

TD de Sémantique et Vérification
VI– Büchi Automata

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Exercise 1.

Let $AP = \{a, b, c\}$. Consider the following LT properties:

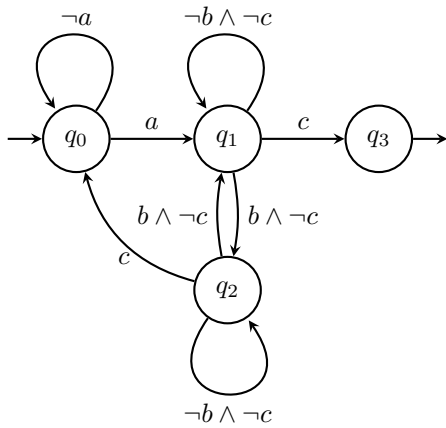
1. If a becomes valid, afterwards b stays valid *ad infinitum* or until c holds.
2. Between two neighbouring occurrences of a , b always holds.
3. Between two neighbouring occurrences of a , b occurs more often than c .
4. $a \wedge \neg b$ and $b \wedge \neg a$ are valid in alternation or until c becomes valid.

For each of these properties, give an ω -regular expression (if the language is ω -regular), decide if it is a regular safety property (justify your answers) and if so, define an automaton recognising its set of bad prefixes.

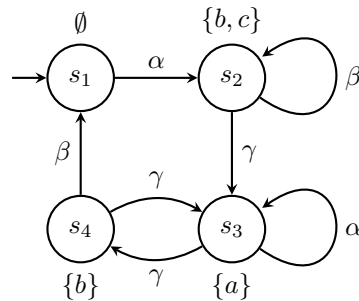
(Hint: You may use propositional formulae over the set AP as transition labels.)

Exercise 2.

Let $AP = a, b, c$. Consider the following NFA \mathcal{A} (over the alphabet 2^{AP}) and the following transition system TS :



Automaton \mathcal{A}

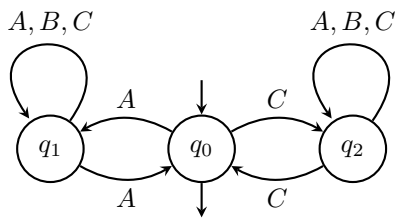


Transition System TS

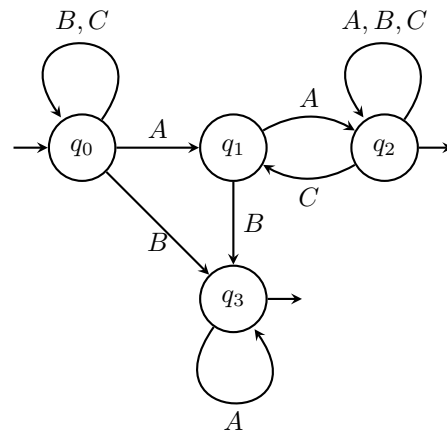
Construct the product $TS \otimes \mathcal{A}$ of the transition system and the NFA.

Exercise 3.

Consider the following NBA \mathcal{A}_1 and \mathcal{A}_2 over the alphabet $\{A, B, C\}$:



Automaton \mathcal{A}_1



Automaton \mathcal{A}_2

Find ω -regular expressions for the languages accepted by \mathcal{A}_1 and \mathcal{A}_2 .

Exercise 4.

Provide an example for a regular safety property P_{safe} over AP and an NFA \mathcal{A} for its minimal bad prefixes such that $\mathcal{L}_\omega(\mathcal{A}) \neq (2^{AP})^\omega \setminus P_{safe}$ when \mathcal{A} is viewed as an NBA.

Exercise 5.

Show that the class of languages of infinite words recognized by a nondeterministic büchi automata exactly coincide with the class of ω -regular languages.