

Exercises “Automata and Formal Languages”

Exercise 12.1

Let $AP = \{p, q\}$ and let $\Sigma = 2^{AP}$. Give S1S and LTL formulas defining the following languages:

- $\{p, q\}\emptyset\Sigma^\omega$
- $\Sigma^*\{q\}^\omega$
- $\Sigma^*\{p\}\Sigma^*\{q\}\Sigma^\omega$
- $\{p\}^*\{q\}^*\emptyset^*\Sigma^\omega$

Exercise 12.2

Let $AP = \{p, q\}$. Find Büchi automata accepting the languages defined by the following LTL formulas:

- $XG\neg p$
- $(GFp) \Rightarrow (Fq)$
- $p \wedge \neg XFp$

Exercise 12.3

Consider an autonomous elevator with the following behavior:

- The elevator operates between two floors, ground floor and first floor.
- Initially, the elevator is at the ground floor with its door open.
- Upon arrival at a certain floor, its door automatically opens. It takes at least 2 seconds from its arrival before the door opens but the door must definitely open within 5 seconds.
- Whenever the door is open, passengers can enter. They enter one by one, and we assume that the elevator has a sufficient capacity to accommodate any number of passengers.
- The door can close only 4 seconds after the last passenger entered.
- After the door closes, the elevator waits at least 2 seconds and then travels up or down to the other floor.

Design a timed automaton model of the elevator. Use the actions *up* and *down* to model the movement of the elevator, *open* and *close* to describe the door operation and the action *enter* which means that a passenger is entering the elevator. Provide two timed traces starting from the initial state.