Quiz4 – Solutions

1. Considering the University Schema below:
Classroom (building, room number, capacity)
Department (dept name, building, budget)
Course (course id, title, dept name, credits)
Instructor (ID, name, dept name, salary)
Section (course id, sec id, semester, year, building, room number, time slot id)
Teaches (ID, course id, sec id, semester, year)
Student (ID, name, dept name, tot cred)
Takes (ID, course id, sec id, semester, year, grade)
Advisor (s ID, i ID)
Timeslot (time slot id, day, start time, end time)
Prereq (course id, prereq id)
Write the following queries in relational algebra, using the university schema.

A) Find the names of all students who have taken at least one Comp. Sci. course.

$$X1 \leftarrow \pi_{dept\_name}(\sigma_{dept\_name='Comp.Sci.'}(Department))$$

$$X2 \leftarrow \pi_{course\_id}(X1 \bowtie Course)$$

$$X3 \leftarrow \pi_{id}(X2 \bowtie Takes)$$

$$X4 \leftarrow \pi_{names}(X3 \bowtie Student)$$

b) Find the ID s and names of all students who have not taken any course o_ering before Spring 2009.

$$X1 \leftarrow \pi_{id}(\sigma_{(year<2009) \ \vee \ (year=2009 \ \wedge \ semester='fall')}(Takes))$$

$$X2 \leftarrow \pi_{id}(Student) - X1$$

$$X3 \leftarrow \pi_{id,name}(X2 \bowtie Student)$$

c) For each department, _nd the maximum salary of instructors in that department. You may assume that every department has at least one instructor.

$$X1 \leftarrow \pi_{id,salary,dept\_name}(Instructor)$$

$$X2(id\_buffer,salary\_buffer,dept\_name\_buffer) \leftarrow X1$$

$$X3 \leftarrow \pi_{id,salary,dept\_name}\ (X1 \bowtie_{salary<salary\_buffer \ \wedge \ dept\_name=dept\_name\_buffer} X2)$$

$$X4 \leftarrow \pi_{salary,dept\_name}\ (X1 - X3)$$

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d) Find the lowest, across all departments, of the per-department maximum salary computed by the preceding query.

$$X4 \leftarrow \pi_{id,salary}(X3^{*})$$ **calculated in (c)*

$$X5(id\_buffer, salary\_buffer) \leftarrow X4$$

$$X6 \leftarrow X4 \times X5$$

$$X7 \leftarrow \pi_{id}(\sigma_{(salary > salary\_buffer)}(X6))$$

$$X8 \leftarrow X4 - X7$$

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2) Find the results of the following relational algebra queries applied on the database provided
thereafter:

P(A,B,C)
1 11 X
2 11 Y
3 11 X
4 12 Z

R(C,D)
X 1
X 2
Y 1

a. $X1 \leftarrow (\pi_{C,A} P) - R$

b. $X2 \leftarrow \pi_{B,C} P \div R$

c. $X3 \leftarrow \sigma_{A=D} (P \times R)$

d. $X4 \leftarrow (P \bowtie R)$

a)

Y	2
X	3
Z	4

b)
Such an operation cannot be performed since relation *R* has distinctive attribute labeled "*D*" so is not sub-part of relation *P*.

c)

1	11	X	X	1
1	11	X	Y	1
2	11	Y	X	2

d)

1	11	X	1
1	11	X	2
2	11	Y	1
3	11	X	1
3	11	X	2

Note: The solutions given here are not unique and there may exist solutions apart from these.