Quiz #1

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1. Explain the following terms. [15pts]
a) database schema and instance
schema: the **logical structure (overall design**) of the database
instance: the actual **content (information)** of the database **at a particular point in time**

b) DDL, DML, and query
DDL: Language for **defining** the database **schema**
DML: Language for accessing and **manipulating** the **data**
Query: part of DML that requests **data retrieval**

c) foreign key
A value in one relation must appear in another relation.

2. Prove or disprove $\prod_A (r \cap s) = \prod_A (r) \cap \prod_A (s)$. [10pts]
False. a counterexample: R, S = (A, B), r = {(a, b}}, s = {(a, c)}
$\prod_A (r \cap s) = \emptyset$, $\prod_A (r) \cap \prod_A (s) = \{a\}$.

3. The *anti-join*, written as $r \triangleright s$ where *r* and *s* are relations, is similar to the natural join, but its result is only those tuples in *r* for which there is no tuple in *s* that is equal on their common attribute names. For example, the result of the antijoin *course* $\triangleright$ *prereq* is as follows:

course

course_id	*title*	*dept_name*	*credits*
BIO-301	Genetics	Biology	4
CS-190	Game Design	Comp. Sci.	4
CS-315	Robotics	Comp. Sci.	3

prereq

course_id	*prereq_id*
BIO-301	BIO-101
CS-190	CS-101
CS-347	CS-101

course $\triangleright$ *prereq*

course_id	*title*	*dept_name*	*credits*
CS-315	Robotics	Comp. Sci.	3

a) Define *anti-join* operation, $r \triangleright s$, in terms of the basic operations and natural join operation. [10pts]
$r - \prod_{r.a1,..,r.an}(r \bowtie s)$
b) Find the IDs and titles of courses in the Comp. Sci. department that do not have any prerequisites, using NOT EXISTS clause. [5pts]

```
SELECT c.course_id, c.title
FROM course c
WHERE   NOT EXISTS (SELECT p.course_id
                    FROM prereq p
                    WHERE c.course_id = p.course_id)
        AND c.dept_name = 'Comp. Sci.';
```

4. Write a SQL query for the following relational algebra expression: [10pts]
$\prod_{dept\_name}(\sigma_{salary > 80000}(instructor))$

```
SELECT DISTINCT dept_name
FROM instructor
WHERE salary > 80000;
```

5. a) What is a *null* value? [2pts]
an unknown value or that a value does not exist
b) What is the result for each of the following aggregate functions: [8pts]

i) sum(budget) = 320000
ii) avg(budget) = 80000
iii) count(budget) = 4
iv) count(*) = 5

department

dept_name	building	budget
Biology	Watson	80000
Comp. Sci.	Taylor	100000
Elec. Eng.	Taylor	70000
History	Painter	70000
Music	Packard	*null*

* Consider the following database for problem 6 and 7.

movie(title, director_name, running_time)
actor(title, actor_name, role)
theater(theater_name, address, phone)
schedule(theater_name, title, showtime)

6. Give an expression in the relational algebra for each of the following queries: [20pts]
a) Find the names of actors who appeared in a movie titled “Godfather“.
$\prod_{actor\_name}(\sigma_{title = \text{“Godfather”}}(actor))$
b) Find the names of directors who appeared in their own movie.
$\prod_{director\_name}(\sigma_{director\_name = actor\_name}(movie \bowtie actor))$
c) Find the names of theaters showing a movie which was directed by “Tim Burton” or in which “Johnny Depp” appeared.
$\prod_{theater\_name}(\sigma_{director\_name = \text{“Tim Burton”}}(movie \bowtie schedule))$
$\cup \prod_{theater\_name}(\sigma_{actor\_name = \text{“Johnny Depp”}}(actor \bowtie schedule))$
d) Find the names of theaters showing a movie which is not showing in any other theaters, with the titles of the movies.
$\prod_{theater\_name,title}(schedule)$
$- \prod_{s.theater\_name,\ s.title}(\sigma_{scheduletheater\_name \neq s.theater\_name \wedge schedule.title = s.title}(schedule \times \rho_s(schedule)))$

7. Write the following queries in SQL: [20pts]
a) Find the address and phone number of a theater named ‘Cinecube’.

```
SELECT address, phone
FROM theater
WHERE theater_name = ‘Cinecube’;
```

b) Find the names of theaters and showtimes for a movie titled ‘Les Miserables’ in ascending order of showtime.

```
SELECT theater_name, showtime
FROM schedule
WHERE title = ‘Les Miserables’
ORDER BY showtime;
```

c) Display the schedules(all attributes of schedule) of all movies in the database in which ‘Brad Pitt’ and ‘Angelina Jolie’ do not appear.

```
SELECT theater_name, title, showtime
FROM schedule NATURAL JOIN actor
WHERE actor_name NOT IN (‘Brad Pitt’, ‘Angelina Jolie’);
```

d) Display the list of all movie titles, with the total number of showings of each movie. Make sure to correctly handle movies with no showings.

```
SELECT title, count(showtime)
FROM movie NATURAL LEFT OUTER JOIN schedule
GROUP BY title
```