Fall 2007 CS186 Discussion Section: Week 6, 10/01 - 10/05

Your Friendly TAs

October 2, 2007

1 Relational Algebra and Relational Calculus

Consider the following schema on figure **??**:

```
Suppliers(sid:integer, sname:string, address:string)
Parts(pid:integer, pname:string, color:string)
Catalog(sid:integer, pid:integer, cost:real)
```

Table 1: Schema for the supply chain database.

The key fields are underlined, and the domain of each field is listed after the field name. The Catalog relation lists the prices charged for parts by Suppliers. Write the following queries in relational algebra:

1. Find the *names* of suppliers who supply some red part.

   $\pi_{name}(\pi_{sid}((\pi_{pid}\sigma_{color='red'}Parts) \bowtie Catalog) \bowtie Suppliers)$

   $\{R|\exists S \in Suppliers \wedge R.name = S.name \wedge (\exists C \in Catalog \wedge (\exists P \in Parts(P.color =' red' \wedge P.pid = C.pid \wedge S.sid = C.sid)))\}$

2. Find the *sids* of suppliers who supply some red or green part.

   $\pi_{sid}(\pi_{pid}(\sigma_{color='red' \vee color='green'}Parts) \bowtie Catalog)$

   $\{R|\exists C \in Catalog \wedge R.sid = C.sid \wedge (\exists P \in Parts((P.color =' red' \vee P.color =' green') \wedge P.pid = C.pid))\}$

3. Find the *sids* of suppliers who supply some red part or are at 221 Packer Street.

   $\rho(R_1, \pi_{sid}((\pi_{pid}\sigma_{color='red'}Parts) \bowtie Catalog))$
   $\rho(R_2, \pi_{sid}\sigma_{address='221 Packer Street'}Suppliers)$
   $R_1 \cup R_2$

   $\{R|\exists S \in Suppliers \wedge R.sid = S.sid \wedge (\exists C \in Catalog \wedge (\exists P \in Parts(P.pid = C.pid \wedge S.sid = C.sid \wedge (P.color =' red' \vee S.address =' 221 \text{ Parker St.}'))))\}$

4. Find the *sids* of suppliers who supply some red part and some green part.

   $\rho(R_1, \pi_{sid}((\pi_{pid}\sigma_{color='red'}Parts) \bowtie Catalog))$
   $\rho(R_2, \pi_{sid}((\pi_{pid}\sigma_{color='green'}Parts) \bowtie Catalog))$
   $R_1 \cap R_2$

   $\{R|\exists C_1 \in Catalog \wedge R.sid = C_1.sid \wedge \exists C_2 \in Catalog(C_1.sid = C_2.sid \wedge C_1.pid \neq C_2.pid \wedge (\exists P_1 \in Parts(P_1.pid = C1.pid \wedge P_1.color =' red')) \wedge (\exists P_2 \in Parts(P_2.pid = C2.pid \wedge P_2.color =' green')))\}$

5. Find the *sids* of suppliers who supply every part.

   $(\pi_{sid,pid}Catalog)/(\pi_{pid}Parts)$

   $\{R|\forall P \in Parts \Rightarrow \exists C \in Catalog(C.sid = R.sid \wedge P.pid = C.pid)\}$

6. Find the *sids* of suppliers who supply *every* red part.

   $(\pi_{sid,pid}Catalog)/(\pi_{pid}\sigma_{color='red'}Parts)$

   $\{R|\forall P \in Parts(P.color =' red') \Rightarrow \exists C \in Catalog(C.sid = R.sid \wedge P.pid = C.pid)\}$

7. Find the *sids* of suppliers who supply *every* red or green part.

   $(\pi_{sid,pid}Catalog)/(\pi_{pid}\sigma_{color='red' \vee color='green'}Parts)$

   $\{R|\forall P \in Parts(P.color =' red' \vee P.color =' green') \Rightarrow \exists C \in Catalog(C.sid = R.sid \wedge P.pid = C.pid)\}$

8. Find the *sids* of suppliers who supply *every* red part or supply every green part.

   $\rho(R_1, ((\pi_{sid,pid}Catalog)/(\pi_{pid}\sigma_{color='red'}Parts)))$
   $\rho(R_2, ((\pi_{sid,pid}Catalog)/(\pi_{pid}\sigma_{color='green'}Parts)))$
   $R_1 \vee R_2$ $(\pi_{sid,pid}Catalog)/(\pi_{pid}\sigma_{color='red' \vee color='green'}Parts)$
   $\{R|(\forall P \in Parts(P.color =' red') \Rightarrow \exists C \in Catalog(C.sid = R.sid \wedge P.pid = C.pid)) \vee (\forall P \in Parts(P.color =' green') \Rightarrow \exists C \in Catalog(C.sid = R.sid \wedge P.pid = C.pid))\}$

9. Find *pairs of sids* such that the supplier with the first sid charges more for some part than the supplier with the second sid.

   $\rho(R_1, Catalog)$
   $\rho(R_2, Catalog)$
   $\pi_{R_1.sid,R_2.sid}\sigma_{R_1.pid=R_2.pid \wedge R_1.sid \neq R_2.sid \wedge R_1.cost > R_2.cost}(R_1 \times R_2)$
   $\{R|\exists C_1 \in Catalog(R.sid_1 = C_1.sid \wedge \exists C_2 \in Catalog(R.sid_2 = C_2.sid \wedge C_1.sid \neq C_2.sid \wedge C_1.pid = C_2.pid \wedge C_1.cost > C_2.cost))\}$

10. Find the *pids* of parts supplied by *at least two* different suppliers.

    $\rho(R_1, Catalog)$
    $\rho(R_2, Catalog)$
    $\pi_{R_1.pid}\sigma_{R_1.pid=R_2.pid \wedge R_1.sid \neq R_2.sid}(R_1 \times R_2)$
    $\{R|\exists C_1 \in Catalog(R.pid = C_1.pid \wedge \exists C_2 \in Catalog(C_1.sid \neq C_2.sid \wedge C_1.pid = C_2.pid))\}$

11. Find the *pids* of the most expensive parts, supplied by suppliers named ACME.

    $\rho(R_1, \pi_{sid}\sigma_{name='\text{ACME}'}Suppliers)$
    $\rho(R_2, R_1 \bowtie Catalog)$
    $\rho(R_3, R_2)$
    $\rho(R_4(sid, pid, cost), \sigma_{R_3.cost < R_2.cost}(R_3 \times R_2))$
    $\pi_{pid}(R_2 - \pi_{sid,pid,cost}R_4)$
    $\{R|\exists C_1 \in Catalog(R.pid = C_1.pid \wedge \exists S \in Suppliers(S.name =' \text{ACME}' \wedge C_1.sid = S.sid \wedge \forall C_2 \in Catalog(C_2.pid \neq C_1.pid \wedge C_2.sid = C_1.sid \wedge C_1.cost \neq C_2.cost) \Rightarrow C_1.cost > C_2.cost))\}$