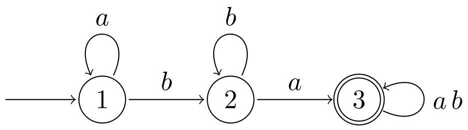
Solved exercises must be marked and solutions (as a single PDF file) uploaded in OLAT. The (strict) deadline is 7 am on December 5.

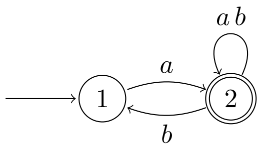
Exercises

⟨2⟩ 1. Consider the following DBA M:



Describe $L(M)$ and $\sim L(M)$ in your own words. Follow the construction on slide 8 to obtain a Büchi automaton M' such that $L(M') = \sim L(M)$.

2. Consider the NBA N:



⟨1⟩ (a) Give regular expressions for L_{pq} and L^{f}_{pq} for all $p, q \in \{1, 2\}$ and use them to compute $[\,aba\,]_{\sim_N}$.

⟨1⟩ (b) Apply the subset construction used for determinizing NFAs (slide 9 of lecture 2) to N and call the resulting DBA N'. Show that N' does not accept the same language as N. In addition to the result on slide 19 of lecture 8, this further illustrates why the determinization known from NFAs cannot be transferred to Büchi automata.

⟨2⟩ 3. Suppose we change the definition of *accepting run* for Büchi automata such that a run is accepting if and only if it visits states in F *finitely often*. We call such an NFA operating on Σ^ω a *co-Büchi automaton*.

(a) Give a *deterministic* co-Büchi automaton for the set $\{x \in \{a, b\}^\omega \mid |x|_b \neq \infty\}$.

(b) It can be shown that every co-Büchi automaton can be transformed into an equivalent *deterministic* co-Büchi automaton. Use this fact (and other useful results from lecture 8) to prove that there are ω-regular sets which are not accepted by any co-Büchi automaton.

⟨2⟩ 4. Prove or disprove the following statement:

For each ω-regular set A, A or its complement (or both) are accepted by a DBA.

⟨2⟩ 5. Give MSO formulas φ_1 and φ_2 with free variables in $\{P_a, P_b\}$ such that $x \in L_i \iff \underline{x} \vDash \varphi_i$ for L_1 and L_2 given below. What regular languages would you obtain if you interpreted your formulas as WMSO formulas?

(a) $L_1 = \{x \in \{a, b\}^\omega \mid x \text{ does not contain consecutive } a\text{'s}\}$

(b) $L_2 = \{x \in \{a, b\}^\omega \mid x(i) = a \text{ for all odd } i\}$