Bit Sum Problem KPS

No Author Given

No Institute Given

The system counts the number of descendants in a tree-like structure of nodes.

$$\mathrm{sk}\Pi_{\mathrm{Broadcast}}(n) = (A, L, IO, \mu, \{C_i\}_{i=0}^3),$$

where:

- $A = \{a, b, c\}$ is the alphabet.
- $L = \{0, 1, 2, 3\}$ is the set of labels corresponding to levels in the tree.
- $IO = \emptyset$, as there is no external input/output.
- μ is the membrane structure representing the hierarchy:

$$\mu = [[[[\ ]_3]_2]_1]_0.$$

- Compartments:
  - $C_0 = (0, w_{0,0}, R_0)$, the root node.
  - $C_1 = (1, w_{1,0}, R_1)$, the first level of child nodes.
  - $C_2 = (2, w_{2,0}, R_2)$, the second level of child nodes.
  - $C_3 = (3, w_{3,0}, R_3)$, the third level of child nodes.

Rules for Each Compartment

Rules in C_0 (Level 0)

$$r_{0,1} : a \rightarrow a(1).$$
$$r_{0,2} : a \rightarrow \emptyset.$$

Rules in C_1 (Level 1)

$$r_{1,1} : b \rightarrow b, b(0).$$
$$r_{1,2} : a \rightarrow b(0), a(2).$$
$$r_{1,3} : a \rightarrow \emptyset.$$
$$r_{1,4} : c \rightarrow \emptyset(0).$$

Rules in C_2 (Level 2)

$$r_{2,1} : b \rightarrow b, b(1).$$
$$r_{2,2} : a \rightarrow b(1), a(3).$$
$$r_{2,3} : a \rightarrow \emptyset.$$
$$r_{2,4} : c \rightarrow \emptyset(1).$$

Rules in C_3 (Level 3)

$$r_{3,1} : a \rightarrow b(2).$$
$$r_{3,2} : a \rightarrow \emptyset.$$
$$r_{3,3} : c \rightarrow \emptyset(2).$$

Initial Configuration

- C_0: $w_{0,0} = \{10a\}$.
- C_1: $w_{1,0} = \{c\}$ in nodes m_{10}, m_{11}, m_{12}.
- C_2: $w_{2,0} = \{c\}$ in nodes $m_{20}, m_{21}, m_{22}, m_{23}, m_{24}, m_{25}$.
- C_3: $w_{3,0} = \{c\}$ in nodes $m_{30}, m_{31}, m_{32}, m_{33}, m_{34}, m_{35}, m_{36}, m_{37}$.

Communication Links

$$C_0 \rightarrow \{C_1\}.$$
$$m_{10} \rightarrow \{m_{20}\}.$$
$$m_{11} \rightarrow \{m_{21}, m_{22}, m_{23}\}.$$
$$m_{12} \rightarrow \{m_{24}, m_{25}\}.$$
$$m_{20} \rightarrow \{m_{30}, m_{31}\}.$$
$$m_{21} \rightarrow \{m_{32}, m_{33}\}.$$
$$m_{25} \rightarrow \{m_{34}, m_{35}, m_{36}, m_{37}\}.$$

References