

EECS 341 Assignment #4 Keys; Spring'2009

Consider the Customers-Agents-Products (CAP) database with schema below.

CUSTOMERS (cid, cname, city, discnt) (C) AGENTS (aid, aname, city, percent) (A)

PRODUCTS (pid, pname, city, quantity, price) (P) ORDERS (ordno, month, cid, aid, pid, qty, dollars) (O)

Write in relational calculus the queries listed below.

1. Get product names that are ordered by at least one customer three different times.

$$\{ t^{(1)} \mid (\exists p) (P(p) \wedge t[1]=p.pname \wedge (\exists o1) (\exists o2) (\exists o3) (O(o1) \wedge O(o2) \wedge O(o3) \wedge o1.ordno \neq o2.ordno \wedge o1.ordno \neq o3.ordno \wedge o2.ordno \neq o3.ordno \wedge o1.pid=o2.pid \wedge o1.pid=o3.pid \wedge p.pid=o1.pid \wedge o1.cid=o2.cid \wedge o1.cid=o3.cid)) \}$$

2. Get product names that are ordered by at least three customers in the same city.

$$\{ t^{(1)} \mid (\exists p) (P(p) \wedge t[1]=p.pname \wedge (\exists o1) (\exists o2) (\exists o3) (\exists c1) (\exists c2) (\exists c3) (O(o1) \wedge O(o2) \wedge O(o3) \wedge C(c1) \wedge C(c2) \wedge C(c3) \wedge o1.ordno \neq o2.ordno \wedge o1.ordno \neq o3.ordno \wedge o2.ordno \neq o3.ordno \wedge o1.pid=o2.pid \wedge o1.pid=o3.pid \wedge o1.pid = p.pid \wedge o1.cid \neq o2.cid \wedge o1.cid \neq o3.cid \wedge o2.cid \neq o3.cid \wedge o1.cid=c1.cid \wedge o2.cid=c2.cid \wedge o3.cid=c3.cid \wedge c1.city=c2.city \wedge c1.city=c3.city)) \}$$

3. Get product names that are ordered by at least one customer in **each and every customer** city listed in the database (**universal quantification**).

$$\{ t^{(1)} \mid (\exists p) (P(p) \wedge t[1]=p.pname \wedge (\forall c) (C(c) \rightarrow (\exists c2) (\exists o) (C(c2) \wedge O(o) \wedge c.city=c2.city \wedge c2.cid=o.cid \wedge o.pid=p.pid))) \}$$

4. Get product names that are **never** ordered by any customer in Tokyo and Cleveland

$$\{ t^{(1)} \mid (\exists p) (P(p) \wedge t[1]=p.pname \wedge (\forall c) ((C(c) \wedge (c.city="Tokyo" \vee c.city="Cleveland")) \rightarrow \neg (\exists o) (O(o) \wedge o.pid=p.pid \wedge o.cid=c.cid))) \} \quad \text{OR}$$
$$\{ t^{(1)} \mid (\exists p) (P(p) \wedge t[1]=p.pname \wedge \neg (\exists c) (\exists o) (C(c) \wedge O(o) \wedge o.pid=p.pid \wedge o.cid=c.cid \wedge (c.city="Tokyo" \vee c.city="Cleveland"))) \}$$

5. Get agent names who have ordered **all** products for all customers (**universal quantification**).

$$\{ t^{(1)} \mid (\exists a) (A(a) \wedge t[1]=a.aname \wedge (\forall p) (\forall c) ((P(p) \wedge C(c)) \rightarrow (\exists o) (O(o) \wedge o.aid=a.aid \wedge o.pid=p.pid \wedge o.cid=c.cid))) \}$$

6. Get customer names who have ordered through **all** agents living in their own cities (**universal quantification**).

$$\{ t^{(1)} \mid (\exists c) (C(c) \wedge t[1]=c.cname \wedge (\forall a) ((A(a) \wedge a.city = c.city) \rightarrow (\exists o) (O(o) \wedge o.aid=a.aid \wedge o.cid=c.cid))) \}$$

Q7: Get customer names who have **never** ordered through agents living in their own cities (**universal quantification**).

$$\{ t^{(1)} \mid (\exists c) (C(c) \wedge (\forall a) ((A(a) \wedge a.city = c.city) \rightarrow \neg (\exists o) (O(o) \wedge o.aid=a.aid \wedge o.cid=c.cid))) \}$$

OR

$$\{ t^{(1)} \mid (\exists c) (C(c) \rightarrow \neg (\exists a) (\exists o) (A(a) \wedge O(o) \wedge a.city=c.city \wedge o.aid=a.aid \wedge o.cid=c.cid)) \}$$

Q8: Get customer names who have **never** ordered products cheaper than \$100,000(**universal quantification**).

$$\{ t^{(1)} \mid (\exists c) (C(c) \wedge t[1] = c.cname \wedge (\forall o) (\forall p) ((O(o) \wedge P(p) \wedge o.cid = c.cid \wedge p.pid = o.pid) \rightarrow p.price \geq 100,000)) \}$$

No quite correct, but also accepted:

$$\{ t^{(1)} \mid (\exists c) (C(c) \wedge t[1]=c.cname \wedge (\forall o) ((O(o) \wedge o.cid=c.cid) \rightarrow o.dollars \geq 100,000)) \}$$

Q9: Get customer names who have **always** ordered in dollar amounts more than \$1,000,000, and **never** through agents in New York (**universal quantification**).

$$\{ t^{(1)} \mid (\exists c) (C(c) \wedge t[1] = c.cname \wedge (\forall o) (\forall a) ((O(o) \wedge A(a) \wedge o.cid = c.cid \wedge o.aid = a.aid) \rightarrow o.dollars > 1,000,000 \wedge a.city \neq "NY")) \}$$

10. Get agent names whose commissions are **always** below 10%, and never ordered products with prices less than \$100,000 (**universal quantification**).

$$\{ t^{(1)} \mid (\exists a) (A(a) \wedge t[1]=a.aname \wedge a.percent < 10 \wedge (\forall o) (\forall p) ((O(o) \wedge P(p) \wedge o.aid=a.aid \wedge o.pid=p.pid) \rightarrow p.price > 100,000)) \}$$