The Paradigm Shop

Luuk Groenewegen[*] Erik de Vink[†]

Abstract

Yet to come.

1 Operational Semantics

Definition 1.1

(a) Let $P = \langle \mathtt{ST}, \mathtt{LB}, \mathtt{TS} \rangle$ be a process. A collection $\mathtt{PT}$ of subprocesses of P, $\mathtt{PT} = \{ S_i \mid i \in I \}$ with $S_i = \langle \mathtt{ST}_i, \mathtt{LB}_i, \mathtt{TS}_i \rangle$ is called a partitioning of P if $\mathtt{ST} = \bigcup_{i \in I} \mathtt{ST}_i$, $\mathtt{LB} = \bigcup_{i \in I} \mathtt{LB}_i$ and $\mathtt{TS} = \bigcup_{i \in I} \mathtt{TS}_i$. A trap structure $\mathtt{TR}$ for a partitioning $\mathtt{PT} = \{ S_i \mid i \in I \}$ of P, $\mathtt{PT} = \{ S_i \mid i \in I \}$, is a collection of $\{ \mathtt{tr}_i \mid i \in I \}$ of sets of traps such that $\mathtt{tr}_i \subseteq \mathcal{P}(\mathtt{st}(S_i))$ and $\mathtt{st}(S_i) \in \mathtt{tr}_i$, for $i \in I$. An attainability rule with respect to a partitioning $\mathtt{PT}$ and trap structure $\mathtt{TR}$ is a triple $S \xrightarrow{t} S'$ such that $S, S' \in \mathtt{PT}$, $t \in \mathtt{TR}$, $t \subseteq \mathtt{st}(S)$ and $t \subseteq \mathtt{st}(S')$.

no partial overlapping of traps

(b) An employee role $\mathtt{ER}$ of a process P, $P = \langle \mathtt{ST}, \mathtt{LB}, \mathtt{TS} \rangle$ say, is a triple $\langle \mathtt{PT}, \mathtt{TR}, \mathtt{AT} \rangle$ where $\mathtt{PT}$ is a partitioning of P, $\mathtt{TR}$ a trap structure for $\mathtt{PT}$ and $\mathtt{AT}$ a collection of attainability rules of P with respect to $\mathtt{PT}$ and $\mathtt{TR}$. The notation $\mathtt{at}(\mathtt{ER})$ is used to denote $\mathtt{AT}$. If P is a process with employee roles $\mathtt{ER}_1, \ldots, \mathtt{ER}_m$ then $\mathtt{er}(P)$ denotes the tuple $\langle \mathtt{ER}_1, \ldots, \mathtt{ER}_m \rangle$.

(c) A manager role $\mathtt{MR}$ of a process P with respect to processes $P_1, \ldots, P_n$ with possible employee roles $\langle \mathtt{er}(P_1), \ldots, \mathtt{er}(P_n) \rangle$ is a tuple $\langle \mathtt{ER}_1, \ldots, \mathtt{ER}_n \rangle$ together with a relation $\gamma \subseteq \mathtt{TS} \times \mathtt{at}(\mathtt{ER}_1) \times \cdots \times \mathtt{at}(\mathtt{ER}_n)$ where $\mathtt{ER}_i \in \mathtt{er}(P_i)$ is some employee role of P_i. The relation γ is referred to as the consistency relation of $\mathtt{MR}$. If P is a process with manager roles $\mathtt{MR}_1, \ldots, \mathtt{MR}_m$ then $\mathtt{mr}(P)$ denotes the tuple $\langle \mathtt{MR}_1, \ldots, \mathtt{MR}_m \rangle$.

(d) Let $P_1, \ldots, P_n$ be n processes. A Paradigm-model $\mathtt{PM}$ of $P_1, \ldots, P_n$ consists of a list of employee roles $\mathtt{er}(P_1), \ldots, \mathtt{er}(P_n)$ and manager roles $\mathtt{mr}(P_1), \ldots, \mathtt{mr}(P_n)$ for $P_1, \ldots, P_n$, respectively. Notation $\mathtt{PM} = (\langle \mathtt{er}(P_i) \rangle_{i=1}^n, \langle \mathtt{mr}(P_i) \rangle_{i=1}^n)$.

Definition 1.2 Let $\mathtt{PM} = (\langle \mathtt{er}(P_i) \rangle_{i=1}^n, \langle \mathtt{mr}(P_i) \rangle_{i=1}^n)$ be a Paradigm-model for the processes $P_1, \ldots, P_n$.

[*]LIACS, Leiden University, the Netherlands, e-mail: luuk@liacs.nl

[†]Department of Mathematics and Computer Science, Technische Universiteit Eindhoven, the Netherlands and LIACS, Leiden University, the Netherlands, e-mail: evink@win.tue.nl

(a) Put $m_i = \#\mathtt{mr}(P_i)$ and $m = m_1 + \cdots + m_n$. Note $m_i \geq 0$. Let, for $1 \leq i \leq n$, $\mathtt{mr}(P_i) = \langle\, \mathtt{MR}_{i,j}\, \rangle_{j=1}^{m_i}$ and, for $1 \leq j \leq m_i$, $\mathtt{MR}_{i,j} = \langle\, \mathtt{ER}_{i,j,k}\, \rangle_{k=1}^{n}$. Define for $1 \leq h \leq m$ two numbers $\mathtt{mp}(h)$ and $\mathtt{mr}(h)$, referring to a managing process and its manager role, as follows:

$$\mathtt{mp}(h) = i \wedge \mathtt{mr}(h) = j \iff (1 \leq j \leq m_i) \wedge (m_1 + \cdots + m_{i_1} + j = h)$$

(b) A global state of the Paradigm-mode $\mathtt{PM}$ is an n-tuple of the format

$$[\langle\, x_i\, ;\ (S_{i,j}(t_{i,j}))_{j=1}^{m}\, ;\ (\, S_{i,j,k}(t_{i,j,k})\,)_{k=1}^{n}\,)_{j=1}^{m_i}\, \rangle]_{i=1}^{n}$$

where

- $x_i \in \mathtt{st}(P_i)$ for $1 \leq i \leq n$;
- $S_{k,h} \in \mathtt{pt}(\mathtt{ER}_{i,j,k})$ where $i = \mathtt{mp}(h)$, $j = \mathtt{mr}(h)$ for $1 \leq k \leq n$, $1 \leq h \leq m$;
- $t_{i,j} = \mathtt{trap}(x_i, S_{i,j})$ for $1 \leq i \leq n$, $1 \leq j \leq m$;
- $S_{i,j,k}(t_{i,j,k}) = S_{k,h}(t_{k,h})$ where $\mathtt{mp}(h) = i$, $\mathtt{mr}(h) = j$ for $1 \leq h \leq m$, $1 \leq k \leq n$.

(c) A global transition of the Paradigm-model $\mathtt{PM}$ is a transition of the form

$$[\langle\, x_i;\, (S_{i,j}(t_{i,j}))_{j=1}^{m};\, (\, S_{i,j,k}(t_{i,j,k})\,)_{k=1}^{n}\,)_{j=1}^{m_i}\, \rangle]_{i=1}^{n} \xrightarrow{a} [\langle\, x_i';\, (S_{i,j}'(t_{i,j}'))_{j=1}^{m};\, (\, S_{i,j,k}'(t_{i,j,k}')\,)_{k=1}^{n}\,)_{j=1}^{m_i}\, \rangle]_{i=1}^{n}$$

for which there exists a process index i, $1 \leq i \leq n$, such that

1. $x_i \xrightarrow{a} x_i' \in \mathtt{ts}(S_{i,j})$ for all j, $1 \leq j \leq m$;
2. $t_{i,j}' = \mathtt{trap}(x_i', S_{i,j}')$ for all j, $1 \leq j \leq m$;
3. $\langle\, x_i \xrightarrow{a} x_i', (S_{i,j,k} \xrightarrow{t_{i,j,k}} S_{i,j,k}')_{k=1}^{n}\, \rangle \in \mathtt{at}(\mathtt{MR}_{i,j})$ for all j, $1 \leq j \leq m_i$.