CMSC424: Homework 1

Due: February 14, 2012

Note: If you'd like to write the answer in Latex, a tex file is provided on the website. You should submit the pdf file however. You can submit electronically using the submit server, or turn in a hard-copy in class before the class begins.

1. Name four major disadvantages of a file system to manage structured data like *banking*, or *airline* data.

2. Is SQL a procedural language or a declarative language? Give three reasons why something like SQL is a better choice than say C++ for writing database applications.

3. In words, describe the *left natural outer join* operation over two relations, $R(A, B)$ and $S(B, C)$.

4. Design a relational schema for a pizza delivery place. The database is to keep track of CUSTOMERs, their PREFERENCEs, and for each preference the INGREDIENTs (onions, ham, bacon, etc.). Each customer may have several preferences. Each preference CONTAINs one or more incredients. The database has to keep track of the DRIVERs delivering, dates, and money collected. Identify the primary keys, candidate keys, and foreign keys.

5. Section 2.3.3 (5th edition) or Problem 6.4 (6th edition) describe the "division operation". What is the result of the operation $(R \div S)$ on the following two instances ?

A	B
1	α
2	β
3	γ
1	β
2	γ
2	α

Instance 1: R

B
α
γ

Instance 1: S

A	B	C
3	1	α
3	2	β
1	3	γ
2	1	α
3	1	β
1	2	γ
3	2	α

Instance 2: R

B
2

Instance 2: S

6. Consider the two SQL queries:

```
select p.a
from p
where p.b <>all (select r.b from r);
```

```
select p.a
from p
where p.b not in (select r.b from r);
```

Are these equivalent? Examine the case of p and/or r being empty.

7. Given the following relations: $R(A, B), S(B, C, D), T(D, E)$:

   (a) Explain the result of the following RA expression in plain English.

   $$\pi_A(R) - \pi_{R2.A}(\sigma_{R2.A<R.A}(R \times \rho_{R2}(R)))$$

   (b) Write a relational algebra expression to generate a relation $RESULT(A, D, E)$, that is a natural join of R, S, and T, followed by a projection.

   (c) Write a relational algebra expression to find those E values that do not appear in the above RESULT relation.

8. Consider the division operation again on relations $R(A, B)$ and $S(B)$. You are to write $R \div S$ using SQL. As a starting point, here is the relational algebra expression for $\div$ using other operators:

   $$R \div S = \pi_A(R) - \pi_A((\pi_A(R) \times S) - R)$$