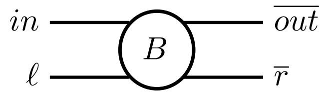
1999 Paper 8 Question 15

Communicating Automata and Pi Calculus

Explain the notions of *abstraction* and *concretion* in the π-calculus. Explain the components of a *commitment* $P \xrightarrow{\alpha} A$, and say what it means for each form which α may take. (You need not give the rules of commitment.) Define *strong bisimulation* in terms of commitments. [5 marks]

Consider each pair of the three processes $(\mathsf{new}\, x)\overline{x}\langle y\rangle$, $(\mathsf{new}\, x)\overline{y}\langle x\rangle$, and $\mathsf{0}$. Are they structurally congruent ($\equiv$)? Are they strongly equivalent ($\sim$)? Briefly justify each of your six answers. [4 marks]

The following equations define the behaviour of a buffer cell which has the ability to cut itself out of a chain of similar cells:



$$B(in, out, \ell, r) \stackrel{\text{def}}{=} in(x).C\langle x, in, out, \ell, r\rangle + \overline{r}\langle in, \ell\rangle.\mathsf{0}$$

$$C(x, in, out, \ell, r) \stackrel{\text{def}}{=} \overline{out}\langle x\rangle.B\langle in, out, \ell, r\rangle + \ell(in', \ell').C\langle x, in', out, \ell', r\rangle$$

Let $P = \mathsf{new}\, mid\, m\, (B\langle in, mid, \ell, m\rangle \mid C\langle x, mid, out, m, r\rangle)$. Express P as a summation up to $\sim$, i.e. $P \sim \Sigma\alpha_i A_i$. Use structural congruence to make the expression as simple as possible. Justify your expression. [6 marks]

Now suppose that the name *out* is replaced by *in* in the definition of P. What effect does this have upon the behaviour of P? Briefly justify your answer in terms of commitments. [5 marks]