G51DBI Lab Week 2: Relational Algebra

INTRODUCTION

The following exercises aim to help you understand and practice the various Relational Algebra Operators. The University (Uni), Student (St) and Apply Relations below are the ones defined in the lecture slides.

Exercise 1

Assume that we are given relations R(A,B,C) and S(A,B,C):

R

A	B	C
1	2	3
4	2	3
4	5	6
2	5	3
1	2	6

S

A	B	C
2	5	3
2	5	4
4	5	6
1	2	3
2	5	3

A. Compute the union of R and S. Which of the following tuples DOES NOT appear in the result?

I. (1, 2, 3)
II. (4, 5, 3)
III. (4, 5, 6)
IV. (2, 5, 4)

B. Compute the intersection of R and S. Which of the following tuples appears in the result?

I. (2, 5, 3)
II. (2, 5, 4)
III. (4, 2, 3)
IV. (1, 2, 6)

C. Compute (R - S) union (S - R). Which of the following tuples is in the result?

I. (1, 5, 6)
II. (4, 5, 6)
III. (2, 5, 4)
IV. (4, 5, 3)

Exercise 2

Assume that we are given relations R(A,C) and S(B,C,D):

R	
A	B
1	2
3	4
5	6

S		
B	C	D
2	4	6
4	6	8
4	7	9

Compute the theta-join of R and S with the condition R.A < S.C AND R.B < S.D. Which of the following tuples is in the result? Assume each tuple has schema (A, R.B, S.B, C, D).

I. (5,6,2,4,6)

II. (3,4,5,7,9)

III. (1,2,2,6,8)

IV. (3,4,4,6,8)

Exercise 3

Assume that we are given relation R(A,B,C) :

R		
A	B	C
1	2	3
4	2	3
4	5	6
2	5	3
1	2	6

Compute the projection $\pi_{C,B}(R)$. Which of the following tuples is in the result?

I. (1, 2, 6)

II. (6, 5)

III. (2,6)

IV. (5,6)

Exercise 4

Assume that we are given relations R(A,C) and S(B,C,D):

R	
A	B
1	a
7	t
2	g
4	c
9	t

S		
B	C	D
c	5	6
a	7	8
t	8	9

Compute the theta-join of R and S with the condition R.B = S.B AND R.A < S.C. Which of the following tuples is in the result? Assume each tuple has schema (A, R.B, S.B, C, D).

I. (2, g, g, 7, 8)

II. (4, c, c, 7, 8)

III.(2, g, t, 8, 9)

IV.(4, c, c, 5, 6)

Exercise 5

Which of the following describes the result of this expression?

$$\pi_{uName}(Uni) - \pi_{uName}(\ Ap \bowtie (\pi_{sID}(\sigma_{GPA>19}(St)) \cap \pi_{SID}(\sigma_{subj='CS'}(Ap))\ )$$

I. All Universities with no GPA>19 Applicants who applied for CS at that University.
II. All Universities with no GPA>19 Applicants who applied for CS at any University.
III. All Universities where all Applicants either have GPA>19 or applied for CS at that University.
IV. All Universities where no Applicants have GPA>19 or no Applicants applied for CS at that University.

Exercise 6

Which of the following describes the result of this expression?

$$\pi_{sName,uName}(\ \sigma_{HS>enr}(\sigma_{county='London'}(Uni \bowtie St \bowtie \sigma_{subj='CS'}(Ap))\ )\ )$$

I. All Student-University name pairs, where the student is applying to CS at the University, the University is in London, and the University is smaller than some High School.
II. Students paired with all London Universities to which the Student applied to CS, where at least one of those Universities is smaller than the Student's High School.
III. Students paired with all Universities smaller than the Student's high school to which the Student applied to CS, where at least one of those Universities is in London.

IV. Students paired with all London Universities smaller than the Student's High School to which the Student applied to CS.

Exercise 7

Suppose that the Student relation has 20 tuples. ρ is the Rename operator. What is the minimum and maximum number of tuples in the result of the following expression?

$$\rho_{s1(i1,n1,g,h)}\text{Student} \bowtie \rho_{s2(i2,n2,g,h)}\text{Student}$$

I. minimum = 0, maximum = 400

II. minimum = 20, maximum = 20

III. minimum = 20, maximum = 400

IV. minimum = 20, maximum = 400

Exercise 8

Assume that relations University, Student, and Apply have 5, 20, and 50 tuples respectively. Assume that uName is a key for University. Do not assume sName is a key for Student. Assume that university names in Apply also appear in University. What is the minimum and maximum number of tuples in the result of this expression:

$$\pi_{uName}(\text{Uni}) \cup \rho_{uName}(\pi_{sName}(\text{Student})) \cup \pi_{uName}(\text{Apply})$$

I. minimum = 5, maximum = 25

II. minimum = 5, maximum = 75

III. minimum = 25, maximum = 45

IV. minimum = 75, maximum = 75