

Modeling Concurrent and Probabilistic Systems

Winter Term 07/08

– Solution 1 –

Exercise 1

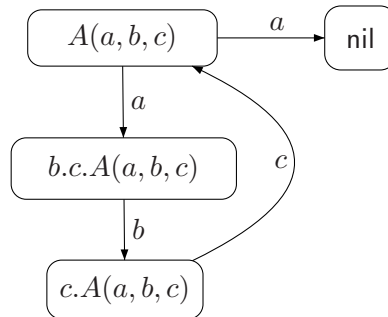
(3 points)

$$\begin{array}{c}
 \text{(Act)} \frac{}{\overline{com}.B(in, com) \xrightarrow{com} B(in, com)} \qquad \text{(Act)} \frac{}{com.\overline{out}.B(com, out) \xrightarrow{com} \overline{out}.B(com, out)} \\
 \text{(Com)} \frac{}{\overline{com}.B(in, com) \parallel B(com, out) \xrightarrow{\tau} B(in, com) \parallel \overline{out}.B(com, out)} \qquad \text{(Call)} \frac{}{B(com, out) \xrightarrow{com} \overline{out}.B(com, out)} \\
 \text{(New)} \frac{}{new\ com(\overline{com}.B(in, com) \parallel B(com, out)) \xrightarrow{\tau} new\ com(B(in, com) \parallel \overline{out}.B(com, out))}
 \end{array}$$

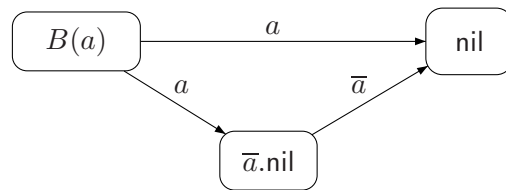
Exercise 2

(4 points)

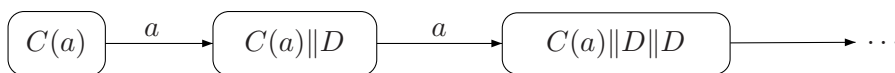
a)



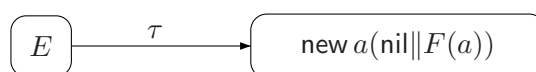
b)



c)



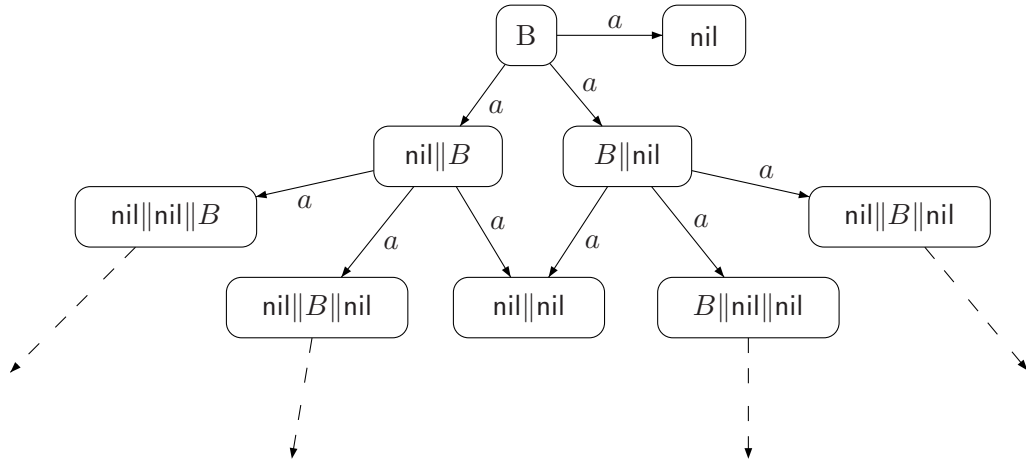
d)



Exercise 3

(4 points)

- a) No derivation for A exists, therefore the corresponding LTS has only one node ($S = \{A\}$) and no transitions.
- b) The LTS is infinite:



- c) The LTS has only one transition (with different possible derivations): $C \xrightarrow{a} \text{nil}$
- d) The process can be interpreted as a counter data structure, with a meaning “increment” and b meaning “decrement”. Since there is no artificial limit to the counter’s value, the corresponding LTS is naturally infinite.

Exercise 4

(3* points)

$$\begin{aligned}
 S(\text{push}, \text{pop}) &= \text{new } sl_0, sr_1 E(\text{push}, \text{pop}, sl_0, sr_1) \\
 &\parallel \text{new } sl_1, sr_2 E(sr_1, sl_0, sl_1, sr_2) \\
 &\parallel \text{new } sl_2, sr_3 E(sr_2, sl_1, sl_2, sr_3)
 \end{aligned}$$

Derivation tree:

$$\begin{array}{c}
 \text{(Act)} \frac{}{\text{push}.F(\vec{a}) \xrightarrow{\text{push}} F(\vec{a})} \\
 \text{(Sum}_1) \frac{}{\text{push}.F(\vec{a}) + sl.F(\vec{a}) \xrightarrow{\text{push}} F(\vec{a})} \\
 \text{(Call)} \frac{}{E(\vec{a}) \xrightarrow{\text{push}} F(\vec{a})} \\
 \text{(Par}_1) \frac{}{E(\vec{a}) \parallel \dots \xrightarrow{\text{push}} F(\vec{a}) \parallel \dots} \\
 \text{(New)} \frac{}{\text{new } sl_0, sr_1 E(\text{push}, \text{pop}, sl_0, sr_1) \parallel \dots \xrightarrow{\text{push}} \text{new } sl_0, sr_1 F(\text{push}, \text{pop}, sl_0, sr_1) \parallel \dots} \\
 \text{(Call)} \frac{}{S(\text{push}, \text{pop}) \xrightarrow{\text{push}} \text{new } sl_0, sr_1 F(\text{push}, \text{pop}, sl_0, sr_1) \parallel \dots}
 \end{array}$$

*Additional exercise with extra points only.