

System Architecture (block course) - SS13  
Exercise Sheet 6 (due: 28.08.13) - 15 points

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**Exercise 1:** (5)

Recall derivation trees that encode sequences, i.e., derivation tree using production rules  $XS \rightarrow X|XoXS$ , where  $X$  is a non-terminal and  $o$  is some terminal. Let  $u \in \mathbb{N}^*$  be the root of such a derivation tree.

- (a) (2 points) Recall, for  $i \in \mathbb{N} \setminus \{0\}$ , the definition of  $se(u, i)$  that gives the  $i$ -th sequence element of the tree starting in  $u$ . Consider the following (alternative) recursive definition:

$$se'(u, 1) = u \circ 0$$
$$se'(u, i + 1) = se'(u \circ 2, i)$$

Prove that  $se'(u, i) = u \circ 2^{i-1} \circ 0$ .

- (b) (1 point) Recall the definition of  $fseq(u) = se(u, 1) \circ \dots \circ se(u, n)$ , which turns such a derivation tree into the list of its sequence elements. Give a formal definition of  $fseq(u)$ , i.e., a definition that does not use dot notation.
- (c) Give a string in  $L(TyDs)$  where the derivation tree starting with the non-terminal  $TyDs$  has three nodes with label  $\langle TyD \rangle$ . In the following, consider this derivation tree.
- (1 point) Give  $bw(se(\epsilon, i) \circ 1)$  and  $bw(se(\epsilon, i) \circ 2)$  for  $i \in \{1, 2, 3\}$ .
  - (1 point) Explain in two or less sentences why in the lecture we use  $bw(se(0, i) \circ 1)$  and  $bw(se(0, i) \circ 2)$  to get the  $i$ -th type declaration, and why this does not work in our example.

**Exercise 2:** (2)

Consider the following example of a string formed by a type declaration sequence:

```
typedef LEL* u;  
typedef struct { int content; u next_lel} LEL
```

Explain why our definition of  $e = e'$  for  $e \in TN$  and  $e' \in L(TE)$  does not allow, e.g.,  $LEL = \{ \text{int content; LEL* next} \}$  or  $u = \{ \text{int content; LEL* next} \}$ .

**Exercise 3:** (3)

Recall context conditions, which correspond to semantic analysis in classical compiler theory.

- (1 point) Write down two context conditions of C0.
- (1 point) Explain why we have these two context conditions.
- (1 point) Explain why the context conditions are not part of the grammar of C0.

**Exercise 4:** (2)

Give definitions on how to get  $t_i$  and  $x_i$ , i.e., the  $i$ -th global type and variable name, from a derivation tree where the root  $\epsilon$  has label  $\langle Prog \rangle$ .

**Exercise 5:** (1)

Fill in the type table and function table of the function `HardnessOfLecture`, which is given below:

```
int HardnessOfLecture(int lecture_id) {  
    int result;  
    if lecture_id == 73896 {
```

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```
        result = 100
    } else {
        if lecture_id == 69695 {
            result = - 100
        }
    };
    return result
}
```

$x$   
HardnessOfLecture  $\left\| \left\| \begin{array}{c} ft(x).t \\ ft(x).p \\ ft(x).VN \\ ft(x).body \\ tt(x) \end{array} \right. \right\|$

**Exercise 6:**

Prove that  $ra(t)$  is well-defined for  $t \in TN$ .

(2)