# Psi-Calculi Workbench Exercises: Implementing Instances

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Formalise and implement the following instances of increasing complexity in Psi-Calculi Workbench (Pwb). These exercises will help you understand the Pwb's architecture and determine the size of the project; they are not part of examination.

You can get Pwb from the following website

`http://www.it.uu.se/research/group/mobility/applied/psiworkbench`

Pwb runs on UNIX like systems. On Windows, you can use Cygwin.

To get started, you could try modifying the FHSS instance found in Pwb's source `psi-instances/fhss.ML` into the following.

1. Define and implement an instance using the following description. Implement the following data structure

$$\begin{array}{rcl} L & ::= & \mathsf{cons}(L, L) \\ & | & \mathsf{Nil} \\ & | & x \in \mathcal{N} \end{array}$$

where $\mathcal{N}$ is a set of names. This data structure also serves as a channel. Channels are equivalent if they are structurally the same. Use the usual substitution.

In addition to the channel equivalence $\leftrightarrow$, define the following condition

$$C \quad ::= \quad L = L$$

which denotes structural equality, that is, $\mathsf{cons}(x, y) = \mathsf{cons}(z, w)$ if $x = z$ and $y = w$. You could possibly reuse this condition as the channel equivalence.

There is only the unit assertion.

Formalise and implement the transition constraint solver for this instance. Hint: Use unification.

2. Extend and implement the previous instance with the following condition.

$$C' \quad ::= \quad L \neq L$$

3. Extend and implement the previous instane with the following data structure:

$$\begin{array}{rcl} L' & ::= & L \\ & | & \mathsf{car}(L') \\ & | & \mathsf{cdr}(L') \end{array}$$

and the following conditions

$$C'' \quad ::= \quad L' = L'$$

where equality is also modulo the following equations

$$\begin{array}{rcl} \mathsf{car}(\mathsf{cons}(x,y)) & = & x \\ \mathsf{cdr}(\mathsf{cons}(x,y)) & = & y \end{array}$$

Hint: generate equations while unifying.

4. Extend and implement the previous instane with the following. Take $\mathbf{A} = \mathcal{P}_{\mathrm{fin}}(\mathbb{N})$, assertion composition to be the set union. Add a new condition for each natural number $n$, $\mathsf{time}(n)$. It is entailed whenever there is $i$ in the current assertion $\Psi$ such that $n \leq i$.

For example, the following process after two $\tau$ transitions outputs the list $\mathsf{cons}(t_1, \mathsf{cons}(t_2, \mathsf{Nil}))$ via the channel $c$.

$$\mathbf{case}\ \mathsf{time}(2) : c\langle \mathsf{cons}(t_1, \mathsf{cons}(t_2, \mathsf{Nil}))\rangle.\mathbf{0} \quad | \quad \tau.((\!|\{1\}|\!) \,|\, \tau.(\!|\{2\}|\!))$$