Prof. Bernd Finkbeiner, Ph.D.
Felix Klein, M.Sc.

Problem Set 13
Discussions: July 22th, 2015

Automata, Games, and Verification

Please send a mail to `agv15@react.uni-saarland.de` if you can't make it to the discussion session.

1. **Tree Automata** (presented by Group 09)

   a) Give a Büchi tree automaton for the language:

   $$L_1 = \{v \in T_{\{a,b\}} \mid \text{there is a branch in } v \text{ with infinitely many } a\text{'s}\}$$

   b) Give a co-Büchi tree automaton for the language:

   $$L_2 = \{v \in T_{\{a,b,c\}} \mid \text{each branch in } v \text{ has at least one } a \text{ and the entire tree has at most one } b\}$$

   c) Give a Muller tree automaton for the language:

   $$L_3 = \{v \in T_{\{a,b\}} \mid \text{each branch in } v \text{ has only finitely many } a\text{'s}\}$$

2. **Deterministic Tree Automata** (presented by Group 06)

   Compare the expressive power of deterministic and non-deterministic parity tree automata. We call a parity tree automaton $\mathcal{A} = (\Sigma, Q, q_0, T, \text{PARITY}(c))$ deterministic if for every $q \in Q$ and $\sigma \in \Sigma$, there exists at most one pair $(q_1, q_2) \in Q^2$ such that $(q, \sigma, q_1, q_2) \in T$.

3. **Parity Tree Automata** (presented by Group 12)

   Show that parity tree automata are closed under intersection, i.e., for two parity tree automata $\mathcal{A}_1$ and $\mathcal{A}_2$, show that there exists a parity tree automaton $\mathcal{A}$ such that $\mathcal{L}(\mathcal{A}) = \mathcal{L}(\mathcal{A}_1) \cap \mathcal{L}(\mathcal{A}_2)$.

4. **From Muller to Parity Tree Automata** (presented by Group 03)

   Show that for every Muller tree automaton $\mathcal{A}$ there is a parity tree automaton $\mathcal{A}'$ with $\mathcal{L}(\mathcal{A}) = \mathcal{L}(\mathcal{A}')$.

5. **Büchi vs. Parity Tree Automata (Challenge)**

   Compare the expressive power of Büchi tree automata and parity tree automata.