RHEINISCH-
WESTFÄLISCHE
TECHNISCHE
HOCHSCHULE
AACHEN

LEHRSTUHL FÜR INFORMATIK 2
RWTH Aachen · D-52056 Aachen
http://www-i2.informatik.rwth-aachen.de/

Prof. Dr. Ir. J.-P. Katoen
Dr. T. Han and A. Mereacre

Introduction to Model Checking
Summer term 2010

– Series 5 –

Hand in on June 2 before the exercise class.

Exercise 1 (3 points)

Let $AP = \{a, b, c\}$. Consider the following linear time properties:

(a) If a becomes valid, afterwards b stays valid ad infinitum or until c holds.

(b) Between two neighbouring occurrences of a, b always holds.

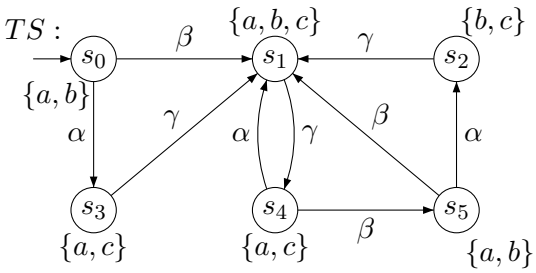
(c) Between two neighbouring occurrences of a, b occurs more often than c.

(d) $a \wedge \neg b$ and $b \wedge \neg a$ are valid in alternation or until c becomes valid.

For each property P_i $(1 \leq i \leq 4)$, decide if it is a regular safety property (argument why!) and if so, define the NFA $\mathcal{A}_i$ with $\mathcal{L}(\mathcal{A}_i) = BadPref(P_i)$.
Hint: You may use propositional formulas over the set AP as transition labels.

Exercise 2 (2 + 2 points)

Consider the following transition system TS



and the regular safety property

$$P_{safe} = \begin{array}{l}\text{“always if } a \text{ is valid and } b \wedge \neg c \text{ was valid somewhere before,} \\ \text{then } a \text{ and } b \text{ do not hold thereafter at least until } c \text{ holds”}\end{array}$$

As an example, it holds:

$$\begin{aligned} \{b\}\emptyset\{a,b\}\{a,b,c\} &\in pref(P_{safe}) \\ \{a,b\}\{a,b\}\emptyset\{b,c\} &\in pref(P_{safe}) \\ \{b\}\{a,c\}\{a\}\{a,b,c\} &\in BadPref(P_{safe}) \\ \{b\}\{a,c\}\{a,c\}\{a\} &\in BadPref(P_{safe}) \end{aligned}$$

Questions:

(a) Define an NFA $\mathcal{A}$ such that $\mathcal{L}(\mathcal{A}) = MinBadPref(P_{safe})$.

(b) Decide whether $TS \models P_{safe}$ using the $TS \otimes \mathcal{A}$ construction.
Provide a counterexample if $TS \not\models P_{safe}$.

Exercise 3 **(2 + 2 points)**

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

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

(b) $L_2 = \mathcal{L}\left((AB + C)^*((AA + B)C)^\omega + (A^*C)^\omega\right)$