

Database and Information Systems

Homework 1

Due on September 26, 2007

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

Sellers(*sellerID*:int, *rating*:char, *email*:string)
 Items(*itemID*:int, *type*:string)
 Buyers(*buyerID*:int, *email*:string, *city*:string, *state*:string)
 Stock(*itemID*:int, *sellerID*:int, *startBid*:float, *quantity*:int, *endTime*:int)
 Purchase(*itemID*:int, *buyerID*:int, *sellerID*:int, *price*:float, *purchaseQuantity*:int, *bidTime*:int)

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 items purchased for price < \$50.
2. Find the **emails** of buyers from PA who buy items with purchaseQuantity > 3.
3. Find the **IDs** of buyers who purchased items from of purchaseQuantity less than 10% of the quantity provided by the same seller the buyer purchase from in the stock.
4. Find the **IDs** of buyers who purchased items with type “furniture” for over 10% of the startBid price of the items they bought.
5. Find the **IDs** of buyers who either always make purchases with purchaseQuantity < 5 or haven’t made any purchases.
6. Find the types of items stocked by ≥ 2 sellers or bought by ≥ 2 buyers.

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

1. $\{Q \mid \exists P \in \text{Purchase}, \exists S \in \text{Sellers} (S.\text{rating} = \text{“A”} \wedge P.\text{sellerID} = S.\text{sellerID} \wedge P.\text{purchaseQuantity} = 2 \wedge Q.\text{buyerID} = P.\text{buyerID})\}$
2. $\{ \langle e \rangle \mid \exists i, s (\exists r (\langle s, r, e \rangle \in \text{Sellers}) \wedge \exists d, q, n (\langle i, s, d, q, n \rangle \in \text{Stock} \wedge (d < 20) \wedge (q = 5)) \wedge \exists b, p, u, m (\langle i, b, s, p, u, m \rangle \in \text{Purchase} \wedge (p > 50))) \}$
3. $\pi_{\text{email}}(\sigma_{\text{city}=\text{“Philadelphia”}}(\text{Buyers}) \bowtie \pi_{\text{buyid}}(\sigma_{\text{price} < 2 * \text{startBid}}(\sigma_{\text{type}=\text{“book”}} \wedge \text{purchaseQuantity}=2(\text{Items} \bowtie \text{Purchase}) \bowtie \text{Stock})))$
4. $\pi_{\text{rating}}(\pi_{s1}(\sigma_{i1 \neq i2 \wedge s1=s2}(\rho_{\text{itemID} \rightarrow i1, \text{sellerID} \rightarrow s1}(\text{Stock}) \bowtie \rho_{\text{itemID} \rightarrow i2, \text{sellerID} \rightarrow s2}(\sigma_{\text{quantity} \geq 3}(\text{Stock})))) \bowtie_{s1=\text{sellerID}} \text{Sellers})$

Problem 3 [10 points]: Explain how Codd's points of access path dependence and indexing dependence relate to today's Java objects. (Assume the goal is to return all instances of a particular member variable of a particular object, which might be linked to by other objects.)