2011 Paper 8 Question 13

Topics in Concurrency

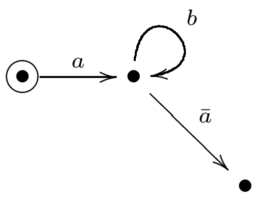
(*a*) Draw the transition systems of the following two pure CCS terms:

$$P_1 \stackrel{\text{def}}{=} (a.(b+c) \parallel \bar{b}) \setminus \{b\} \qquad\qquad P_2 \stackrel{\text{def}}{=} a.(c+\tau)$$

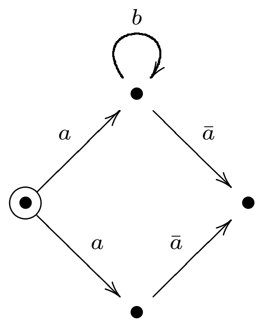
[3 marks]

(*b*) Write down pure CCS terms for the following two transition systems:

P_3 :



P_4 :



[3 marks]

(*c*) Carefully justify your answers to the following two questions either by exhibiting a bisimulation or by providing a Hennessy–Milner logic formula satisfied by one process and not by the other:

(*i*) Are P_1 and P_2 bisimilar? [3 marks]

(*ii*) Are P_3 and P_4 bisimilar? [3 marks]

(*d*) A *trace* of a process p_0 is a finite sequence of action labels

$$\pi = (\lambda_1, \ldots, \lambda_k)$$

for which, if π is nonempty, there exist $p_1, \ldots, p_k$ such that $p_{i-1} \xrightarrow{\lambda_i} p_i$ for all $0 < i \leq k$. Two processes p and p' are said to be *trace-equivalent* if, for all sequences of action labels π,

$$\pi \text{ is a trace of } p \text{ if, and only if, } \pi \text{ is a trace of } p'$$

(*i*) Are trace-equivalent processes always bisimilar?

(*ii*) Are bisimilar processes always trace-equivalent?

In each case, provide either a proof or a counterexample. [8 marks]