| | Lehrstuhl für Informatik 2 | Compiler Construction 2018/19 |
| RWTHAACHEN UNIVERSITY | Software Modeling and Verification | Exercise Sheet 0 |

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Compiler Construction 2018/19
— Exercise Sheet 0 —

General Remarks

- This exercise sheet is meant to recap topics of automata theory and will not be graded.

- The solution for this exercise sheet will be presented in the first exercise class on October 15th.

- You are expected to hand in your solutions in groups of four. If you are looking for a group or your group has less than four members, please post in the L2P forum or come to the first exercise class.

Exercise 1 (0 Points)

Which of the following statements hold?

(a) Deterministic finite automata (DFA) are strictly less expressive than regular expressions.

(b) Non-deterministic finite automata (NFA) are strictly more expressive than DFA.

(c) The languages of regular expressions are closed under:

    (i) union,

    (ii) intersection,

    (iii) complement,

    (iv) concatenation,

    (v) Kleene closure.

(d) Context Free Languages (CFL) are closed under:

    (i) union,

    (ii) intersection,

    (iii) complement,

    (iv) concatenation,

    (v) Kleene closure.

(e) DCFL is the set of context free languages that are accepted by deterministic push down automata. Is DCFL = CFL?

Exercise 2 (0 Points)

(a) Describe the language of the following regular expression in words:

$$r = (0 + 1)^*0(0 + 1)^*0(0 + 1)^*.$$

(b) Construct the regular expression for...

    (i) the set of all strings with at most one pair of consecutive 0's and at most one pair of consecutive 1's,

    (ii) the set of all strings with equal number of 0's and 1's such that no prefix has two more 0's than 1's nor two more 1's than 0's.

(c) Construct a context free grammar (CFG) for a set of strings of $\{(,)\}^*$ such that every string of the set has equal number of left and right parenthesis, and every prefix has at least as many left parenthesis as right parenthesis.

Exercise 3 (0 Points)

(a) Let r and s be regular expressions. Consider the set X such that $X = r.X + s$. Under the assumption that the language of r does not contain ε (i.e., $\varepsilon \notin L(r)$), find X.

(b) (i) Show that the language $L = \{0^{i^2} \mid i \in \mathbb{N}\}$ is not regular.

   (ii) Show that the language $L = \{a^i b^i c^i \mid i \in \mathbb{N}\}$ is not a CFL.