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LEHRSTUHL FÜR INFORMATIK 2
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Introduction to Model Checking
Summer term 2010

– Series 3 –

Hand in on May 12 before the exercise class.

Exercise 1 (6 points)

Consider the set AP of atomic propositions defined by $AP = \{x = 0, x > 1\}$ and consider a non-terminating sequential computer program P that manipulates the variable x over the domain $\mathbb{N}$. Formulate the following informally stated properties as LT properties:

- false and true
- initially x is equal to zero
- initially x differs from zero
- x exceeds one only finitely many times
- the value of x alternates between zero and one
- initially x is equal to zero, but at some point x exceeds one

Determine which of these LT properties are safety properties.

Exercise 2 (4 points)

Let P and P' be liveness properties over AP. Prove or disprove the following claims:

a) $P \cup P'$ is a liveness property and

b) $P \cap P'$ is a liveness property.

Answer the same question for safety properties.

Exercise 3 (3 points)

Let P denote the set of traces of the form $\sigma = A_0 A_1 A_2 \cdots \in \left(2^{AP}\right)^\omega$ such that

$$\exists^{\infty}\, k.\ A_k = \{a, b\} \quad \wedge \quad \exists n \geq 0.\ \forall k > n.\ \big(a \in A_k \Rightarrow b \in A_{k+1}\big).$$

Consider the following fairness assumptions with respect to the transition system TS outlined on the right:

a) $\mathcal{F}_1 = \big(\{\{\alpha\}\}, \{\{\beta\}, \{\delta, \gamma\}, \{\eta\}\}, \emptyset\big)$.
Decide whether $TS \models_{\mathcal{F}_1} P$.

b) $\mathcal{F}_2 = \Big(\{\{\alpha\}\}, \{\{\beta\}, \{\gamma\}\}, \{\{\eta\}\}\Big)$.
Decide whether $TS \models_{\mathcal{F}_2} P$.

Justify your answers!