

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 **F** and **G** operators. Use it to construct a Büchi automaton for $\phi = \mathbf{GF}p$. Is it necessary to construct states which do not contain ϕ ?

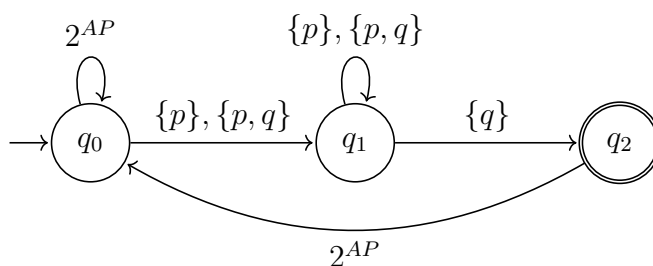
Exercise 5.2

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 $\{\phi, q, q \mathbf{U} \mathbf{X}q, \mathbf{F}q\}$.
- (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 $\mathcal{L}(\mathcal{B}) = \llbracket \phi \rrbracket$.
- (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} .