1994 Paper 8 Question 14

Concurrency

What is meant by a *strong bisimulation* on CCS agents? How are strong bisimulations used to show that two agents are strongly equivalent? [5 marks]

Suppose that $M = (Q, \Sigma, \Delta, i, F)$ is a finite non-deterministic automaton with set of states Q, input alphabet Σ, transition relation $\Delta \subseteq Q \times \Sigma \times Q$, initial state i, and set of accepting states F. Show how to define CCS agents A_q (for each state $q \in Q$) and *Stop* with the properties

$$\begin{array}{rll} A_{q_1} \xrightarrow{a} A_{q_2} & \text{if and only if} & (q_1, a, q_2) \in \Delta \\ A_q \xrightarrow{\tau} B & \text{if and only if} & B = \mathit{Stop} \text{ and } q \in F \end{array}$$

for all $q_1, q_2, q \in Q$, all $a \in \Sigma$, and all agents B. [5 marks]

Suppose that $M' = (Q', \Sigma, \Delta', i', F')$ is another finite non-deterministic automaton (over the same input alphabet) and corresponding CCS agents $A'_{q'}$ ($q' \in Q'$) and Stop' are defined for M' as above. Show that the languages accepted by M and M' are equal if A_i and $A_{i'}$ are strongly equivalent CCS agents. [6 marks]

Is the converse true? [4 marks]