

Assignment One: Database Design and Implementation

Weight 15%, marks out of 50

Deadline: 3:30pm (GMT) Mon 22nd Feb 2021

Overview:

The coursework takes the form of a group project. You must register your group on Vision using the group sign up form linked from the Assessment section.

The coursework involves the design of a relational database (using MySQL) for a specified task, that involves the design of an ERD, relational schema, the SQL to generate the relations in MySQL, and indexes.

Groupwork:

Form groups of 5 or 6, then register your group on Vision. Ensure you sign up to the correct campus, and only join a group once you have teammates (i.e. don't sign up to a random group before you've formed a team).

Share the work among the group members, ensuring that everyone has an equal share. All members should contribute to all areas of the coursework as experience gained in these topics will help in the examination.

Ensure that all members of the group have access to the files developed by the group. You can use the collaboration tools on Vision to support this, or other cloud-based system. However, you must ensure that it is secure against other groups gaining access.

Please provide a summary in your report stating the contributions of each group member. If necessary, marks will be adjusted if some students have not participated enough.

Collaboration and Plagiarism:

Coursework reports and code must be the group's own work. If some text or code in the coursework has been taken from other sources, these sources must be properly referenced. Failure to reference work that has been obtained from other sources or to copy the words and/or code of another student is plagiarism¹ and if detected, this will be reported to the School's Discipline Committee. If a group is found guilty of plagiarism, the penalty could involve voiding the course.

Students must never give hard or soft copies of their coursework reports or code to students in another group. Students must always refuse any request from another student not in their group for a copy of their report and/or code. It is expected that all group members will have read and write access to the report and code for their group. Sharing a coursework report and/or code with another group is collusion, and if detected, this will be reported to the School's Discipline Committee. If found guilty of collusion, the penalty could involve voiding the course.

¹ Heriot-Watt guidelines on plagiarism

<https://www.hw.ac.uk/students/studies/examinations/plagiarism.htm>

Scenario:

You have been hired by **HW Marketing**, a global marketing agency, to develop a MySQL database to manage advertising campaigns for their clients. They look after a range of clients running campaigns on their behalf which place adverts on the web, TV, radio and in magazines. Each advertising campaign can use a range of these channels (not necessarily all of them), and has a defined start and end date.

- TV and Radio adverts will be costed according to the advert length (e.g. 15 seconds), broadcast timeslot price band (options: prime time; day; night), station (e.g. ITV, C4, Forth FM) and number of broadcasts (e.g. play advert 5 times).
- Magazine adverts will be costed by the particular magazine targeted, size of advert (as % of the page), position in the magazine (options: inside front; inside back; other), and the number of issues they appear in.
- Web adverts will be handled by an external company (e.g. Google, Facebook), but the client will specify the target demographic, target region, and total cost (which will define the total number of impressions). Each web advert will target to single region/demographic.
- Each advert will have a release date within the overall campaign, and a campaign can have many adverts.
- The system you develop should also keep a record of which employees worked on each campaign and for how long, as well as the invoices charged to the clients.

Assumptions:

- The media to be marketed will be produced elsewhere (i.e. you do not need to be concerned with costs to make or design the actual advert), so this database is just for managing the marketing campaign.
- The market research has already been done and the client knows which ad channel/time slots they wish each advert to be placed (i.e. market research is not to be included in this DBMS).

The Tasks:

Overview (full details below):

Task	Description	Marks
1.	Design and draw an ER-diagram that captures the requirements	15
2.	Translate your ER-diagram into a relational schema	10
3.	Implementation of the schema in MySQL	10
4.	Define 5 suitable indexes for your tables (other than PKs)	5
5	SQL queries	10

Submission

- Report through TurnItIn assignment on Vision as a single **PDF**
- This should include the 5 sections clearly labelled with headings.
- SQL code should be included as text in the report, not screenshots.
- **Ensure the REPORT includes the team member names on the first page.**
- **Just 1 member of the each group should submit the final report via TurnItIn (Vision).**

T1 Conceptual model (15 marks)

Create an ER diagram for the stated database requirements in the scenario provided using UML notation.

The diagram should include one-to-many and many-to-many relationships, and several other advanced ER features such as:

- A recursive relationship;
- Derived attributes;
- Composite attributes;
- Composite keys;
- Repeating attributes;
- Use of generalization and specialisation.

The diagram **should contain a minimum of 10** (entities and relationships) for a group of 5/6 students, e.g. *Employee Works for Department*, and *Department* has *Employee* as manager => 2 entities and 2 relationships = 4 (entities and relationships).

- You might need to use a drawing tool like yEd², draw.io, or Microsoft Visio; rather than a relational database tool which will put in the foreign keys.
- Make a note in your report of any details of the requirements that could not be captured by the diagram.

² <https://www.yworks.com/products/yed> accessed Dec 2020

Deliverable: Report to include the ER diagram for your database, and any supporting notes for you diagram.

T2 Translation into Relational Schema (10 marks)

Define a relational schema from your conceptual ER diagram.

Use the steps given in the lectures to convert your conceptual design into a relational schema. The schema will include foreign keys, and extra tables where required, e.g. for many-to-many relationships. Primary and foreign keys should be clearly identified. Make a note explaining how it has been derived from the original conceptual ER diagram, for those cases where you have had to make a decision.

Deliverable: Report to include the relational schema and notes for any unusual steps that were followed.

T3 Implementation of the Schema in MySQL (10 marks)

Generate a script to create the tables in MySQL using the InnoDB storage engine. The data definition language statements must specify:

- Appropriate types for the attributes
- The primary key;
- Constraints such as NOT NULL and UNIQUE whenever appropriate;
- Default values if appropriate;
- FOREIGN KEY constraints, together with the policy for reacting to changes
- Write comments into the script explaining what is happening in each part.

Deliverable: Commented SQL script should be included in your report

T4 Indexes (5 marks)

Provide 5 index definitions that are designed to improve performance for queries that could be asked from your database. This must be for fields **other than the Primary Keys**, which will be indexed already.

Write an SQL script containing a set of CREATE INDEX commands.

Deliverables:

- Report to contain five INDEX definitions using MySQL syntax.
- Report to contain an explanation why each index is needed.

T5 Queries over the Database (10 marks)

It is recommended you make some dummy data and load into your database before writing the queries.

The group must provide SQL queries to answer the following queries:

- a) Find all the staff that have NOT previously worked on a RADIO advert campaign (1 mark)
- b) For each client calculate how many adverts of each type (e.g. radio, web) have been marketed by the company. (1 mark)
- c) Which employee (by name) has charged out the most time across all campaigns? (1 mark)
- d) Write an UPDATE query to automatically calculate the total staff time cost for a specified advert campaign (1 mark).
- e) Design your own **complex query** that contains at least one of the following features: (3 marks)
 - Joins involving a composite key,
 - Joins involving the same table twice,
 - Aggregation with group by **and** having,
 - Nesting with aggregation,
 - Nested negation, involving NOT EXISTS or NOT IN
 - Using MySQL built in functions
 - Using views
- f) **A transaction** containing multiple CRUD (Create, Read, Update, Delete) operations, e.g. you may look up a person, change some value, and then check the update has happened, or you may insert some new data that requires multiple tables to be updated. (3 marks)

Many queries are likely to contain search condition(s) in which the data is supplied at run-time.

*However, for this report you should supply the query with data, e.g. **WHERE** gender= 'M'.*

Deliverables:

- Report to contain a description for each query and transaction in English, the SQL, and the output or a subset of the output if there is a lot of it from any dummy data you loaded into your database.

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