CS 1555/2055 – Database Management Systems (Fall 2019)
Dept. of Computer Science, University of Pittsburgh

Assignment #5: SQL Transactions and SQL Views

Release: Oct. 3, 2019 Due: 8PM, Oct. 9, 2019

Goal

Gain familiarity with SQL transactions and SQL views. You will continue with the US forest database of Assignment #2.

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)
    FK (Forest_No) → FOREST(Forest_No)
    FK (State) → STATE(Abbreviation)
  - ROAD = (Road_No, Name, Length)
  - INTERSECTION = (Forest_No, Road_No)
    FK (Forest_No) → FOREST(Forest_No)
    FK (Road_No) → ROAD(Road_No)
  - SENSOR = (Sensor_Id, X, Y, Last_Charged, Maintainer)
    FK (Maintainer) → WORKER(SSN)
  - REPORT = (Sensor_Id, Report_Time, Temperature)
    FK (Sensor_Id) → SENSOR(Sensor_Id)
  - WORKER = (SSN, Name, Age, Rank)

- Answer the following questions [for a total of 100 points] (Please answer Question 1-2 in PostgreSQL. Please answer Question 3-5 in both PostgreSQL and Oracle):

  1. [10 points total] Modify `hw5-db.sql` to define the evaluation modes of the syntactic integrity constraints of primary keys and foreign keys. You need to make all primary keys **not deferrable**, all foreign key constraints to be **initially deferred deferrable**, and all unique constraints **initially immediate deferrable**.

  2. [20 points total] Make necessary updates to the database to reflect each of the following changes. You need to use transaction appropriately when necessary to guarantee the atomicity of the SQL update statements.
     (a) PennDOT built a new road which crosses Allegheny National Forest. The road is named "century road", which has road_no 5 and length 201.
     (b) The administration office has switched John and Jason's duties. They are now maintaining sensors that have been maintained by the other in the past.

(c) The administration office have hired a new worker, Paula, who is age 22 and rank 1. Paula's SSN is "555575555". She is assigned to maintain sensor 2 from now on (and the previous maintainer of sensor 2 will not maintain sensor 2 any more).

3. [20 points total] Recreate the database by re-running the file `hw5-db.sql` and `hw5-db-oracle.sql`. Then express the following queries in PostgreSQL and Oracle.
   (a) Find the top 3 sensors that have issued the highest amount of reports.
   (b) Find the next 2 sensors after the top 3 sensors that have issued the highest amount of reports.

4. [20 points total] Create the following views in PostgreSQL and Oracle.
   (a) A view named DUTIES that counts, for each worker, the total number of sensors that are maintained by the him/her.
   (b) Create a materialized view named DUTIES_MV that corresponds to the DUTIES view.
   (c) A view named FOREST_SENSOR that lists all forests along with its sensors (Forest_no, Name, Sensor_Id).

5. [30 points total] Express the following queries in SQL and answer them using the views you have created above in both PostgreSQL and Oracle. Before answering the following questions, run the provided `hw5-extra-data.sql` to insert new tuples into the database and update the materialized view using:
   For PostgreSQL: `REFRESH MATERIALIZED VIEW DUTIES_MV;`
   For Oracle: `EXECUTE DBMS_MVIEW.REFRESH('DUTIES_MV');`
   (a) Q1: Find the names of the workers who maintain the maximum number of sensors.
   (b) Q2: Find the names of all forests such that no sensors in those forests reported anything between 10-AUG-2019 00:00:00 and 11-AUG-2019 00:00:00.
   (c) If you have used DUTIES (or DUTIES_MV) in any of the above queries, then write a second query SQL using DUTIES_MV (or DUTIES). When annotating the answers, annotate with "MV" the queries which use DUTIES_MV; e.g., Q1_MV and Q2_MV.
   (d) Compare and report the differences between views and materialized views in term of execution time. Execution time recording can be turned on using:
   For `psql` (PostgreSQL): `\timing on;`
   For `sqlplus` (Oracle): `set timing on;`

What to submit

You are required to submit **exactly five** files under your **pitt_user_name** (e.g, abc01).

- **pitt_user_name-db.sql** (e.g., abc01-db.sql)
  In this file, please submit the answers to question 1-2 (i.e., the modified `hw5-db.sql` file and the queries for transactions). In addition to providing the answers, you are expected to:
  - **include your name and pitt user name at the top of the text file**, and
  - identify the question number before each answer
  - 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 those tables in this assignment.

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

- **pitt_user_name-query.sql** (e.g., abc01-query.sql)
  In this file, please submit the answers to question 3-5 for PostgreSQL.
  In addition to providing the answers, you are expected to:
  * **include your name and pitt user name at the top of the file** using SQL comments
  * identify the question number before each answer using SQL comments
  * write simple queries at the beginning of this file to list the content of all the tables.

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

- **pitt_user_name-output.txt** (e.g., abc01-output.txt)
  In this file, please submit the output after running the pitt_user_name-query.sql file. You should use the PostgreSQL interactive terminal `psql` to generate the output. You can find the guide to start and use `psql` on class server at `QuickGuidePostgres_1555.pdf`. Briefly speaking, you need to add `psql` to your system's `PATH`, run your query file in `psql` and output the query output to a text file.
  In addition to providing the query output, you are expected to:
  * **include your name and pitt user name at the top of the file**
  * identify the question number before each answer

- **pitt_user_name-query-oracle.sql** (e.g., abc01-query-oracle.sql)
  In this file, please submit the answers to question 3-5 for Oracle.
  In addition to providing the answers, you are expected to:
  * **include your name and pitt user name at the top of the file** using SQL comments
  * identify the question number before each answer using SQL comments
  * write simple queries at the beginning of this file to list the content of all the tables.

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

- **pitt_user_name-output-oracle.txt** (e.g., abc01-output-oracle.txt)
  In this file, please submit the output after running the pitt_user_name-query-oracle.sql file. You need to use the Oracle interactive terminal `sqlplus` to generate the output. In `sqlplus`, you could use the command `spool` to begin a recording session and the command `start` to run your query file. More details about how to run and use `sqlplus` can be found at: `db.cs.pitt.edu/courses/cs1555/current.term/handouts/OracleEnvironment_1555.pdf`.

How to submit your assignment

1. Submit your assignment (the 5 files described above) through the Web-base 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 (8PM, Oct. 9, 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.