Formal methods for System Verification

Exercises

Exercise 1

Consider a web server which offers html pages for download and only when the transfer is complete will the server be released and available again for acquisition. Its clients are web browsers, in a domain with a local cache of frequently requested pages. Thus any display request may have two possible outcomes: demand for access to data stored at the remote server (with probability p) or demand for access to data available in the local cache (with probability $(1-p)$). The browser and the server cooperate when the browser needs to download data which is not available locally.

$$\begin{array}{lcl} Server & \stackrel{\text{def}}{=} & (get, \top).(download, \mu).(rel, \top).Server \\ Browser & \stackrel{\text{def}}{=} & (display, p\lambda).(get, g).(download, \top).(rel, r).Browser + (display, (1-p)\lambda).(cache, m).Browser \\ WEB & \stackrel{\text{def}}{=} & Browser \underset{L}{\bowtie} Server \end{array}$$

where $L = \{get, download, rel\}$.

(a) Define the set of current action types $\mathcal{A}(WEB)$.

(b) Define the activity multiset $\mathcal{A}ct(WEB)$.

(c) Draw the derivation graph of the $Server$ component.

(d) Draw the derivation graph of the $Browser$ component.

(e) Define $r_{display}(Browser)$, that is the apparent rate of action of type $display$ in the $Browser$ component.

(f) Draw the derivation graph of the WEB component.

Exercise 2

Referring to the system above, suppose that we wish to hide the access of a browser to its local cache. This leads to the a new representation of the browser:

$$Browser' \stackrel{\text{def}}{=} Browser/\{cache\}$$

A system with two browsers cooperating with the server on action types $L = \{get, download, rel\}$ is represented as:

$$WEB' \stackrel{\text{def}}{=} (Browser' || Browser') \underset{L}{\bowtie} Server$$

(a) Draw the derivation graph of $Browser'$.

(b) Define $r_{display}(WEB')$, that is the apparent rate of action of type $display$ in the WEB' component.

(c) Define the activity multiset $\mathcal{A}ct(WEB')$.

Exercise 3

Let us consider $L = \{get, download, rel\}$ and

$$\begin{array}{lcl} Browser'' & \stackrel{\text{def}}{=} & (get, g).(download, \top).(rel, r).Browser'' \\ WEB'' & \stackrel{\text{def}}{=} & (Browser'' || Browser'') \underset{L}{\bowtie} Server \end{array}$$

(a) Determine whether WEB'' is a derivative of WEB (justify the answer).

(b) Define the set of current action types $\mathcal{A}(WEB'')$.

(c) Define $r_{get}(WEB'')$, that is the apparent rate of action of type get in the WEB'' component.

(d) Define the activity multiset $\mathcal{A}ct(WEB'')$.