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# Compiler Construction 2025

# — Exercise 0 —

## General Remarks

- Exercises are *optional*, i.e., not required for admission to exams. However, corrections to students' solutions are provided as annotations to the submissions.
- Please use the corresponding task in the Moodle room to submit your solution. Paper submissions are not accepted.
- Please hand in your solutions in *groups of four* and hand in only one solution per group. You can use the forum in this Moodle room to find group members.

## 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 regular languages 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 $\varepsilon$ (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.