

Process Algebra (2IMF10)

Bas Luttik

s.p.luttik@tue.nl

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Solution to Exercise 8.6.1

$$\begin{aligned}
 & \tau.a.b.1 \parallel \tau.(\tau.a.1 + \tau.b.1) \\
 & \stackrel{M}{=} \tau.a.b.1 \parallel \tau.(\tau.a.1 + \tau.b.1) + \tau.(\tau.a.1 + \tau.b.1) \parallel \tau.a.b.1 + \tau.a.b.1 \mid \tau.(\tau.a.1 + \tau.b.1) \\
 & \stackrel{SC9, SC10, A6}{=} \tau.a.b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.(\tau.a.1 + \tau.b.1) \parallel a.b.1 \\
 & \stackrel{LM3}{=} \tau.(a.b.1 \parallel (\tau.a.1 + \tau.b.1)) + \tau.((\tau.a.1 + \tau.b.1) \parallel a.b.1) \\
 & \stackrel{M}{=} \tau.(a.b.1 \parallel (\tau.a.1 + \tau.b.1) + (\tau.a.1 + \tau.b.1) \parallel a.b.1 + a.b.1 \mid (\tau.a.1 + \tau.b.1)) \\
 & \quad + \tau.((\tau.a.1 + \tau.b.1) \parallel a.b.1 + a.b.1 \parallel (\tau.a.1 + \tau.b.1) + (\tau.a.1 + \tau.b.1) \mid a.b.1) \\
 & \stackrel{LM4, SC1, CM2}{=} \tau.(a.b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \parallel a.b.1 + \tau.b.1 \parallel a.b.1 + a.b.1 \mid \tau.a.1 + a.b.1 \mid \tau.b.1) \\
 & \quad + \tau.(\tau.a.1 \parallel a.b.1 + \tau.b.1 \parallel a.b.1 + a.b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \mid a.b.1 + \tau.b.1 \mid a.b.1) \\
 & \stackrel{SC1, SC10, A6}{=} \tau.(a.b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \parallel a.b.1 + \tau.b.1 \parallel a.b.1) \\
 & \quad + \tau.(\tau.a.1 \parallel a.b.1 + \tau.b.1 \parallel a.b.1 + a.b.1 \parallel (\tau.a.1 + \tau.b.1)) \\
 & \stackrel{LM3}{=} \tau.(a.(b.1 \parallel (\tau.a.1 + \tau.b.1)) + \tau.(a.1 \parallel a.b.1) + \tau.(b.1 \parallel a.b.1)) \\
 & \quad + \tau.(\tau.(a.1 \parallel a.b.1) + \tau.(b.1 \parallel a.b.1) + a.(b.1 \parallel (\tau.a.1 + \tau.b.1))) \\
 & \stackrel{M}{=} \tau.(a.(b.1 \parallel (\tau.a.1 + \tau.b.1) + (\tau.a.1 + \tau.b.1) \parallel b.1 + b.1 \mid (\tau.a.1 + \tau.b.1)) \\
 & \quad + \tau.(a.1 \parallel a.b.1 + a.b.1 \parallel a.1 + a.1 \mid a.b.1) \\
 & \quad + \tau.(b.1 \parallel a.b.1 + a.b.1 \parallel b.1 + b.1 \mid a.b.1)) \\
 & \quad + \tau.(\tau.(a.1 \parallel a.b.1 + a.b.1 \parallel a.1 + a.1 \mid a.b.1) \\
 & \quad + \tau.(b.1 \parallel a.b.1 + a.b.1 \parallel b.1 + b.1 \mid a.b.1) \\
 & \quad + a.(b.1 \parallel (\tau.a.1 + \tau.b.1) + (\tau.a.1 + \tau.b.1) \parallel b.1 + b.1 \mid (\tau.a.1 + \tau.b.1))) \\
 & \stackrel{LM4, SC1, CM2}{=} \tau.(a.(b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \parallel b.1 + \tau.b.1 \parallel b.1 + b.1 \mid \tau.a.1 + b.1 \mid \tau.b.1) \\
 & \quad + \tau.(a.1 \parallel a.b.1 + a.b.1 \parallel a.1 + a.1 \mid a.b.1) \\
 & \quad + \tau.(b.1 \parallel a.b.1 + a.b.1 \parallel b.1 + b.1 \mid a.b.1)) \\
 & \quad + \tau.(\tau.(a.1 \parallel a.b.1 + a.b.1 \parallel a.1 + a.1 \mid a.b.1) \\
 & \quad + \tau.(b.1 \parallel a.b.1 + a.b.1 \parallel b.1 + b.1 \mid a.b.1) \\
 & \quad + a.(b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \parallel b.1 + \tau.b.1 \parallel b.1 + b.1 \mid \tau.a.1 + b.1 \mid \tau.b.1)) \\
 & \stackrel{SC1, SC10, A6}{=} \tau.(a.(b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \parallel b.1 + \tau.b.1 \parallel b.1) \\
 & \quad + \tau.(a.1 \parallel a.b.1 + a.b.1 \parallel a.1 + a.1 \mid a.b.1) \\
 & \quad + \tau.(b.1 \parallel a.b.1 + a.b.1 \parallel b.1 + b.1 \mid a.b.1))
 \end{aligned}$$

$$\begin{aligned}
& + \tau.(\tau.(a.1 \parallel a.b.1 + a.b.1 \parallel a.1 + a.1 \mid a.b.1) \\
& \quad + \tau.(b.1 \parallel a.b.1 + a.b.1 \parallel b.1 + b.1 \mid a.b.1) \\
& \quad + a.(b.1 \parallel (\tau.a.1 + \tau.b.1) + \tau.a.1 \parallel b.1 + \tau.b.1 \parallel b.1)) \\
LM3, CM5, CM6, A6 \quad & \tau.(a.(b.(1 \parallel (\tau.a.1 + \tau.b.1)) + \tau.(a.1 \parallel b.1) + \tau.(b.1 \parallel b.1)) \\
& \quad + \tau.(a.(1 \parallel a.b.1) + a.(b.1 \parallel a.1)) \\
& \quad + \tau.(b.(1 \parallel a.b.1) + a.(b.1 \parallel b.1) + b.(1 \parallel a.b.1))) \\
& + \tau.(\tau.(a.(1 \parallel a.b.1) + a.(b.1 \parallel a.1)) \\
& \quad + \tau.(b.(1 \parallel a.b.1) + a.(b.1 \parallel b.1) + c.(1 \parallel a.b.1)) \\
& \quad + a.(b.(1 \parallel (\tau.a.1 + \tau.b.1)) + \tau.(a.1 \parallel b.1) + \tau.(b.1 \parallel b.1))) \\
M, A1, A2, SC2 \quad & \tau.(a.(b.(\tau.a.1 + \tau.b.1) + \tau.(a.1 \parallel b.1) + \tau.(b.1 \parallel b.1)) \\
& \quad + \tau.(a.a.b.1 + a.(b.1 \parallel a.1)) \\
& \quad + \tau.(b.a.b.1 + a.(b.1 \parallel b.1) + c.a.b.1)) \\
& + \tau.(\tau.(a.a.b.1 + a.(b.1 \parallel a.1)) \\
& \quad + \tau.(b.a.b.1 + a.(b.1 \parallel b.1) + b.a.b.1) \\
& \quad + a.(b.(\tau.a.1 + \tau.b.1) + \tau.(a.1 \parallel b.1) + \tau.(b.1 \parallel b.1))) \\
M, LM3, CM5, CM6 \quad & \tau.(a.(b.(\tau.a.1 + \tau.b.1) + \tau.(a.b.1 + b.a.1 + c.1) + \tau.b.b.1) \\
A1, A2, SC2 \quad & \quad + \tau.(a.a.b.1 + a.(b.a.1 + a.b.1 + c.1)) \\
& \quad + \tau.(b.a.b.1 + a.b.b.1 + c.a.b.1)) \\
& + \tau.(\tau.(a.a.b.1 + a.(b.a.1 + a.b.1 + c.1)) \\
& \quad + \tau.(b.a.b.1 + a.(b.b.1) + b.a.b.1) \\
& \quad + a.(b.(\tau.a.1 + \tau.b.1) + \tau.(a.b.1 + b.a.1 + c.1) + \tau.b.b.1))
\end{aligned}$$