CSCI 585- Database Systems

Spring 2015

Homework Assignment 3

Deadline: April 8th 11:59PM (Pacific Time zone)

The goal of this assignment is to design and query a spatial database using ***Oracle Express 11g***. We will **NOT** accept other databases (e.g., MySQL, PostgreSQL, etc.).

Project specification:

USC Transportation Department wants to improve their transportation services for which they have selected certain buildings inside campus and some data of student coordinates. They have also kept track of tram stops on campus used by the students. The department is mulling over the idea of moving some tram stops so that they can cover maximum students and building. You are given 3 files for this project:

- *building.txt*
- *student.txt*
- *tramstops.txt*

These files store the spatial data in the following format:

- *building.txt*. Each building is represented by a 2-dimensional polygon. Each line in this file represents a building and the meanings of the columns are: (1) Building ID; (2) Building name; (3) Number of vertices on the polygon (denoted n); (4) The following 2n columns are the coordinates of the vertices, respectively, where the x-coordinate and y-coordinate of each vertex is represented by to consecutive columns. For example, the line "b1, PHA, 4, 100, 120, 150, 130, 120, 200, 120, 220" represents a building with building ID "b1" and its name "PHA". It has 4 vertices whose coordinates are (100, 120), (150, 130), (120, 200) and (120, 220), respectively.

- *student.txt.* Each student is represented as a 2-dimensional point and each line represents a student. The columns are: (1) The student ID; (2) The x-coordinate of the student; (3) The y-coordinate of the student.

- *tramstops.txt*: Imagine a tram stop to be circular. Each tram stop is represented as a 2-dimensional point and each line in the file represents a tram station. The columns are: (1) tram station id; (2) The x-coordinate of the tram stop; (3) The y-coordinate of the tram stop; (4) radius it covers.

Assignment:

Submit three SQL files as follows**:**

File 1) *createdb.sql* (30 pts)

- ✓ We will use this SQL file to create and populate the database that is used for this project on Oracle Express 11g.
- ✓ You need to design the tables and assign data types to attributes such that the information of the buildings and tramstops can be accessed and manipulated.
- ✓ You must use spatial data types such as SDO_GEOMETRY to store location data. For example, rather than defining two integers to store x and y coordinates, you need to create one column of SDO_GEOMETRY type and store both coordinates as a point object.
- ✓ You must create spatial indices (R-tree) in the database that might be used for this project.

File 2) *dropdb.sql* (10pts)

- ✓ This file will be used to clean up all tables, indices and other objects that are created by *createdb.sql*.

File 3) *queries.sql* (60 pts)

- ✓ This file should contain the following queries.

a) Rectangular Range Query (Window Query):

- ✓ It finds all objects that are completely inside the query window.
- ✓ Find all students inside the query window (200, 200) (300, 300). The coordinates indicate (x, y) values of the lower left and upper right vertices of query window, respectively.

b) Circular Range Query:

- ✓ It finds all the objects that are within the given distance to the given student id.
- ✓ Find all buildings and tramstops which are at most 300 units away from student p1.

c) Circular Range Query:

- ✓ Find all the students and buildings which are at most 300 units away from by tram stops: t2ohe, t5vhe and t6ssl.

d) K Nearest Neighbor Query:

- ✓ It finds the nearest k objects to a given object.
- ✓ Find 5 nearest students to the student: p12.
- ✓ Nearest neighbors must be ordered from the closest the furthest one.

e) Reverse Nearest Neighbor Query:

- ✓ If a building b1 is the nearest neighbor to a student s1 among all other buildings, then that student s1 should be a reverse nearest neighbor to building b1. This is query can be translated as “Who have me as nearest neighbor” as well.
- ✓ Find top 2 buildings that have the most reverse nearest neighbors. We are only interested in students as reverse nearest neighbors.

f) Spatial Join Query:

- ✓ A spatial join is the same as a regular join except that the predicate involves a spatial operator. In Spatial, a spatial join takes place when you compare all geometries of one layer to all geometries of another layer. This is unlike a query window, which compares a single geometry to all geometries of a layer. You can use SDO_JOIN statement.
- ✓ List all the students and buildings where a student is inside a building.

Useful Links:

- ✓ Oracle Express 11g Download: http://www.oracle.com/technetwork/database/database-technologies/express-edition/downloads/index.html

- ✓ Oracle Spatial Tutorial: http://docs.oracle.com/cd/E11882_01/appdev.112/e11830/toc.htm

Notes for Mac Users:

To use Oracle Express 11g on Mac, you may use a virtual machine. Please follow these steps:

- ✓ Step 1. Install VirtualBox software from https://www.virtualbox.org/
- ✓ Step 2. Download virtual images which already have Oracle Express 11g installed and run the image on VirtualBox. See the following link for prebuilt virtual images http://www.oracle.com/technetwork/middleware/soasuite/learnmore/vmsoa-172279.html