RWTH RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

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

Prof. Dr. Ir. J.-P. Katoen
F. Gretz & F. Sher

Introduction to Model Checking
Winter term 2011/2012

– Series 11 –

Hand in on January 18th before the exercise class.

Exercise 1 (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 2 (4 points)

Express the following properties as CTL formulas over $AP = \{a, b, c\}$ and provide a justification. For more complicated formulas, also comment on their subformulas!

a) There exists a path on which for every state s it holds: there exists a path which starts in s and on which eventually a holds and in the next state, $\neg a$ holds.

b) There exists a state s for which it holds: a is true and on all paths starting from s, c holds as long as b does not hold.

c) On every path it holds for every state: a is valid iff (b is valid and in the previous state, c is valid). *Hint*: Note that this excludes the case where a is valid at the beginning.

Exercise 3 (2 points)

Provide two finite transition systems TS_1 and TS_2 (without terminal states, and over the same set of atomic propositions) and a CTL formula Φ such that $Traces(TS_1) = Traces(TS_2)$ and $TS_1 \models \Phi$, but $TS_2 \not\models \Phi$.

Exercise 4 (1 + 1 points)

Prove or disprove the following implications:

(a) Let $\Phi_1 = \forall\Diamond a \vee \forall\Diamond b$ and $\Phi_2 = \forall\Diamond(a \vee b)$.
Prove or disprove the following implications: $\Phi_1 \Longrightarrow \Phi_2$ and $\Phi_2 \Longrightarrow \Phi_1$.

(b) Now consider $\Psi_1 = \exists(a \mathsf{U} \exists(b \mathsf{U} c))$ and $\Psi_2 = \exists(\exists(a \mathsf{U} b) \mathsf{U} c)$.
Again, prove or disprove $\Psi_1 \Longrightarrow \Psi_2$ and $\Psi_2 \Longrightarrow \Psi_1$.