Automata, Computability and Complexity

Spring Semester 2023
Prof. Dr. Peter Zaspel

Assignment Sheet 2. Submit on **Monday, Feb. 20, 2023, 12:00 (noon)**.

Excercise 1. (Formal description of nondeterministic finite automata)

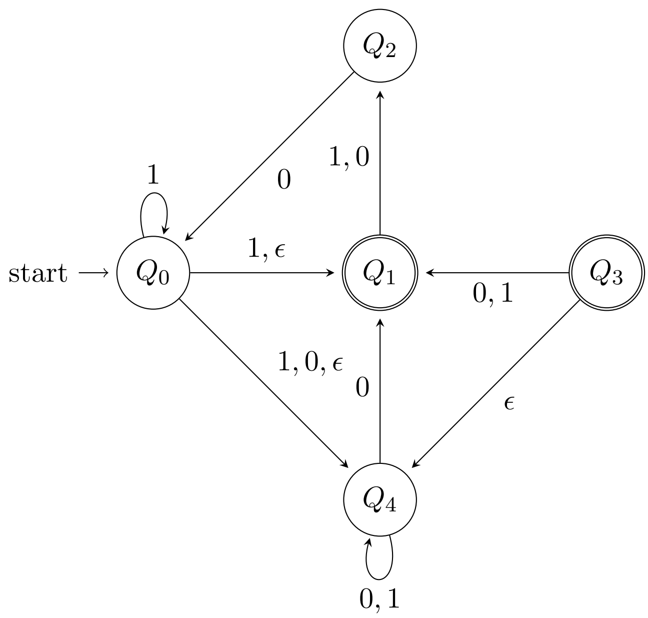
a) Draw the state transition diagram for the NFA

$$N_1 = (\{s_0, s_1, s_2, s_3\},\ \{0,1\},\ \delta,\ s_0,\ \{s_1\})$$

where the transition function δ is:

	0	1	ϵ
s_0	$\{s_0, s_1, s_3\}$	$\{s_1\}$	$\emptyset$
s_1	$\{s_1\}$	$\{s_2\}$	$\{s_3\}$
s_2	$\{s_1\}$	$\{s_2, s_3\}$	$\{s_0, s_1\}$
s_3	$\emptyset$	$\emptyset$	$\{s_3\}$

b) The state transition diagram of the automaton N_2 is given below. Using the usual conventions, describe N_2 as a 5-tuple.

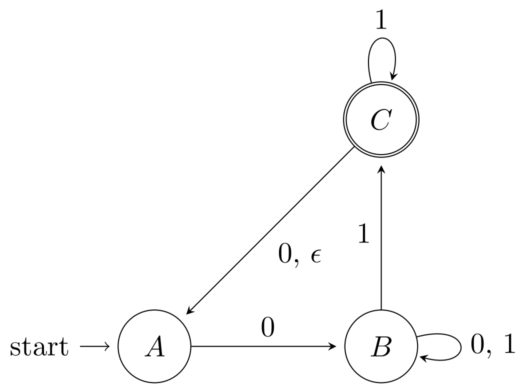


(4 Points)

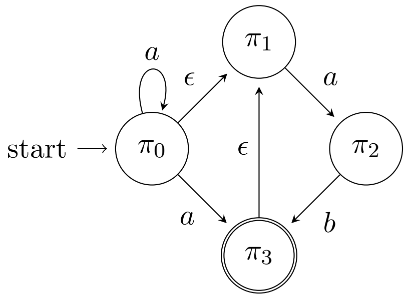
Excercise 2. (Languages accepted by nondeterministic automata)

Describe the language accepted by the nondeterministic finite automata given below.

a)



b)



(4 Points)

Excercise 3. (Equivalence of NFAs and DFAs)

a) Consider the language L over $\sum = \{A, B\}$ that contains all words beginning with A and that satisfy at least one of these two conditions:

- Every B is immediately followed by an A
- The symbol B appears an even amount of times

Design a NFA that accepts L with at most 5 states.

b) Given the NFA

$$N_3 = (\{s_0, s_1, s_2\},\ \{0,1\},\ \delta,\ s_0,\ \{s_1\})$$

with the transition function

	0	1	ϵ
s_0	$\{s_0, s_1, s_2\}$	$\{s_1\}$	$\emptyset$
s_1	$\{s_1\}$	$\emptyset$	$\emptyset$
s_2	$\{s_1, s_2\}$	$\{s_0, s_2\}$	$\{s_0\}$

design a DFA that accepts the same language using the subset construction (see the proof of Theorem from the lecture).

(4 Points)

Excercise 4. (Variants of NFAs)

Given a language L over an alphabet $\sum$, define the complement language $L^C = \{w \in \sum^* \,|w \notin L\}$. Given an STD of an NFA accepting L, provide a general recipe how to construct a NFA that accepts L^C.

(4 Points)