**T-79.231** **Autumn 2002**

**Parallel and Distributed Digital Systems**

**Process Algebra**

**Answers to tutorial 9**

**Nov 18th 2002**

1. We define the protocol in four parts: sender, receiver, data-channel and acknowledgement channel.

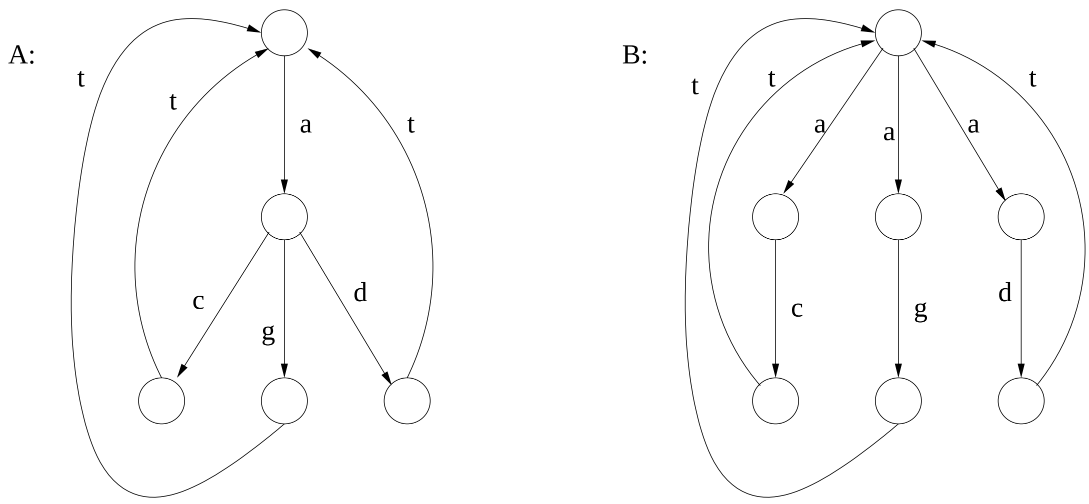
$$\mathrm{S} \;:=\; \mathrm{send}.\overline{\mathrm{sdata}}.\mathrm{rack}.\mathrm{S}$$

$$\mathrm{R} \;:=\; \mathrm{rdata}.\mathrm{rec}.\overline{\mathrm{sack}}.\mathrm{S}$$

$$\mathrm{D} \;:=\; \mathrm{sdata}.(\overline{\mathrm{rdata}}.\mathrm{D} + \mathrm{ldata}.\mathrm{D})$$

$$\mathrm{A} \;:=\; \mathrm{sack}.(\overline{\mathrm{rack}}.\mathrm{A} + \mathrm{lack}.\mathrm{A})$$

2. The transition diagrams of the agents:




The traces of agent $A$ are $\{a, ac, ag, ad, aca, aga, ada, \ldots\}$. The traces of agent $B$ are $\{a, ac, ag, ad, aca, aga, ada, \ldots\}$. As both agents return to their initial state after two actions, we can deduce that the agents are trace equivalent.

The set of failures for agent $A$, $\mathit{Fail}(A)$ is

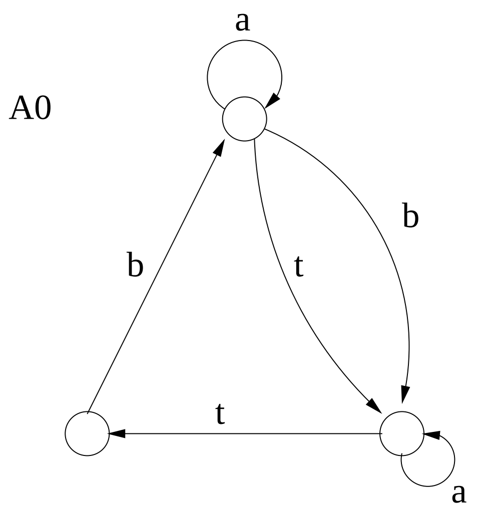
$$\{\langle\emptyset,\{c,g,d\}\rangle,\langle a,\{a\}\rangle,\langle ac,\{g,d\}\rangle,\langle ag,\{c,d\}\rangle,\langle ad,\{g,d\}\rangle\}$$

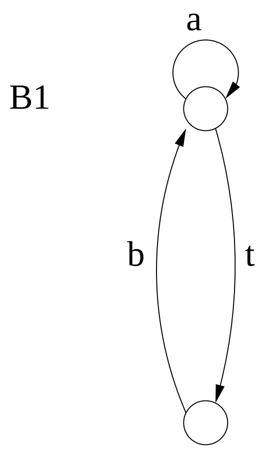
The set of failures for agent $B$, $\mathit{Fail}(B)$ is

$$\{\langle\emptyset,\{c,g,d\}\rangle,\langle a,\{a,g,d\}\rangle,\langle a,\{a,c,d\}\rangle,\langle a,\{a,c,g\}\rangle,\langle ac,\{g,d\}\rangle,\langle ag,\{c,d\}\rangle,\langle ad,\{g,d\}\rangle\}$$

Because $\mathit{Fail}(A) \neq \mathit{Fail}(B)$, the agents are not failure equivalent

3. The transition diagrams of the agents:




The set of traces of agent $A_0$ is $\{a,b,aa,ab,ba,bb,\ldots\}$. The set of traces of agent $B_1$ is $\{a,b,aa,ab,ba,bb,\ldots\}$.

The sets are the same. Therefore the agents are trace equivalent.

Neither of the agents have any failures. Therefore the agents are also failure equivalent.