Model Checking – Exercise sheet 5

Exercise 5.1

Extend the set of rules of the LTL to Büchi automata translation to directly deal with the $\mathbf{F}$ and $\mathbf{G}$ operators. Use it to construct a Büchi automaton for $\phi = \mathbf{G}\,\mathbf{F}\,p$. Is it necessary to construct states which do not contain ϕ?

Exercise 5.2

Let $\phi = \mathbf{G}\,((\mathbf{X}(p\;\mathbf{U}\;q)) \rightarrow ((\neg p \wedge \mathbf{F}\,q) \vee (q\;\mathbf{U}\;\mathbf{X}\,q)))$ and $\mathcal{G}$ be a generalized Büchi automaton translated from ϕ using the construction presented in the lecture and the extended set of rules defined in the previous exercise.

(a) Write down the set of subformulae $Sub(\phi)$.

(b) What is the size of $CS(\phi)$?

(c) How many sets of accepting states does $\mathcal{G}$ have?

(d) Is $\{\phi\}$ an accepting state of $\mathcal{G}$?

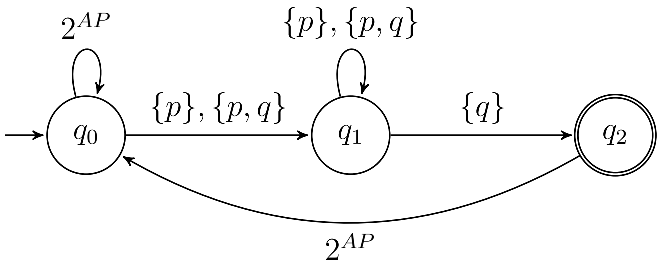
(e) Give a reachable state that has no successors.

(f) Give a successor state of the smallest consistent state containing $\{\phi, p, q, q\;\mathbf{U}\;\mathbf{X}\,q, \mathbf{F}\,q\}$.

(g) Give a predecessor state of the smallest consistent state containing $\{\phi, q, q\;\mathbf{U}\;\mathbf{X}\,q, \mathbf{F}\,q\}$.

Exercise 5.3

Consider the following Büchi automaton $\mathcal{B}$:



(a) Give an LTL formula ϕ such that $\mathcal{L}(\mathcal{B}) = [\![\phi]\!]$.

(b) By using the result from (a), propose a method to construct a Büchi automaton that accepts the complement of the language accepted by $\mathcal{B}$.

(c) Construct a Büchi automaton for the formula $\mathbf{G}(\neg p \vee (\neg p \ \mathbf{R}\ (p \vee \neg q)))$.

(d) By using the result from (c), construct a Büchi automaton that accepts the complement of the language accepted by $\mathcal{B}$.