

Specification and Verification of Distributed Systems

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Exercise 12

Let $\mathcal{L} \subseteq \text{MSC}$ and suppose $|Proc| \leq 3$. Show that the following statements are equivalent:

- There is an MPA \mathcal{A} such that $\mathcal{L}(\mathcal{A}) = \mathcal{L}$.
- There is a locally accepting MPA \mathcal{A} such that $\mathcal{L}(\mathcal{A}) = \mathcal{L}$.

Exercise 13

Let $Proc = \{1, 2, 3, 4\}$ and let Msg be a singleton. Consider the following subsets of MSC:

$$\mathcal{L}_1 = \{\mathcal{M} \in \text{MSC} \mid \mathcal{M} \text{ is connected}\}$$

$$\mathcal{L}_2 = \{\mathcal{M} \in \text{MSC} \mid \mathcal{M} \text{ is not connected}\}$$

$$\mathcal{L}_3 = \{(E, \leq, \lambda) \in \text{MSC} \mid |\{e \in E \mid \lambda(e) \text{ is a send action}\}| \text{ is even}\}$$

$$\mathcal{L}_4 = \{(E, \leq, \lambda) \in \text{MSC} \mid \text{for any } e \in E, \lambda(e) \in \{1!2, 2?1, 2!3, 3?2, 3!4, 4?3\}\}$$

\mathcal{L}_5 is the set of MSCs $\mathcal{M} \in \text{MSC}$ such that, for any $u, v \in Act^*$, any $p \in Proc$, any $\sigma \in Act_p^?$, and any $\tau \in Act$:

- if $u\sigma\tau v \in Lin(\mathcal{M})$, then $\tau \in Act_p^!$, and
- if $\tau v \in Lin(\mathcal{M})$, then $\tau \in Act_1$

For $i = 1, \dots, 5$, determine a sentence $\varphi \in \text{EMSO}(Act, \{\prec, \prec_{\text{mes}}\})$ such that $\mathcal{L}(\varphi) = \mathcal{L}_i$. Which of these languages can be defined by some rational expression of MSC?

Exercise 14

Consider the MSC languages from Exercise 13. For $i = 1, \dots, 5$, determine an MPA \mathcal{A} such that $\mathcal{L}(\mathcal{A}) = \mathcal{L}_i$. Which of the languages are recognized by some safe MPA?