

CISS430: Database Systems Assignment 6

OBJECTIVES

1. Write queries using relational algebra operators.

Enter your answers in `q1.tex`, `q2.tex`, etc.

Hans Solo need to get some parts to fix the Millenium Falcon. Unfortunately the website is down. You'll have to help him enter the queries using relational algebra.

Here's the schemas of the database at the rebel base:

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

(Note: There are \LaTeX macros for the relations and the column names. See `main.tex`. For instance `\Suppliers` gives you `Suppliers`.

Set operations:

\cup \cap $-$

Relational algebra operators:

σ π ρ

Comparison:

$=$ \neq $<$ \leq $>$ \geq

Logical operators:

\neg \wedge \vee

Cross product and join:

\times $\bowtie_{a=b}$

Example:

$\sigma_{\text{sid}=42}(\text{Suppliers})$

$\sigma_{\text{sid} \neq 42}(\text{Suppliers})$

$$\sigma_{\neg(\text{sid} < 42)}(\text{Suppliers})$$
$$\sigma_{\text{sid} \leq 42 \wedge \text{sname} = \text{'Bar'}}(\text{Suppliers})$$
$$\rho(T(\text{sid} \rightarrow a), \text{Suppliers})$$

Q1. Find the names of suppliers who supply some red part.

SOLUTION.

$\pi_{\text{sname}}(\text{Suppliers} \bowtie_{\text{sid}=\text{sid}} \text{Catalog} \bowtie_{\text{pid}=\text{pid}} \sigma_{\text{color}=\text{'red'}}(\text{Parts}))$

Q2. Find the sids of suppliers who supply some red or green part.

SOLUTION. $\pi_{\text{sid}}(\text{Catalog} \bowtie_{\text{pid}=\text{pid}} \sigma_{\text{color}=\text{'red'} \vee \text{color}=\text{'green'}}(\text{Parts}))$

Q3. Find the sids of suppliers who supply some red part or are at 221 Baker Street.

SOLUTION.

$$\pi_{\text{sid}}(\text{Catalog} \bowtie_{\text{pid}=\text{pid}} \sigma_{\text{color}=\text{'red'}}(\text{Parts}))$$
$$\cup$$
$$\pi_{\text{sid}}(\sigma_{\text{address}=\text{'221 Baker Street'}}(\text{Suppliers}))$$

Q4. Find the sids of suppliers who supply some red part and some green part.

SOLUTION.

$$\pi_{\text{sid}}(\text{Catalog} \bowtie_{\text{pid}=\text{pid}} \sigma_{\text{color}=\text{'red'}}(\text{Parts})) \cap \pi_{\text{sid}}(\text{Catalog} \bowtie_{\text{pid}=\text{pid}} \sigma_{\text{color}=\text{'green'}}(\text{Parts}))$$

Q5. Find the sids of suppliers who supply every part.

SOLUTION.

$$\pi_{\text{sid}}(\text{Suppliers}) - \pi_{\text{sid}}(\pi_{\text{sid,pid}}(\text{Suppliers} \times \text{Parts}) - \pi_{\text{sid,pid}}(\text{Catalog}))$$

Q6. Find the sids of suppliers who supply every red part.

SOLUTION.

$$\pi_{\text{sid}}(\text{Suppliers}) - \pi_{\text{sid}}(\pi_{\text{sid,pid}}(\text{Suppliers} \times \sigma_{\text{color}=\text{'red'}}(\text{Parts})) - \pi_{\text{sid,pid}}(\text{Catalog}))$$

Q7. Find the sids of suppliers who supply every red or green part.

SOLUTION.

$$\pi_{\text{sid}}(\text{Suppliers}) - \pi_{\text{sid}}(\pi_{\text{sid,pid}}(\text{Suppliers} \times \sigma_{\text{color}=\text{'red'} \vee \text{color}=\text{'green'}}(\text{Parts})) - \pi_{\text{sid,pid}}(\text{Catalog}))$$

Q8. Find the sids of suppliers who supply every red part or supply every green part.

SOLUTION.

$$\pi_{\text{sid}}(\text{Suppliers}) - \pi_{\text{sid}}(\pi_{\text{sid,pid}}(\text{Suppliers} \times \sigma_{\text{color}=\text{'red'}}(\text{Parts})) - \pi_{\text{sid,pid}}(\text{Catalog}))$$

\cup

$$\pi_{\text{sid}}(\text{Suppliers}) - \pi_{\text{sid}}(\pi_{\text{sid,pid}}(\text{Suppliers} \times \sigma_{\text{color}=\text{'green'}}(\text{Parts})) - \pi_{\text{sid,pid}}(\text{Catalog}))$$

Q9. Find pairs of sids such that the supplier with the first sid charges more for some part than the supplier with the second sid.

SOLUTION.

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

Q10. Find the pids of parts supplied by at least two different suppliers.

SOLUTION.

$$\rho(R1(\text{sid} \rightarrow \text{sid1}, \text{pid} \rightarrow \text{pid1}), \pi_{\text{sid}, \text{pid}}(\text{Suppliers} \bowtie \text{Catalog}))$$
$$\rho(R2(\text{sid} \rightarrow \text{sid2}, \text{pid} \rightarrow \text{pid2}), \pi_{\text{sid}, \text{pid}}(\text{Suppliers} \bowtie \text{Catalog}))$$
$$\pi_{\text{pid1}}(\sigma_{\text{pid1}=\text{pid2} \wedge \text{sid1} \neq \text{sid2}}(R1 \times R2))$$

Q11. Find the pids of the most expensive parts supplied by suppliers names Jabba the Hutt.

SOLUTION.

$$\rho(JH, \sigma_{\text{sname}='Jabba the Hutt'}(\text{Suppliers}))$$

$$\rho(\text{Catalog} \Join_{\text{Catalog.sid}=\pi_{\text{sid}}(JH)} JH)$$

$$\pi_{\text{pid}}(\text{Catalog} \Join_{\text{Catalog.sid}=\pi_{\text{sid}}(JH)} JH - \pi_{C1.\text{pid}}(\sigma_{C1.\text{pid} \neq C2.\text{pid} \wedge C1.<C2.\text{cost}}(\rho(C1, \text{Catalog} \Join_{\text{Catalog.sid}=\pi_{\text{sid}}(JH)} JH)) \times (\rho(C2, \text{Catalog} \Join_{\text{Catalog.sid}=\pi_{\text{sid}}(JH)} JH))))$$

Q12. Find the pids of parts supplied by every supplier at less than \$200. (If any supplier either does not supply the part or charges more than \$200 for it, the part is not selected.)

SOLUTION.

$$\pi_{\text{pid}}(\text{Parts}) - \pi_{\text{pid}}(\pi_{\text{pid,sid}}(\text{Parts} \times \text{Suppliers}) - \pi_{\text{pid,sid}}(\sigma_{\text{cost} < 200}(\text{Catalog})))$$