Database and Information Systems

Homework 1

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

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

\textbf{Problem 1} \textit{[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.

\textbf{Problem 2} \textit{[30 points]}: State in English what the following queries compute:

\begin{enumerate}
  \item \( \pi_{\text{desc}}(\pi_{\text{itemID}}(\sigma_{\text{startBid}>1000}(\text{Stock} \Join \sigma_{\text{soldFor}<2000}(\text{Purchases}) \Join \text{Description})) \)
  \item \( \pi_{\text{desc}}(\sigma_{\text{soldFor}<2000}(\sigma_{\text{startBid}>1000}(\text{Stock} \Join \text{Purchases} \Join \text{Description})) \)
  \item \( \pi_{\text{email}}((\pi_{\text{sellerID}}(\sigma_{\text{startBid}<10}(\text{Stock} \Join \text{SoldBy}) \cap \\
\pi_{\text{sellerID}}(\sigma_{\text{startBid}>1000}(\text{Stock} \Join \text{SoldBy})) \Join \text{Sellers})) \)
  \item \( \pi_{\text{email}}((\pi_{\text{sellerID}}(\sigma_{\text{startBid}<10}(\text{Stock} \Join \text{SoldBy}) \cup \\
\pi_{\text{sellerID}}(\sigma_{\text{startBid}>1000}(\text{Stock} \Join \text{SoldBy})) \Join \text{Sellers})) \)
  \item \( \pi_{\text{typeID}}((\pi_{\text{sellerID}}(\sigma_{\text{startBid}<10}(\sigma_{\text{qty}>100}(\text{Stock} \Join \text{SoldBy}) \cap \\
\pi_{\text{sellerID}}(\sigma_{\text{startBid}>1000}(\sigma_{\text{qty}<3}(\text{Stock}) \Join \text{SoldBy}) \Join \text{SoldBy} \Join \text{Items})) \)
\end{enumerate}

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