CS143: Database Systems
Homework #1 SOLUTION

1. $(R - S) \cup (S - R)$ is:

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

2. $R \bowtie_{R.A<S.C \wedge R.B<S.D} S$ is:

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

3. (a)

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

(b)

$$\pi_{customer-name}(\sigma_{A.city<>B.city \wedge A.branch-name=B.branch-name}(\rho_B(Branch) \times \rho_A(Customer \bowtie Account)))$$

(c)

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

(d)

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

(e)

$$\pi_{customer-name}(Customer) - \pi_{customer-name}(\pi_{customer-name}(Customer) \times \pi_{branch-name}(\sigma_{city='LosAngeles'}(Branch)) - \pi_{customer-name,branch-name}(Account))$$

(f)

$$\pi_{customer-name}(Customer) - \pi_{A.customer-name}(\sigma_{A.branch-name<>B.branch-name \vee A.account-number<>B.account-number) \wedge A.customer-name=B.customer-name}(\rho_A(Account) \times \rho_B(Account)))$$

4. $\pi_{sid}(Student) - \pi_{A.sid}(\sigma_{A.GPA>B.GPA \wedge A.sid<>B.sid}(\rho_A(Student) \times \rho_B(Student)))$

SQL Queries
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.

```
seleect A1.customer-name
from Account as A1,  Branch as B1
where A1.branch-name=B1.branch-name
and B1.city='Region12'
```

```
% explain why we used B1.branch-name > B2.branch-name
% instead of B1.branch-name <> B2.branch-name
```

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

```
seleect A1.customer-name
from Account as A1 A2, Branch as B1 B2
where A1.customer-name= A2.customer-name
and A1.branch-name=B1.branch-name
and A2.branch-name=B2.branch-name
and B1.branch-name > B2.branch-name
```

(*c) Find the branches that do not have any accounts.*

```
select branch-name
from Branches
where branch-name NOT IN (select branch-name from Account)
```

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

```
select customer-name
from Account
where customer-name NOT IN (seleect A1.customer-name
                              from Account as A1, Branch as B1
                             where A1.branch-name=B1.branch-name
                             and B1.city='Region12')
```

(*e) Find the customer names who have accounts in all the branches located in 'Los Angeles'*

```
select customer-name
from Account as A,  Branch as B
where A.branch-name=B.branch-name and B.city = 'Los Angeles'
group by customer-name
having count(distinct B.branch-name) = (select count(distinct branch-name)
                                        from Branch where city='Los Angeles')
```

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

```
select customer-name
from Account
group by customer-name
having count(distinct acoount-number)=1
```

The relation Student(sid, GPA) captures the student-GPA information,
where sid is the id of a student and GPA is the student's GPA.
Write a relational algebra that finds the ids of the students with the lowest GPA.

```
select sid
from Student
where GPA = (min GPA from Student)
```