CSIT 5300 - Spring 2019 - HKUST
Assignment 2

Deadline: Thursday, March 14, 2019, 7:30pm
Submission: Please bring a hard copy of your solutions to the lecture

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For T.A. use only

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<th>Problem</th>
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Consider an e-Auction system, which allows users (buyers and sellers) participate in the sale of items. You are required to design a simple database for this e-Auction database system, which has the following specifications:

- A user in the system may be either a buyer and a seller. Each user is described by an email address, name, password, and phone number. Email address is used as an unique id to login the e-Auction system.
- For every buyer, the database records a shipping address.
- For each seller, the database records a bank account number and a routing number.
- Items are placed by a seller. Each item has a unique item number, a description, a postage rate, and a start bid price.
- A seller can place at most 50 items on the e-Auction system.
- Buyers make bids for items they are interested in. Each bid is assigned with a unique bid id. Bid price, time and date are recorded for each bid.
- A buyer can place an arbitrary number of bids on the e-Auction system, whereas each bid is placed by exactly one buyer.
- An item can have an arbitrary number of bids, whereas each bid belongs only to exactly one item.
- A buyer 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.

We also make the following assumptions:

- The same item cannot be sold by two or more different sellers via the e-Auction system.
- Every seller in the database sells at least one product.
Problem 1 [25-points] ER-Diagram
Create the ER-diagram for the e-Auction database specified above.

Answer:
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)

User(email, password, name, phone)
Buyer(email, address)
Seller(email, bank-acc, routing-num)
Bid(bid-id, bid-price, time, date, email, item-num)
Item(item-num, description, postage, price, email)
Handling-Fee(item-num, handling-rate, description, item-num)
Problem 3 [25 points] Relational Algebra

Give an expression in relational algebra to formulate each of the following queries:

(a) [5 points] Find the item numbers of the items whose postage rate is 0.

\[ \pi_{item\text{-}num}(\sigma_{postage=0}(Item)) \]

(b) [5 points] Find the description of the items bid by the buyer with the email “kenneth@eauction.com”.

\[ \pi_{description}(\sigma_{Bid\text{-}email="kenneth@eauction.com"}(Bid \bowtie_{item\text{-}num} Item)) \]

(c) [5 points] Find the items whose prices are higher than 50 and which do not have any bids.

\[ \pi_{item\text{-}num}(\sigma_{price>50}(Item)) - \pi_{item\text{-}num}(Bid) \]

(d) [5 points] Find the phone numbers of the users who have bid on any items placed by themselves.

\[ \pi_{phone}(User \bowtie_{email}(Bid \bowtie_{Bid\text{-}email=Item\text{-}email\land Bid\text{-}item\text{-}num=Item\text{-}item\text{-}num}(Item))) \]
(e) [5 points] Find the email of the seller who posted the item with the highest handling rate.

Answer:

$$\begin{align*}
\rho(I1, Item) \\
\rho(I2, Item) \\
\pi_{\text{Item.email}}(\text{Item} \bowtie_{\text{item-num}} (\pi_{\text{I1.item-num}} \pi_{\text{I1.item-num}}(\sigma_{\text{I1.handling-rate < I2.handling-rate}(I1 \times I2))))
\end{align*}$$
Problem 4 [25 points] SQL
Give an expression in SQL to formulate each of the following queries:

(a) [5 points] Find the emails of the buyers who made bids on “01/07”.

Answer:

```sql
select distinct email
from Buyer, Bid
where Buyer.email = Bid.email and date = “01/07”
```

(b) [5 points] Find the biggest bid price on every day, in descending order of dates.

Answer:

```sql
select date, max(bid-price) as max-bid
from Bid
group by date
order by date desc
```

(c) [5 points] Find the emails of sellers who have not placed any items with a handling rate larger than 10.

Answer:

```sql
select S.email
from Seller as S
where not exists ( select l.email
                  from Item as l, Handling-Fee as F
                  where S.email = l.email and l.item-num = F.item-num
                              and F.handling-rate > 10)
```

(d) [5 points] Find the email of the seller who placed the item with the largest number of bids.

Answer:

```sql
select email
from Item
where item-num = ( select item-num
                  from ( select item-num, count(item-num) as count
                          from Bid
                          group by item-num) as C
                  where count = ( select max(count)
                                 from C )
```

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(e) [5 points] Find the emails of the buyers who bid all the items posted by the seller with email “kenneth@eauction.com”.

Answer:

```sql
select B.email
from Buyer as B
where not exists
    ((select l.item-num
        from Item as l
        where email = "kenneth@eauction.com"
    )
except
    (select D.email
        from Bid as D
        where D.email = B.email))
```