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

Warm-up Questions 6
Discussions: June 3th, 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. Every deterministic Büchi automaton is semi-deterministic.

   ☐ True ☐ False

2. Consider the construction of a semi-deterministic Büchi automaton $\mathcal{A}'$ from a given Büchi automaton $\mathcal{A} = (\Sigma, Q, I, T, \text{BÜCHI}(F))$, as given in the lecture. The number of *accepting* states of $\mathcal{A}'$ is

super-exponential in	☐ $\lvert Q \rvert$.	☐ $\lvert F \rvert$.
exponential in	☐ $\lvert Q \rvert$.	☐ $\lvert F \rvert$.
quadratic in	☐ $\lvert Q \rvert$.	☐ $\lvert F \rvert$.
linear in	☐ $\lvert Q \rvert$.	☐ $\lvert F \rvert$.
equal to	☐ $\lvert Q \rvert$.	☐ $\lvert F \rvert$.

3. The languages recognizable by a semi-deterministic Büchi automaton are closed under $\cup$.

   ☐ True ☐ False

4. The languages recognizable by a semi-deterministic Büchi automaton are closed under $\cap$.

   ☐ True ☐ False

5. Let $\mathcal{A}' = (\Sigma, Q', I', T', \text{BÜCHI}(F'))$ be a semi-deterministic automaton constructed from a Büchi automaton $\mathcal{A} = (\Sigma, Q, I, T, \text{BÜCHI}(F))$ as given in the lecture. Which of the following are true?

   ☐ $\exists \mathcal{A}.\ \mathcal{L}(\mathcal{A}) \subseteq \mathcal{L}(\mathcal{A}')$ ☐ $q \in Q$ is reachable $\Rightarrow$ $(\{q\}, \emptyset) \in Q'$ is reachable

   ☐ $\forall \mathcal{A}.\ \mathcal{L}(\mathcal{A}) \subseteq \mathcal{L}(\mathcal{A}')$ ☐ $(\{q\}, \emptyset) \in Q'$ is reachable $\Rightarrow$ $q \in Q$ is reachable

   ☐ $q \in F \ \Rightarrow\ \exists L_1, L_2, L'_1, L'_2 \subseteq Q, \sigma \in \Sigma.\ q \in L'_2 \ \wedge\ ((L_1, L_2), \sigma, (L'_1, L'_2)) \in T'$

6. A run of a parity automaton is accepting iff $\max\{c(q) \mid q \in \text{Inf}(\alpha)\}$ is even. The expressiveness of parity automata does not change iff we change

   ☐ $\max$ to $\min$. ☐ even to odd. ☐ $q \in \text{Inf}(\alpha)$ to $q \in Q$.

   ☐ $q \in \text{Inf}(\alpha)$ to $q \in Q \setminus \text{Inf}(\alpha)$.

7. Consider the construction of a deterministic Muller automaton $\mathcal{A}' = (\Sigma, Q', \{q_0\}, T', \text{MULLER}(\mathcal{F}))$ from a semi-deterministic Büchi automaton $\mathcal{A} = (\Sigma, Q, I, T, \text{BÜCHI}(F))$, as given in the lecture. Then $\mathcal{F} = \{F' \subseteq Q' \mid \exists i \in 1, ..., 2m \mid \dots$

   ☐ $\dots \forall (N', f) \in F'.\ f(i) \neq \text{␣}\}$ ☐ $\dots \exists (N', f) \in F'.\ f(i) \notin F\}$

   ☐ $\dots \forall (N', f) \in F'.\ f(i) = \text{␣}\}$ ☐ $\dots \exists (N', f) \in F'.\ f(i) \in F\}$

   ☐ $\dots \forall (N', f) \in F'.\ f(i) \neq \text{␣} \ \vee\ f(i) \notin F\}$

8. Consider the construction of a deterministic Muller automaton $\mathcal{A}' = (\Sigma, Q', \{q_0\}, T', \text{MULLER}(\mathcal{F}))$ from a semi-deterministic Büchi automaton $\mathcal{A} = (\Sigma, Q, I, T, \text{BÜCHI}(F))$, as given in the lecture. Do we conceptually need the additional "␣" element, as used in this construction, or is it just introduced to make the formulation of the construction simpler?

   ☐ Yes ☐ No