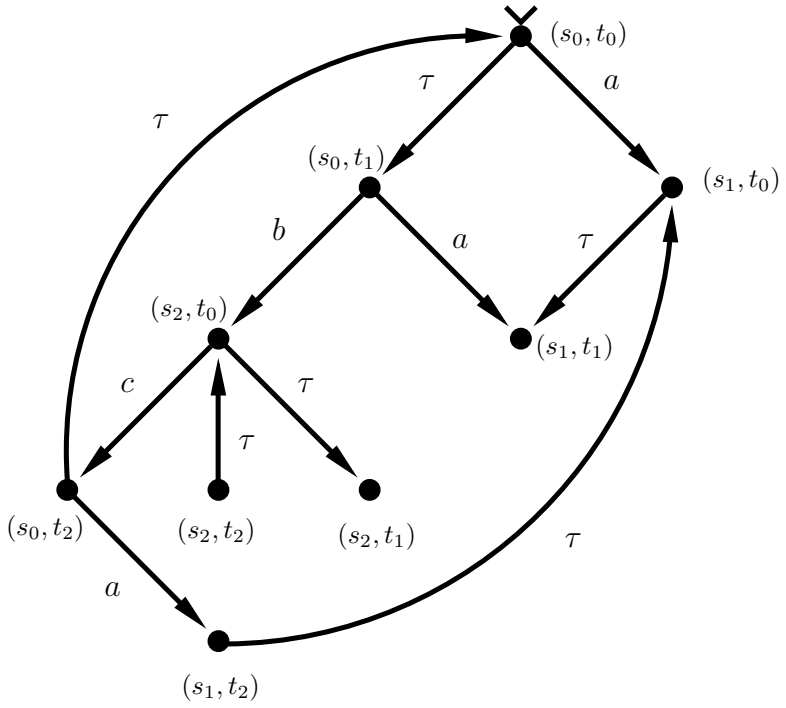
**T–79.4301** **Spring 2006**
**Parallel and Distributed Systems**
**Tutorial 5 – Solutions**

1. a) $L_1 \,||\, L_2 = (\Sigma_{12}, S_{12}, S^0_{12}, \Delta_{12})$, where

$$\begin{aligned}
\Sigma_{12} &= \Sigma_1 \cup \Sigma_2 = \{a, b, c\}, \\
S_{12} &= S_1 \times S_2 = \big\{(s_0, t_0), (s_0, t_1), \ldots, (s_2, t_2)\big\}, \\
S^0_{12} &= S^0_1 \times S^0_2 = \big\{(s_0, t_0)\big\},
\end{aligned}$$

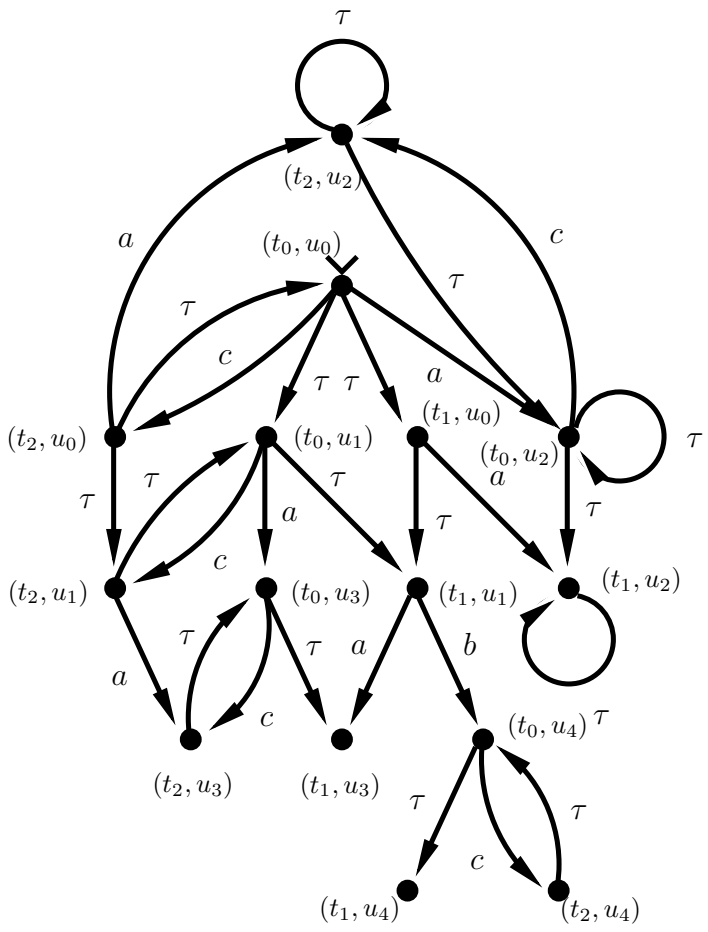
and the transition relation $\Delta_{12}$ is defined as shown in the figure below.



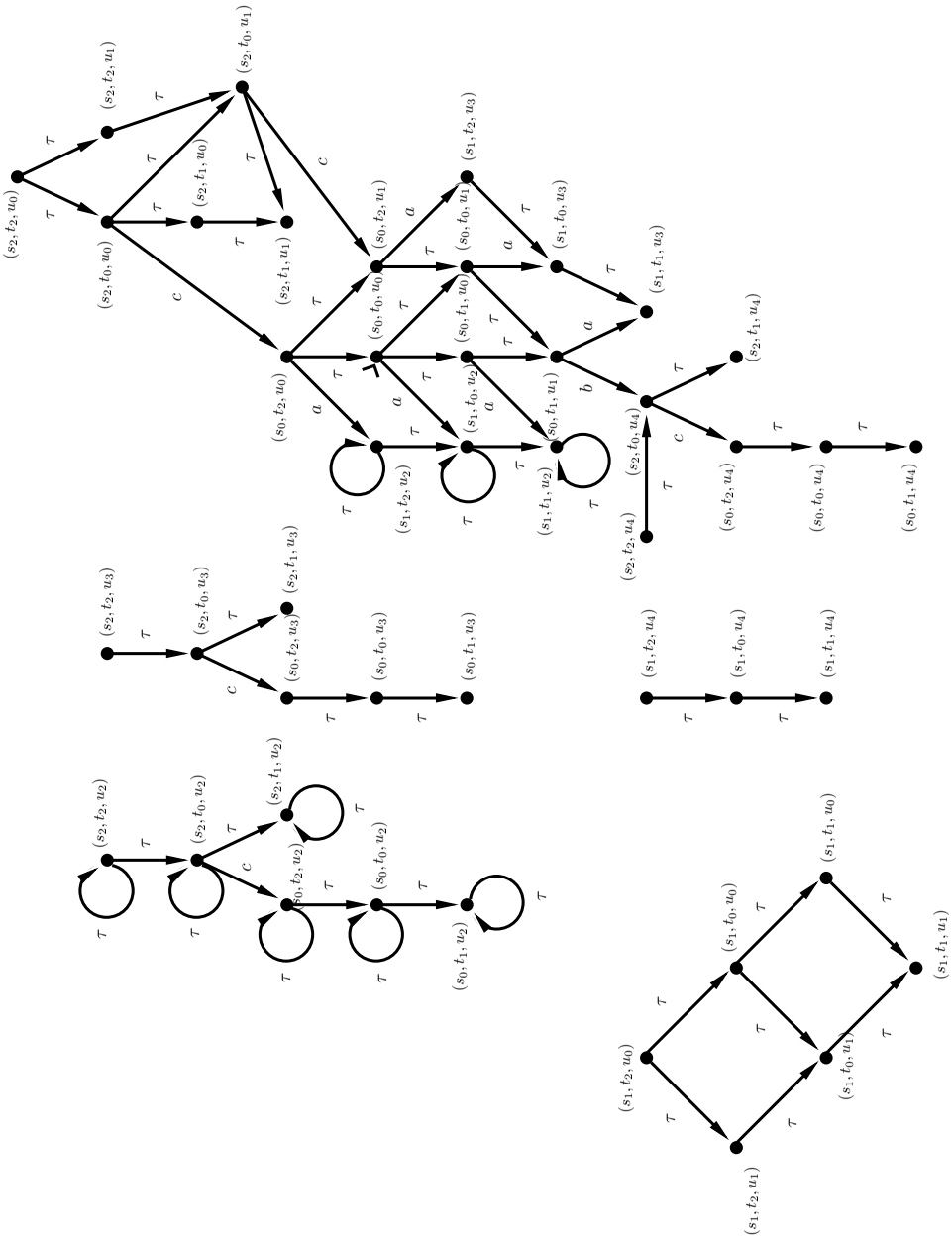
b) $L_2 \,||\, L_3 = (\Sigma_{23}, S_{23}, S^0_{23}, \Delta_{23})$, where

$$\begin{aligned}
\Sigma_{23} &= \Sigma_2 \cup \Sigma_3 = \{a, b, c\}, \\
S_{23} &= S_2 \times S_3 = \big\{(t_0, u_0), (t_0, u_1), \ldots, (t_2, u_4)\big\}, \\
S^0_{23} &= S^0_2 \times S^0_3 = \big\{(t_0, u_0)\big\}, \text{ and}
\end{aligned}$$

$\Delta_{23}$:



c) $L_1 \,||\, L_2 \,||\, L_3 = (\Sigma_{123}, S_{123}, S^0_{123}, \Delta_{123})$, where

$$\begin{aligned}
\Sigma_{123} &= \Sigma_1 \cup \Sigma_2 \cup \Sigma_3 = \{a, b, c\}, \\
S_{123} &= S_1 \times S_2 \times S_3 = \big\{(s_0, t_0, u_0), (s_0, t_0, u_1), \ldots, (s_2, t_2, u_4)\big\}, \\
S^0_{123} &= S^0_1 \times S^0_2 \times S^0_3 = \big\{(s_0, t_0, u_0)\big\}, \text{ and}
\end{aligned}$$

$\Delta_{123}$: