Exercises PV 09/10

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CSP and Refinement Checking

1. Let's write the $M_{<2}$ protocol in CSP. Express the sender and the receiver as separate processes (because it seems convenient to do so). Take into account that you somehow has to express:

   (a) the fetching of a new data package by the sender.

   (b) the acceptance of a package by the receiver.

   (c) corrupted package.

2. Give a CSP process R which is equivalent with $P||Q$, where:

$$\begin{array}{lcl} P & = & x \to ((a \to P) \;\Box\; (b \to P)) \\ Q & = & y \to a \to Q \end{array}$$

   with $\alpha P = \{x, a, b\}$ and $\alpha Q = \{y, a, b\}$. That is we want to have an expression directly in terms of the underlying subprocesses, that equivalently describes $P||Q$.

3. Consider these processes:

$$P \quad = \quad (a \to STOP) \;\;\Box\;\; (a \to ((b \to P) \;\sqcap\; (a \to STOP)))$$

$$Q \quad = \quad (a \to b \to Q) \;\sqcap\; (a \to a \to STOP)$$

   We want to check whether $P \sqsubseteq Q$ (or the other way around) under the trace semantic. How does the refinement checking procedure proceed?

   Redo the question above to check $P \sqsubseteq R$ and $R \sqsubseteq P$ (in trace semantic), where P is as above, and R is defined as below:

$$R \;=\; a \to (b \to (b \to R))$$

4. Prove the following under the trace semantic:

   (a) $P \;\Box\; STOP \;\; = \;\; P$

   (b) $P \;\sqcap\; STOP \;\; = \;\; P$

   Do they still hold under the failure semantic?

5. What is a 'failure' in CSP?

   Describe the failure sets of the following processes. Assume $\{a, b\}$ as the alphabet.

(a) $(b \rightarrow STOP) \, \Box \, STOP$

(b) $(b \rightarrow STOP) \, \sqcap \, STOP$

(c) $P \; = \; a \rightarrow ((b \rightarrow P) \, \Box \, STOP)$

(d) $Q \; = \; a \rightarrow ((b \rightarrow Q) \, \sqcap \, STOP)$

So, does P refines Q under the failures semantic? (or perhaps the other way around, or perhaps neither?)

6. Redo exercise No. 3, but now using the failures semantic. That is, refinement is now defined in terms of failures, and you're asked to perform the refinement checking to check whether $P \sqsubseteq Q$ and whether $P \sqsubseteq R$.

References

[1] C.A.R. Hoare, *Communicating Sequential Processes*, Prentice Hall, 2004.