Reconfigurable Broadcast Networks and Asynchronous Shared-Memory Systems are Equivalent

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Reconfigurable Broadcast Network

introduced in [Delzanno, Sangnier & Zavattaro, CONCUR ’10]

RBN and ASMS are Equivalent, C. Weil-Kennedy
Reconfigurable Broadcast Network

Goal: put a process in $final$

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Reconfigurable Broadcast Network

Goal: put a process in \textit{final}
Reconfigurable Broadcast Network

Goal: put a process in \textit{final}

\begin{itemize}
\item init
\item sent
\item final
\end{itemize}
Reconfigurable Broadcast Network

Goal: put a process in $final$

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Reconfigurable Broadcast Network

Goal: put a process in $\text{final}$

- processes communicate by selective broadcast
- broadcast and receives happen at the same time
- multiple receives can happen simultaneously
Asynchronous Shared Memory System

introduced in [Esparza, Ganty & Majumdar, CAV ’13]

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Asynchronous Shared Memory System

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Goal: put a process in $\text{final}$

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Asynchronous Shared Memory System

Goal: put a process in \textit{final}

\begin{center}
\begin{tikzpicture}
  \node[shape=ellipse,fill=cyan!50] (q1) at (0,0) {$q_1$};
  \node[shape=ellipse,fill=cyan!50] (q2) at (2,0) {$q_2$};
  \node[shape=ellipse,fill=cyan!50] (final) at (4,0) {\textit{final}};

  \path[->] (q1) edge [bend left] node {$W(1)$} (q2);
  \path[->] (q2) edge [bend left] node {$W(2)$} (q1);
  \path[->] (q2) edge [bend left] node {$R(1)$} (q1);
  \path[->] (q2) edge node {$R(2)$} (final);
\end{tikzpicture}
\end{center}

RBN and ASMS are Equivalent, C. Weil-Kennedy
Asynchronous Shared Memory System

Goal: put a process in \textit{final}

RBN and ASMS are Equivalent, C. Weil-Kennedy
Asynchronous Shared Memory System

Goal: put a process in \textit{final}

\[ W(1) \rightarrow W(2) \rightarrow R(1) \rightarrow R(2) \rightarrow \text{final} \]

\[ q_1 \rightarrow q_2 \rightarrow \text{final} \]

RBN and ASMS are Equivalent, C. Weil-Kennedy
Asynchronous Shared Memory System

Goal: put a process in \textit{final}

\[ W(1) \rightarrow W(2) \rightarrow R(1) \rightarrow R(2) \rightarrow \text{final} \]

2

RBN and ASMS are Equivalent, C. Weil-Kennedy
Asynchronous Shared Memory System

Goal: put a process in \textit{final}

\[ W(1) \quad W(2) \quad R(2) \]

\[ q_1 \quad R(1) \quad q_2 \quad \text{final} \]
Asynchronous Shared Memory System

Goal: put a process in \textit{final}

\begin{align*}
W(1) & \rightarrow q_1 \\
W(2) & \rightarrow q_2 \\
R(1) & \rightarrow q_2 \\
R(2) & \rightarrow \text{final}
\end{align*}

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Asynchronous Shared Memory System

Goal: put a process in final

- processes communicate by writing to a shared register
- writes and reads are asynchronous events
- only one process reads at a time

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Equivalence

A **cube** is a boolean combination of constraints:

$$a \leq \#q \leq b$$

where $a, b \in \mathbb{N}$ and $\#q \in \mathbb{N} \cup \{\infty\}$.

Number of processes in $q$
A **cube** is a boolean combination of constraints \( a \leq \#q \leq b \) where \( a, b \in \mathbb{N} \cup \{\infty\} \) is the number of processes in \( q \).

**cube-reachability**: given cubes \( \mathcal{C} \) and \( \mathcal{C}' \), does there exist \( M \in \mathcal{C} \) and \( M' \in \mathcal{C}' \) such that \( M \) reaches \( M' \)?

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*RBN and ASMS are Equivalent, C. Weil-Kennedy*
Equivalence

RBN and ASMS are polynomial-time equivalent w.r.t. to cube-reachability

**cube-reachability**: given cubes \( C \) and \( C' \), does there exist \( M \in C \) and \( M' \in C' \) such that \( M \) reaches \( M' \)?
RBN and ASMS are polynomial-time equivalent w.r.t. to cube-reachability.

**cube-reachability:** given cubes $C$ and $C'$, does there exist $M \in C$ and $M' \in C'$ such that $M$ reaches $M'$?

Thank you!