Cyber-Physical Programming
TPC-1

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Exercise 1. Consider the CCS processes $c.(a.\mathtt{0} \parallel b.\mathtt{0})$ and $\mathtt{rec}\ X.\ (a.X + a.b.X)$.

Part 1.1. Informally describe what they do.

Part 1.2. Present their transition systems using the semantic rules provided in the lectures.

Exercise 2. Consider the following scenario. There exist four processes $P_1, \ldots, P_4$, each of them responsible for performing a certain task repetitively. For example P_1 might read the current velocity, P_2 the current altitude, P_3 current radiation levels, etc... These processes (re)start their tasks in increasing order (P_1 then P_2 etc ...) but can finish in any order. Note as well that process P_1 can restart its task only when all processes $P_1, \ldots, P_4$ finish their current tasks. Let us thus consider the process $P = (I \parallel S \parallel P_1 \parallel \cdots \parallel P_4)\backslash\{st_1, \ldots, st_4, end\}$ where,

$$
\begin{aligned}
I &= \overline{st_1} \ldots \overline{st_4}.\mathtt{0} \\
S &= \mathtt{rec}\ X.\ end.end.end.end.\overline{st_1} \ldots \overline{st_4}.X \\
P_i &= \mathtt{rec}\ Y_i.\ st_i.a_i.b_i.\overline{end}.Y_i \qquad\qquad (1 \leq i \leq 4)
\end{aligned}
$$

Part 2.1. Explain why process P corresponds (or not) to the description above.

Part 2.2. Process S acts a *central scheduler* that coordinates the processes $P_1, \ldots, P_4$. Rewrite P so that it does not rely on a central scheduler and explain the reasoning behind your refactoring.

Part 2.3 (***). Use the tool mCRL2 to further explore this scenario, *formally* discussing properties that the system already has as well as limitations and possible improvements.

What to submit: A report in `PDF` with the solutions of the exercises. Please send it by email (`nevrenato@di.uminho.pt`) with the name "`cpp-N.pdf`", where "`N`" is your student number. The subject of the email should be "`cpp-N-TPC-1`".