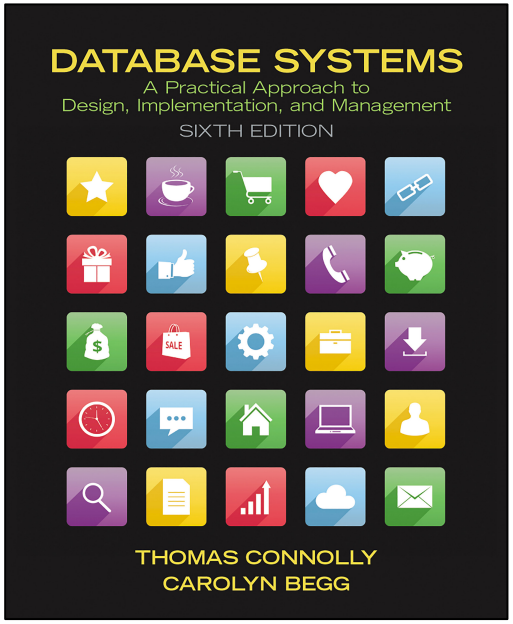
Division Example

Topic 2
Lesson 11 – Division RA operation

Chapter 5 section 1 Connolly and Begg



DEFINING DIVISION

- Given 2 relations A (student_register) and B (course);
- A/B = let x, yA be two attributes in A and yB is an attribute in B, yB and yA have the same domain
- A/B = {<x> such that for all <y> in B there exists <x ,y> an element of A = $\{< x > \mid \forall < y > \in B \; \exists < x, y > \in A\}$
- A/B contains all x tuples (student, course) such that for every y tuple value (course) in B, there is an xy tuple in A.
- • Or: If the set of y values (courses) associated with an x value (students) in A contains all y values in B, the x value is in A/B.
  - In general, x and y can be any lists of attributes
  - y is the list of fields in B, and x U y is the list of fields of A.

Meaning of Division operator

Assume x = student_id and y = course_id

Then A/B is xy/y where A represents a student registering for a course and B are courses and y values are the existing courses.

What does A/B represent? Well, for every course there needs to be a corresponding tuple in A for a student.

The student who has taken all courses

Find the disqualifying set

Compute all x values in A that are not disqualified.

How ?

If by attaching a y value from B, we obtain a tuple NOT in A

$$\pi_x((\pi_x(A) \text{x } B) - A\ )$$

$$\pi_x(A) - \ \pi_x((\pi_x(A) \text{x } B) - A\ )$$

We use set difference to find the disqualifying values, for the A values.

Step by step process

Course Id
cs200

Student Id (x)	Course Id (Cid y)
10	cs200
10	cs100
10	cs300
10	cs400
20	cs300
30	cs200
15	cs400
15	cs100
25	cs100
25	cs200

$\pi_x(A)$

Student ID
10
15
20
25
30

$(\pi_x(A) \text{x } B)$

Student Id, CId
10, cs200
20, cs200
30, cs200
15,cs200
25, cs200

$(\pi_x(A) \text{x } B)$ - A

Student Id,Cid
20, cs200
15,cs200

$\pi_x((\pi_x(A) \text{x } B) - A)$

Student Id
20
15

$\pi_x(A) - \pi_x((\pi_x(A) \text{x } B) - A)$

Student Id
10
30
25

Examples of divisions

Table A

Student Id (x)	Course Id (y)
10	cs200
10	cs100
10	cs300
10	cs400
20	cs300
30	cs200
15	cs400
15	cs100
25	cs100
25	cs200

Instances of B

Course Id
cs200

Course Id
cs200
cs100

Course Id
cs100
cs200
cs300

Corresponding Instances of A/B

Student Id
10
30
25

Student Id
10
25

Student Id
10

```
SELECT x, oount(*) FROM
  ( SELECT X FROM A WHERE
Y IN (SELECT Y ROM B ) ) as t GROUP BY x;
HAVING count(*) = ( SELECT COUNT(*) FROM B
```

Question:

What can we use in MySQL to perform division?

Need some type of cartesian product, as well as set difference to build up the operation.

DIVISION in MySQL

```
SELECT DISTINCT c1.y AS y
      FROM c c1
          WHERE NOT EXISTS
             (SELECT d.x FROM d
                 WHERE d.x NOT IN
                  (SELECT c2.x FROM c c2
                      WHERE c2.y = c1.y));

SELECT DISTINCT c1.y AS y
FROM c c1
  WHERE NOT EXISTS
       (SELECT * FROM d
             WHERE NOT EXISTS
                (SELECT * FROM c c2
                   WHERE c2.y = c1.y AND c2.x = d.x));
```

Summary

In this module you saw an example of division

Schema for RA exercises

S1

SID	Name	Login	DoB	GPA
55515	Smith	smith@ccs	Jan 10,1990	3.82
55516	Jones	jones@hist	Feb 11, 1992	2.98
55517	Ali	ali@math	Sep 22, 1989	3.11
55518	Smith	smith@math	Nov 30, 1991	3.32

S2

SID	Name	Login	DoB	GPA
55575	Chen	chen@ccs	Jan 10,1990	3.01
55579	Alton	alton@hist	Jun 11, 1992	2.07
55517	Ali	ali@math	Sep 22, 1989	3.11
55518	Smith	smith@math	Nov 30, 1991	3.32

registration

Sid	CId	LID	Grade
55515	History 101	45	C
5516	History 101	47	a
5515	Music 101	48	B
5516	Biology 220	46	C
55515	Biology 220	46	A
55517	History 101	45	B
55518	Music 101	48	A

Lecturers

LID	Name	CID
45	Fisk	History 101
46	Alder	Biology 220
47	Wong	History 101
48	Foster	Music 101