Principles for software composition 2020/21
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 $(Pid, \texttt{cs}, C)$ or $(Pid, \texttt{ft}, F)$ 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:

$$p \simeq q \;\Rightarrow\; p\backslash\alpha \simeq\; q\backslash\alpha$$

[**Ex. 7**] Prove that the CCS agents

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

are not strong bisimilar.

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

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

1. Draw the LTSs of the processes p, q, r and $s \stackrel{\text{def}}{=} (p|q|r)\backslash\alpha\backslash\beta\backslash\gamma$.
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:

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