

Principles for software composition 2023/24

06 - Erlang and CCS

[Ex. 1] Write a server in erlang to convert temperatures from Celsius degrees to Fahrenheit degrees and vice versa, using the formula $F = 1.8C + 32$. The server receives requests of the form (Pid, \mathbf{cs}, C) or (Pid, \mathbf{ft}, F) and replies to Pid by sending messages in analogous format. The server can be stopped by sending the message `stop`. All the other messages are ignored. Spawn a copy of the server, send it some temperatures to convert, check out the results and stop the server.

[Ex. 2] Write an erlang function `copy` that receives an integer n and if n is positive it prints n copies of n (one per line). Write an erlang function that receives a list of integers and spawn an instance of `copy` for each integer in the list.

[Ex. 3] Write an erlang function `view` that displays the content of the mailbox but makes all messages remain available in the mailbox afterwards.

[Ex. 4] Define a CCS process B_k^n that represents an in/out buffer with capacity n of which k positions are taken. Show that B_0^n is strongly bisimilar to n copies of B_0^1 that run in parallel.

[Ex. 5] Write a guarded CCS process whose LTS has infinitely many states without using parallel composition.

[Ex. 6] Prove that CCS strong bisimilarity is a congruence w.r.t. restriction, i.e., that for all p, q, α :

$$p \simeq q \Rightarrow p \setminus \alpha \simeq q \setminus \alpha$$

[Ex. 7] Prove that the CCS agents

$$p \stackrel{\text{def}}{=} \alpha.(\alpha.\beta.\mathbf{nil} + \alpha.(\beta.\mathbf{nil} + \gamma.\mathbf{nil})) \quad \text{and} \quad q \stackrel{\text{def}}{=} \alpha.(\alpha.\beta.\mathbf{nil} + \alpha.\gamma.\mathbf{nil})$$

are not strong bisimilar.

[Ex. 8] Let us consider the guarded CCS processes

$$p \stackrel{\text{def}}{=} \mathbf{rec} x.(\alpha.x + \beta.x) \quad q \stackrel{\text{def}}{=} \mathbf{rec} y.(\bar{\alpha}.\mathbf{nil} + \gamma.y) \quad r \stackrel{\text{def}}{=} \mathbf{rec} z.(\bar{\beta}.\mathbf{nil} + \bar{\gamma}.z)$$

1. Draw the LTSs of the processes p, q, r and $s \stackrel{\text{def}}{=} (p|q|r) \setminus \alpha \setminus \beta \setminus \gamma$.
2. Show that s is strong bisimilar to the process $t \stackrel{\text{def}}{=} \mathbf{rec} w.(\tau.w + \tau.\tau.\mathbf{nil})$.

[Ex. 9] Prove that the following property is valid for any agent p , where \approx is the weak bisimilarity:

$$p + \tau.p \approx \tau.p$$