CS145 Written Assignment #7

Due Thursday May 27*

1. Consider a relation `ParentChild(parent, child)` which records parent-child relationships. Write a SQL3 `WITH` statement to compute all pairs `(person1, person2)`, where `person1` and `person2` have a common ancestor and are of the same generation with respect to this ancestor. Please use linear recursion only, and make sure that every `RECURSIVE` clause is monotone.

2. Suppose we are given a table `Flight(fromCity, toCity, airline)` containing nonstop flights from one city to another. Note that flights from city A to city B are independent of the flights from B to A. Here is a small sample table:

fromCity	toCity	airline
Springfield	Denver	Frontier
Springfield	Denver	United
Springfield	NY	American
Denver	Springfield	Frontier
Denver	Chicago	American
Chicago	Springfield	United
NY	Denver	American
NY	Chicago	TWA

   Mr. Burns has a bizarre travel habit—he will only travel by air under the following restrictions: The first flight he take must be United; the second must be American; the third must be United; the fourth must be American; and so on. He has ordered you to find out whether he could travel by air from one city to another. As a concrete example, for the sample table above, the only way for Mr. Burns to travel from Springfield to NY is to take a United flight from Springfield to Denver first, then an American flight from Denver to Chicago, then a United flight from Chicago to back Springfield, and finally an American flight from Springfield to NY. On the other hand, Mr. Burns would get stuck in NY, because there is no United flight out of the city.

   Write a SQL3 `WITH` statement to find all pairs `(city1, city2)` such that there exists a flight plan from `city1` to `city2` (possibly with intermediate stops and even loops) in which United and American flights alternate, starting with a United flight. Again, please use linear recursion only, and make sure that every `RECURSIVE` clause is monotone.

3. Suppose we have three tables $R(X, Y)$, $S(X, Y)$, and $T(X)$, with the following contents:

R:

X	Y
a	b
b	c
c	d
d	e

S:

X	Y
a	b
b	c
c	a

T:

X
a
b
c

*Please refer to CS145 Course Information Page (`http://www.stanford.class/cs145/info.html`) for submission instructions and late policy.

Consider the following SQL3 `WITH` statement:

```
WITH
  RECURSIVE P(X, Y) AS
    SELECT * FROM R
    WHERE X NOT IN (SELECT * FROM Q),
  RECURSIVE Q(X) AS
    SELECT X FROM S
    WHERE Y NOT IN (SELECT * FROM T)
    OR Y IN (SELECT * FROM Q)
SELECT * FROM P;
```

(a) Draw the dependency graph for the above `WITH` statement.

(b) What are the strata of P and Q? Is the `WITH` statement stratified?

(c) Show the result of the `WITH` statement.

(d) (Complete this part if you want to get a "+" for this assignment.) Find a fixed point which is different from the one you obtained in (c).

4. (This part is completely optional.) Design your own problem for the final exam! We will review all candidate problems and select a few interesting and/or challenging ones to put on the exam. You will not receive extra credits for doing this, but we will acknowledge you on the exam paper if your problem is chosen.

   Be creative! Both multiple-choice and short-answer formats are acceptable. Please also provide a sample solution to your problem (at the same level of detail as our midterm sample solution). It is fine to borrow problems from other textbooks; if you do, please cite the appropriate sources.