DATABASE SYSTEMS

Practice Exercises 1

CMPT 354, Course Section of Dr. E. Ternovska

Database schema. Consider the following schema:

CUSTOMER : *ID*, *Name*, *City*

where *ID* is the primary key.

ACCOUNT : *Number*, *Branch*, *CustID*, *Balance*

where *Number* is the primary key and *CustID* is a foreign key referencing CUSTOMER on *ID*.

Problem 1. Write the following queries in relational algebra:

(1) "ID and name of customers who own an account in a branch in their city."

(2) "ID and name of customers who do **not** own any account."

(3) "ID and name of customers who own an account in **every** branch."

(4) "ID and name of customers who own an account with a balance which is no less than the balance of any other account."

Solution.

(1) $\pi_{\text{ID, Name}}(\text{CUSTOMER} \bowtie_{\text{ID=CustID} \wedge \text{City=Branch}} \text{ACCOUNT})$

(2) $\pi_{\text{ID, Name}}(\text{CUSTOMER} \,\overline{\ltimes}_{\text{ID=CustID}}\, \text{ACCOUNT})$

(3) $\pi_{\text{ID, Name, Branch}}(\text{CUSTOMER} \bowtie_{\text{CustID=ID}} \text{ACCOUNT}) \div \pi_{\text{Branch}}(\text{ACCOUNT})$

(4) $\pi_{\text{ID, Name}}\big(\text{CUSTOMER} \bowtie_{\text{CustID=ID}} (\text{ACCOUNT} \,\overline{\ltimes}_{\text{Balance<Bal}}\, \text{ACC})\big)$
with $\text{ACC} = \rho_{\text{Number}\to\text{Num},\, \text{Branch}\to\text{Br},\, \text{CustID}\to\text{Cust},\, \text{Balance}\to\text{Bal}}(\text{ACCOUNT})$

Problem 2. Can query (4) of Problem 1 ever return more than one tuple? If yes, come up with a database (over the given schema) on which that happens; otherwise, explain why it cannot happen.

Solution. Yes:

CUSTOMER

ID	Name	City
1	John	London
2	Mary	Edinburgh

ACCOUNT

Number	Branch	CustID	Balance
111	London	1	100
222	Edinburgh	2	100

Problem 3. Write query (1) of Problem 1 in SQL.

Solution.

```
SELECT C.id, C.name
FROM   customer C, account A
WHERE  A.custid = C.id AND A.branch=C.city
```

Problem 4. Given the database below

CUSTOMER

ID	Name	City
1	John	London
2	Mary	Edinburgh
3	Jeff	London
4	Jane	Cardiff

ACCOUNT

Number	Branch	CustID	Balance
111	London	1	120
222	Edinburgh	1	62
333	London	3	76
444	London	2	200

compute the answer to the query

$$\text{CUSTOMER} \bowtie \left(\pi_{\text{ID,City}}(\text{CUSTOMER}) \cap \rho_{\text{CustID}\to\text{ID},\, \text{Branch}\to\text{City}}\left(\pi_{\text{Branch,CustID}}(\text{ACCOUNT})\right)\right)$$

Solution.

ID	Name	City
1	John	London
3	Jeff	London