

CITS1402 Relational Database Management Systems

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Assignment

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This assignment is worth 30% of your final grade. It is due on **Sunday 3 February, 11.30pm**, and should be submitted via `cssubmit`. All work is to be done individually.

You are expected to have read and understood the University's guidelines on academic conduct. In accordance with this policy, you may discuss with other students the general principles required to understand this project, but the work you submit must be the result of your own effort.

You must submit your project before the submission deadline above. The penalties for late submission are described in the University's guidelines on assessment: For late submissions a penalty of 10% of the total mark allocated to the assessment item must be deducted per day for the first 7 days (including weekends and public holidays). After 7 days the assigned work will not be accepted and will receive a mark of zero (unless an application for mitigation is approved).

Overview

This assignment requires you to:

- design an Entity–Relationship diagram for a database
- write SQL commands for creating the database, and document the process by which you arrived at them
- write queries for the database

Any SQL commands you write should be able to be run using MySQL 8.0. You should run them on a MySQL instance to ensure they work. SQL commands which produce errors will be awarded only very few marks.

Tasks

1. Database design and implementation

You are a database developer for an evil Galactic Empire, which is in the business of conquering planets, destroying rebel bases, and developing superweapons. You are asked to design a database to help the Empire manage its work. Your database should be based on the following business scenario:

The Empire develops superweapons at research centres. Each research centre is staffed by numerous scientists, some of whom are *traitors*.

Scientists have a name, date of birth, employee ID, telephone number, monthly salary and an area of expertise. Some scientists are also Chief Scientists for a section, and manage other scientists. Every scientist who is not a Chief Scientist reports to one Chief Scientist. (Chief scientists all report directly to the Emperor, so we need not record this.) Every Chief Scientist manages one and only one section, and has one or more scientists that report to them. Sections are identified by a section ID and a name, and a record of which research centre they are located in. Scientists who are *traitors* have this fact recorded on their HR records, so that their dues to the Rebel Alliance can be automatically deducted from their pay.

Research centres have an ID code, a street address and a postal address, as well as a planet, solar system and Galactic Sector Number where they are located. Each research centre develops one superweapon. Superweapons have a particular target type they are intended to be used against (either continent, planet, or solar system), and require various components. (You may decide what components are required, and what information about them needs to be tracked.)

Each superweapon has at least one *flaw*, which is carefully documented and stored with the superweapon design and specifications. Flaws can either be *critical flaws* (which result in the complete destruction of the superweapon) or *major flaws* (which simply render it inoperable). (There are no minor flaws, as the scientists are careful about removing these.) For each *major flaw*, the Empire needs:

- a description of the flaw
- the date it was introduced into the design
- the scientist who introduced it

For each *critical flaw*, the Empire needs:

- a description of the flaw
- the date it was introduced into the design
- the scientists who introduced it (introducing critical flaws is a great deal of work, and may require more than one scientist)

The superweapon specifications, and details of the flaws, will all later be stored in the Imperial Archives.

For each superweapon, the Empire tracks the progress of its development, assigning it a project ID. Each project is associated with one and only one weapon, and has a time and date of commencement, and a current status (analysis, design, in development, tested, delivered, deployed, and destroyed). Each project is made up of one or more *phases*, each of which has a time and date of commencement and an estimated duration (in months). Once a phase is complete, it will also be assigned a completion date.

Based on the above business scenario:

1. Design and draw an ER model for the database system. You must clearly identify relevant entities, their attributes, and primary keys.

You must clearly identify all relationships, and for each relationship, specify its cardinality

(including the minimum cardinality).

You should use the “crow’s foot” notation used in lecture slides.

If you need to make a (reasonable) assumption that is not specified in the scenario above, you should state it clearly and justify it in your discussion section (see next item).

[10 marks]

2. Please provide a paragraph or two (approx. 500 words) explaining the entities, attributes and relations you have used, and any non-trivial decisions you have made in the design.

[10 marks]

3. Implement a relational database schema based on your ER model. You should:

- a. State the schemas for any database tables used. Ensure that any tables are normalised to at least 3NF. Provide a description of any decomposition you performed, and list the functional dependencies.

[5 marks]

- b. Identify data types for each attribute in your tables, and explain for each why you chose that data type. It is suggested you do so using a table – for each database table, include a table in your report showing field names, data types, and an explanation of why the data type was chosen.

[5 marks]

- c. Provide the **SQL statements** needed to create the database tables and populate them with dummy records. These should be submitted in a separate file named “**empire.sql**”. Ensure that this file can be run by MySQL, and that each statement ends with a semicolon. Around 10 records per table for the dummy records is fine. Ensure that this dummy data complies with any requirements given in the scenario.

[10 marks]

Ensure that you complete task 3 as specified – you need to create and submit **SQL statements**; simply creating tables and data using the MySQL Workbench is insufficient, and will lead to few, if any, marks being awarded for this section and the following one.

2. SQL queries

Provide both SQL queries and relational algebra expressions that answer the following questions. Ensure that you have inserted sufficient data in the previous section of the assignment that all of the queries return at least one record.

Your relational algebra expressions should be included in your PDF report. Your SQL queries should be placed in a file named “**queries.sql**”. (Again: ensure that these queries run correctly on MySQL 8.0, and that each statement is terminated with a semicolon.) If you have difficulty writing the relational algebra expressions in your chosen editor or word processor, you may hand-write the expressions and include a scan of them in your PDF report, as long as they are clear and legible.

Queries:

1. List the names of all scientists and the ID and postal address of the research centre they work for.

2. List the names and IDs of all scientists, and for each of them, the name and ID of the Chief Scientist they work for.
3. List the planet which has the largest number of superweapons being developed on it.
4. List all scientists who have not contributed to a flaw in the past month.
5. Find the average time spent on developing superweapons. (This is the sum of the durations of the phases for that weapon's project.) You should consider only superweapons that have been at least *delivered*.
6. For all scientists who have contributed to a critical flaw in the past year, raise their pay by 10% (rounded).
7. Find the names, IDs, and number of staff supervised of the Chief Scientists whose scientists have incorporated the most critical flaws to completed (i.e. delivered, deployed or destroyed) superweapon projects in the past year. You should report the top 3 Chief Scientists.

[10 marks]

Assessment

The submission will be marked out of 50. Each component should be correct (where applicable) or reasonably justified, and written clearly. Marks will be deducted for incorrect, poorly justified or unclear work.

To be awarded any marks, an `.sql` file must run without errors using MySQL 8.0 – if it does not meet those requirements, it will be awarded 0 marks.

Submission

You should submit:

- A PDF file report, “`report.pdf`”, containing your ER diagram and written discussion.
- An SQL file, “`empire.sql`”, containing SQL commands to create your database.
- An SQL file, “`queries.sql`”, containing SQL queries to be run on the provided database.

Diagrams in the report may be drawn by hand (as long as they are clear and legible) and scanned for inclusion in the submitted report, or they can be drawn with tools like MS Word, MS Excel, draw.io, or ERDPlus.

You should structure your report clearly:

- Divide your report into numbered sections with meaningful section headings.
- Include your name and student number on the first page or title page.
- The font you use must be clear legible, ideally with a font size of between 10 and 12 point.
- Your report should be no more than 5 pages of non-diagram content in length (excluding a title page, if you use one).
- Any captions or text in diagrams must also be clear and legible, with a font size no smaller than 8 point.

The file names in your submitted work must match the specifications exactly. If you submit code which cannot be run using MySQL 8.0, your submission will be awarded 0 marks for that portion of the assignment.

Submissions which do not comply with other specification requirements will have marks deducted.

Good luck!

Arran Stewart, CITS1402 Unit co-ordinator