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 $b a b b a a a a b a b$, the automaton should be in an accepting state exactly after the reception of an underlined symbol. Construct a deterministic finite automaton that precisely fulfills 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: $(00 \cup 0(0 \cup 1)^*)^\ast$.

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 $\varepsilon$-transitions.

![NFA diagram]

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 “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.