 marks)**

Research cascading style sheets (CSS), which are used to control the visual appearance of web pages. Use HTML and CSS to add some basic graphic styling to your page. Consider changing the background colour and font; elements on the page could be styled with colours, spacing, border colours, or other styles of your choosing.

You may need to check Flask tutorials to see how to add a style sheet to your web app. Explain what you did in this step in your own words, and include a screenshot. Show also the relevant new code.

Question 6 **(5 marks)**

Drawing upon online resources such as tutorials, create a new page in your app which allows you to add information to your new database table. The page will need a form with several fields and a Submit button. Verify that this page works by adding rows and refreshing the page which displays the contents of your new table.

Explain what you did in this step in your own words, and include a screenshot of the form and a screenshot showing the newly added rows; show also the new code.

Question 7 : Case study **(10 marks)**

You are a consultant in analytics. Describe a situation in which a business could use a web app, backed by a relational database, to aid its operations; then propose a plan to deliver this solution. Your answer should discuss the current situation (before introducing the web app), motivation for the new solution, an implementation strategy, potential problems, and costings.

Conclusion **(2 marks)**

Write a conclusion to your report, explaining the work done and how you resolved any challenges you faced along the way.