Exercise 4

Integrated Logic Systems (Part I)

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Exercise 4.1

Download the Prolog code for the tableau prover (`tableau.pl`) from the course web page.

a) Find a formula with n variables that is unsatisfiable and needs a variable limit (`VarLim`) greater than n for a successful proof with the tableau prover.

b) Transform the following formula into a Skolem CNF formula and check the validity with Prolog:

$$[(\forall x \exists y)(p(x,y)) \wedge (\forall x,y)(p(x,y) \rightarrow p(y,x)) \wedge (\forall x,y,z)(p(x,y) \wedge p(y,z) \rightarrow p(x,z))]$$

$$\rightarrow (\forall x)(p(x,x))$$

Exercise 4.2

Consider the following statement:

"Jaden is a parent without a child."

a) Using the definitions from SI. IV/18, formulate this statement as an ABox A.

b) Transform A to negation normal form and replace all defined concepts (i.e. all concepts that occur in a left-hand side of the definitions from SI. IV/18) by their definitions in terms of primitive concepts (those that only occur on right hand sides).

c) Apply the Transformation Rules for $\mathcal{ALC}$ (SI. IV/23) to show that A is inconsistent.

Exercise 4.3

Download the constraint handling rules (CHRs) for $\mathcal{ALC}$ Reasoning (`dl.chr`) from the course web page and load them into Eclipse Prolog using the query $?- lib(chr), chr(dl)$.

a) Apply the CHRs by hand to show that the following statement leads to a contradiction:

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isa(X,not(some(hasChild,human))), isa((X,Y),hasChild),
isa(Y,or(man,woman)).
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b) Use the CHRs to automatically show the truth of the following statements by contradiction:

1) Every proud parent has only happy children.
2) If Fritz is a parent and a child of Jody, then Jody is a grandparent.