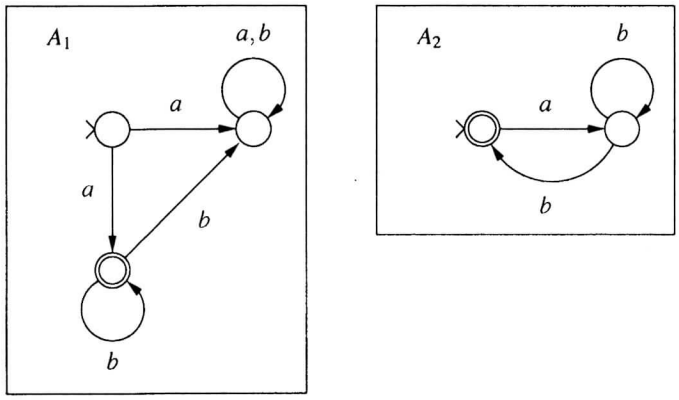
Aalto University, Department of Information and Computer Science KH

T-79.5306 Reactive Systems

Examination, May 31, 2012

Assignment 1 Consider the following two Büchi automata A_1 and A_2 both over the alphabet $\Sigma = \{a, b\}$. (4p)



a) Construct the Büchi product automaton $A_3 = A_1 \times A_2$.

b) Is it true that $\mathcal{L}(A_3) = \emptyset$? If not, give an accepting run of the automaton A_3.

Assignment 2 Give Büchi automata over the alphabet $\Sigma = 2^{AP}$ that accept the same language as the LTL formula: (7p)

a) $\mathbf{GF}a$, when $AP = \{a\}$

b) $a\,\mathbf{R}\,b$, when $AP = \{a, b\}$

c) $\mathbf{XXX}a$, when $AP = \{a\}$

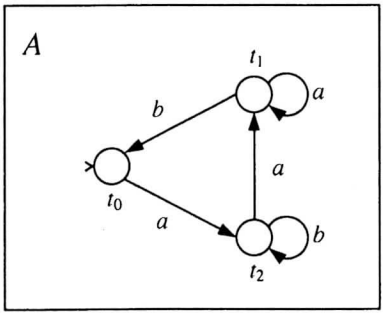
d) $\mathbf{G}(a \Rightarrow \mathbf{Y}b)$, when $AP = \{a, b\}$

e) $((\mathbf{GF}a) \Rightarrow (\mathbf{F}b))$, when $AP = \{a, b\}$

f) $(\mathbf{GF}a) \wedge (\mathbf{G}b)$, when $AP = \{a, b\}$

g) $(\mathbf{X}a) \wedge (a\,\mathbf{U}\,b)$, when $AP = \{a, b\}$

Assignment 3 Consider the following generalized Büchi automaton A with acceptance sets $\mathcal{F} = \{\{t_1, t_2\}, \{t_2\}\}$. Generate a (non-generalized) Büchi automaton A' accepting the same language. (4p)

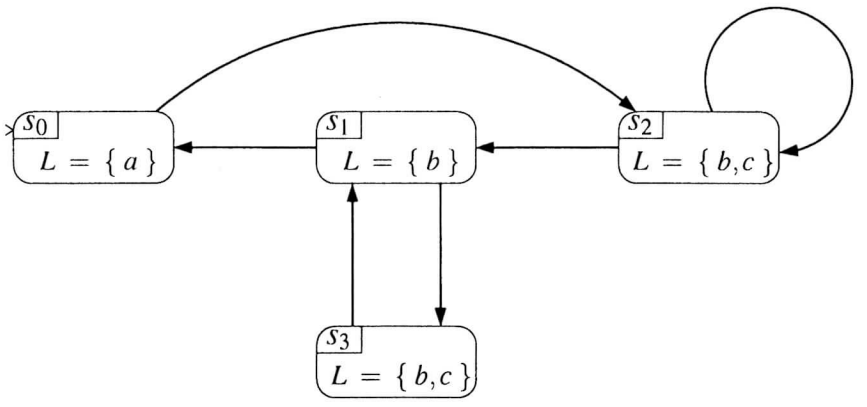


Note! More assignments on the other side of the paper.

The name of the course, the course code, the date, your name, your student id, and your signature must appear on every sheet of your answers.

Course feedback (deadline 1.6): Use the "Course feedback" link on the course Noppa main page.

Assignment 4 Consider the following Kripke structure M over $AP = \{a, b, c\}$. (8p)



Please indicate for each CTL* formula below those states of M where the formula holds.

a) $\mathbf{EF}a$

b) $\mathbf{EG}(b \vee c)$

c) $\mathbf{EG}((\mathbf{EX}c) \vee (\mathbf{AX}a))$

d) $\mathbf{AGF}c$

e) $\mathbf{EG}c$

f) $\mathbf{EF}b$

g) $\mathbf{A}(c\,\mathbf{U}\,a)$

h) $\mathbf{A}(\mathbf{GF}a \Rightarrow \mathbf{GF}c)$

Assignment 5 Define formally the following notions: (3p)

a) Streett Automaton

b) Safety Property

c) Bisimulation (for Kripke structures)

Assignment 6 Shortly (max 1/2 page) describe the the theory behind the ample set partial order reduction method. You description should contain the formal definitions of conditions C0-C3 imposed on the ample sets but you need not cover practical implementation issues regarding ample sets. Instead concentrate purely on the theoretical background of the method. (4p)

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