RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

LEHRSTUHL FÜR INFORMATIK 2
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Introduction to Model Checking
Winter term 2013/2014

– Series 8 –

Hand in on December 18th before the exercise class or in the box in front of the chair's secretary's office.

Exercise 1 (2 points)

Consider a lift system that services $N > 0$ floors numbered 0 through $N-1$. There is a lift door at each floor with a call-button and an indicator light that signals whether or not the lift has been called. In the lift cabin there are N send-buttons (one per floor) and N indicator lights that inform to which floor(s) is sent.

For simplicity consider $N = 4$. Present a set of atomic propositions – try to minimize the number of propositions – that are needed to describe the following properties of the lift system as LTL-formulas and give the corresponding LTL-formulas:

(a) The doors are "safe", i.e., a floor door is never open if the cabin is not present at a given floor.

(b) A requested floor will be served sometime.

(c) Again and again the lift returns to floor 0.

(d) When the top floor is requested, the lift serves it immediately and does not stop on the way there.

Exercise 2 (2 points)

Provide a non-deterministic Büchi Automaton $\mathcal{A}_i$ for each of the following LTL-formulas φ_i such that $\mathcal{L}_\omega(\mathcal{A}_i) = Words(\varphi_i)$:

(a) $\varphi_1 = \Box\left(a \vee \neg \bigcirc b\right)$

(b) $\varphi_2 = \Diamond a \vee \Box\Diamond(a \leftrightarrow b)$

(c) $\varphi_3 = \bigcirc\bigcirc\left(a \vee \Diamond\Box b\right)$

Hint: You can infer the NBA directly, i.e. without the algorithm given in the lecture.

Exercise 3 (2 points)

Let φ be an LTL-formula over a set of atomic propositions AP. Prove the following property:
For all elementary sets $B \subseteq closure(\varphi)$ and for all $B' \in \delta(B, B \cap AP)$, it holds:

$$\neg \bigcirc \psi \in B \iff \psi \notin B'.$$

Exercise 4 (4 points)

Consider the LTL-formula $\varphi = a \,\mathsf{U} \bigcirc a$ over the set of atomic propositions $AP = \{a\}$. Construct an equivalent GNBA $\mathcal{G}$ (i.e. $\mathcal{L}_\omega(\mathcal{G}) = Words(\varphi)$) according to the algorithm given in the lecture (slides from LTLMC 3.2-39 onwards).