

Formal methods for system verification

Consider the following PEPA model which describes a producer which puts goods into one of two buffers. These goods are extracted from each of the buffers by the consumer which is associated with that buffer. Thus the producer and the buffers cooperate on the *put* action and the consumers cooperate with their buffer on the *get* action.

$$\begin{aligned}
 \textit{Producer} &\stackrel{\text{def}}{=} (\textit{put}, \lambda). \textit{Producer} \\
 \textit{Consumer} &\stackrel{\text{def}}{=} (\textit{get}, \mu). \textit{Consumer} \\
 \textit{Buffer} &\stackrel{\text{def}}{=} (\textit{put}, \top). (\textit{get}, \top). \textit{Buffer} \\
 \textit{System} &\stackrel{\text{def}}{=} \textit{Producer} \bowtie_{\{\textit{put}\}} \left((\textit{Buffer} \bowtie_{\{\textit{get}\}} \textit{Consumer}) \parallel (\textit{Buffer} \bowtie_{\{\textit{get}\}} \textit{Consumer}) \right)
 \end{aligned}$$

For simplicity, we use the following abbreviations:

$$\begin{aligned}
 BC &\stackrel{\text{def}}{=} \textit{Buffer} \bowtie_{\{\textit{get}\}} \textit{Consumer} \\
 2BC &\stackrel{\text{def}}{=} (\textit{Buffer} \bowtie_{\{\textit{get}\}} \textit{Consumer}) \parallel (\textit{Buffer} \bowtie_{\{\textit{get}\}} \textit{Consumer})
 \end{aligned}$$

Set of current action types

- (a) Define the set of current action types $\mathcal{A}(2BC)$.
- (b) Define the set of current action types $\mathcal{A}(\textit{System})$.

Activity multiset

- (c) Define the activity multiset $\mathcal{Act}(2BC)$.
- (d) Define the activity multiset $\mathcal{Act}(\textit{System})$.

Apparent rate

- (e) Define $r_{\textit{get}}(2BC)$ that is the apparent rate of action type *get* in the *2BC* component.
- (f) Define $r_{\textit{put}}(2BC)$ that is the apparent rate of action type *put* in the *2BC* component.
- (g) Define $r_{\textit{put}}(\textit{System})$ that is the apparent rate of action type *put* in the *System* component.

Derivation graph

- (h) Draw the derivation graph of the *BC* component.
- (i) Draw the derivation graph of the *2BC* component.
- (l) Draw the derivation graph of the *System* component.