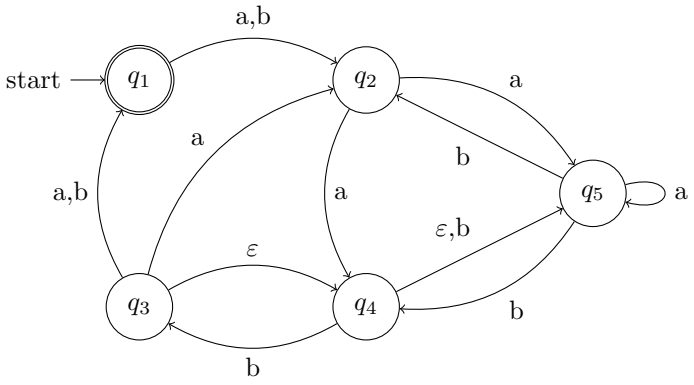
Syntax and Semantics
Exercise Session 3

Exercise 1

Consider the NFA N in the state diagram below.



1. Describe N. What are $Q, \Sigma, \delta, q_0, F$?
2. Find an accepting computation (sequence of states) of N on the input aabba.
3. Which of the following inputs are accepted?
   (a) aabbbba
   (b) abbabb
   (c) aaabab
   (d) abbbaab
   (e) abababa

Exercise 2

Construct the state diagram for the NFA $N = (Q, \Sigma, \delta, q_0, F)$ where

$Q = \{q_0, q_1, q_2, q_3\}$
$\Sigma = \{0, 1\}$
$q_0 = q_0$
$F = \{q_1, q_2, q_3\}$

δ	0	1	ε
q_0	$\emptyset$	$\{q_1, q_2\}$	$\{q_3\}$
q_1	$\{q_3\}$	$\{q_1\}$	$\emptyset$
q_2	$\{q_1, q_2, q_3\}$	$\{q_0, q_1\}$	$\{q_1, q_2\}$
q_3	$\emptyset$	$\{q_2, q_3\}$	$\emptyset$

Which of the following inputs are accepted by this machine?

(a) 0011010

(b) 0001110

(c) 1010111

(d) 1101011

Exercise 3

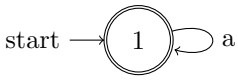
Construct automata that recognize the following languages:

1. $L_1 = \{w \in \{0,1\}^* \mid w$ has the prefix 001 and the suffix $00\} \cup \{\varepsilon\}$
2. $L_2 = \{w \in \{0,1\}^* \mid w = \underbrace{00\ldots0}_{2n}1010\underbrace{11\ldots1}_{3k}$ where $n, k \in \mathbb{N}_0\}$
3. $L_3 = \{w \in \{0,1\}^* \mid w = \underbrace{00\ldots0}_{2n}$ or $w = \underbrace{11\ldots1}_{3n}$ for $n \geq 0$ or w contains substring $101\}$

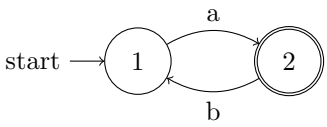
Exercise 4

For each NFA given below, construct an equivalent DFA, where $\Sigma = \{a, b\}$.

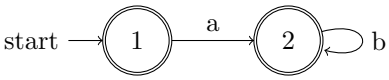
(1)



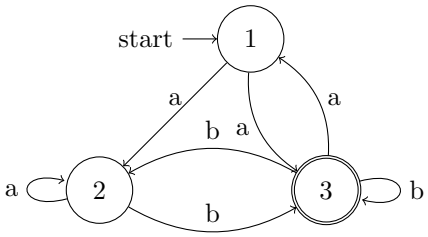
(2)



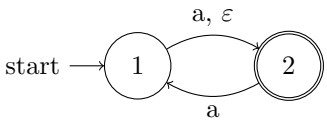
(3)



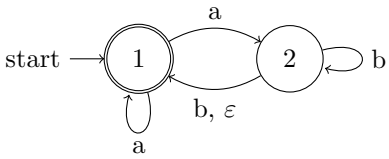
(4)



(5)

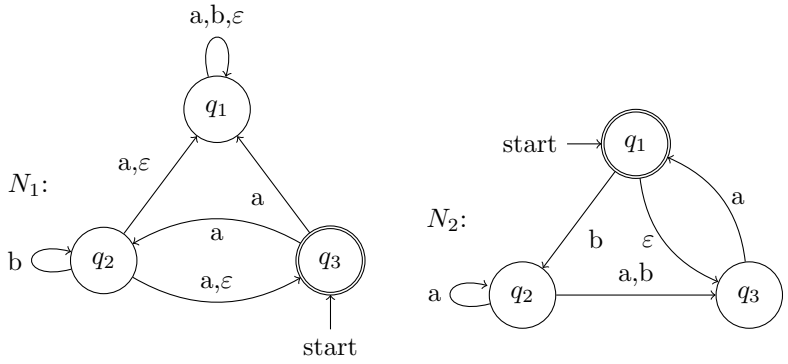


(6)



Exercise 5

Consider the following automata



1. Construct an automaton that recognizes $L(N_1) \cup L(N_2)$
2. Construct an automaton that recognizes $L(N_1) \circ (L(N_2) \cup L(N_2))$
3. Construct an automaton that recognizes $(L(N_1) \cup L(N_2)) \circ L(N_2)$
4. Construct an automaton that recognizes $(L(N_1) \cup L(N_2)^*) \circ L(N_2)$