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CS143 Homework #1

1. Given the relations R(A,B,C) and S(A,B,C) with their tuples:

R(A,B,C)

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

S(A,B,C)

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

Then we determine:

(R-S)

A	B	C
4	5	6
1	2	6

(S-R)

A	B	C
2	5	3

Therefore, we find that the union is:

$(R - S) \cup (S - R)$

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

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2. Given R(A,B) and S(B,C,D):

R(A,B)

A	B
1	2
3	4
5	6

S(B,C,D)

B	C	D
2	4	6
8	6	8
7	5	9

(R x S)(R.A, R.B, S.B, S.C, S.D)

R.A	R.B	S.B	S.C	S.D
1	2	2	4	6
1	2	8	6	8
1	2	7	5	9
3	4	2	4	6
3	4	8	6	8
3	4	7	5	9
5	6	2	4	6
5	6	8	6	8
5	6	7	5	9

$R \bowtie_{R.A<S.C \wedge R.B<S.D} S = \sigma_{R.A<S.C \wedge R.B<S.D} (R \times S)$

Therefore, after using the theta-join operator (which we skipped in lecture), we have:

(R x S)(R.A, R.B, S.B, S.C, S.D)

R.A	R.B	S.B	S.C	S.D
1	2	2	4	6
1	2	8	6	8
1	2	7	5	9
3	4	2	4	6
3	4	8	6	8
3	4	7	5	9
5	6	8	6	8

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3. Given the database relations:

   Customer(customer-name, street, city)
   Branch(branch-name, city)
   Account(customer-name, branch-name, account-number)

   a. Find the names of all customers who have an account in the 'Region12' branch.

   $$\pi_{customer-name}(\sigma_{branch-name='Region12'}(Account))$$

   b. Find the names of all customers who have an account in a branch NOT located in the same city that they live in.

   $$\pi_{c1.customer-name}(\sigma_{c1.customer-name=c2.customer-name \text{ ^ } c1.branch-name>c2.branch-name}$$
   $$(\rho_{c1}(Customer \bowtie Branch) \times \rho_{c2}(Account)))$$

   c. Find the branches that do not have any accounts.

   $$\pi_{branch-name}(Branch) - \pi_{branch-name}(Account)$$

   d. Find the customer names who do not have any account in the 'Region12' branch.

   $$\pi_{customer-names}(Customer) - \pi_{customer-names}(\sigma_{branch-name='Region12'}(Account))$$

   e. Find the customer names who have accounts in all the branches located in 'Los Angeles'. You are not allowed to use the division operator directly for this question.

   $$\pi_{customer-name}(Customer)$$
   $$- \pi_{customer-name}\left(\pi_{customer-name}(Customer)\right.$$
   $$\times \pi_{branch-name}\left(\sigma_{city='Los\ Angeles'}(Branch)\right.$$
   $$\left.\left.- \pi_{customer-name,branch-name}\left(\sigma_{city='Los\ Angeles'}(Account)\right)\right)\right)$$

   f. Find the customer names who have only one account.

   $$\pi_{customer-name}(Account)$$
   $$- \pi_{customer-name}(\sigma_{a1.customer-name=a2.customer-name \text{ ^ } a1.account-number>a2.account-number}$$
   $$\left(\rho_{a1}(Account) \times \rho_{a2}(Account)\right))$$

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4. Given the relation Student(sid, GPA), write a relational algebra that finds the ids of the students with the lowest GPA.

$$\pi_{sid}(Student) - \pi_{sid}\left(\sigma_{s1.sid \neq s2.sid \,\wedge\, s1.GPA > s2.GPA}\left(\rho_{s1}(Student) \times \rho_{s2}(Student)\right)\right)$$