Model Checking – Exercise sheet 4

Exercise 4.1
Let $AP = \{p, q\}$ and let $\Sigma = 2^{AP}$. Give Büchi automata recognizing the ω-languages over Σ defined by the following LTL formulas:

(a) $\mathbf{XG}\neg p$

(b) $(\mathbf{GF}p) \rightarrow (\mathbf{F}q)$

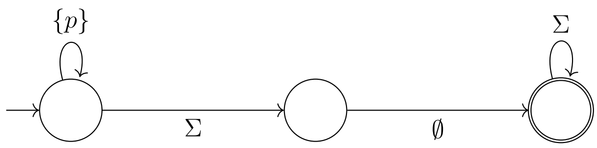
(c) $p \wedge \neg(\mathbf{XF}p)$

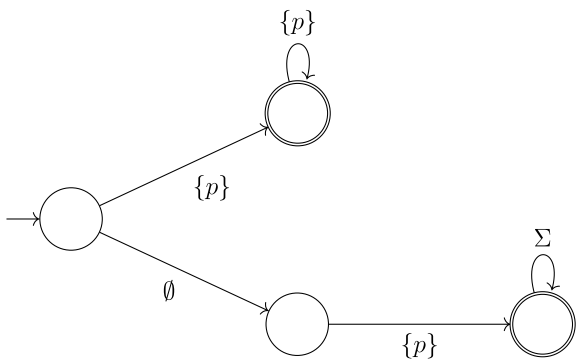
(d) $\mathbf{G}(p\ \mathbf{U}\ (p \rightarrow q))$

(e) $\mathbf{F}q \rightarrow (\neg q\ \mathbf{U}\ (\neg q \wedge p))$

Exercise 4.2
Given $L = \{\{p\}^m\{q\}^n\emptyset^\omega : m \leq n\}$, show that there is no Büchi automata recognizing L. [Hint:]

Exercise 4.3
Let $AP = \{p\}$. Given two Büchi automata recognizing ω-regular languages over $\Sigma = 2^{AP}$, prove or disprove that one is the negation of the other. [Hint:]

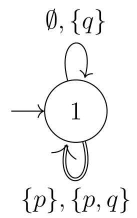




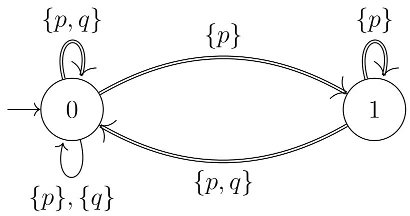
Exercise 4.4
Given $AP = \{p\}$, come up with an LTL formula (without $\mathbf{X}$) over $\Sigma = 2^{AP}$ which might have the largest automaton (use Spot).

Exercise 4.5
Convert the following Büchi automata with transition-based acceptance condition ("doubled"-transitions have to be seen infinitely often) to equivalent Büchi automata with state-based acceptance conditions. Moreover, give a general procedure to perform this conversion.

(a)



(b)



(c)