

Written Assignment #2

Problem 1. [24pts]

Consider the following relational database that stores information about credit card companies:

Issuer(bank, card)
Bank_location(bank, location)
Max_limits(card, max_limit)

An instance of the database is the following:

Issuer	
Bank	Card
Amex	American Express
Fist Federal	Visa
Fist Federal	MasterCard
Chase	Visa
Citizens	Visa
Citizens	MasterCard
Citizens	Discovery
Fleet	Visa

Bank_location	
Bank	Location
Amex	Chicago
Fist Federal	LA
Chase	NY
Citizens	Boston
Fleet	Boston

Max_limits	
Card	Max_limit
Visa	\$50,000
MasterCard	\$100,000
Discovery	\$100,000
American Express	\$500,000

Write the following queries in **relational algebra** (note it is important to avoid “query by instance”):

1. Which credit cards are issued by banks in Boston?
2. Which credit cards *are not* issued in NY?
3. Which banks issue credit cards with a limit less than \$100,000?
4. Which banks issue only one credit card?
5. Which banks issue MasterCard and Visa but *no* other cards?
6. Which banks issue all credit cards?

Problem 2. [50pts]

Consider a database with the following schema (when more than one attribute is underlined, the combination of them is the primary key):

Customer (cname, address)
 Shops (sname, address)
 Product (pname, manufacturer)
 Visits (cname, sname, times_a_year)
 Likes (cname, pname)
 Serves (sname, pname, price)

Write the following queries in **relational algebra**:

- (1) Find the names of all customers who has visited “Macy Downtown SLC”.
- (2) Find the names of all shops that serve both “iPhone8” and “Galaxy10”.
- (3) Find the names of all shops that serve at least one products John likes for no more than \$100.
- (4) For each shop, find products served at this shop that are liked by none of the customers who visited that shop.
- (5) Find all customers who visit *only* those shops that serve some products they like.
- (6) Find all customers who have visited *every* shops that serves some products they like.
- (7) Find those customers who visited all shops Alice has visited.
- (8) Find those customers who visited all and only those (i.e. exactly the same set of) shops Alice has visited.
- (9) For each product, find the shop(s) that serves it at the lowest price.
- (10) Find the name(s) of the shop(s) visited by all customers from SLC (SLC is an address).

Problem 3. [10pts]

Consider the following specification: Each athlete has a unique athlete id and a distinct login id, and a name. Each club has a unique club id and an address, as well as a unique club title. Each athlete must be a member of some club, but can be a member in at most one club. A club make take multiple athletes. Athletes in the same club must be assigned with distinct ratings.

Suppose we have two schemas describing the above specification, namely, *Athlete* and *Club*.

What are the primary key, candidate key(s), and super key(s) for each of these tables?

Problem 4. [16pts]

Consider the following two tables, T1 and T2:

T1			T2		
A	Q	R	A	B	C
20	a	5	20	b	6
25	b	8	45	c	3
35	a	6	20	b	5

Show the results of the following relational algebra queries:

1. $T1 \bowtie_{T1.A=T2.A} T2$
2. $T1 \bowtie_{T1.Q=T2.B} T2$
3. $T1 \bowtie T2$
4. $T1 \bowtie_{T1.A=T2.A \text{ AND } T1.R=T2.C} T2$