CS 1555 – Database Management Systems (Fall 2019)
Dept. of Computer Science, University of Pittsburgh

Assignment #2 (HW2): Relational Model & SQL DDL

Release: Sept. 12, 2019 Due: 8:00 PM, Wednesday, Sept. 18, 2019

Goal

Gain familiarity with the theoretical foundations of the relational model and practice SQL DDL.

Description

- Assume the following relational database schema that records information related to US forests.
  - FOREST = (Forest_No, Name, Area, Acid_Level, MBR_XMin, MBR_XMax, MBR_YMin, MBR_YMax)
  - STATE = (Name, Abbreviation, Area, Population)
  - COVERAGE = (Forest_No, State, Percentage, Area)
  - ROAD = (Road_No, Name, Length)
  - INTERSECTION = (Forest_No, Road_No)
  - SENSOR = (Sensor_Id, X, Y, Last_Charged)
  - REPORT = (Sensor_Id, Temperature, Report_Time)
  - WORKER = (SSN, Name, Age, Rank)

  Here are some basic assumptions: A forest can extend to more than one state. MBR stands for Minimum Boundary Rectangle, which is a rectangle that contains the forest with minimum size. The corners with coordinates (XMin, YMin) and (XMax, YMax) define the size of MBR. Area in FOREST table is the total area of the forest. Area in STATE table is the total area of the state. Area in COVERAGE table is the area of a forest in a state. Percentage in COVERAGE table is the ratio of the area of a forest in a state over the total area of the forest. A sensor is assumed to be in a forest if it is in the MBR of that forest.

- Answer the following questions [for a total of 100 points]:

  1. [25 points total] Identify the primary key (PK) and alternate key (UQ), if any, for each of the relations. Identify the foreign keys (FK) and specify referential integrity constraints. For example, consider the relation STUDENTS that is associated with the relation DEPARTMENT.

     - STUDENT (StudentID, SSN, Major)
       PK (StudentID);
       UQ (SSN);
       FK (Major) → DEPARTMENT(DeptCode);

     Please state any assumptions that you make.

2. [25 points total] Use CREATE TABLE statement to create tables for these eight relations. You need to define the primary keys and foreign keys in your statement. We assume the following data types:
   - Name: varchar(30)
   - Forest_No, Road_No: varchar(10)
   - Abbrevation: varchar(2)
   - State (in COVERAGE table): varchar(2)
   - Population, Sensor_Id, Age, Rank: int
   - Last_Charged, Report_Time: timestamp
   - SSN: varchar(9)
   - All other attributes: float

3. [25 points total] Use ALTER TABLE statement to incorporate the following information/constraints in the US Forest Database.
   (a) In each table, add a Unique constraint for every of its alternate keys.
   (b) Add a new attribute, Energy, to table SENSOR. The new attribute should be in a domain called energy_dom. The energy_dom contains integers with a value in the range of 0 to 100 inclusive, representing a percentage. Note that all sensors are powered by battery thus we need to know how much energy remains.
   (c) In table FOREST, the Acid_Level should be not less than 0 and not greater than 1. Specify this constraint without the use of domain.
   (d) Add a new attribute, Maintainer, to table SENSOR. Each sensor is maintained by a person, with the default being NULL.
   (e) The attribute Maintainer in table SENSOR refers to a worker in table WORKER.

4. [25 points total] Verify constraints using SQL INSERT statements.
   (a) After creating the database using your SQL statements, populate the database according to the data in `sample-data.txt` using the SQL INSERT command.
   (b) After inserting the data in `sample-data.txt`, try to insert additional tuples, such that the new tuples will violate the constraints of the tables. For example, the primary key constraint of a table will be violated if you try to insert two tuples with the same value in the primary key column(s) of the table. Write SQL INSERT statements to verify all the constraints defined in your schema.

What to submit

You are required to submit **exactly three** files under your **pitt_user_name** (e.g, pitt01).

- **pitt_user_name.pdf** (e.g, pitt01.pdf)
  In this file, please submit your answers to question 1.
  Please include your name and Pitt user name at the top of the file.

- **pitt_user_name-db.sql** (e.g, pitt01-db.sql)
  In this file, please submit the answers to question 2, 3 and 4(a) (i.e., CREATE TABLE, ALTER TABLE and INSERT correct tuples). In addition to providing the answers, you are expected to:

- **Include your name and Pitt user name at the top of the file**.
- Identify the question number before each answer in the form of a comment. Comments are introduced using "– –".
- Use SQL **DROP TABLE** and **DROP DOMAIN** statements at the beginning of this file so that you can make sure your database does not have pre-existed tables and domains which have the same name as those to be created in this assignment.

The entire file should be composed of **valid SQL statements**.

- **pitt_user_name-output.txt** (e.g, pitt01-output.txt)
  In this file, please submit the answers to question 4(b) (i.e., INSERT incorrect tuples). You shall run individual queries in DataGrip's console and save (i.e., copy and paste) the query output to a text file after running all the queries. **Please include your name and Pitt user name at the top of the file**

To submit your assignment

1. Submit your assignments through the Web-based submission interface (i.e., go to the class web page `http://db.cs.pitt.edu/courses/cs1555/current.term` and click the Submit button). **It is your responsibility to make sure the assignment was properly submitted.**
2. Submit your assignment by the due date **(8:00 PM, Wednesday, Sept. 18, 2019)**. There is no late submission.

Academic Honesty

The work in this assignment is to be done *independently*. Discussions with other students on the assignment should be limited to understanding the statement of the problem. Cheating in any way, including giving your work to someone else will result in an F for the course and a report to the appropriate University authority.