University of Toronto
CSC343, Winter 2017

Relational Algebra Exercises

These are solutions to some of the exercises we worked on in class. The remaining solutions will be posted once we have finished the exercises. **Important:** There are other good answers to each of these queries.

Schema

Note: "breadth" is a boolean indicating whether or not a course satisfies the breadth requirement for degrees in the Faculty of Arts and Science.

Student(sID, surName, firstName, campus, email, cgpa)

Course(dept, cNum, name, breadth)

Offering(oID, dept, cNum, term, instructor)

Took(sID, oID, grade)

Offering[dept, cNum] $\subseteq$ Course[dept, cNum]

Took[sID] $\subseteq$ Student[sID]

Took[oID] $\subseteq$ Offering[oID]

Queries

Write a query for each of the following:

1. Student number of all students who have taken csc343.

   Answer:

   $\Pi_{sID}\sigma_{dept=\text{“}csc\text{”}\wedge cNum=343}(Took \bowtie Offering)$

2. Student number of all students who have taken csc343 and earned an A+ in it.

   Answer:

   $Good343(sID) := \Pi_{sID}\sigma_{dept=\text{“}csc\text{”}\wedge cNum=343\wedge grade\geq 90}(Took \bowtie Offering)$

3. The names of all such students.

   Answer:

   Here we reuse relation Good343 from the previous question.

   $\Pi_{surName,firstName}(Good343 \bowtie Student)$

4. The names of all students who have passed a breadth course with Professor Picky.

   Answer:

   $PickyBreadth(oID) := \Pi_{oID}\sigma_{breadth=true \wedge instructor=\text{“}Picky\text{”}}(Course \bowtie Offering)$

   $Passers(sID) := \Pi_{sID}\sigma_{grade \geq 50}(PickyBreadth \bowtie Took)$

   $Answer(surName, firstName) := \Pi_{surName,firstName}(Passers \bowtie Student)$

5. sID of all students who have earned some grade over 80 and some grade below 50.

   Answer:

   $(\Pi_{sID}\sigma_{grade>80}Took) \cap (\Pi_{sID}\sigma_{grade<50}Took)$

6. Terms when Cook and Pitassi were both teaching something.
7. Terms when either of them was teaching csc463.
8. sID of students who have earned a grade of 85 or more, or who have passed a course taught by Atwood.
9. Terms when csc369 was not offered.

   Answer:

   $(\Pi_{term}\, Offering) - (\Pi_{term}\sigma_{dept=\text{“}csc\text{”} \wedge cNum=369}\, Offering)$

10. Department and course number of courses that have never been offered.
11. SIDs and surnames of all pairs of students who've taken a course together.
12. sID of student(s) with the highest grade in csc343, in term 20099.
13. sID of students who have a grade of 100 at least twice.
14. sID of students who have a grade of 100 exactly twice.
15. sID of students who have a grade of 100 at most twice.
16. Department and cNum of all courses that have been taught in every term when csc448 was taught.
17. Name of all students who have taken, at some point, every course Gries has taught (but not necessarily taken them from Gries).

Integrity Constraints

Use the notation

<relational algebra expression> = $\emptyset$

to write an integrity constraint for each of the following.

1. Courses at the 400-level cannot count for breadth.
2. CSC490 can only be offered at the same time as CSC454.