Database and Information Systems

Homework 1

The first two problems concern the Penn Ebay (PBAY) System, which is represented by the following schema:

$$\text{Sellers}(sellerID\text{:}\texttt{int},\ rating\text{:}\texttt{char[2]},\ email\text{:}\texttt{string})$$
$$\text{Items}(itemID\text{:}\texttt{int},\ typeID\text{:}\texttt{int})$$
$$\text{Stock}(itemID\text{:}\texttt{int},\ startBid\text{:}\texttt{float},\ qty\text{:}\texttt{int})$$
$$\text{SoldBy}(itemID\text{:}\texttt{int},\ sellerID\text{:}\texttt{int})$$
$$\text{Description}(itemID\text{:}\texttt{int},\ desc\text{:}\texttt{string})$$
$$\text{Purchases}(purchaseID\text{:}\texttt{int},\ itemID\text{:}\texttt{int},\ custID\text{:}\texttt{int},\ soldFor\text{:}\texttt{float},\ qty\text{:}\texttt{int})$$
$$\text{Customers}(custID\text{:}\texttt{int},\ address\text{:}\texttt{string})$$

Problem 1 [60 points]: Express the following queries in (a) the relational algebra, (b) the tuple relational calculus, and (c) the domain relational calculus:

1. Find the IDs of sellers with rating "A+";

2. Find the IDs of sellers with the IDs of items they sell;

3. Find the IDs of customers who bought at least 2 of the same item, or who bought the entire stock of an item;

4. Find the IDs of customers who paid no more than $100 for any item;

5. Find the IDs of item types bought by at least 3 customers;

6. Find the IDs of sellers who sell an item for less than at least one other seller.

Problem 2 [30 points]: State in English what the following queries compute:

1. $\pi_{desc}(\pi_{itemID}(\sigma_{startBid>1000}(Stock) \bowtie \sigma_{soldFor<2000}(Purchases)) \bowtie Description)$

2. $\pi_{desc}(\sigma_{soldFor<2000}(\sigma_{startBid>1000}(Stock \bowtie Purchases \bowtie Description)))$

3. $\pi_{email}((\pi_{sellerID}(\sigma_{startBid<10}(Stock) \bowtie SoldBy) \cap$
   $\pi_{sellerID}(\sigma_{startBid>1000}(Stock) \bowtie SoldBy)) \bowtie Sellers)$

4. $\pi_{email}((\pi_{sellerID}(\sigma_{startBid<10}(Stock) \bowtie SoldBy) \cup$
   $\pi_{sellerID}(\sigma_{startBid>1000}(Stock) \bowtie SoldBy)) \bowtie Sellers)$

5. $\pi_{typeID}((\pi_{sellerID}(\sigma_{startBid<10}(\sigma_{qty>100}(Stock)) \bowtie SoldBy) \cap$
   $\pi_{sellerID}(\sigma_{startBid>1000}(\sigma_{qty<3}(Stock)) \bowtie SoldBy)) \bowtie SoldBy \bowtie Items)$

Problem 3 [10 points]: What is a data model, and why was it an important innovation?