Theoretical Foundations of the UML - SS 2020
— Exercise Sheet 7 —

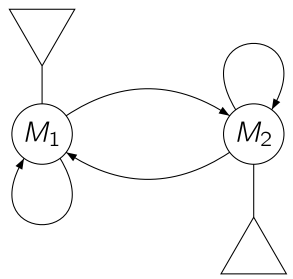
Hand in until Monday June 15, 09:00 am via RWTHmoodle

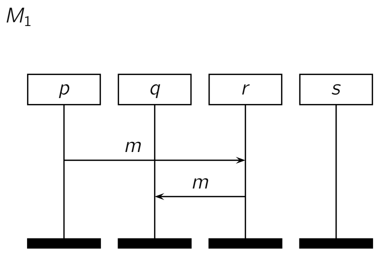
General Remarks

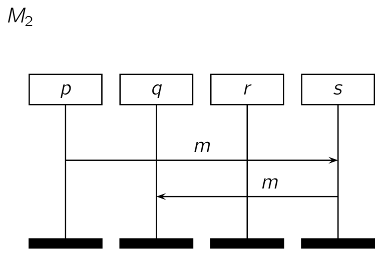
- There will be NO lecturing, exercise-class, or Q&A activities in the week after Pentecost ("excursion week" in Aachen), i.e., week 23 (June 1 - 5).
- Questions regarding the lectures and exercises, if any, are expected in the Q&A session via Zoom (instead of emails), with the next on Wednesday 10 June, at 16:00. Zoom ID: 369 366 110, Password: FUML-QA

Exercise 1 (Communication-Closedness) (1+2 Points)

Consider the following MSG G.





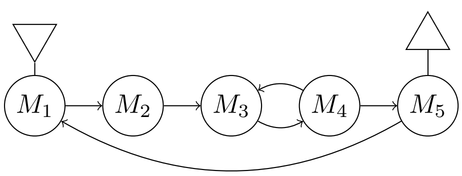


1. Check whether G is locally communication-closed;
2. Find a CFM $\mathcal{A}$, such that $L(\mathcal{A}) = L(G)$.

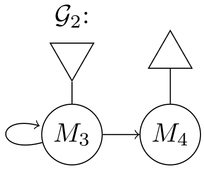
Exercise 2 (MSG Properties) (4+4+4 Points)

Consider the following MSGs:

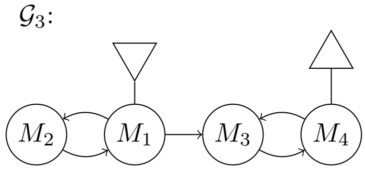
$\mathcal{G}_1$:

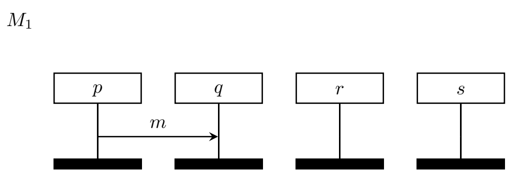


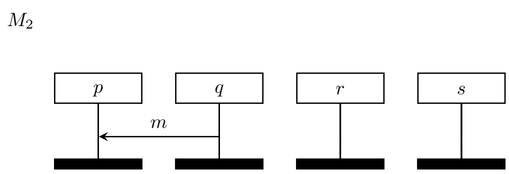
$\mathcal{G}_2$:



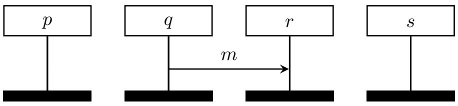
$\mathcal{G}_3$:



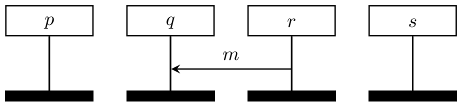




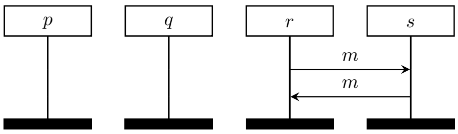
M_3



M_4



M_5



Decide for each MSG $\mathcal{G}_i$, $i \in \{1, 2, 3\}$ whether it is ...

a) communication-closed

b) locally communication-closed

c) regular

d) realizable

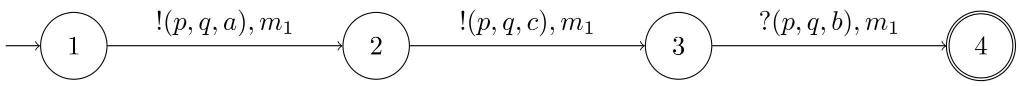
Justify each (positive or negative) answer.

Exercise 3 (Regularity and Well-Formedness) (2.5 Points)

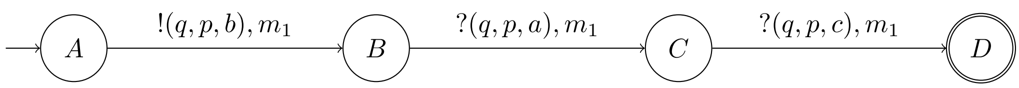
Consider the following CFM $\mathcal{A}$.

$\mathcal{A}$:

process p:



process q:



a) Determine whether $L(\mathcal{A})$ is regular.

b) Determine the configuration graph of CFM $\mathcal{A}$.

c) Apply the construction using channel capacity functions (Lecture 12, slides 11 and 12) to determine the smallest B such that $\mathcal{A}$ is $\forall B$-bounded.

Exercise 4 (3-SAT Reduction) (2.5 Points)

Consider the 3-SAT Formula $\Phi = (\bar{x_1} \vee x_2 \vee x_3) \wedge (x_1 \vee \bar{x_2} \vee x_3)$.

a) According to the reduction schema in Lecture 12, reduce Φ to the MSG G, in a way that ensures:

$$\Phi \text{ is satisfiable iff } G \text{ is not communication closed.}$$

b) Provide the communication graph of MSG G and check the connectivity from p_0 (the initial process) to p_3 (the last process) for the evaluation $x_1 = false$, $x_2 = true$, and $x_3 = false$.