# Relational Algebra Exercises

## Part I

Go over these exercises before you attend your tutorial. For each exercise, try it first, and then look at the answer. Discuss with the TAs any problems you may have.

### Questions

Consider the Sailors-Boats-Reserves DB described in the textbook.

***S (sid, sname, rating, age)***

***B (bid, bname, color)***

***R (sid, bid, date)***

Give a Relational Algebra expression for each of the following queries:

1. Find the colors of boats reserved by Albert.

2. Find all IDs of sailors who have a rating of at least 8 or have reserved boat 103.

3. Find the names of sailors who have not reserved a red boat.

4. Find the IDs 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 IDs of sailors whose rating is better than some sailor called Bob.

9. Find the IDs of sailors whose rating is better than every sailor called Bob.

10. Find the IDs of sailors with the highest rating.

11. Find the name and age of the oldest sailor.

**Answers**

Note: Other solutions are acceptable, providing they produce equivalent output.

1. $\pi_{color}\ [\ (\sigma_{sname='Albert'}\ (S))\ \bowtie R\ \bowtie\ B\ ]$

2. $\pi_{sid}\ (\sigma_{rating>=8}\ (S)) \cup \pi_{sid}\ [\sigma_{bid=103}\ (R)]$

3. $\pi_{sname}\ ([\pi_{sid}\ (S) - \pi_{sid}\ (\sigma_{color='red'}\ (B) \bowtie\ R)] \bowtie S\ )$

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

5. $\pi_{sname}\ (\sigma_{\ R.sid=R2.sid\ \wedge\ R.bid\ \neq\ R2.bid}\ (R \times \rho\ (R2, R)) \bowtie S)$

6. $\pi_{sname}\ ([\pi_{sid,\ bid}\ (R) / \pi_{bid}\ (B)] \bowtie S\ )$

7. $\pi_{sname}\ ([\pi_{sid,\ bid}\ (R) / \pi_{bid}\ (\sigma_{name='BigBoat'}\ (B))] \bowtie S\ )$

8. $\pi_{S2.sid}\ (\sigma_{\ S2.rating\ >\ S.rating}\ [\ \rho\ (S2,S) \times\ \sigma_{sname='Bob'}\ (S)]\ )$

9. $\pi_{sid}\ (S) -\ \pi_{S2.sid}\ (\sigma_{\ S2.rating\ <=\ S.rating}\ [\ \rho\ (S2,S) \times\ \sigma_{sname='Bob'}\ (S)]\ )$

10. $\pi_{sid}\ (S) -\ \pi_{S2.sid}\ (\sigma_{\ S2.rating\ <\ S.rating}\ [\ \rho\ (S2,S) \times S]\ )$

11. $\pi_{sname,\ age}\ (\ [\pi_{sid}\ (S) -\ \pi_{S2.sid}\ (\sigma_{\ S2.age\ <\ S.age}\ (\ \rho\ (S2,S) \times S)\ )]\ \bowtie\ S\ )$

# Part II

You should do these exercises in the tutorial.

## Questions

Consider the following collection of relational schemas:

- **professor(<u>profname</u>, deptname)**
  professor **profname** is in department **deptname**
- **department(<u>deptname, building</u>)**
  department **deptname** has offices in building **building**
- **committee(<u>commname, profname</u>)**
  professor **profname** is in the committee **commname**

a. Find all the professors who are in any one of the committees that Professor Smith is in.

b. Find all the professors who are in at least all those committees that Professor Smith is in.

c. Find all the professors who are in exactly (i.e., no more and no less) all those committees that Professor Smith is in.

d. Find all the professors who have offices in at least all those buildings that Professor Smith has offices in (a professor's offices are in the building in which her/his department is in).