



# Discrete Event Systems

## Exercise Sheet 2

### 1 Filter for an Input Stream [exam problem]

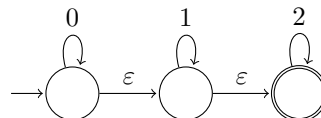
We would like to construct an automaton that recognizes substrings from an input stream. The input stream consists of symbols  $\{a, b\}$  and the substrings that the automaton should detect are of the form  $bab^*$ . In other words, the input of the automaton is a series of  $a$ 's and  $b$ 's. The 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

- Consider the alphabet  $\{a, b\}$ . Construct an NFA that accepts all strings containing the substring  $abba$  at least twice. (This means that words containing  $abbabba$  as a substring should also be accepted!)
- Construct an NFA which accepts the following regular expression:  $(00 \cup (0(0 \cup 1)^*))^*$ .
- Construct an NFA accepting  $1^*0^*1^+$  with as few states as possible. (cf. Exercise 1.1.a)
- 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

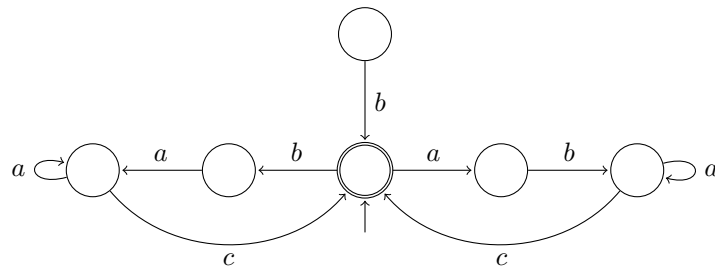
- Give a regular expression for the following NFA and construct an equivalent NFA *without*  $\varepsilon$ -transitions.



- 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 “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.