Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Networked Systems Group (NSG)

HS 2021

Prof. L. Vanbever / R. Schmid
based on Prof. R. Wattenhofer's material

Discrete Event Systems

Exercise Sheet 2

1 Nondeterministic Finite Automata

a) Consider the alphabet $\{a, b\}$. Construct an NFA that accepts all strings containing the substring $a\,b\,b\,a$ at least twice. (This means that words containing $a\,b\,b\,a\,b\,b\,a$ as a substring should also be accepted!)

b) Construct an NFA which accepts the following regular expression: $(00 \cup (0(0 \cup 1)^*))^*$.

c) Construct an NFA accepting $1^*0^*1^+$ with as few states as possible. (cf. Exercise 1.1.a)

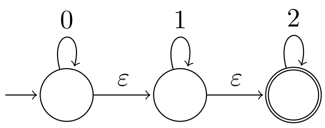
d) Consider a machine $M := (Q, \Sigma, \delta, q_0, Q)$. Is it possible to make a statement about the strings being accepted by M? Does it make a difference whether M is deterministic or not?

2 Exam question [2018]

Assume that the alphabet Σ is $\{0, 1\}$ and consider the language $L = \{w \mid \text{there exist two zeros in } w \text{ that are separated by a string whose length is } 4i \text{ for some } i \geq 0\}$. For example, the strings 1001 and 10110101 belong to L, whereas the strings 101 and 010101 do not. Design an NFA that recognizes L with 6 states or less.

3 De-Randomization

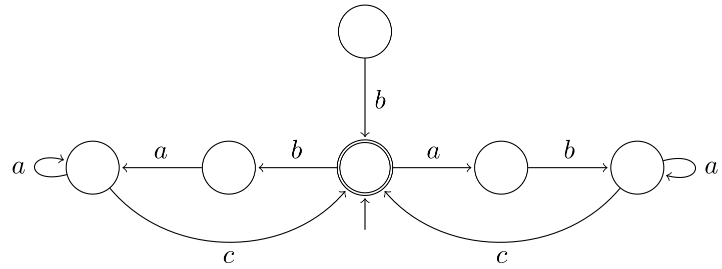
a) Give a regular expression for the following NFA and construct an equivalent NFA *without* ε-transitions.



b) Finally, transform the machine into a deterministic automaton.

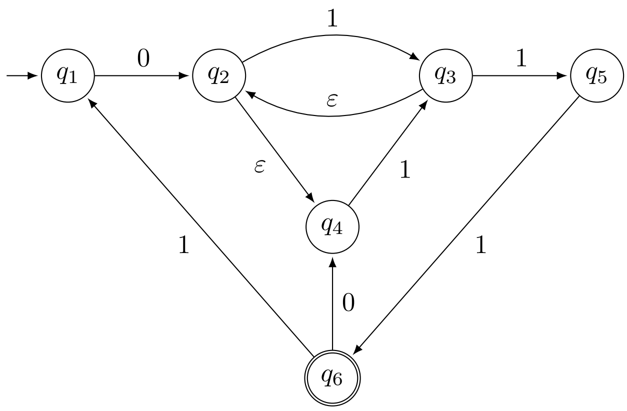
4 States Minimization

Simplify the following automaton. Explain why your changes are allowed. Finally, give the corresponding regular expression.



5 Derandomizing a large NFA [Exam HS14]

Transform the given NFA into an equivalent DFA, while assuming $\Sigma = \{0, 1\}$.
Hint: Only construct states which are necessary!



6 "Regular" Operations in UNIX

In this exercise you are asked to provide a UNIX command to output all lines in a file ending with "password" or "passwort", followed by an unknown number (potentially zero) of vowels.