Bernd Finkbeiner
Rüdiger Ehlers
Andrey Kupriyanov

Problem Set 4
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Automata, Games, and Verification

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1. **co-Büchi Automata** (tutorial A: group G07, tutorial B: group G12)

   Prove or provide a counter example to the statement: the co-Büchi recognizable languages and the Büchi recognizable languages are the same.

2. **Deterministic Muller Automata** (tutorial A: group G09, tutorial B: group G14)

   a) Give an ω-regular expression for which the smallest deterministic Muller automaton recognizing it is larger than the smallest nondeterministic Muller automaton recognizing it, and prove this fact.

   b) For all $i \in \mathbb{N}$, let Z_i describe the set of languages representable by deterministic Muller automata with at most i tables (i.e., for every language in Z_i, there exists a corresponding deterministic Muller automaton $\mathcal{A} = (S, I, T, \mathcal{F})$ with $|\mathcal{F}| \leq i$). Obviously, $Z_1 \subseteq Z_2 \subseteq Z_3 \subseteq \ldots$ holds. Prove that this sequence of inequalities is strict, i.e., $Z_1 \subset Z_2 \subset Z_3 \subset \ldots$ holds as well.

3. **Limit languages** (tutorial A: group G13, tutorial B: group G02)

   Show that a language is recognizable by a deterministic Muller automaton **if and only if** it is a Boolean combination of limit languages $\{\overrightarrow{W}_i\}_{i \in I}$, where $\{W_i \subseteq \Sigma^*\}_{i \in I}$ are regular.

4. **co-Büchi Automata** (challenge question)

   Prove or disprove the statement: an ω-language is co-Büchi recognizable if and only if it is recognizable by a deterministic co-Büchi automaton.