Assignment One: Database Design and Implementation

Weight 20%, marks out of 60 Deadline: 15:30 (GMT) 4 March 2016

Overview

The coursework takes the form of a group project. Form your own groups of 3 – 5 people and email the course lecturer details of your group. The first section of the coursework involves the design and implementation of a relational database (using MySQL). To get a good mark, your coursework must demonstrate many of the advanced topics covered in lectures rather than merely a repeat of material covered in the first year database course.

Task Summary and Timeline

When	What
Week 2	Form into groups, send email lecturer with names and user names
Weeks 2 – 4	Get R2 ER diagram and RM tables checked
Week 6	Aim to have R1-R7 finished
Week 8	R8 JBDC submission, demo TBA

Groupwork

Share the work out amongst yourselves as you wish, but make sure everyone has an equal share. If you work together at the same machine, swap the 'driving position' regularly (every 10 minutes?) to ensure that everyone contributes.

Experience gained in these topics will help in the examination, so maybe get some people to work on a section, then the others could review it and make suggestions for improvements – that way everyone knows about what is going on at each stage. If necessary, marks will be adjusted if it is obvious that some students have not participated enough.

The task

As you proceed through the project, you might need to change some earlier decisions. You should:

Task	Description	Marks
1.	Determine the scenario for your application and draw an ER-diagram that captures these requirements	10
2.	Translate the ER-diagram into a relational schema	10
3.	Implement the schema in MySQL	5
4.	Fill the MySQL database with data	5
5.	Define roles, access permissions, and views for the users of your database	5
6.	Write a set of queries for your MySQL database	10
7.	Define suitable indexes for your tables	5
8.	Add details of your tables, views and queries to the supplied java application	10

Submission

- Report through TurnItIn assignment on Vision
- Scripts and source code as a zip or tar.gz (no rar) file through GradeCenter assignment on Vision.

R1 Scenario and Conceptual model (10 marks)

"A courier company arranges for the collection and delivery of packages for clients. Each consignment can consist of multiple packages. The company has several vehicles and members of staff. The company has asked you to create a database system that will allow them to manage the data about consignments, their vehicles, and staff."

Design a database according to the fairly general request above. Invent more details as appropriate to fit the requirements of this database exercise – for example, take into account the features that you have to include in the ER diagram (see below), the fact that you need a few different roles of users, and the type of SQL query that you are asked for. You may consider the type of courier firm (bicycle, small vans, large lorries, and the scope within a city or multinational).

You are NOT asked to produce a complete working application or a complete set of queries that the company would actually need to run your database system successfully. Rather, you are asked to use this scenario to demonstrate your proficiency in the various aspects of this assignment. You will need to extend the scenario quite a bit, and invent some extra details.

Write a description of your extended scenario, so that the reader can understand what your diagram represents.

Create an ER diagram for the conceptual model of your scenario. The diagram MUST include one-to-many and many-to-many relationships, ideally with a variety of participation constraints, 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 9/12/15 (entities and relationships) for a group of 3/4/5 students, e.g. Employee Works for Department and Dept has Employee as manager => 2 entities and 2 relationships = 4 (entities and relationships).

This ER diagram should **not** show foreign keys (this comes in R3), it should only show the links between entities as relationships (linking lines). Each attribute only occurs ONCE in the diagram. You might need to use a drawing tool like Dia (I use yEd[1], although Microsoft Visio is another option) rather than a relational database tool which will put in the foreign keys.

Make a note of any details of the requirements that could not be captured by the diagram.

Get this ER diagram checked in tutorials before continuing.

Include the description of the scenario, the diagram, and any supporting notes in your report.

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[1] https://www.yworks.com/products/yed accessed December 2015

R2 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 create extra tables where required. 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.

Create a data dictionary for your tables – for each table, include column names, domain and other constraints (including keys).

Check that your tables are all in 2nd and 3rd Normal form (i.e. no columns just dependent on one part of a composite primary key, and no columns dependent on a column which is not a key). Make changes to your tables if you decide it is necessary.

Include your supporting notes and the data dictionary in your report.

R3 Implementation of the Schema in MySQL (5 marks)

Create the tables either using phpMyAdmin or through the SQL command line, using the innoDB storage engine.

To use the command line, you will need an SQL script containing `CREATE TABLE` and `ALTER TABLE` commands. If you use phpMyAdmin, you can run the SQL script, or create the tables using a GUI and finally export this SQL script (and check it makes sense, e.g. not multiple identical indexes).

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 that explain the rationale behind the definition of your constraints, if necessary.

There is a document on Vision on how to use MySQL in the linux lab or using phpMyAdmin.

Include your commented SQL script containing the data definition language commands in your report.

Your script should be included in your zip file.

R4 Loading Data (5 marks)

Load interesting data into the database, experimenting with insert statements and the bulk loader. The data should be realistic, and there should be enough to enable you to demonstrate a range of queries in R6.

Write a report stating which data was loaded from insert statements, which from the bulk loader, plus the contents of a few sample related records from each table – this is to give the marker a feel for whether you have entered suitable data, without having to read insert statements or poorly formatted output from SELECT *.

Your data loading scripts should be included in your zip file in a loader directory.

R5 Roles, permissions and views (5 marks)

Define some typical users and roles. (You don't have permission on the departmental MySQL server to actually define users and roles, so you don't have to implement this.)

Define and implement several views to give restricted access to a subset of the data. Produce a grid showing which users can access which tables and views.

Create a report explaining your typical users, and for each view provide a description in English, the reason for creating this view, and the SQL script used to create the view. Include the access grid in the report.

Your script should be included in your zip file.

R6 Queries over the Database (10 marks)

Write a set of transactions for your scenario, some of which must contain multiple CRUD (Create, Read, Update, Delete) operations. Create one or more views, for example to simplify queries with a frequently used base query.

Groups of 3/4/5 should write at least 9/12/15 essentially different transactions.

Many queries are likely to contain search condition(s) in which the data is supplied at run-time. However, for the purposes of R6, you should supply the query with data, e.g. `WHERE gender='M'`.

Among your set of queries the majority should be interesting in the sense that they contain at least one of the following features:

- 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

Don't provide a large set of basic queries, since you will not get many marks for this.

In your report provide a description for each transaction in English, the SQL, and the output or a subset of the output if there is a lot of it. For views created in this section, include a description, the reason for creating the view, and the SQL Create View statement.

You should provide a script file for each transaction. These script files should be included within a directory in your zip file, e.g. queries.

R7 Indexes (5 marks)

Define appropriate index definitions that are designed to speed up the queries that you have created. Write an SQL script containing a set of `CREATE INDEX` commands. A group of 3/4/5 should define at least 3/4/5 indexes.

In your report provide an explanation why each index is needed. If your design doesn't need at least 3 of your own indexes, explain why not.

Your script should be included in your zip file.

R8 Java Application (10 marks)

For this part of the coursework you should extend the provided Java application to connect to your database.

Download the Java application from Vision and refer to the separate document explaining the Java application.

Alter the class JDBCMySQLApp to provide a selection of your own queries to run in the application. A sample set of queries is already there, and these should be altered or deleted. Instructions on what to alter is in the code. Groups of 3/4/5 should ideally supply 6/8/10 queries. Your queries could be a subset of the queries in R6, or some other suitable queries. Particularly, ensure that you include some prepared queries, updates of some kind, and some which are based on user input. It is more important that you demonstrate the range of types of Java coding rather than the range of SQL queries. Don't forget to alter my comments if necessary. If allowing the user to type in data, do some form of validation.

Include your JDBCMySQLApp source code in the zip file submission. Don't attempt to embed these in a Word document, but make sure your names are in the file.

You will need to perform a demo of your application. A timeslot will be arranged.