CSIT 5300 - Spring 2018 - HKUST
Assignment 2

Deadline: Wednesday, March 14, 2018, 10:20pm
Submission: Please bring a hard copy of your solutions to the lecture

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For T.A. use only

<table>
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<th>Problem</th>
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An e-Shop Database

Consider an e-Shop system, which allows users (customers and merchants) participate in the sale of items. You are required to design a simple database for this e-Shop database system, which has the following specifications:

- A user in the system is either a merchant, or a customer, but not both.
- For every customer, the database records a unique id, name, city, credit card number.
- For each merchant, the database records a unique id, name, city, account number, and a phone number list with arbitrary size.
- The e-Shop can distribute only up to 10 different products from each merchant.
- The same product cannot be sold by two different merchants via the e-Shop.
- Each product has a unique id, a description, and a price.
- A merchant may impose additional handling fees on an item. Each handing fee has a handling rate and a description. Handling rate is unique within each item. Each handling fee is associated with exactly one product, whereas many handling fees can be associated with the same item.
- A customer can make purchase orders through the e-Shop. Each purchase order has a purchase id, time, and date. Each purchase order can consist of an arbitrary number of products. For each product in a purchase order, the purchase quantity is recorded.

We also make the following assumptions:

- Every merchant in the database sells at least one product.
- Every product must be sold by a merchant.
- Every purchase order must have at least one product.
Problem 1 [25-points] ER-Diagram
Create the ER-diagram for the e-Shop database specified above.

Answer:

![ER-Diagram for e-Shop database]
Problem 2 [25-points] Relational Tables
Construct the relational tables for the ER-diagram you created in Problem 1, underlining the primary keys.

Answer:

(*The foreign keys appear in red)

Customer(id, name, city, credit_card)
Merchant(id, name, city, account)
Merchant-Phone(id, phone)
Handling-Fee(product-id, handling-rate, description)
Purchase(purchase-id, time, date, id)
Product(product-id, description, price, id)
Consist(purchase-id, product-id, quantity)
Problem 3 [25 points] Relational Algebra
Give an expression in relational algebra to formulate each of the following queries:

(a) [5 points] Find the ids of the products whose price is greater than 50.

Answer:

$$\pi_{pid}(\sigma_{price>50}(Product))$$

(b) [5 points] Find the descriptions of the products purchased by the customer with the id “1356”.

Answer:

$$\pi_{description}(\sigma_{Purchase.id='1356'}(Purchase \bowtie_{purchase-id} Consist \bowtie_{product-id} Product))$$

(c) [5 points] Find the ids of the products whose prices are higher than 100 and are not purchased by any customer.

Answer:

$$\pi_{product-id}(\sigma_{price>100}(Product)) - \pi_{product-id}(Consist)$$
(d) [5 points] Find the ids of the customers who purchased all the products sold by the merchant with the id “1169”.

\[ \pi_{id, \text{product-id}}(\text{Purchases} \bowtie_{\text{purchase-id Consist}}) / \pi_{\text{product-id}}(\sigma_{\text{id}=1169}(\text{Product})) \]

Answer:

(e) [5 points] Find the id of the most expensive product sold by the merchant with the id “1169”.

\[ \rho(\pi_{\text{product-id}}(\sigma_{\text{id}=1169}(\text{Product}))) \]

All product ids of merchant “1169”:

Two copies of all “1169” products:

\[ \rho(P1, \sigma_{\text{id}=1169}(\text{Product})) \]
\[ \rho(P2, \sigma_{\text{id}=1169}(\text{Product})) \]

Ids of “1169” products whose price is smaller than the price of some other “1169” product:

\[ \rho(B, \pi_{\text{product-id}}(\sigma_{\text{P1.price}<\text{P2.price}}(\text{P1} \times \text{P2}))) \]

Final result: A – B
Problem 4 [25 points] SQL
Give an expression in SQL to formulate each of the following queries:

(a) [5 points] Find the ids of the customers who purchased products on “03/22”.

Answer:
```
select distinct id
from Purchase
where date = "03/22"
```

(b) [5 points] Find the ids of the customers who have purchased products sold by the merchant with the id “1169”.

Answer:
```
select distinct Purchase.id
from Purchase, Consist, Product
where Purchase.purchase-id = Consist.purchase-id and Consist.product-id = Product.product-id and Product.id = "1169"
```

(c) [5 points] For each merchant, return the id and total amount of money that its products cost (disregarding handling fees), under the condition that the total amount is greater than 1000. The result should be ordered in ascending order of the total amount.

Answer:
```
select id, sum(price) as total
from Product
group by id
having total > 1000
order by total asc
```
(d) [5 points] Find the ids of the customers who have not purchased any product with handling fee.

**Answer:**

```sql
select distinct C.id
from Customer as C
where not exists ( select P.id
    from Purchase as P, Consist as I, Handling-Fee as F
    where C.id = P.id and P.purchase-id = I.purchase-id and I.product-id = F.product-id )
```

(e) [5 points] Find the ids of the customers who purchased all the products sold by the merchant with the id “1169”.

**Answer:**

```sql
select distinct C.id
from Customer as C
where not exists
((select P.product-id
    from Product as P
    where id="1169")
except
(select l.product-id
    from Purchase as R, Consist as l
    where C.id=R.id and R.purchase-id=l.purchase-id))
```