Assignment #2: Relational Model, SQL DDL

Release: Jan. 24, 2018   Due: 8:00 PM, Wednesday, Jan. 31, 2018

Goal

Gain familiarity with the theoretical foundations of the relational model and SQL DDL. Further, be exposed to the application of RDBMS in Geo-information systems.

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(e.g. PA,OH,WV,...). 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. 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. [32 points] Identify the primary key (PK) and alternate key (UQ), if any, for each of the eight 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. [32 points] Use CREATE TABLE statement to create tables for these eight relations. You need to define the primary keys and foreign keys in your CREATE TABLE statements, only.

   Assume following data types:
   - Name: varchar(30)
   - Forest_No, Road_No: varchar2(10)
   - Abbrevation: varchar(2)
   - State (in COVERAGE table): varchar2(2)
   - Population, Sensor_Id, Age, Rank: int
   - Last_Charged, Report_Time: date
   - SSN: varchar2(9)
   - all other attributes: float

3. [30 points] 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 with int data type to table SENSOR. Note that all sensors are powered by battery thus we need to know how much energy remains.
   (c) The attribute Energy in table SENSOR should be non-negative.
   (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's SSN in table WORKER.

4. [2 points] Use the following files to test your answers to Question 2 and 3.
   (a) Insert tuples using `hw2-insert-good.sql`. All statements should succeed.
   (b) Subsequently, insert tuples using `hw2-insert-bad.sql`. Each statement should cause a constraint violation error.

5. [4 points] Use SQL SELECT statements to retrieve all tuples from all 8 tables. For example, the SQL SELECT to retrieve all tuples of the FOREST table is

   ```
   SELECT *
   FROM FOREST;
   ```

What to submit

You are expected to submit the folloing 3 files. **Please include your name and pitt user name at the top of each file**.

1. `hw2-<pitt_user_name>.pdf`
   In this file, please submit your answers to question 1.

2. `hw2-<pitt_user_name>-db.sql`
   In this file, please submit your answers to question 2 and 3 (i.e., CREATE TABLE and ALTER TABLE statements). In addition to providing the answers, you are expected to:

- Identify the question number before each answer. You can do it using SQL comments.
- You must use SQL **DROP TABLE** statements at the beginning of this file so that you can make sure your database does not have pre-existed tables which have the same name as the tables in this assignment.

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

3. `hw2-<pitt_user_name>-output.txt`
   In this file, please submit your query results (i.e., script output) of question 4 and 5 (i.e., INSERT and SELECT statements). You could use the command "SPOOL log_file_name" in SQLPLUS to record your query results. In addition to providing the answers, you are expected to:

   - Identify the question number before each answer.

How to submit your assignment

1. Submit your assignment (the 3 files described above) through the Web-based submission interface (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, Jan. 31, 2018). 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.