

Assignment 3

Due: Friday, 27.5.2016, 15:59 via Git

For help, contact alp-staff@lists.iai.uni-bonn.de (staff only) or
alp-course@lists.iai.uni-bonn.de (staff and participants).

Submit answers as suitably named txt, docx or pdf files in the folder "assignment03/" in the Git repository of your group.

Task 1. *Declarative semantics* (4 Points)

```
extends(a, b).  
extends(c, d).  
extends(d, e).  
subtype(X, Y) :- extends(X, Y).  
subtype(X, Y) :- extends(X, Z), subtype(Z, Y).
```

For the above program write down

- (2 Points) its translation to first order logic (quantified implications).
- (2 Points) its model (its logical consequences).

Tip: See Chapter 2 of the lecture slides.

Task 2. *Declarative semantics* (2 Points)

```
extends(class(a), class(b)).  
extends(class(c), class(d)).  
extends(class(d), class(e)).  
subtype(X, Y) :- extends(X, Y).  
subtype(X, Y) :- extends(X, Z), subtype(Z, Y).
```

Write down the model of the above, slightly modified, program.

Task 3. *Declarative semantics* (5 Points)

```
natural(0).  
natural(s(X)) :- natural(X).
```

- (2 Points) Write down the model of the above program.
- (1 Points) What difficulty did you encounter in step a)?
- (2 Points) Compare this task to Task 2 and try to make a general statement about the effect of function symbols in logic programs.

Task 4. Unification (3 Points)

Give the most general unifier for all successful unifications. If the unification doesn't succeed describe why.

- a) $\text{likes}(\text{calvin}, \text{hobbes}) = \text{likes}(X, Y)$
- b) $\text{likes}(\text{calvin}, \text{hobbes}) = \text{likes}(X, \text{susie})$
- c) $\text{father}(\text{Jim}, \text{father}(X)) = \text{grandfather}(\text{john}, \text{jane})$
- d) $\text{append}([A, B, C], [D, E, F], G) = \text{append}([h, i, j], [k, l, m], [N | O])$
- e) $[a, [b | H] | C] = [a, b, c, d]$
- f) $[[X, Y], e | [y, z]] = [A, B, C, D]$

Task 5. Application of substitution (3 Points)

Write down the term resulting from applying the respective substitution, or explain why the substitution cannot be applied. For example, write " $f(X)\{X \leftarrow 1\} \equiv f(1)$ ".

- a) $f(X, Y)\{X \leftarrow 'Z'\} \equiv$
- b) $g(X, Y)\{X \leftarrow 2, Y \leftarrow g(X)\} \equiv$
- c) $h(X, Y)\{X \leftarrow h(Z, Y), Y \leftarrow h(Z), Z \leftarrow 3\} \equiv$

Task 6. Composition of substitutions (3 Points)

Write down the result of each of the following substitution compositions:

- a) $\{X \leftarrow h(Z, Y)\}\{Y \leftarrow h(Z), Z \leftarrow 3\} \equiv$
- b) $\{X \leftarrow h(Z, Y)\}\{X \leftarrow h(Z), Z \leftarrow 3\} \equiv$
- c) $\{X \leftarrow h(Z, Y)\}\{Y \leftarrow h(Z), Z \leftarrow X\} \equiv$