3. Structured Query Language

Exercises 1
Let $R(A,B,C)$ and $S(D,E,F)$ be two union compatible relation schemas. Convert the following algebra expressions to SQL (for simplicity, you can omit $\text{DISTINCT}$):

1] $\pi_A R$
   
   SELECT A, FROM R

2] $\sigma_{C=12} R$
   
   SELECT *, FROM R
   WHERE C=12

3] $\pi_{A,F}(R \text{ JOIN }_{C=D} S)$
   
   SELECT A,F
   FROM R, S
   WHERE C=D

4] $\pi_A R - \pi_D S$
   
   SELECT A, FROM R
   EXCEPT
   SELECT D FROM S
**Sailors** (sid, sname),

**Reserves** (sid, bid, date),

**Boats** (bid, bname, color)

<table>
<thead>
<tr>
<th>sid</th>
<th>sname</th>
<th>rating</th>
<th>age</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>dustin</td>
<td>7</td>
<td>45.0</td>
</tr>
<tr>
<td>31</td>
<td>lubber</td>
<td>8</td>
<td>55.5</td>
</tr>
<tr>
<td>58</td>
<td>rusty</td>
<td>10</td>
<td>35.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>sid</th>
<th>bid</th>
<th>day</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>101</td>
<td>10/10/96</td>
</tr>
<tr>
<td>58</td>
<td>103</td>
<td>11/12/96</td>
</tr>
</tbody>
</table>
Find the names of sailors who reserved bid=103

```sql
SELECT  S.sname
FROM    Sailors as S, Reserves as R
WHERE   S.sid=R.sid AND R.bid=103
```

<table>
<thead>
<tr>
<th>(sid)</th>
<th>sname</th>
<th>rating</th>
<th>age</th>
<th>(sid)</th>
<th>bid</th>
<th>day</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>dustin</td>
<td>7</td>
<td>45.0</td>
<td>22</td>
<td>101</td>
<td>10/10/96</td>
</tr>
<tr>
<td>22</td>
<td>dustin</td>
<td>7</td>
<td>45.0</td>
<td>58</td>
<td>103</td>
<td>11/12/96</td>
</tr>
<tr>
<td>31</td>
<td>lubber</td>
<td>8</td>
<td>55.5</td>
<td>22</td>
<td>101</td>
<td>10/10/96</td>
</tr>
<tr>
<td>31</td>
<td>lubber</td>
<td>8</td>
<td>55.5</td>
<td>58</td>
<td>103</td>
<td>11/12/96</td>
</tr>
<tr>
<td>58</td>
<td>rusty</td>
<td>10</td>
<td>35.0</td>
<td>22</td>
<td>101</td>
<td>10/10/96</td>
</tr>
<tr>
<td>58</td>
<td>rusty</td>
<td>10</td>
<td>35.0</td>
<td>58</td>
<td>103</td>
<td>11/12/96</td>
</tr>
</tbody>
</table>
Find sid’s of sailors who’ve reserved a red or a green boat

SELECT  R.sid
FROM   Boats as B, Reserves as R
WHERE  R.bid=B.bid
   AND (B.color='red' OR B.color='green')

Alternative

SELECT  R.sid
FROM   Boats as B, Reserves as R
WHERE  R.bid=B.bid
   AND B.color='red'
UNION
SELECT  R.sid
FROM   Boats as B, Reserves as R
WHERE  R.bid=B.bid
   AND B.color='green'

• If we replace OR by AND in the first version, what do we get?

• What do we get if we replace UNION by EXCEPT in the second version?
Find sid’s of sailors who’ve reserved a red and a green boat

SELECT S.sid
FROM Sailors as S, Boats as B1, Reserves as R1,
     Boats as B2, Reserves as R2
WHERE S.sid=R1.sid AND R1.bid=B1.bid
     AND B1.color='red' AND S.sid=R2.sid
     AND R2.bid=B2.bid AND B2.color='green'

• What if instead of the sid we want the sname? Would the queries be correct if we replace SELECT S.sid with S.sname?

SELECT S.sid
FROM Sailors as S, Boats as B, Reserves as R
     AND B.color='red'
INTERSECT
SELECT S.sid
FROM Sailors as S, Boats as B, Reserves as R
     AND B.color='green'

Key field!
SELECT  S.sname
FROM  Sailors S
WHERE  S.sid NOT IN (SELECT  R.sid
                     FROM  Reserves R
                     WHERE  R.bid=103)

Find the names of sailors who have not reserved bid=103
Find the names of sailors who have reserved a red boat (with \text{IN})

\text{SELECT} \ S.sname
\text{FROM} \ Sailors \ S
\text{WHERE} \ S.sid \ \text{IN} \ (\text{SELECT} \ R.sid
\text{FROM} \ Reserves \ R
\text{WHERE} \ R.bid \ \text{IN} \ (\text{SELECT} \ B.bid
\text{FROM} \ Boats \ B
\text{WHERE} \ B.color=\text{red})

What if we replace the first \text{IN} with \text{NOT IN}?
What if we replace the second \text{IN} with \text{NOT IN}?
What if we replace both \text{IN} with \text{NOT IN}?
Find the names of sailors who have reserved bid=103 (with EXISTS)

SELECT S.sname
FROM Sailors as S
WHERE EXISTS (SELECT *
               FROM Reserves as R
               WHERE R.bid=103 AND S.sid=R.sid)

What if we replace EXISTS with NOT EXISTS?
What if we replace EXISTS with UNIQUE?
Find the record of the sailor with the highest rating

SELECT  *  
FROM  Sailors as S  
WHERE  S.rating ≥ ALL (SELECT  S2.rating  
                           FROM  Sailors as S2)

What if we replace ALL with SOME?
SELECT  S.sname
FROM  Sailors as S
WHERE  NOT EXISTS
((SELECT  B.bid
  FROM  Boats as B)
EXCEPT
(SELECT  R.bid
  FROM  Reserves as R
  WHERE  R.sid=S.sid))

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