Database Management System (DBMS)

Lecture-23

Dharmendra Kumar

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Exercise(cont.)

Let R = (A, B) and S = (A, C), and let r(R) and s(S) be relations. Write relational-algebra expressions equivalent to the following domain-relational calculus expressions:

1. $\{< a > \mid \exists b(< a, b > \in r \wedge b = 17)\}$
2. $\{< a, b, c > \mid < a, b > \in r \wedge < a, c > \in s\}$
3. $\{< a > \mid \exists b(< a, b > \in r) \vee \forall c(\exists d(< d, c > \in s) \Rightarrow < a, c > \in s)\}$
4. $\{< a > \mid \exists c(< a, c > \in s \wedge \exists b_1, b_2(< a, b_1 > \in r \wedge < c, b_2 > \in r \wedge b_1 > b_2))\}$

Solution

1. $\Pi_A(\sigma_{B=17}(r))$
2. $r \bowtie s$
3. $\Pi_A(r) \cup (s \div \Pi_C(s))$
4. $\Pi_{r.A}(\sigma_{r.B>r1.B}((r \bowtie s) \times (\rho_{r1}(r))))$

Exercise(cont.)

Given two relations R_1 and R_2, where R_1 contains N_1 tuples, R_2 contains N_2 tuples, and $N_2 > N_1 > 0$, give the minimum and maximum possible sizes (in tuples) for the result relation produced by each of the following relational algebra expressions. In each case, state any assumptions about the schemas for R_1 and R_2 that are needed to make the expression meaningful:

1. $R_1 \cup R_2$
2. $R_1 \cap R_2$
3. $R_1 - R_2$
4. $R_1 \times R_2$
5. $\sigma_{a=5}(R_1)$
6. $\Pi_a(R_1)$

Solution

1. Minimum number of tuples $= N_2$
   Maximum number of tuples $= N_1 + N_2$
2. Minimum number of tuples $= 0$
   Maximum number of tuples $= N_1$
3. Minimum number of tuples $= 0$
   Maximum number of tuples $= N_1$
4. Minimum number of tuples $= N_1 * N_2$
   Maximum number of tuples $= N_1 * N_2$

Solution(cont.)

5. Assume attribute a in R_1 is a primary key. In this case
Minimum number of tuples $= 0$
Maximum number of tuples $= 1$
Assume attribute a in R_1 is not a primary key. In this case
Minimum number of tuples $= 0$
Maximum number of tuples $= N_1$
6. Assume attribute a in R_1 is a primary key. In this case
Minimum number of tuples $= N_1$
Maximum number of tuples $= N_1$
Assume attribute a in R_1 is not a primary key. In this case
Minimum number of tuples $= 1$
Maximum number of tuples $= N_1$
7. Minimum number of tuples $= 0$
Maximum number of tuples $= 0$

Exercise

Consider the following schema:
Suppliers(sid: integer, sname: string, address: string)
Parts(pid: integer, pname: string, color: string)
Catalog(sid: integer, pid: integer, cost: real)
The key fields are underlined, and the domain of each field is listed after the field name. Thus sid is the key for Suppliers, pid is the key for Parts, and sid and pid together form the key for Catalog. The Catalog relation lists the prices charged for parts by Suppliers. Write the following queries in relational algebra, tuple relational calculus, and domain relational calculus:

1. Find the names of suppliers who supply some red part.
2. Find the sids of suppliers who supply some red or green part.
3. Find the sids of suppliers who supply some red part or are at 221 Packer Street.
4. Find the sids of suppliers who supply some red part and some green part.
5. Find the sids of suppliers who supply every part.
6. Find the sids of suppliers who supply every red part.

Solution

Ans.(1):

Relational algebra query is

$\Pi_{sname}(Suppliers \bowtie Catalog \bowtie \Pi_{pid}(\sigma_{color=''red''}(Parts)))$

Tuple relational calculus query is

$\{\ t \mid \exists s \in Suppliers(t[sname] = s[sname] \wedge \exists u \in Catalog(s[sid] = u[sid] \wedge \exists w \in Parts(u[pid] = w[pid] \wedge w[color] = ''red'')))\}$

Domain relational calculus query is

$\{< b > \mid \exists a, c(< a, b, c > \in Suppliers \wedge \exists d, e(< a, d, e > \in Catalog \wedge \exists f, g(< d, f, g > \in Parts \wedge g = ''red'')))\}$

Solution

Ans.(2):

Relational algebra query is

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

Tuple relational calculus query is

$$\{\ t \mid \exists u \in Catalog(t[sid] = u[sid] \wedge \exists w \in Parts(u[pid] = w[pid] \wedge (w[color] = "red" \vee w[color] = "green")))\}$$

Domain relational calculus query is

$$\{< a > \mid \exists b, c(< a, b, c > \in Catalog \wedge \exists d, e(< b, d, e > \in Parts \wedge (e = "red" \vee e = "green")))\}$$

Solution

Ans.(3):

Relational algebra query is

$\prod_{sid}(\sigma_{color="red"}(Catalog \bowtie Parts)) \cup$
$\prod_{sid}(\sigma_{address="220\ Packer\ Street"}(Suppliers))$

Tuple relational calculus query is

$\{\ t \mid \exists u \in Catalog(t[sid] = u[sid] \wedge \exists w \in Parts(u[pid] = w[pid] \wedge w[color] = "red"))) \vee \exists s \in Suppliers(t[sid] = s[sid] \wedge s[address] = "220\ Packer\ Street")\}$

Domain relational calculus query is

$\{< a > \mid \exists b, c(< a, b, c > \in Catalog \wedge \exists d, e(< b, d, e > \in Parts \wedge e = "red"))) \vee \exists b, c(< a, b, c > \in Suppliers \wedge c = "220\ Packer\ Street")\}$

Solution

Ans.(4):

Relational algebra query is

$\prod_{sid}(\sigma_{color="red"}(Catalog \bowtie Parts)) \cap \prod_{sid}(\sigma_{color="green"}(Catalog \bowtie Parts))$

Tuple relational calculus query is

$\{\ t \mid \exists u \in Catalog(t[sid] = u[sid] \wedge \exists w \in Parts(u[pid] = w[pid] \wedge w[color] = "red"))) \wedge \exists u \in Catalog(t[sid] = u[sid] \wedge \exists w \in Parts(u[pid] = w[pid] \wedge w[color] = "green")))\}$

Domain relational calculus query is

$\{< a > \mid \exists b, c(< a, b, c > \in Catalog \wedge \exists d, e(< b, d, e > \in Parts \wedge e = "red")) \wedge \exists b, c(< a, b, c > \in Catalog \wedge \exists d, e(< b, d, e > \in Parts \wedge e = "green"))\}$

Solution

Ans.(5):

Relational algebra query is

$\prod_{sid,pid}(Catalog) \div \prod_{pid}(Parts)$

Tuple relational calculus query is

$\{\ t \mid \forall s \in Parts \Rightarrow \exists u \in Catalog(t[sid] = u[sid] \wedge s[pid] = u[pid])\}$

Domain relational calculus query is

$\{\ < s > \mid \forall a, b, c(< a, b, c > \in Parts \Rightarrow \exists d(< s, a, d > \in Catalog))\}$

Solution

Ans.(6):

Relational algebra query is

$\prod_{sid,pid}(Catalog) \div \prod_{pid}(Parts)$

Tuple relational calculus query is

$\{ t \mid \forall s \in Parts \Rightarrow \exists u \in Catalog(t[sid] = u[sid] \wedge s[pid] = u[pid])\}$

Domain relational calculus query is

$\{ < s > \mid \forall a, b, c(< a, b, c > \in Parts \Rightarrow \exists d(< s, a, d > \in Catalog))\}$