CSE 132A Solutions to Homework# 1

We will use the database schema from the SQL assignment:

<table>
<thead>
<tr>
<th>student</th>
<th>sid</th>
<th>course</th>
<th>cid</th>
<th>prerequisite</th>
<th>cid</th>
<th>pre_cid</th>
</tr>
</thead>
<tbody>
<tr>
<td>record</td>
<td>sid</td>
<td>cid</td>
<td>qtr</td>
<td>year</td>
<td>grade</td>
<td></td>
</tr>
</tbody>
</table>

Consider the following queries (from the SQL assignment):

1. List the students who have taken all prerequisites for CSE132X with a grade of 2 or higher. The answer should have one attribute sid. Note that, if CSE132X has no prerequisites, then all students should be in the answer.

   (i) write the query in relational calculus using (at least one) universal quantification \( \forall \)

   \[
   \{ x : sid \mid \exists s \in student(x(sid) = s(sid) \land \forall p \in prerequisite \\
   (p(cid) = CSE132X \rightarrow \exists r \in record (r(sid) = s(sid) \land \\
   r(cid) = p(pre_cid) \land r(grade) \geq 2))) \}
   \]

   (ii) rewrite the query in (i) in using only existential quantification \( \exists \)

   \[
   \{ x : sid \mid \exists s \in student(x(sid) = s(sid) \land \exists p \in prerequisite \\
   (p(cid) = CSE132X \land \exists r \in record (r(sid) = s(sid) \land \\
   r(cid) = p(pre_cid) \land r(grade) \geq 2))) \}
   \]

   (iii) write the SQL query corresponding directly to the relational calculus query in (ii), that uses NOT EXISTS tests on nested queries

   ```sql
   select s.sid from student s
   where not exists
   (select * from prerequisite p
   where p.cid = CSE132X and not exists
   (select * from record r
   where r.sid = s.sid and r.cid = p.pre_cid and r.grade \geq 2))
   ```
2. Find the courses taken by every student who has taken CSE132A.

(i) write the query in relational calculus using (at least one) universal quantification \(\forall\)

\[
\{ x : cid \mid \exists c \in course \land (x(cid) = c(cid) \land \forall r \in record \land (r(cid) = CSE132A \rightarrow \exists v \in record \land (v(sid) = r(sid) \land v(cid) = c(cid))) \}\}

(ii) rewrite the query in (i) in using only existential quantification \(\exists\)

\[
\{ x : cid \mid \exists c \in course \land (x(cid) = c(cid) \land \neg \exists r \in record \land (r(cid) = CSE132A \land \neg \exists v \in record \land (v(sid) = r(sid) \land v(cid) = c(cid))) \}\}

(iii) write the SQL query corresponding directly to the relational calculus query in (ii), that uses NOT EXISTS tests on nested queries

```
select c.cid from course c
where not exists
(select * from record r
where r.cid = CSE132A and not exists
(select * from record v
where v.sid = r.sid and v.cid = c.cid))
```