Practical 5

ER to relational mapping, normalization and creating SQL statements to implement relations with foreign keys

Learning objectives

1. Convert a ER diagram to suitable relational schema, mapping the entities, attributes and different forms of relationships
2. Check whether a relational schema is in 1NF, 2NF, 3NF or BCNF
3. Decompose a relational schema to make it adhering to different normal forms.
4. Implement a relational schema with basic foreign key constraints in MySQL
5. Use FDs to identify keys of a given relation.

Setting-up

- Tasks 1- 4 of this practical will use ER diagrams you have created in the previous week.
- Save your work of this practical is DBS/Prac05 directory. If Prac05 directory is not already there, create a one.
- Write down your answers in a text file named '**prac05Answers**', unless another specific file is supposed to create for any task. Add your name, student ID at the top of the text document.

1. ER to relational mapping – a simple airport scenario

1. Convert the ER diagram you have created last week for a 'simple airport scenario' (Practical 04, task 1) to set of relations. You can follow the steps given in the lecture 04 and do the relational mapping.

2. If there are any foreign keys in the relations you have identified, indicate them by adding a statement like the following to identify the foreign key.
   Example 1:

   `Student(studentID,firstName,lastName,courseName)` **FK courseName REF Course(courseName)**

   `Course(courseName,CourseType)`

2. Normal forms

1. Check whether the relations you have created are in 1NF.

2. Use suitable checks based on FDs and test whether the relations you have created are in 2NF or 3NF. If not, convert them to 3NF.
   Note -1

- First, identify all the FDs of each relation of your schema. Write them and then use a diagram (as shown in the lecture 04 slides, normalization section) to indicate them.
- Once you have written out all of the FDs, first go through them to make sure that each makes sense.
- Check that you chose the correct keys – if you removed one or more FDs this may not be the case. Also, if one of the relations from the ER diagram has multiple foreign keys as well as other FDs, it may be possible to find a smaller key.
- Converting to normal forms is done by decomposing the relations.

3. Implementing the relations in MySQL

Example2 below shows the SQL statements for creating the relations listed in example -1 above as MySQL tables.
Example 2 :

```
CREATE TABLE Courses(
      courseName VARCHAR(30) PRIMARY KEY,
      courseType VARCHAR(10)
)
CREATE TABLE Students(
      studentID VARCHAR(8) PRIMARY KEY,
      firstName VARCHAR(25) NOT NULL,
      lastName VARCHAR(25),
      courseName VARCHAR(30)
      CONSTRAINT fk_course
      FOREIGN KEY (courseName) REFERENCES Courses(courseName)
)
```

For this question, use a text editor (e.g. Vim) to type the MySQL statements and save the file as ‘ airport.sql’

1. Using the example 2 as a guideline, write down the SQL statements to convert the relational schema you have identified above (for the airport scenario). Implement primary keys, foreign keys and any other constraints you can find as well.
   Add suitable comments and indicate any assumptions you made.

2. Using ‘dsworks’ as the current database, run the ‘airport.sql’ file to create relations to manage airport scenario.

Note -2

- You will learn more about constraints in the CREATE TABLE statements in the next lecture. Example 2 shows only a basic statement.

4. ER to relational mapping and checking the normal forms – Car racing competition

1. Convert the ER diagram you have created last week for a ‘car racing competition’ (Practical 04, task 2) to set of relations. You can follow the steps given in the lecture 04 and do the relational mapping.

2. If there are any foreign keys in the relations you have identified, indicate them following the style shown in the example 1 above.

3. Check whether the relations you have created are in 1NF.

4. Use suitable checks based on FDs and test whether the relations you have created are in 2NF, 3NF or BCNF. If not, convert them to BCNF.

5. Write down the SQL statements to convert the relational schema you have identified above. Implement primary keys, foreign keys and any other constraints you can find as well. Use a text editor (e.g. Vim) to type the MySQL statements and save the file as ‘carRace.sql’. Add suitable comments and indicate any assumptions you made.

6. Use the following statement to create a new database called ‘carrace’ in the MySQL server.

```
CREATE DATABASE carrace;
```

7. Using ‘carrace’ as the current database, run the ‘carRace.sql’ file to create relations to manage car racing scenario.

5. Functional Dependencies

1. Consider a relation with schema R (A, B, C, D) and FD’s AB → C, C → D, and D → A.
   a) Find all nontrivial FD’s that follow from the given FD’s. Consider only FD’s with single attributes on the right side.
   b) What are the keys of R?
   c) What are the super-keys of R that are not keys?

6. Normal tests

Consider the following FDs for the relation R (A,B, C,D,E,F,G).

AB→ABCDEFG
A→D
B→EF
G→A

a) Draw a diagram to indicate above FDs on the relation R.

b) Find what normal foam the relation is adhering to.

c) Convert the relation to BCNF.

7. Additional task:

1. Suppose we have a database for an investment firm, consisting of the following attributes: B (broker), O (office location of a broker), I (investor), S (stock), Q (quantity of a stock owned by an investor), P (current price of stock), and D (last dividend paid by a stock). An investor has only one broker, and a broker has only one office location. For each stock, there is only one value of dividend and only one price in the database. For each investor who owns a stock, the total quantity of the stock is recorded.
   a) Determine the functional dependencies that apply to this database.
   b) Find the keys of the relation R (B,O,I,S,Q,P,D).

2. Consider a relation R (A, B, C, D), with the following set of functional dependencies (FD's) over. R: AB $\rightarrow$ C, BC $\rightarrow$ D, CD $\rightarrow$ A, AD $\rightarrow$ B.

   a) Find all the nontrivial FD's (with single attributes on the right hand sides) that follow from the given FD's.

   b) What are the keys of this relation? Give the reasons for your answer.

8. Submitting your work

Your prac05 directory should have 'prac05Answers' document and two .sql files. All

Zip your Prac05 directory and upload it to Blackboard under 'Assessments/In Class Practical Submissions'

Check whether you have achieved learning outcomes:

I am confident that I can,

Convert an ER to relational schema, mapping entities, attributes and different forms of relationships (cardinality (one-one, one-many, many-many) and the participation (fully or partial participation)).	✓
Use FDs and find keys of a relational schema	
Identify whether a schema is in 1NF and if not convert it to 1NF	
Identify whether a schema is in 2NF and if not convert it to 2NF	
Identify whether a schema is in 3NF and if not convert it to 3NF	
Identify whether a schema is in BCNF and if not convert it to BCNF	
Implement a given relational schema with primary key and basic foreign key constraints in MySQL.	

Please refer lecture slides, reading materials, and online resources and attempt again, if all the learning outcomes were not achieved. Ask your tutor and get help if you need any clarification.

It's always a good practise to try to finish the practical of a particular week, before attempting the next practical worksheet as your work will be building upon the previous week's tasks.