CS1555 Recitation 4 - Solution

Objectives: 1. To practice more relational algebra.
2. To practice SQL queries.

Consider the following relation schemas:

Student (SID, Name, Class, Major)
Student_Dir (ID, Address, Phone)
FK: (ID) → Student (SID)
Courses_taken (Course_No, Term, SID, Grade)
FK: (Course_No) → Course (Course_No); (SID) → Student (SID)
Course (Course_No, Course_Name, Level)
Instructor (ID, Fname, Lname)
Courses_offered(Course_No, Term, InstructorID)
FK: (Course_No) → Course (Course_No); (InstructorID) → Instructor (ID)

Part 1: Relational Algebra

Write a relational algebra query for each of the queries below:

1. List the students who did not enroll in any course in Fall 19.

   $SID\_enroll\_fall19 \leftarrow \pi_{SID}(\sigma_{Term = 'Fall\ 19'}(Courses\_Taken))$

   $SID\_all \leftarrow \pi_{SID}(Student)$

   $RSLT \leftarrow SID\_all - SID\_enroll\_fall19$

   If we were interested in all of the student attributes then :

   $\pi_{Student.SID,\ Student.name,\ Student.class,\ Student.major}(Student \bowtie_{Student.SID = RSLT.SID} RSLT)$

2. (Optional) Find the total number of students.

   $\mathcal{F}_{COUNT\ SID}(Student)$

3. Find the total number of students who have enrolled in the course "Operating Systems".

   $OS\_Taking \leftarrow \pi_{SID}(\sigma_{Course.Name = 'Operating\ Systems'}(Course\_Taken * Course))$
   $RSLT \leftarrow \mathcal{F}_{COUNT\ SID}(OS\_Taking)$

   (or you can combine the two steps into one expression (nested operations))

4. List the SID, name, and address (if available) of all students.

   $\pi_{SID,\ name,\ address}$ (Student] $\bowtie_{Student.SID=StudentDir.\ ID}$ Student_Dir)

   (note the left outer join)

5. Find the SID(s) of the student(s) who has/have the highest GPA

   Student_GPA(SID, GPA) ← $_{SID}\mathcal{F}_{AVERAGE\ GRADE}$ (Courses_taken)

   Highest_GPA (Max_GPA) ← $\mathcal{F}_{MAX\ GPA}$(Student_GPA)

   RSLT ← π_{SID} (Student_GPA $\bowtie_{GPA\ =\ Max\_GPA}$ (Highest_GPA))

6. Find the SID(s) of the student(s) who has/have taken all courses at the UGrad level

   Course_Denominator ← π_{Course_No} ($\sigma_{Level\ =\ 'UGrad'}$ Course)

   RSLT ← ($\pi_{SID,\ Course\_No}$(Course_Taken)) ÷ Course_Denominator

7. Find for each instructor, the course names of the courses he/she was teaching in Fall 19. List in addition to the course name, the first name and the last names of the instructor.

   $\pi_{Course.Name,Instructor.fname,\ Instructor.Lname}$ ($\sigma_{term='Fall\ 19'}$ (Instructor $\bowtie_{Instructor.ID\ =\ Courses\_offered.InstructorID}$ (Course * Courses_offered)))

8. (Optional) Find for each instructor the number of courses he/she has taught or is teaching. List the first name and the last name of each instructor along with his/her ID and number of courses.

   Courses_taught(ID, N_courses) ← $_{InstructorID}\mathcal{F}_{Count\ course\_no}$ (Courses_offered)

   RSLT ← Courses_taught * Instructor