York University	**Midterm Exam / Winter 2008**
Department of Computer Science and Engineering	**CSE3421**

- This is a closed book, **75 minutes** test. (1 hour and 15 minutes)
- **No questions are allowed during the test. If in doubt, write down your doubts and assumptions and proceed with your answer.**

LAST NAME	**SOLUTIONS**
FIRST NAME	**SOLUTIONS**
YORK ID#	**SOLUTIONS**
CS LOGIN	**SOLUTIONS**

Exercise 1 [30 points]
Let R = (A,B,C), and let r1 and r2 both be relations on schema R. Give an expression in SQL that is equivalent to each of the following queries.

a. r1 ∩ r2. You are NOT allowed to use the INTERSECT SQL keyword in formulating this query.
b. r1 − r2. you are NOT allowed to use EXCEPT SQL keyword when formulating this query.
c. $\pi_{A,B}(r1) \bowtie \pi_{B,C}(r2)$

Answer:

[10 points] a: $r1 \cap r2$

```
select *
from r1
where (A, B, C) in (select * from r2)
```

[10 points] b: r1 − r2

```
select * from r1
where (A, B, C) not in (select * from r2)
```

[10 points] c: $\pi_{A,B}(r1) \bowtie \pi_{B,C}(r2)$

```
select r1.A, r2.B, r2.C
from r1, r2
where r1.B = r2.B
```

Exercise 2 [30 points]
Define $R \otimes S$ (R XOR S) as the relation which contains tuples that belong to either R or S but to both R and S. Assume that both R and S have the same schema, (A, B) and that they are "XOR compatible", wherever applicable.

a. Can you express $R \otimes S$ in terms of the basic relational operations? If yes, then show your expression. If no, explain why and what is missing.
b. Can you express $R \otimes S$ in SQL? If yes, then show your SQL. If no, explain why/what is missing.

Answer:

[15 points] a: (relational algebra) Yes. The RA expression is:
$R \otimes S = R \cup S - R \cap S$.

[15 points] b: (SQL) Yes. The SQL is:

```
(select *  from R
```

where (R.A, R.B) not in (select * from S))
UNION
(select * from S
where (S.A, S.B) not in (select * from R))

Exercise 3 [40 points]
Consider the following Professors-Courses-Teachings schema:

Professors(pid, pname, office#)
Courses(cid, cname, year)
Teachings(pid, cid)

Query: "Find the names of the professors who teach every 2nd year course or teach every 3rd year course (or both)".

Write the above query in:
a. Relational algebra
b. SQL

Answer:

a. [20 points] relational algebra

$$W1 \leftarrow \pi_{cid}\left(\sigma_{year=2}\left(Courses\right)\right)$$
$$W2 \leftarrow Teachings / W1$$
$$W3 \leftarrow \pi_{name}\left(W2 \underset{pid}{\rhd\lhd} Professors\right)$$
$$W4 \leftarrow \pi_{cid}\left(\sigma_{year=3}\left(Courses\right)\right)$$
$$W5 \leftarrow Teachings / W4$$
$$W6 \leftarrow \pi_{name}\left(W5 \underset{pid}{\rhd\lhd} Professors\right)$$
$$final\ result \leftarrow W3 \cup W6$$

b. [20 points] SQL

Convert the above into sql …

Exercise 4 [40 points]

Consider the following relations:

- PARENT(P, C) : a tuple (p, c) in PARENT means that p is parent of c (i.e., c is child of p).
- BROTHER(B, X): a tuple (b, x) in BROTHER means that b is brother of x (x may be male or female).
- SISTER(S, Y): a tuple (s, y) in SISTER means that s is sister of y (y may be male or female).

Use

a. relational algebra and
b. SQL

to produce a relation SECOND_COUSIN with all the tuples (s, z) such that s and z are second cousins, based on the information given from the above 3 tables. (note: two people are second cousins if their parents are 1st cousins).

Answer:

a. [20 points] Relational algebra

$$P1 \leftarrow PARENT$$

$$P2 \leftarrow PARENT$$

$$GP \leftarrow \pi_{P1.P,P2.C}\left(P1 \underset{P1.C=P2.P}{\bowtie} P2\right)$$

$$SC1 \leftarrow \pi_{GP.C,Brothers.X}\left(GP \underset{GP.P=Brothers.B}{\bowtie} Brothers\right)$$

$$SC2 \leftarrow \pi_{GP.C,Sisters.Y}\left(GP \underset{GP.P=Sisters.S}{\bowtie} Sisters\right)$$

$$final\ result \leftarrow SC1 \cup SC2$$

b. [20 points] SQL

Convert the above to SQL …