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

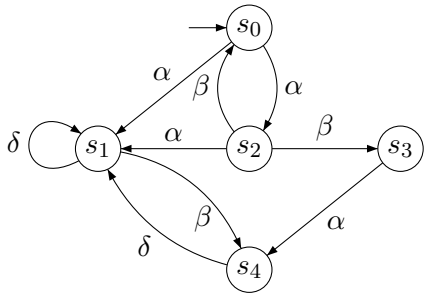
Introduction to Model Checking
Winter term 2011/2012

– Series 5 –

Hand in on November 23rd before the exercise class.

Exercise 1 (3 points)

Consider the transition system TS on the right (where atomic propositions are omitted). Decide which of the following fairness assumptions $\mathcal{F}_i$ are realizable for TS. Justify your answers!



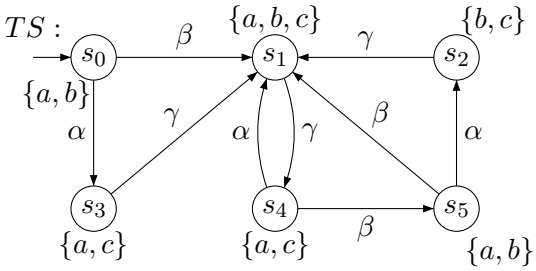
a) $\mathcal{F}_1 = (\{\{\alpha\}\}, \{\{\delta\}\}, \{\{\alpha, \beta\}\})$

b) $\mathcal{F}_2 = (\{\{\alpha, \delta\}\}, \{\{\alpha, \beta\}\}, \{\{\delta\}\})$

c) $\mathcal{F}_3 = (\{\{\alpha, \delta\}, \{\beta\}\}, \{\{\alpha, \beta\}\}, \{\{\delta\}\})$

Exercise 2 (3 points)

Consider the following transition system TS



and the regular safety property

$$P_{safe} = \text{“always if } a \text{ is valid and } b \wedge \neg c \text{ was valid somewhere before, then neither } a \text{ nor } b \text{ holds thereafter at least until } c \text{ holds”}$$

As an example, it holds:

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

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 **(4 points)**

Prove or disprove the following equivalences for ω-regular expressions:

a) $(E_1 + E_2).F^\omega \equiv E_1.F^\omega + E_2.F^\omega$

b) $E.(F_1 + F_2)^\omega \equiv E.F_1^\omega + E.F_2^\omega$

c) $E.(F.F^*)^\omega \equiv E.F^\omega$

d) $(E^*.F)^\omega \equiv E^*.F^\omega$

Here, E, E_1, E_2, F, F_1, F_2 denote regular expressions with $\varepsilon \notin \mathcal{L}(F) \cup \mathcal{L}(F_1) \cup \mathcal{L}(F_2)$.
Note: Two ω-regular expressions G_1 and G_2 are *equivalent*, denoted $G_1 \equiv G_2$, if $\mathcal{L}_\omega(G_1) = \mathcal{L}_\omega(G_2)$