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Warm-up Questions 3
Discussions: May 13th, 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. The language of $bb^\omega + ((ab)^+ + (ba)^+ + (aa)^+)^\omega$ is recognizable by a deterministic Büchi automaton.

   ☐ True ☐ False

2. The complement of the language of $bb^\omega + ((ab)^+ + (ba)^+ + (aa)^+)^\omega$ is recognizable by a deterministic Büchi automaton.

   ☐ True ☐ False

3. For each $W \subseteq \Sigma^*$ there exist infinitely many different $W' \subseteq \Sigma^*$ s.t. $\overrightarrow{W} = \overrightarrow{W'}$.

   ☐ True ☐ False

4. For each Büchi-recognizable language $L \subseteq \Sigma^\omega$ there exists a language $W \subseteq \Sigma^*$ s.t. $L = \overrightarrow{W}$.

   ☐ True ☐ False

5. Let L be the set of Büchi-recognizable languages, A the set of languages which are not recognizable by a deterministic Büchi automaton, and B the set of languages whose complements are not recognizable by a deterministic Büchi automaton. Which of the following are true.

   ☐ $A \neq B$ ☐ $A \cap B \neq \emptyset$ ☐ $A \cup B \neq L$ ☐ $A \subseteq B$

6. If L is recognizable by an automaton over finite words, then L^ω is Büchi-recognizable.

   ☐ True ☐ False

7. Which of the following constructions preserve determinism, i.e., starting from a deterministic Büchi automaton (automaton over finite words), we obtain again a deterministic Büchi automaton after applying the construction?

   ☐ Constr. 3.1 ☐ Constr. 3.2 ☐ Constr. 3.3 ☐ Constr. 3.5

8. Which of the following languages are not recognizable by deterministic Büchi automata?

   ☐ $((ab^*a)^* + (ba^*b)^*)^\omega$ ☐ $(b + ab)^*(ab + b)^\omega$

   ☐ $((a^*b)^*(b^*a)^*)^\omega$ ☐ $(ab + aab)^*(ba)^\omega$

9. Let $\mathcal{A}$ and $\mathcal{A}'$ be automata over finite words over the common alphabet Σ such that $\mathcal{L}(\mathcal{A}) = \Sigma^* \setminus \mathcal{L}(\mathcal{A}')$. Which of the following are true?

   ☐ $\overrightarrow{\mathcal{L}(\mathcal{A})} = \Sigma^\omega \setminus \overrightarrow{\mathcal{L}(\mathcal{A}')}$ ☐ $\overrightarrow{\mathcal{L}(\mathcal{A})} \subseteq \Sigma^\omega \setminus \overrightarrow{\mathcal{L}(\mathcal{A}')}$ ☐ $\overrightarrow{\mathcal{L}(\mathcal{A})} \supseteq \Sigma^\omega \setminus \overrightarrow{\mathcal{L}(\mathcal{A}')}$

10. Is there a language $L \subseteq \Sigma^\omega$ such that both L and $\Sigma^\omega \setminus L$ are Büchi-recognizable languages, but neither is recognizable by a deterministic Büchi automaton?

    ☐ Yes ☐ No