TDDD55 Lesson 2: GRAMMARS AND FORMAL LANGUAGES

Assignments

1. Given the alphabet A = { 1, 2, 3} and the strings x = 2, y = 13, z = 323:

   a. What are the strings xz, zyx, z^2, $x^{7,}$ and what are their lengths?

   b. What are A^1, A^2, A^0

   c. Describe A^* and A^+

2. Given the following grammar for arithmetic expressions G(<exp>):

   <exp> ::= <term> | <exp> + <term> | <exp> - <term>
   <term>::= <factor> | <term> * <factor> | <term> / <factor>
   <factor> ::= (<exp>) | <ident>
   <ident> ::= A | B | C ... | Z

   a. Find derivations and draw a parse tree for the statements:

   A*B-C, A*(B-C), A/B/C, and -A*B

   b. State the handle in statement form <term> * <factor> + B/C

   c. State a canonic derivation of one of the statements, in example 2a.

   d. Why is A * <exp> * D not in statement form?

   e. What are **V** (Vocabulary), **Σ** (Alphabet), and **N** (Non-terminals) in this grammar?

   f. Describe Σ^+ and L(G). State some string in Σ^+ which is not in L(G).

3. Using the grammar in exercise 2, draw the parse tree for the statement

   A - <term> * B + (<term>)

   Argue why there is no canonic derivation of the statement.

4. Consider the grammar in exercise 2 again.

   a. Why can't the grammar be parsed using a topdown LL-parser? What options do we have?

   b. Rewrite the grammar so that a leftmost derivation is possible.

   c. Derive A*B-C using leftmost derivation and provide the corresponding parse-tree

5. Construct a context-free grammar for even integers, which may not begin with zeros (this also applies to a single zero).

6. Given the alphabet A = { a, b, c, d, e, f, g, h, i }:

   a. Construct a context-free grammar for words of one syllable (i.e., words containing exactly one vowel).

   b. Construct a context-free grammar for multi-syllable words.

7. Given the alphabet A = { a, b, c }: Write regular expressions that describe

   a. all strings starting with a sequence of zero or several a's followed by an arbitrary number of b's and c's mixed together. The strings finish with another sequence of a's. (Example: aaabbcbca, bbca, aa).

   b. $a^n b^n c^n$, can this expression be described using a regular expression? If so, write down the regular expression. If not, motivate why.

8. Describe the languages (sets) that the following grammars generate: <S> is the start symbol.

   a.

   <S> ::= <A> <A>

   <A> ::= 1 <A> 0 | 10

   b.

   <S> ::= 1 <S> 0 | <B>

   <B> ::= 0 <B> 1 | ε

   c.

   <S> ::= 1 <A> | <B> 0

   <A> ::= 1 <A> | <C>

   <B> ::= <B> 0 | <C> <C>
   ::= 1 <C> 0 | ε