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Problem Set 5
discussion session: 27th of November 2012

Automata, Games, and Verification

Please check out the new group chart

1. **Language Emptiness** (Group G02, discussion session 12:00 with Felix Klein)

   An automaton is called *empty* if its language is empty.

   Describe a method to test language emptiness for

   - nondeterministic Büchi automata $\mathcal{B} = (S, I, T, F)$,
   - nondeterministic Rabin automata $\mathcal{R} = (S, I, T, \{(N_j, R_j) \mid j \in J\})$, and
   - nondeterministic Muller automata $\mathcal{M} = (S, I, T, \mathcal{F})$.

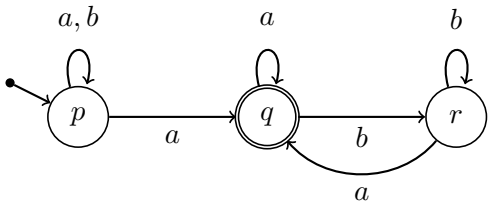
2. **Universal Automata** (Group G08, discussion session 12:00 with Hazem Torfah)

   A *universal* Büchi automaton $\mathcal{A} = (S, I, T, F)$ is defined as a nondeterministic Büchi automaton, with the exception that a universal automaton accepts a word $\alpha \in \Sigma^\omega$ iff *all* runs r of $\mathcal{A}$ on α are accepting.

   Compare the expressive power of deterministic, nondeterministic, and universal Büchi automata.

3. **McNaughton's Theorem** (Group G01, discussion session 12:20 with Hazem Torfah)

   Consider the following semi-deterministic Büchi automaton over $\Sigma = \{a, b\}$:

   Construct an equivalent Muller automaton using the construction from Lemma 2 in Section 7 of the lecture (McNaughton's Theorem).

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

   Show that deterministic parity automata are closed under

   - negation,
   - union, and
   - intersection.