Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Networked Systems Group (NSG)

HS 2019

Prof. L. Vanbever / M. Apostolaki, T. Holterbach
based on Prof. R. Wattenhofer's material

Discrete Event Systems

Exercise Sheet 2

1 Filter for an Input Stream [exam problem]

We would like to construct an automaton that recognizes substrings from an input stream. The input stream consists of symbols $\{a, b\}$ and the substrings that the automaton should detect are of the form bab^*. In other words, the input of the automaton is a series of a's and b's. The automaton should go into an accepting state whenever the most recently received symbols form a string of the form bab^*. For example, in the input stream $b\ \underline{a}\ \underline{b}\ \underline{b}\ \underline{b}\ \underline{a}\ a\ a\ a\ b\ \underline{a}\ \underline{b}\ \underline{a}\ a$, the automaton should be in an accepting state exactly after the reception of an underlined symbol. Construct a deterministic finite automaton that precisely fulfils the above specification.

2 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!)

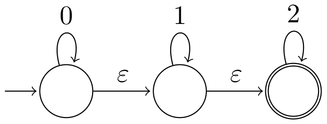
b) Construct an NFA which accepts the following regular expression: $(00 \cup (0(0 \cup 1)^*))^*$.

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?

3 De-randomization

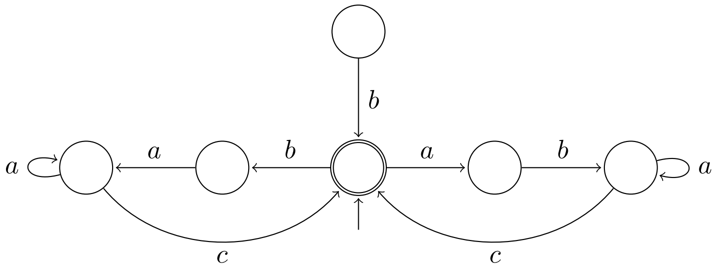
a) Give a regular expression for the following NFA and construct an equivalent NFA *without* ε-transitions.



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

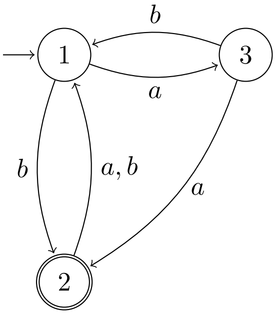
4 States Minimization

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



5 From DFA to Regular Expression

Build a language-equivalent GNFA for the DFA below. Then, as seen during the lecture, eliminate the intermediate states of the GNFA and derive the regular expression that represents the language accepted by the DFA.



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.