Exercise 3

Foundations of Logic Programming

Prof. Michael Thielscher, Sebastian Voigt

International Master Program in Computational Logic — winter term 2009/2010

Date of Exercise: 16.11.2009

Exercise 3.1

Use the Martelli-Montanari algorithm step by step to unify the terms $t(f(h(x)), y, h(b))$ and $t(y, f(z), z)$ with variables x, y, and z. For each step indicate the reduction wrt. $\prec_3$ of the termination proof for the MM-algorithm.

Exercise 3.2

In the proof of the termination of the MM algorithm, a lexicographic ordering on triples of the form $(uns(E), lfun(E), card(E))$ is used. Show examples why orderings on triples of the form $(lfun(E), uns(E), card(E))$ or of the form $(uns(E), card(E), lfun(E))$ would not work.

Exercise 3.3

Consider the following description: "A dog is happy if the sun is shining or if it plays with a toy. It can play with a toy only if somebody is present and is willing to launch it. Frank and Max are present and Max is willing to launch a stick."

a) Formalize the given description by specifying a Prolog program. Additionally, give the logic formulae that correspond to the program.

b) Show a query and an SLD-derivation which proves that the dog is happy. What are the resultants of the derivation?

c) Give the computed answer substitution (CAS) of the derivation from b).

Exercise 3.4

Find a program P and a query Q such that for some θ there is a proof of $Q\theta$ (i.e. a successful SLD-derivation providing θ) via some selection rule R which cannot be found if Standardization Apart (Slide III/15) were not required.

Can you specify P and Q such that the problem occurs no matter which selection rule is applied?

Exercise 3.5

Consider the program

```
fact(0,s(0)).
fact(s(N),F):- fact(N,G), mul(s(N),G,F).
```

and the query `?- fact(0,Y),fact(Y,s(0)).`

a) Give an SLD-derivation using the Prolog selection rule (you don't have to show the multiplication in detail). Give the substitutions and resultants of each step and the CAS.

b) Show that the Switching Lemma (Slide III/26) holds for the initial query (i.e., for $n = 0$).

Hint: Give a second SLD-derivation selecting the second atom at the beginning and using the Prolog selection rule afterwards. Show the correspondence of both derivations.