Bernd Finkbeiner
Rüdiger Ehlers
Andrey Kupriyanov

Problem Set 5
Summer term 2011
Due: May 19, 2011

Automata, Games, and Verification

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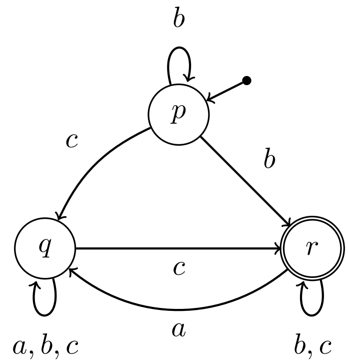
1. **Semi-deterministic automata** (tutorial A: group G05, tutorial B: group G16)

   Let $\Sigma = \{a, b, c\}$ be an alphabet and $\mathcal{A}$ be the following Büchi automaton over Σ having the states $\{p, q, r\}$:

   Construct an equivalent semi-deterministic automaton using the construction from the proof of Lemma 1 in Section 7 of the lecture (McNaughton's Theorem).

2. **More Acceptance Conditions** (tutorial A: group G09, tutorial B: group G12)

   Besides Büchi and Muller automata, there are three further important types of ω-automata.

   - A *parity automaton* is a tuple $(S, I, T, c : S \to \mathbb{N})$.
     A run r of a parity automaton is accepting iff $max\{c(s) \mid s \in In(r)\}$ is even.
   - A *Rabin automaton* is a tuple $(S, I, T, \{(A_i, R_i) \mid i \in J\})$.
     A run r of a Rabin automaton is accepting iff, for some $i \in J$, $In(r) \cap A_i \neq \emptyset$ and $In(r) \cap R_i = \emptyset$.
   - A *Streett automaton* is a tuple $(S, I, T, \{(A_i, R_i) \mid i \in J\})$.
     A run r of a Streett automaton is accepting iff, for all $i \in J$, $In(r) \cap A_i \neq \emptyset$ or $In(r) \cap R_i = \emptyset$.

   Compare the expressive power of Büchi, Muller, Rabin, Streett and parity automata. Which ones are equi-expressive? Which are less expressive than others? Provide proofs for all your claims.

3. **Deterministic Parity Automata** (challenge question)

   Show that deterministic parity automata are closed under

   - negation,
   - union, and
   - intersection.

4. **Deterministic Automata** (tutorial A: group G13, tutorial B: group G06)

   Compare the expressive power of *deterministic* Muller, Rabin, Streett and parity automata (again, prove your claims).

   Hint: In the literature you will find methods based on appearance records. Do *not* use them. It is much simpler to use the results of the previous tasks.