CS1555 Recitation 5 – Class Solution

Objective: To practice relational algebra, especially aggregations, joins, and division.

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)

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

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

$$\text{Student\_GPA}(\text{SID, GPA}) \leftarrow {}_{\text{SID}}\mathcal{F}_{\text{AVERAGE GRADE}}(\text{Courses\_taken})$$

$$\text{Highest\_GPA}\ (\text{Max\_GPA}) \leftarrow \mathcal{F}_{\text{MAX GPA}}(\text{Student\_GPA})$$

$$\text{RSLT} \leftarrow \pi_{\text{SID}}(\text{Student\_GPA} \bowtie_{\text{GPA = Max\_GPA}} (\text{Highest\_GPA}))$$

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

$$\text{Course\_Denominator} \leftarrow \pi_{\text{Course\_No}}(\sigma_{\text{Level = 'UGrad'}}\ \text{Course})$$

$$\textit{RSLT} \leftarrow (\pi_{\text{SID, Course\_No}}(\text{Course\_Taken})) \div \text{Course\_Denominator}$$

3. 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.

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

4. 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.

$Courses\_taught(ID, N\_courses) \leftarrow {}_{InstructorID}\mathcal{F}_{Count\ course\_no}\ (Courses\_offered)$

$RSLT \leftarrow Courses\_taught * Instructor$