- These problem sets are not graded. However students are strongly encouraged to solve these problems and submit solutions for feedback.
- Submissions shall be accepted till Thursday, 9th January 2020 for feedback. Feel free to contact the TA in case of any doubts.

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1. Specify Büchi automata which recognize the following ω-regular languages over $\Sigma = \{a, b, c\}$:
   (a) The set of $\alpha \in \Sigma^\omega$, in which abc appears as an infix at least once.
   (b) The set of $\alpha \in \Sigma^\omega$, in which abc appears as an infix infinitely often.
   (c) The set of $\alpha \in \Sigma^\omega$, in which abc appears as an infix only finitely often.
2. Let the NFA A recognize the language $U \subseteq \Sigma^*$. Prove or disprove:
   (a) $L(A) \subseteq \lim U$
   (b) $L(A) \supseteq \lim U$
3. Prove or disprove the following equations (for $U, V \subseteq \Sigma^+$):
   (a) $(U \cup V)^\omega = U^\omega \cup V^\omega$
   (b) $\lim(U \cup V) = \lim U \cup \lim V$
   (c) $U^\omega = \lim(U^+)$
   (d) $\lim(U.V) = U.V^\omega$
4. Show that one needs the union operation to generate all Büchi recognizable ω-languages by giving an example of a Büchi recognizable ω-language $L \subseteq \Sigma^\omega$ which cannot be written as $U.V^\omega$, with regular languages $U, V \subseteq \Sigma^*$.

Problems taken from Lecture notes of the course "Automata and Reactive Systems" by Prof. Dr. Wolfgang Thomas.