Exercise 7 “Implementation of Databases”

Due until 12 Dec, 2007 (before exercise)  

News: We are planning to move the exam to Feb. 21, 2008 (10 am). If you have any problem with it, please contact us until Dec. 12.

Exercise 7.1[Datalog]:

Given the following database containing fact sets for following predicates.

Male(X): Person X is male
Married(X,Y): Person X and Y are married
Child(X,Y): Person X is a child of person Y
Lives(X): Person X has not died so far

1. Please formulate Datalog rules for the following connections: 
   (a) Parent  
   (b) Sibling  
   (c) Aunt  
   (d) Daughter  
   (e) Brother  
   (f) Niece  
   (g) Only child  
   (h) Grandchild  
   (i) Brother-in-law  
   (j) Widow  
   (k) Male Ancestor  
   (l) Orphan  

2. Given your rule for Parent(X,Y) from previous task, the rule for same generation (sg(X,Y)) and the following facts:

   Parent(X,Y) :- Your Solution.
   sg(X,Y) :- Parent(Z,X), Parent(Z,Y), XY.
   sg(X,Y) :- Parent(X,W), Parent(Y,Z), sg(W,Z), XY.
   Child(Hera,Kronos).
   Child(Hera,Rhea).
   Child(Kronos,Ga).
   Child(Rhea,Uranos).
   Child(Zeus,Kronos).

   Compute the extension of sg(X,Y), write down all intermediate steps leading to new results.

Exercise 7.2[Herbrand Model and Datalog]:

Given the following DATALOG program:
t(X) :- p(X).
t(X) :- q(Y,X).
q(X,Y) :- p(X), q(Y,X).
q(X,X) :- t(X).
q(c,a).
p(a).
p(b).

1. Find a corresponding Herbrand base. (2 pt.)
2. Calculate the minimal Herbrand model. (2 pt.)
3. Find two more not minimal Herbrand models. (2 pt.)

Exercise 7.3 [Fixpoint of Datalog]:
Consider a tennis tournament database with information about players with predicates

beats(X1,X2): X1 beats X2 // EDB
superior(X1,X2): X1 is superior to X2 // IDB

Assume that if a player beats another player he is superior to that player and assume that if player 1 beats player 2 and player 2 is superior to player 3 then player 1 is superior to player 3.

1. Construct a set of recursive rules for “superior” using the above predicates. (2 pt.)
2. Suppose the EDB predicate is as follows:
   \[
   \text{beats} = \{(1,2), (2,3), (3,6), (5,1), (2,6), (4,3), (5,4), (6,1), (4,5)\}
   \]
   Show the computation of the least fixpoint of the immediate consequence operator \( T_D \) using the data. (2 pt.)
3. Does the computation of the superior table have a fixpoint? Why or why not? Is this always the case? Why? (2 pt.)