UMass Lowell
Department of Computer Science
Fall 2017

Instructor: Prof. Chen

COMP.5730 Midterm Exam
Closed Book, 2 Hours
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Problem	Score	
1	(35%)	28
2	(65%)	34
Total	(100%)	62

NOTE: Write clearly — if your handwriting can not be read easily, your exam will not be graded.

Use the following relations about sailors and boats for Problems 1 and 2.

```
sailors (sid, sname, age, rating)
boats (bid, bname, color)
reserve (sid, bid, date)
```

(NOTE: sname and bname may not be unique.)

Problem 1

(7 points each question)

Express the following queries in Relational Algebra.

1. Find the names of red boats.

$\Pi_{bname}(\sigma_{color='red'}(boats))$

2. Find the names of sailors who have reserved a red boat.

$\Pi_{sname}(\sigma_{color='red'}(boats) \bowtie sailors \bowtie reserves)$

3. Find the names of sailors who have reserved a red boat and a green boat.

$R \leftarrow \Pi_{sname}(\sigma_{color='red'}(boats) \bowtie sailors \bowtie reserves)$

$G \leftarrow \Pi_{sname}(\sigma_{color='green'}(boats) \bowtie sailors \bowtie reserves)$

$Result = R \cap G$

4. Find the names of sailors who have reserved exactly one boat.

$all\_sailor\_reserved\_boat \leftarrow \Pi_{name}(sailors \bowtie reserves)$

$sailor\_reserved\_morethan\_1\_boat \leftarrow \Pi_{name}(sailors \bowtie \sigma_{r_1.sid != r_2.sid \text{ and } r_1.sid == r_2.sid}(reserves \bowtie reserves))$

$result = all\_sailor\_reserved\_boat - sailor\_reserves\_>=1\_boat$

-2

5. Find the names of sailors who have reserved all the red and green boats.

$sname\_red\_reserves \leftarrow \Pi_{sname}(\sigma_{color='red'}(boats) \bowtie sailors \bowtie reserves)$

$sname\_all\_reserves \leftarrow \Pi_{sname}(boats \bowtie sailors \bowtie reserves)$ ④

$sname\_non\_red\_reserves \leftarrow$ ~~$sname\_all\_red\_reserves$~~

$= sname\_all\_reserves - sname\_red\_reserves$ ④

① $sname\_red\_only\_reserves = sname\_all\_reserves - sname\_non\_red\_reserves$

$sname\_green\_reserves \leftarrow \Pi_{sname}(\sigma_{color='green'}(boats) \bowtie sailors \bowtie reserves)$

$sname\_non\_green\_reserves = sname\_all\_reserves$ ④ $- sname\_green\_reserves$

② $sname\_green\_only\_reserves = sname\_all\_reserves - sname\_non\_green\_reserves$

$result = sname\_red\_only\_reserves$ ① $\cap$ $sname\_green\_only\_reserves$ ②

What if a sailor has never reserved any boats?

$R_1 \leftarrow \Pi_{sid,bid}(sailor \times \sigma_{color='red'}(boats)) \cup \Pi_{sid,bid}(sailors \times \sigma_{color='green'}(boats))$ (all-possible)

$R_2 \leftarrow R_1 - \Pi_{sid,bid}(reserves)$ (not-exist)

$Result \leftarrow \Pi_{sname}(sailors \bowtie (\Pi_{sid} sailors - \Pi_{sid} R_2))$

Problem 2

(6 points each for the first five questions; 7 points each for the last five questions)

Express the following queries in SQL. (Only standard SQL syntax is allowed. Each query should be answered in a single SQL statement.)

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1. Find the names of red boats.

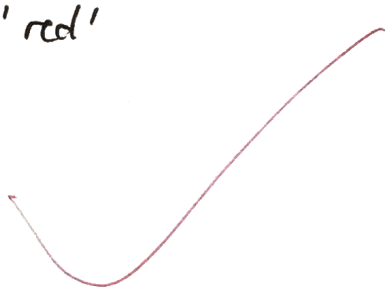
```
select bname from boats where color = 'red'
```

✓

2. Find the names of sailors who have reserved a red boat.

```
select bname from ~~boats~~ sailors
Join reserves on reserves.sid = sailors.sid
Join boats on boats.bid = reserves.Sid
where boats.color = 'red'
```

6



3. Find the names of sailors who have reserved a red boat and a green boat.

```
Select sname from sailors
Join reserves ~~as r on sid = r.sid~~ on reserves.sid = sailors.sid
Join boats on boat.bid = reserves.bid
where boats.color = 'red'
and boats.color = 'green'
```

X

```
select sname from sailors
  where sid in ( select sid from reserve
                 minus
                 select R1.sid from reserve R1, reserve R2
                 where r1.sid = r2.sid and r1.sid ≠ r2.sid
                 )
```

4. Find the names of sailors who have reserved exactly one boat.

```
with T1 as (select name from sailors
            join reserves on sailors.sid = reserves.sid)

with T2 as (select sailor name from sailors
            join reserves as r1 on sailor.sid = reserves.sid
            join reserves as r2 on sailor.sid = reserves.sid
            where r1.sid = r2.sid
            and r1.Sid != r2.bid
            )

select T1 not exist in T2
```

```
select sname from sailors
 where sid in In (select sid from reserves
                  minus
                  select R1.sid
                  from reserves R1 .sid
```

5. Find the names of sailors who have reserved all the red and green boats.

0

```
select name from sailors
    join reserves on sailors.sid = reserves.sid
    join boats on boats.sid = reserv.sid
where boats.color = 'red'
and boats.color = 'green'
```

X

```
with T1 as (select sname from sailors
        join reserv on reserv.sid = sailors.sid
        join boats on boats.sid = boats.sid)
    where color = 'red')

with T2 as select snam from sailors
        join reserves on res.sid = sailors.sid
        join boats on boats.sid = boats.sid

with T3 as select snam from sailors
        join res. on res.sid = sailor sid
        join boats n boat.sid

sele
```

6. Count how many unique boats each sailor has reserved. List the result in ascending order of sailors' IDs.

```
select reserves.sid, count(distinct(boats.bid)) from boats
Join reserves on reserves.bid = boats.bid
group by boats.bid
order by reserves.sid asc
```

7. Find the names of boats that have been reserved more frequently than the boat named Interlake. 6

```
select bname from boats
Join reserves on reserves.bid = boats.bid
where count(sid) >= in ( select count(sid) from reserves
                         Join boats on boats.bid = reserves.bid
                         where boats.name = 'Interlake'
                         group by sid )
group by sid
```

reserves.sid (for the count(sid) in the where clause)

reserves.sid (for the count(sid) in the subquery)

reserves.sid (for the group by sid in the subquery)

reserves.sid (for the group by sid at the end)

8. Find the average age of the rating group if the group has the youngest sailor of all sailors.

```
select avg(age) from sailors
  where sailors.rating = (select ratings from sailors
                          where sailors.name = (select sname from sailors
                                                where sailor.age
                                                = min(sailors.age)
                                                group by age)))
  group by sailors.age
```

```
select avg(age)
 from sailors as S, (select rating from sailor as S2
                     where age <= all (select age from
                                       sailors)
                                       as youngest)
 where s.rating = youngest.rating;
```

```
select rating, avg(age)
  from sailors
  group by rating
  having min(age) <= all (select age
                          from subtwo));
```

9. Find the names and ratings of sailors who have reserved the most number of unique boats.

```
select sname, ratings from sailors
    where sid = ( select max (count (sid)) from reserves
                  where reserves.sid = (select bid from boats)
                  group by reserves.sid) where
```

not unique

```
with take as (select distinct sid, distinct bid from reserve)
    select s.sname, s.rating
    from sailor as S, (select T1.sid from take as T1
                       where (ount (T1.sid) >= all (select count(t2.sid)
                                                    from take as T2
                                                    groups by T2.sid))
                                                    as R1
    where S.sid = R1.sid
```

10. For sailors in the rating group that reserve boats the most often, find how many times each sailor reserves boats.

6

```
select count (bid) from reserves
    join sailors on sailor.sid = reserves.sid
    where ratings = (select ratings from sailors
                     Join reserves on reserves.sid = sailor.sid
                     having count (bid) in (select max(count(bid))
                                            from reserves
                                            group by bid))
                     group by bid
                     group by sid
```

1+