Prof. Dr. Ir. Joost-Pieter Katoen
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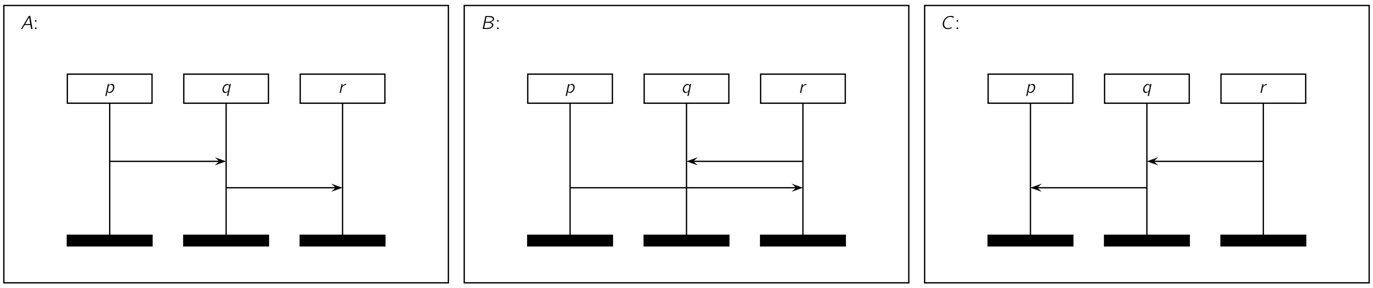
Exercise 1 (Regular Expressions and Realizability): (5 Points)



Check whether the following regular expressions are realisable or not:

- $\alpha_1 = A^* + B^* + C^*$,
- $\alpha_2 = A \cdot (B + C)^*$,
- $\alpha_3 = (A \cdot B \cdot C)^*$,
- $\alpha_4 = (A \cdot B)^*$,
- $\alpha_5 = (A \cdot C)^*$,

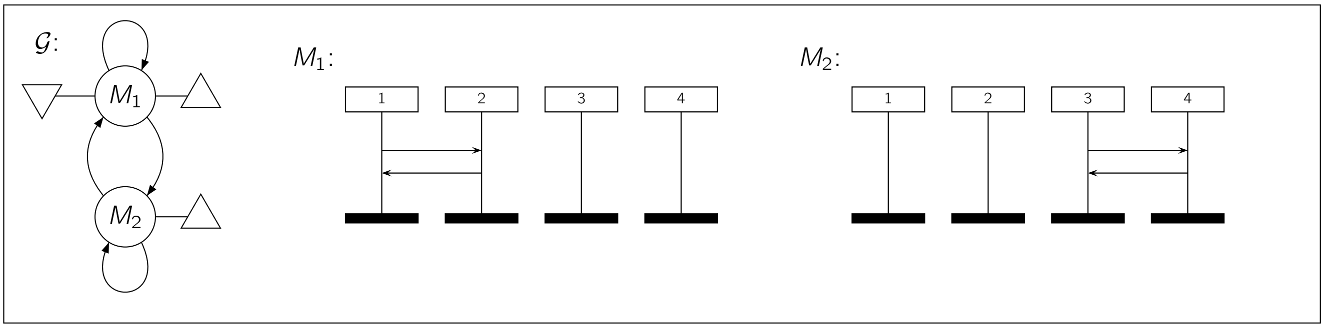
and if so, whether they can be realized by a universally bounded, deadlock-free CFM?

Exercise 2 (Expressiveness of CFMs): (6 Points)

Prove that for $\mathcal{P} = \{p, q, r, s\}$ and $\mathbb{C} = \{a\}$, locally accepting CFMs are strictly weaker than CFMs.

Exercise 3 (Regular Expressions and MSGs): (6 Points)

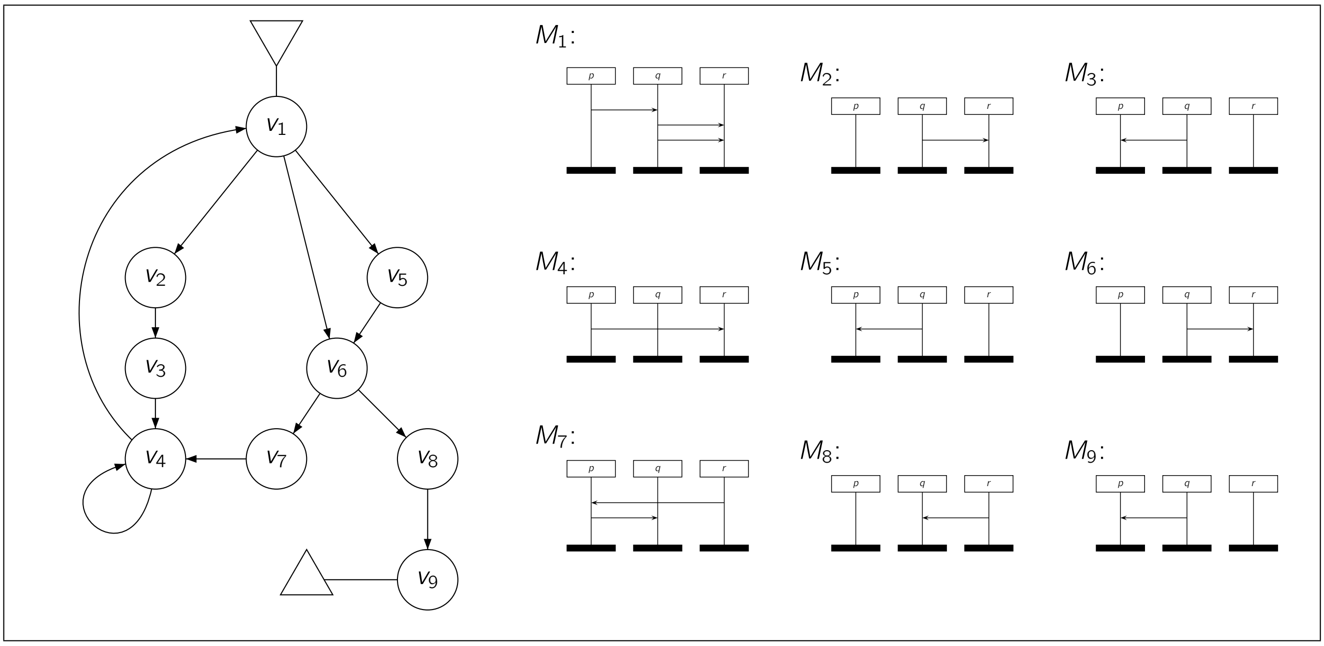
Reconsider the MSG $\mathcal{G}$ from the lecture:



$\mathcal{G}$ is not communication-closed but the set of linearizations $Lin(\mathcal{G})$ is regular. Find a regular expression α over $\{M_1, M_2\}$ such that the MSG $\mathcal{G}'$ induced by α is communication-closed and recognizes the same language as $\mathcal{G}$. For your solution write down α, $\mathcal{G}'$ and argue why $\mathcal{G}'$ is communication-closed and $L(\mathcal{G}) = L(\mathcal{G}')$.

Exercise 4 (Realizability of MSGs): (8 Points)

Given the following local-choice MSG $\mathcal{G}$ over $\mathcal{P} = \{p, q, r\}$, where $\lambda(v_i) = M_i$ (for $i \in \{1, \ldots, 9\}$):



Construct a deadlock-free CFM $\mathcal{A}$ according to the algorithm presented in lecture 11. Determine, moreover, for every node $v \in V$ of $\mathcal{G}$ the maximal non-branching path $nbp(v)$.