RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

LEHRSTUHL FÜR INFORMATIK 2
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Introduction to Model Checking
Winter term 2011/2012

– Series 6 –

Hand in on November 30th before the exercise class.

Exercise 1 **(1 points)**

Find nondeterministic Büchi automata that accept the following ω regular languages:

a) $L_1 = \{\sigma \in \{A,B\}^\omega \mid \sigma \text{ contains } ABA \text{ infinitely often, but } AA \text{ only finitely often}\}$

Exercise 2 **(3 points)**

Provide NBA $\mathcal{A}_1$ and $\mathcal{A}_2$ for the languages given by the expressions $(AC+B)^*B^\omega$ and $(B^*AC)^\omega$ and apply the product construction (using GNBA) to obtain an NBA $\mathcal{A}$ with $\mathcal{L}_\omega(\mathcal{A}) = \mathcal{L}_\omega(\mathcal{A}_1) \cap \mathcal{L}_\omega(\mathcal{A}_2)$. Justify, why $\mathcal{L}_\omega(\mathcal{G}) = \emptyset$ where $\mathcal{G}$ denotes the GNBA accepting the intersection.

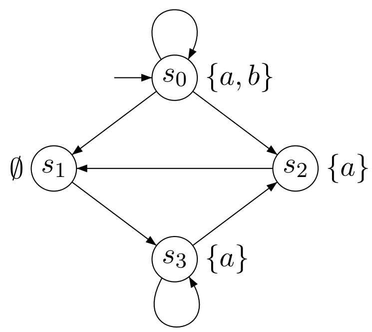
Exercise 3 **(2 points)**

Provide an example for a liveness property that is not ω-regular. Justify your answer.

Exercise 4 **(4 points)**

We consider model checking of the ω–regular properties P_1 and P_2 which are defined over the set $AP = \{a, b\}$ of atomic propositions:

P_1 := "if a holds infinitely often, then b holds infinitely often"
P_2 := "eventually a state is reached where a holds and in the next state a holds again"



Further, our model is represented by the transition system TS which is given on the right. We want to check whether $TS \models P_i$ for $i = 1, 2$ using the nested depth–first search algorithm from the lecture. Therefore proceed as follows:

a) Derive a NBA $\mathcal{A}_i$ for the complement $\overline{P}_i$ of P_i for $i = 1, 2$.
More precisely, for $\mathcal{A}_i$ it must hold $\mathcal{L}_\omega(\mathcal{A}_i) = \overline{P}_i$.
Hint: Four, respectively three states suffice. Derive the automata directly.

b) Outline the reachable fragment of the product transition system $TS \otimes \mathcal{A}_i$.

c) Check persistence (based on SCC analysis) on $TS \otimes \mathcal{A}_i$.

d) Decide if the property P_i is satisfied and provide a counterexample in case that $TS \not\models P_i$.