Theory of Computer Science

G. Röger
Spring Term 2018

University of Basel
Computer Science

Exercise Sheet 4

Due: Wednesday, March 28, 2018

Exercise 4.1 (Formal grammars; 0.5 + 1 + 0.5 Points)
Consider the following formal language:

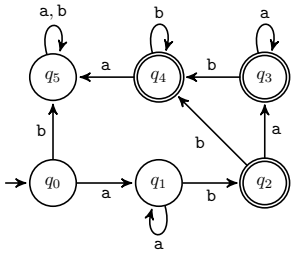
$$S = \{a^n b^{2n} \mid n \geq 0\}$$

(a) Is ε an element of S? Justify your answer.

(b) Specify a *complete description* of a formal grammar G that generates S (i.e., $\mathcal{L}(G) = S$). A formal grammar is a four tuple $G = (\Sigma, V, P, S)$, remember to define all components of this tuple.

(c) Which types (in the Chomsky-Hierarchy) is your formal grammar part of? You don't have to prove your answers.

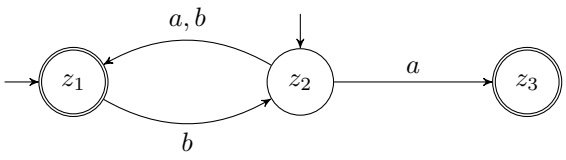
Exercise 4.2 (DFAs and regular grammars; 1.5 + 1.5 Points)
Consider the following DFA M:



(a) Which language does the DFA accept?

(b) Specify a *regular* grammar, which generates the same language.

Exercise 4.3 (DFA and NFA; 2 Points)
Specify a DFA that is equivalent to the following NFA.



Exercise 4.4 (1.5+1.5 marks)

(a) Specify a deterministic finite automaton that accepts the language of all words over $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ that do *not* contain `bab` (e.g., ther word `ababa` is not contained).

(b) Specify a non-deterministic finite automaton that accepts the language of those words over $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ that start with `ab` or contain `abba`.