Problem Set for Relational Algebra

1. 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. 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.
(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.
(7) Find the *sids* of suppliers who supply every red or green part.
(8) Find the *sids* of suppliers who supply every red part or supply every green part.

2. Consider the Sailors-Boats-Reserves DB described in the text.

s (sid, sname, rating, age)
b (bid, bname, color)
r (sid, bid, date)

Write the following queries in relational algebra.

(1) Find the colors of boats reserved by Albert.
(2) Find all sailor id's of sailors who have a rating of at least 8 or reserved boat 103.
(3) Find the names of sailors who have not reserved a red boat.
(4) Find the sailor id's of sailors with age over 20 who have not reserved a red boat.
(5) Find the names of sailors who have reserved at least two boats.
(6) Find the names of sailors who have reserved all boats.
(7) Find the names of sailors who have reserved all boats called BigBoat.
(8) Find the sailor id's of sailors whose rating is better than some sailor called Bob.
(9) Find the sailor id's of sailors whose rating is better than every sailor called Bob.
(10) Find the sailor id's of sailors with the highest rating.
(11) Find the name and age of the oldest sailor.
(12) Find the names of sailors who have reserved every boat reserved by those with a lower rating.

Problem 1

Solution:

(1)

$P(S, \text{suppliers}),\ P(P, \text{parts}),\ P(C, \text{catalog})$

$\Pi_{\text{sname}}(((\sigma_{p.\text{color}=\text{'red'}} P) \bowtie C) \bowtie S)$

(2)

$\Pi_{\text{sid}}(\sigma_{p.\text{color}=\text{'red'} \vee p.\text{color}=\text{'green'}}(P \bowtie C))$

(3)

$P(R1, \Pi_{\text{sid}}((\sigma_{p.\text{color}=\text{'red'}} P) \bowtie C))$

$P(R2, \Pi_{\text{sid}}(\sigma_{s.\text{address}=\text{'221 Packer Ave'}} S))$

$P(R3, R1 \cup R2)$

(4)

$P(R1, \Pi_{\text{sid}}((\sigma_{p.\text{color}=\text{'red'}} P) \bowtie C))$

$P(R2, \Pi_{\text{sid}}((\sigma_{p.\text{color}=\text{'green'}} P) \bowtie C))$

$P(R3, R1 \cap R2)$

(5)

$(\Pi_{\text{sid, pid}} C) / (\Pi_{\text{pid}} P)$

(6)

$(\Pi_{\text{sid, pid}} C) / (\Pi_{\text{pid}}(\sigma_{p.\text{color}=\text{'red'}} P))$

(7)

$(\Pi_{\text{sid, pid}} C) / (\Pi_{\text{pid}}(\sigma_{p.\text{color}=\text{'red'} \vee p.\text{color}=\text{'green'}} P))$

(8)

$P(R1, (\Pi_{\text{sid, pid}} C) / (\Pi_{\text{pid}}(\sigma_{p.\text{color}=\text{'red'}} P)))$

$P(R2, (\Pi_{\text{sid, pid}} C) / (\Pi_{\text{pid}}(\sigma_{p.\text{color}=\text{'green'}} P)))$

$P(R3, R1 \cup R2)$

(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.

$P(C1, \text{catalog}),\ P(C2, \text{catalog})$

$\Pi_{C1.\text{pid}, C2.\text{pid}}(\sigma_{C1.\text{cost} > C2.\text{cost} \wedge C1.\text{pid} = C2.\text{pid} \wedge C1.\text{sid} \neq C2.\text{sid}}(C1 \times C2))$

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

$P(R1, \text{catalog}),\ P(R2, \text{catalog})$

$\Pi_{R1.\text{pid}}(\sigma_{R1.\text{pid} = R2.\text{pid} \wedge R1.\text{sid} \neq R2.\text{sid}}(R1 \times R2))$

(11) Find the pids of the most expensive parts supplied by suppliers named Yosemite Sham.

$P(R1, \Pi_{\text{sid}}(\sigma_{s.\text{sname}=\text{'Yosemite Sham'}} S))$

$P(R2, \text{catalog}),\ P(R3, \text{catalog})$

$P(R4, \Pi_{R2}(\sigma_{R2.\text{sid} = R1.\text{sid} \wedge R3.\text{sid} = R1.\text{sid} \wedge R2.\text{cost} < R3.\text{cost}}(R2 \times R3)))$

$P(R5, R2 - R4)$

$\Pi_{\text{pid}}(R5)$

Problem 2

Solution:

(1)

$\Pi_{\text{color}}(\sigma_{s.\text{sname}=\text{'Albert'}}(S)) \bowtie R \bowtie B)$

(2)

$\Pi_{\text{sid}}((\sigma_{\text{rating} \geq 8}(S)) \cup \Pi_{\text{sid}}(\sigma_{\text{bid}=\text{'103'}}(R)))$

(3)

$\Pi_{\text{sname}}((\Pi_{\text{sid}}(S) - \Pi_{\text{sid}}((\sigma_{\text{color}=\text{'red'}}(B)) \bowtie R)) \bowtie S)$

(4)

$\Pi_{\text{sid}}(\sigma_{\text{age}>20}(S)) - \Pi_{\text{sid}}((\sigma_{\text{color}=\text{'red'}}(B)) \bowtie R))$

(5)

$P(R1, R)$

$\Pi_{\text{sname}}((\sigma_{R1.\text{bid} \neq R.\text{bid} \wedge R1.\text{sid} = R.\text{sid}}(R1 \times R1)) \bowtie S)$

(6)

$P(\text{temp1}, (\Pi_{\text{sid, bid}}(R)) / (\Pi_{\text{bid}}(B)))$

$\Pi_{\text{sname}}(\text{temp1} \bowtie S)$

(7)

$P(\text{temp1}, (\Pi_{\text{sid, bid}}(R)) / (\Pi_{\text{bid}}(\sigma_{\text{bname}=\text{'BigBoat'}}(B))))$

$\Pi_{\text{sname}}(\text{temp1} \bowtie S)$

(8) $P(S1, S)$

$\Pi_{\text{sid}}(\sigma_{S.\text{rating} > S1.\text{rating}}(S \times (\sigma_{S1.\text{sname}=\text{'Bob'}}(S1))))$

(9) $P(S2, S)$

$\Pi_{\text{sid}}(S) - \Pi_{\text{sid}}(\sigma_{S2.\text{rating} \leq S.\text{rating}}(S2 \times (\sigma_{S.\text{sname}=\text{'Bob'}}(S))))$

(10)

$P(S1, S),\ P(S2, S)$

$P(S3, \sigma_{S1.\text{rating} < S2.\text{rating}}(S1 \times S2))$

$P(S4, S1 - S3)$

$\Pi_{\text{sid}}(S4) \Leftrightarrow \Pi_{\text{sid}}(S1 - \sigma_{S1.\text{rating} < S2.\text{rating}}(S1 \times S2))$

(11)

$P(S1, S),\ P(S2, S)$

$P(S3, \sigma_{S1.\text{age} < S2.\text{age}}(S1 \times S2))$

$P(S4, S1 - S3)$

$\Pi_{\text{sname, age}}(S4)$

(12) $P(S1, S),\ P(S2, S)$

$P(S3, \sigma_{S1.\text{rating} \geq S2.\text{rating}}(S1 \times S2))$

$P(S4, S1 - S3)$

$\Pi_{\text{sname}}(S4)$