We use the following database schema:

- **Sailors (sid, sname)**
- **Reserves (sid, bid, date)**
- **Boats (bid, bname, color)**

**Exercise #1**

Find ids of sailors who’ve reserved boat with bid 103

**Solution**

\[
\pi_{\text{sid}}(\sigma_{\text{bid}=103}(\text{Reserves}))
\]
Exercise #2

We use the following database schema
Sailors (sid, sname), Reserves (sid, bid, date), Boats (bid, bname, color)

Find the names of sailors who’ve reserved boat with bid 103

Solution #1
\[ \pi_{sname}(\sigma_{\text{Reserves}.sid=\text{Sailors}.sid \land \text{bid}=103}(\text{Reserves} \times \text{Sailors})) \]

Solution #2
\[ \pi_{sname}(\sigma_{\text{Reserves}.sid=\text{Sailors}.sid}(\sigma_{\text{bid}=103}(\text{Reserves}) \times \text{Sailors})) \]

Solution #3
\[ \pi_{sname}(\sigma_{\text{bid}=103}(\text{Reserves}) \ JOIN_{\text{sid}} \text{Sailors}) \]
We use the following database schema:

- **Sailors** (sid, sname)
- **Reserves** (sid, bid, date)
- **Boats** (bid, bname, color)

**Exercise #3**

Find the names of sailors who’ve reserved a red boat

**Solution #1**

$$\pi_{sname}(\sigma_{color=red}(Boats) \Join bid Reserves \Join sid Sailors)$$

**More efficient solution?**

$$\pi_{sname}(\pi_{bid}(\sigma_{color=red}(Boats)) \Join bid Reserves \Join sid Sailors)$$

**Query optimization:** real systems do such optimizations based on algebra
We use the following database schema

**Sailors** \((\text{sid}, \text{sname})\), **Reserves** \((\text{sid}, \text{bid}, \text{date})\), **Boats** \((\text{bid}, \text{bname}, \text{color})\)

Find the names of sailors who’ve reserved a red or a green boat

**Solution #1**

\[
\pi_{\text{sname}}(\sigma_{\text{color}=\text{red} \lor \text{color}=\text{green}} \text{(Boats) JOIN} \text{bid Reserves JOIN} \text{sid Sailors})
\]

What happens if \(\lor\) is replaced by \(\land\) in this query?
We use the following database schema

**Sailors (sid, sname)**, **Reserves (sid, bid, date)**, **Boats (bid, bname, color)**

Find the names of sailors who’ve reserved a red and a green boat

**Is this solution correct?**

\[
\pi_{\text{sname}}(\sigma_{\text{color}=\text{red}} \land \text{color}=\text{green} (\text{Boats}) \ \text{JOIN}_{\text{bid}} \ \text{Reserves} \ \text{JOIN}_{\text{sid}} \ \text{Sailors})
\]

**How about this solution?**

\[
\pi_{\text{sname}}(\sigma_{\text{color}=\text{red}} (\text{Boats}) \ \text{JOIN}_{\text{bid}} \ \text{Reserves} \ \text{JOIN}_{\text{sid}} \ \text{Sailors}) \ \cap \\
\pi_{\text{sname}}(\sigma_{\text{color}=\text{green}} (\text{Boats}) \ \text{JOIN}_{\text{bid}} \ \text{Reserves} \ \text{JOIN}_{\text{sid}} \ \text{Sailors})
\]
We use the following database schema:

- **Sailors** (sid, sname),
- **Reserves** (sid, bid, date),
- **Boats** (bid, bname, color)

Find the names of sailors who’ve reserved a red and a green boat.

**Correct Solution**

\[
\pi_{sname} \\
[ \pi_{sid, sname}(\sigma_{\text{color}=\text{red}}(\text{Boats}) \Join_{\text{bid}} \text{Reserves} \Join_{\text{sid}} \text{Sailors}) \cap \pi_{sid, sname}(\sigma_{\text{color}=\text{green}}(\text{Boats}) \Join_{\text{bid}} \text{Reserves} \Join_{\text{sid}} \text{Sailors}) ]
\]
We use the following database schema

Sailors (sid, sname), Reserves (sid, bid, date), Boats (bid, bname, color)

Find the ids of sailors who have made at least two reservations on the same date

Solution #1

$$
\pi_{R1.sid}(\sigma_{R1.sid=R2.sid \land R1.date=R2.date \land R1.bid \neq R2.bid} (p(R1,Reserves) \times p(R2,Reserves)))
$$

Solution #2

$$
\pi_{R1.sid} (p(R1,Reserves) \ JOIN_{R1.sid=R2.sid \land R1.date=R2.date \land R1.bid \neq R2.bid} p(R2,Reserves))
$$

What happens if we omit R1.date=R2.date?
What happens if we omit R1.bid \neq R2.bid?
We use the following database schema

- **Sailors** (sid, sname)
- **Reserves** (sid, bid, date)
- **Boats** (bid, bname, color)

**Exercise #7**

Find the ids of sailors who’ve reserved all boats

**Solution**

\[
\pi_{sid,bid} (\text{Reserves}) / \pi_{bid} (\text{Boats})
\]

Find the ids of sailors who’ve reserved all red boats

**Solution**

\[
\pi_{sid,bid} (\text{Reserves}) / \pi_{bid} (\sigma_{\text{color}=\text{red}} (\text{Boats}))
\]

Find the names of sailors who’ve reserved all red boats

**Solution**

\[
\pi_{\text{sname}} ( \text{Sailors JOIN}_{sid} \left[ \pi_{sid,bid} (\text{Reserves}) / \pi_{bid} (\sigma_{\text{color}=\text{red}} (\text{Boats})) \right] )
\]