Homework 6

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**Question 1**:

*Database design problem*

**Answer**:

The ER diagram of the database is shown below.

graph.eps

By translating the ER diagram, we get the following set of tables. The tables are described using create table statements.

Table 1. Create table statements for the database

|  |  |
| --- | --- |
| table name | create table statement |
| course | CREATE TABLE course  (  id CHARACTER(22) PRIMARY KEY,  title CHARACTER (20) NOT NULL,  description CHARACTER (20),  credit INTEGER,  level CHARACTER(2)  ); |
| prerequisit | CREATE TABLE prerequisite  (  course\_id CHARACTER(22) REFERENCES course(id),  precourse\_id CHARACTER(22) REFERENCES course(id),  PRIMARY KEY(course\_id, precourse\_id)  ); |
| class | CREATE TABLE class  (  id CHARACTER(22) REFERENCES course(id),  section INTEGER,  quarter CHARACTER (22),  PRIMARY KEY(id, section, quarter)  ); |
| instructor | CREATE TABLE instructor  (  emp\_id INTEGER PRIMARY KEY,  name CHARACTER(20),  rank INTEGER  ); |
| teach | CREATE TABLE teach  (  id CHARACTER(22),  section INTEGER ,  quarter CHARACTER (22),  emp\_id INTEGER REFERENCES instructor(emp\_id),  PRIMARY KEY(id, section, quarter, emp\_id),  FOREIGN KEY(id, section, quarter) REFERENCES class(id, section, quarter)  ); |
| student | CREATE TABLE student  (  id INTEGER PRIMARY KEY,  name CHARACTER(22),  level CHARACTER(1)  ); |
| enroll | CREATE TABLE enroll  (  course\_id CHARACTER(22),  section INTEGER,  quarter CHARACTER (22),  student\_id INTEGER REFERENCES student(id),  grade CHARACTER(1),  PRIMARY KEY(course\_id, section, quarter, student\_id),  FOREIGN KEY(course\_id, section, quarter) REFERENCES class(id, section, quarter)  ); |
| room | CREATE TABLE room  (  building CHARACTER(20),  room\_no INTEGER,  capacity INTEGER,  PRIMARY KEY(building, room\_no)  ); |
| teach\_in | CREATE TABLE teach\_in  (  id CHARACTER(22),  section INTEGER,  quarter CHARACTER (22),  room\_no INTEGER,  building CHARACTER(20),  PRIMARY KEY(id, section, quarter, room\_no, building),  FOREIGN KEY(room\_no, building) REFERENCES room(room\_no, building),  FOREIGN KEY(id, section, quarter) REFERENCES class(id, section, quarter)  ); |
| timeslot | CREATE TABLE timeslot  (  time\_day CHARACTER(20) PRIMARY KEY  ); |
| meets | CREATE TABLE meets  (  id CHARACTER(22),  section INTEGER,  quarter CHARACTER (22),  time\_day CHARACTER(22) REFERENCES timeslot(time\_day),  PRIMARY KEY(id, section, quarter, time\_day),  FOREIGN KEY(id, section, quarter) REFERENCES class(id, section, quarter)  ) ; |

For the constraints listed, none of them could be fully supported by a foreign key constraint. We need to create assertions for each of them. The results are shown below.

**1-A room cannot be booked for more than one class (section) at the same time slot.**

For this constraint, we write an assertion to check there are no rows in the table where the number of reservation for a room and a time slot is bigger than 1. The constraint is shown below.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT \*  FROM ( SELECT count(\*) AS C  FROM timeslot, meets, teach\_in, room  WHERE timeslot.time\_day = meets.time\_day AND  meets.id = teach\_in.id AND  meets.section = teach\_in.section AND  meets.quarter = teach\_in.quarter AND  teach\_in.building = room.building AND  teach\_in.room\_no = room.room\_no  group by timeslot.time\_day, room.building, room.room\_no) x  WHERE C > 1  ) |

**2-The number of students enrolled in a class cannot exceed the capacity of the room assigned to the class.**

Similar to last constraint, we write an assertion to check there are no rows in the table where the number of students enrolled in a class exceeds the capacity of the room assigned to the class. The constraint is shown below.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT enroll.course\_id, enroll.quarter, enroll.section, room.building, room.room\_no  FROM student, enroll, teach\_in, room  WHERE student.id = enroll.student\_id AND  enroll.course\_id = teach\_in.id AND  enroll.section = teach\_in.section AND  enroll.quarter = teach\_in.quarter AND  teach\_in.building = room.building AND  teach\_in.room\_no = room.room\_no  group by enroll.course\_id, enroll.quarter, enroll.section, room.building, room.room\_no  having count(\*)>room.capacity)  ) |

**3- Students may not take more than 21 credits in any one quarter. (PSU rules may be more flexible.)**

For this constraint, we write an assertion to check there are no rows in the table where students take more than 21 credits in any one quarter. The SQL statement is shown below.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT class.quarter, enroll.student\_id  FROM enroll, class, course  WHERE  enroll.course\_id = class.id AND  enroll.section = class.section AND  enroll.quarter = class.quarter AND  class.id = course.id  group by class.quarter, enroll.student\_id  having sum(course.credit)>21)  ) |

**4-A student can’t enroll in two sections at the same time slot in a quarter.**

To enforce this constraint, we write an assertion to enforce there are no rows in the table where a student enrolls in more than one section at the same time slot in a quarter. The constraint is shown below.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT count(\*) AS C  FROM timeslot, meets, enroll, student  WHERE timeslot.time\_day = meets.time\_day AND  meets.id = enroll.course\_id AND  meets.section = enroll.section AND  meets.quarter = enroll.quarter AND  enroll.student\_id = student.id  group by student.id, timeslot.time\_day, enroll.quarter  having count(\*)>1)  ) |

**5-A student can’t enroll in two sections of the same class in a quarter.**

This constraint is done by writing an assertion to enforce there are no rows in the table where a student enrolls in more than one section of the same class in a quarter. The SQL statement is shown below.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT enroll.student\_id, class.id, class.quarter  FROM enroll, class  WHERE class.id = enroll.course\_id AND  class.section = enroll.section AND  class.quarter = enroll.quarter  group by enroll.student\_id, class.id, class.quarter  having count(\*)>1)  ) |

**6- A student can’t enroll in a class unless they have earned a grade of C or higher in the prerequisite courses.**

We enforce this constraint by writing an assertion to make sure there are no rows in the table where a student enrolls in a class when they have earned a grade less than C in the prerequisite courses. The following is the SQL statement for this constraint.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT \*  FROM enroll e1, class, prerequisite, enroll e2  WHERE class.id = e1.course\_id AND  class.section = e1.section AND  class.quarter = e1.quarter AND  class.id = prerequisite.course\_id AND  prerequisite.precourse\_id = e2.course\_id AND  e2.grade < 'C')  ) |

**7- A student can’t take the same course more than three times.**

This constraint is done by writing an assertion to enforce there are no rows in the table where a student takes the same course more than three times. The SQL statement is shown below.

|  |
| --- |
| CREATE ASSERTION question1 CHECK(NOT EXISTS  (SELECT count(\*)  FROM enroll  GROUP BY enroll.student\_id, enroll.course\_id  having count(\*)>3)  ) |

Note: As it is shown, all of the constraints are written as assertion statements. Therefore, they are guaranteed to be true at all time

The following is the answer for the query questions.

**Q1: Write a query that will show the class roster for each class.**

The query statement is shown below.

|  |
| --- |
| SELECT enroll.course\_id, enroll.section, enroll.quarter, student.id, student.name  FROM enroll, student  where enroll.student\_id = student.id  GROUP BY enroll.course\_id, enroll.section, enroll.quarter, student.name, student.id  ORDER BY enroll.course\_id, enroll.section, enroll.quarter |

??????Query2:

**Q2: Write a query that will show the transcript for each student.**

The query statement is shown below.

|  |
| --- |
| SELECT student.id, enroll.course\_id, enroll.section, enroll.quarter, enroll.grade  FROM enroll, student  where enroll.student\_id = student.id  GROUP BY student.id, enroll.course\_id, enroll.section, enroll.quarter, enroll.grade |

**Question 2**:

*Normalization problem*

**Answer**:

**1- Identify all of the non-trivial FDs that hold (based on the application).**

mission\_id -> mission\_name

mission\_id -> access\_id

mission\_id -> team\_id

mission\_id -> mission\_status

mission\_id -> team\_name

mission\_id -> meeting\_frequency

team\_id -> team\_name

team\_id -> meeting\_frequency

**2- Identify the key(s) for this table.**

mission\_id is the key for this new table.

**3- Identify any “troublesome” FDs that prevent this table from being in BCNF.**

A table is in BCNF if the left side of every nontrivial FD be a superkey. Therefore, in this table the troublesome FDs are:

team\_id -> team\_name

team\_id -> meeting\_frequency

**4- Describe one insert anomaly, one update anomaly, and one delete anomaly that can arise with this table.**

Insert anomaly:

If we want to insert different missions for one team, we need to know the descriptive information (team\_id, team\_name, team\_meeting\_frequency) and have to insert the same information for all the inserted rows which is redundant.

Also, if we want to insert a team information we can’t until there is at least one mission assigned to that team.

Update anomaly:

If we want to change the name of a specific team, we have to change the name as many times as it is used in the rows of the table.

Delete anomaly:

If one team has only one mission, by deleting the mission the team information would also be deleted.

**5- Given that the system designers have decided to use this table and knowing that there are redundancies, describe (in English) the triggers that would need to be implemented in order to correctly manage the redundancy. You want to make sure that a given piece of information (if it is represented redundantly) is always consistent. That is, you want to make sure that all of the copies of any redundant information have the same, most up-to-date value. You want to make sure that if information is deleted, all of the copies are deleted, etc.**

Basically, we have to have triggers for all the mentioned anomalies.

Trigger on update:

If a team information (team\_name or team\_meeting\_freq) wants to be updated somewhere in the table, the trigger should executed after the update and execute the same update for all rows of the table with the same team\_id.

Trigger on insert:

The trigger should be executed before the insertion and make sure that the desired information to be inserted are in consistence with the previous information in the table and if this is not the case avoid the insertion.

Trigger on delete:

In order to delete a team from the table, a trigger should be executed after the deletion and delete all other rows in the table which have the same team\_id as the deleted team.