

Foundations of Logic Programming

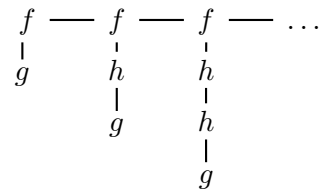
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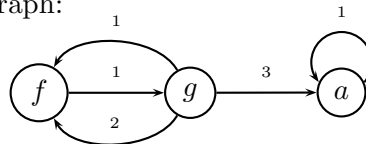
Exercise 3.1 cf. Exercise 2.5

For the following non-regular infinite tree which roots in the leftmost occurrence of function symbol f , give the partial mapping $t : \mathbb{N}_+^* \rightarrow F$.



Exercise 3.2 cf. Exercise 2.6

Consider the following labeled graph:



- Give the infinite tree with root f which is represented by this graph as partial mapping $t : \mathbb{N}_+^* \rightarrow \{f, g, a\}$.
- How many subtrees does the tree from a) have?

Exercise 3.3

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 3/15) were not required.

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

Exercise 3.4

Give a program P , a query Q and two selection rules R_1 and R_2 such that:

- every SLD-derivation of $P \cup \{Q\}$ via R_1 is infinite
- every SLD-derivation of $P \cup \{Q\}$ via R_2 is failed

Is it possible to construct P and Q such that additionally to the properties specified above there exists a successful SLD-derivation via some selection rule R_3 ? Justify your answer.

Exercise 3.5

Consider the following program:

```
p(X) :- q(X), r(X).  
q(f(X)).  
r(f(a)).
```

- Give an SLD-derivation ξ for query $?- p(X)$ that uses the Prolog selection rule.
- For each derivation step of ξ , give the resultant that is associated with this step (Sl. 3/18).
- Give the resultants of every level i of ξ (Sl. 3/19).

Exercise 3.6

Consider the query $?- \text{fact}(0, Y), \text{fact}(Y, s(0))$. together with the program

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

- Give an SLD-derivation using the Prolog selection rule (you don't have to show the multiplication in detail). Give the substitutions and the CAS.
- Show that the Switching Lemma (Slide 3/26) 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.