Mock Exam
Formal Languages and Compilers
(A.Y. 2014/2015)

February 2^{nd}, 2015

1 Semantic Analysis

1.1

Answer to the following requests:

1. define a grammar for generating bynary numbers with no fractional part that can be parsed by an LL(1) parsing algorithm
2. define attributes and the corresponding calculating rules to be able to derive the corresponding number in the base ten codification

1.2

Consider the following grammar to generate binary numbers with no fractional part:

$$S \rightarrow SD \mid D \quad D \rightarrow 0 \mid 1 \tag{1}$$

Answer to the following requests[1]:

1. define an SDD for the grammar in order to transform the corresponding number in the base ten codification
2. transform the grammar so that it can be parsed by an LL(1) parsing algorithm

[1]Note that to transform an attributed grammar with left recursion you can operate according to the following scheme for a general left recursive grammar G:

$A \rightarrow A_1 Y \ \{A.a = g(A_1.a, Y.y)\} \quad A \rightarrow X \ \{A.a = f(X.x)\}$

can be transformed in:

$A \rightarrow X \ \{R.i = f(X.x)\} \ R \ \{A.a = R.s\} \quad R \rightarrow Y \ \{R_1.i = g(R.i, Y.y)\} \ R_1 \ \{R.s = R_1.s\}$
$R \rightarrow \epsilon \ \{R.s = R.i\}$

Solution :

(1). Define an SDD for the grammar in order to transform the corresponding number in the base ten codification

The grammar is structured in a way that a simple SDD can be defined to make the transformation. In particular the following attribure grammar correctly calculate the requested value:

- $S \to SD$ $\quad s.value = s'.value * 2 + d.value$
- $S \to D$ $\quad s.value = d.value$
- $D \to 0$ $\quad d.value = 0.lexval$
- $D \to 1$ $\quad d.value = 1.lexval$

(2). Transform the grammar so that it can be parsed by an LL(1) parsing algorithm

In the footnote 1 the rule to apply is reported. The grammar should be transformed using the "standard" approach. Therefore the resulting grammar is:

- $S \to D \quad \{r.inh = d.value\} \quad \mathrm{R} \quad \{s.value = r.value\}$
- $R \to D \quad \{r'.inh = r.inh * 2 + d.value\} \quad \mathrm{R} \quad \{r.value = r'.value\}$
- $R \to \epsilon \quad \{r.value = r.inh\}$
- $D \to 0 \quad d.value = 0.lexval$
- $D \to 1 \quad d.value = 1.lexval$