SS 2014 27.05.2014

Exercises to the lecture
Concurrency Theory
Sheet 6

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Exercise 6.1

Perfect channel systems are defined like lossy channel systems but with only the first two rules for the transition relation:

$$(q_1, W) \to (q_2, W[c = W(c).m]) \qquad \text{if } q_1 \xrightarrow{c!m} q_2$$

$$(q_1, W[c = m.W(c)]) \to (q_2, W) \qquad \text{if } q_1 \xrightarrow{c?m} q_2$$

Explain how to simulate a Turing machine with a perfect channel system.

Exercise 6.2

Consider two lossy channel systems $L_i = (Q_i, q_{0i}, C, M, \to_i)$ for $i \in \{1, 2\}$.

a) Explain how to construct a lossy channel system $L_1 \| L_2$ that represents L_1 and L_2 running concurrently.

b) Assume that you additionally have a visible alphabet Σ. Thus, transitions are additionally labelled with letters $a \in \Sigma$:

$$\to \subseteq (Q \times (M^*)^{|C|}) \times \Sigma \times (Q \times (M^*)^{|C|}) \ .$$

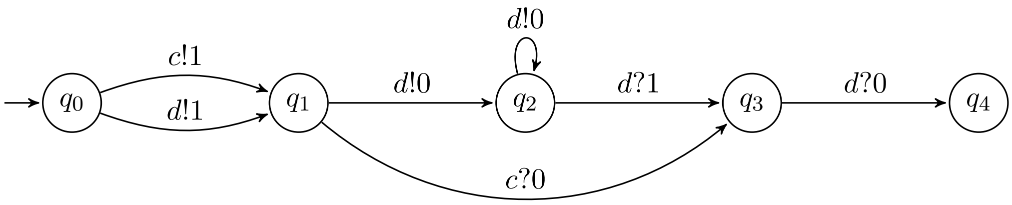
Furthermore, there is a subset $F \subseteq Q$ of final states. The *language* of such a lossy channel system L is defined by

$$a_1 \dots a_n \in \mathcal{L}(L) \quad \text{if and only if} \quad (q_0, \varepsilon) \xrightarrow{a_1} \dots \xrightarrow{a_n} (q_n, W_n) \text{ and } q_n \in F.$$

Given two lossy channel systems L_1 and L_2, explain how to construct a product system $L_1 \times L_2$ so that $\mathcal{L}(L_1 \times L_2) = \mathcal{L}(L_1) \cap \mathcal{L}(L_2)$.

Exercise 6.3

Consider the following lossy channel system:



Use Abdulla's backward search to check whether the configuration $\left(q_4, \binom{0}{\varepsilon}\right)$ is coverable.

Exercise 6.4

Consider a lossy channel system $L = (Q, q_0, C, M, \rightarrow)$. Extend the messages by a set S of *strong* messages that cannot be forgotten.

a) Define a transition relation $\rightarrow'$ for lossy channel systems with strong messages that corresponds to $\rightarrow$ for $S = \emptyset$.

b) Assume that there is a bound $k \in \mathbb{N}$ so that the number of strong messages in each channel is bounded by k. Prove that the new system $L' = (Q, q_0, C, M \cup S, \rightarrow')$ is still a well-structured transition system.

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