DBI Lab 002 - Relational Algebra

COMP1048 - Databases and Interfaces

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Lab Overview

Today, we will complete two activities:

1. Ensure SQLite is installed on our personal computers
2. Practice Relational algebra

Task 1 - Software Installation

Please ensure that all software introduced in Lab 001 has been installed on your personal machines. Lab helpers will be coming around to check that you have completed the installation process.

Task 2 - Relational Algebra

Answer the questions set out in the following 8 parts.

Task 2.1

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	7	3

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

    a. (1, 2, 3)

    b. (4, 5, 3)

    c. (4, 5, 6)

    d. (2, 5, 4)

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

    a. (2, 5, 3)

b. (2, 5, 4)

c. (4, 2, 3)

d. (1, 2, 6)

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

a. (1, 5, 6)

b. (4, 5, 6)

c. (2, 5, 4)

d. (4, 5, 3)

Task 2.2

Assume that we are given relations R(A,B) 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

1. 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 $(A, R.B, S.B, C, D)$.

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

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

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

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

Task 2.3

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

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

    a. (1, 2, 6)

    b. (6, 5)

    c. (2, 6)

d. $(5, 6)$

Task 2.4

Assume that we are given relations $R(A, B)$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

1. 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 $(A, R.B, S.B, C, D)$.

a. (2, g, g, 7, 8)
b. (4, c, c, 7, 8)
c. (2, g, t, 8, 9)
d. (4, c, c, 5, 6)

Task 2.5

> The University (Uni), Student (St) and Apply (Ap) Relations below are the ones defined in the lecture slides.

University		
uName	County	Enrollment

Student			
SID	sName	GPA	HS

Apply			
SID	uName	Subj	Dec

Which of the following describes the result of this expression?

$$\pi_{uName(Uni)} - \pi_{uName}(Ap \bowtie (\pi_{SID}(\sigma_{GPA>19}(ST)) \cap \pi_{SID}(\sigma_{Subj} = 'CS'(Ap))) \quad (1)$$

a. All Universities with no GPA>19 Applicants who applied for CS at that University.
b. All Universities with no GPA>19 Applicants who applied for CS at any University.
c. All Universities where all Applicants either have GPA>19 or applied for CS at that University.
d. All Universities where no Applicants have GPA>19 or no Applicants applied for CS at that University

Task 2.6

> The University (Uni), Student (St) and Apply (Ap) Relations below are the ones defined in the lecture slides.

Which of the following describes the result of this expression?

$$\pi_{sName,uName}(\sigma_{HS>Enrollment}(\sigma_{County='London'}(Uni \bowtie St \bowtie \sigma_{Subj='CS'}(Ap)))) \quad (2)$$

a. 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.
b. 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.
c. 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.

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

Task 2.7

> The University (Uni), Student (St) and Apply (Ap) Relations below are the ones defined in the lecture slides.

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?

$$\rho s1(i1, n1, g, h)Student \bowtie \rho s2(i2, n2, g, h)Student \tag{3}$$

a. minimum = 0, maximum = 400
b. minimum = 20, maximum = 20
c. minimum = 20, maximum = 400
d. minimum = 40, maximum = 40

Task 2.8

> The University (Uni), Student (St) and Apply (Ap) Relations below are the ones defined in the lecture slides.

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:

$$\pi_{uName}(Uni) \cup \rho_{uName}(\pi_{sName}(Student)) \cup \pi_{uName}(Apply) \tag{4}$$

a. minimum = 5, maximum = 25
b. minimum = 5, maximum = 75
c. minimum = 25, maximum = 45
d. minimum = 75, maximum = 75

Submissions

Please submit a PDF document containing your solutions to the above tasks. Submitting this assignment will contribute 1% to your overall Module grade. Your submission should demonstrate reasonable effort and fulfil the specified requirements set out in this lab sheet in order to receive the full marks.

There is no granularity to the marking, the marking is on a pass-or-fail basis.

This assignment will also serve as a part of your attendance registration for this week. Registration is reported to Faculty office on a weekly basis. The submission point is available on Moodle.

Submission Deadline - Monday, 10 October 2022 @ 15:00