Concurrency theory
Exercise sheet 4

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Out: November 15 Due: November 21

Submit your solutions until Wednesday, November 21, 12:00 am. You may submit in groups up to three persons.

Exercise 1: Loop acceleration

Let $\preceq^*_{swap}$ and $\preceq^*_m$ the word orderings for SREs given in class for proving the lemma:

> Let p be a product and ops a sequence of operations. There is a natural number n (linear in the size of p) and a product p' such that either $\mathcal{L}(p \oplus ops^n) = \emptyset$ or $\mathcal{L}(p') = \bigcup_{j \geq n} \mathcal{L}(p \oplus ops^j)$.

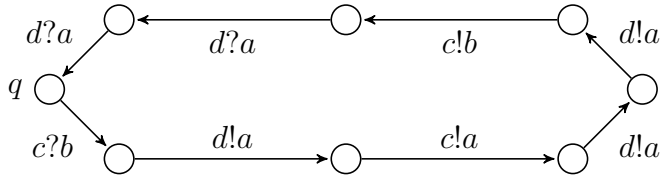
Find n and p' when $p = (a+b)^*(c+\epsilon)b^*$ and ops is each of:

$$?a\,!b\,?c$$
$$!a\,!b\,?c\,?a$$
$$!a\,?c\,!b\,?a\,!c$$
$$?c\,!c\,!a\,?a\,!b\,!c\,!a$$

Don't forget to specify to which of the four cases discussed in class each sequence belongs and argue the correctness of your findings.

Exercise 2: Coverability of loop

Consider the following control loop in a lossy channel system:



Set up the sequences of channel operations ops_c and ops_d and determine

$$\left(q, \begin{pmatrix} ((b+\varepsilon).(a+b)^*) \oplus ops_c^* \\ b^* \oplus ops_d^* \end{pmatrix}\right).$$

State and justify the case (1)-(4) that applies for the acceleration of ops_c and ops_d, respectively. Give numbers n after which the effect of ops_c and ops_d stabilises.

Exercise 3: Undecidability

Prove that the recurrent state reachability problem for LCS is undecidable even with a single channel.