Software-Modellierung und Verifikation
Informatik 2
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8. Exercise sheet *Compiler Construction 09/10*

Due on Wednesday, December 16, *before* the exercise class.

If possible, please submit your solution online to `chfalak@gmail.com`

Exercise 8.1: 3 points

The following grammar describes a binary tree whose leaf nodes contain natural numbers:

$$\begin{array}{lcll} B & \rightarrow & BB & (1) \\ B & \rightarrow & nat & (2) \end{array}$$

Each leaf node contains its value in the associated attribute *nat*.
Extend the grammar with semantic rules such that each node of the syntax tree has an inherited attribute *max* which contains the largest natural number in the tree! Construct the attribute equation system for the tree that has values $1, 2, 3, 4$ on its leaves and solve it!

Exercise 8.2: 3 points

Consider the following grammar:

$$\begin{array}{lcll} S' & \rightarrow & S & w.1 = 1 - b.1 \\ S & \rightarrow & AB & w.1 = w.0, \\ & & & w.2 = b.1, \\ & & & b.0 = b.2 \\ A & \rightarrow & AA & w.1 = w.0, \\ & & & b.0 = b.1 \\ A & \rightarrow & a & b.0 = w.0 \\ B & \rightarrow & BB & w.2 = w.0, \\ & & & b.0 = b.2 \\ B & \rightarrow & b & b.0 = w.0 \end{array}$$

a) Prove that the grammar is circular by graphically representing the dependencies in an appropriate derivation tree.

b) Construct the equation system for the derivation tree chosen in a) and solve it.

Exercise 8.3: 4 points

Consider the following grammar:

$$
\begin{array}{lllll}
S & \to & A & i_1.1 = 1 & \\
 & & & i_2.1 = 2 & \\
 & & & s_1.0 = s_2.1 & \\
\end{array}
\qquad
\begin{array}{lllll}
A & \to & Aa & i_1.1 = s_1.1 & \\
 & & & i_2.1 = i_1.0 & \\
 & & & s_1.0 = s_2.1 & \\
 & & & s_2.0 = 0 & \\
\end{array}
$$

$$
\begin{array}{lllll}
A & \to & a & s_1.0 = 0 & \\
 & & & s_2.0 = i_1.0 & \\
\end{array}
\qquad
\begin{array}{lllll}
A & \to & b & s_1.0 = i_2.0 & \\
 & & & s_2.0 = 0 & \\
\end{array}
$$

a) Show that the grammar is not circular using the method from the lecture.

b) Check whether it is strongly non-circular.