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

February 10^{th}, 2015

Lexical Analysis

Ex. 1 (8pts)

Derive automata and write regular definitions for the following languages:

- All strings on the alphabet $\Sigma = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ representing an even number and not starting with 0 (e.g. 2, 126, 992 OK – 012, 43 NOK).
- All strings on the alphabet $\Sigma = \{0, 1\}$ containing an even number of 0s or 1s (e.g. 00, 110, 010, 1100, 01110, 1010 OK – 0, 1, 10, 1110, 1011 NOK).
- All strings on the alphabet $\Sigma = \{a, b, c\}$ not containing the substring *ccc* (e.g. abacca, c, cc, bbccaccac OK – ccc, accc, abccca NOK).

Syntax Analysis

Ex. 2 (10pts)

Let's G the grammar defined by the following productions:

$$S \longrightarrow P \mid Q \quad P \longrightarrow Qq \mid p \quad Q \longrightarrow Pp \mid q \tag{1}$$

1. Discuss the applicability of parsing LL(1)
2. In case the grammar is not parsable with an LL(1) approach modify the grammar in order to be parsable with a parser LL(1) (obviously without modifying the generated language).
3. derive the FIRST, FOLLOW and nullable sets for G. In deriving the table please indicate with two indexes the iteration and the production responsible for the insertion of the symbol in the table.
4. discuss the applicability of parser LR(0) and SLR for the original grammar.

Ex. 3 (6pts)

Define a context free grammar on the alphabet $\Sigma = \{0, 1\}$ generating words for which each prefix contains more 1s than 0s (e.g. 1100, 1010, 1, 110100 OK – 0, 01, 100, 10100 NOK).

Semantic Analysis

Ex. 4 (6pts)

Answer to the following requests:

1. define a grammar for generating any string on the alphabet $\Sigma = \{0, 1\}$
2. define attributes and the corresponding calculating rules in order to be able to count the number of 1s and 0s in the string, and using an LL(1) parser.