KUTAISI INTERNATIONAL UNIVERSITY

Exercises for TTF

Introduction to Theory of Computation
Summer semester 2025

Exercises below are your homework; after submission, they will also be discussed during exercise classes.

Week two

1.

(1) Describe the nondeterministic automaton $M = (Z, A, \delta, z_0, Z_A)$ on Figure 1 by identifying Z, A, δ and Z_A.

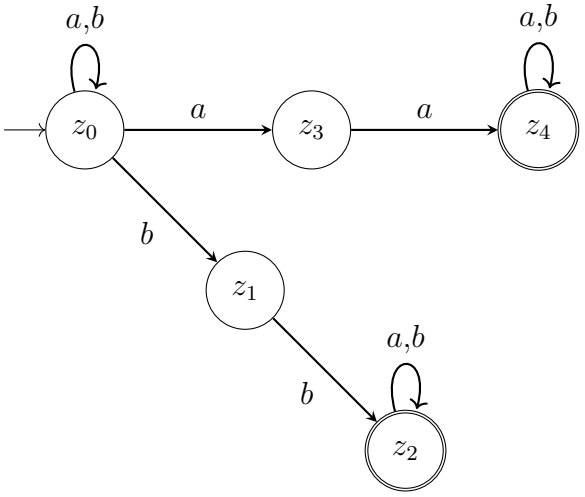

Figure 1

(2) Describe a language accepted by nondeterministic automaton in Figure 1.

2. Draw a nondeterministic automaton M, which accepts the language

$$L = \{1^i \ : \ i \equiv 0 \bmod 3\} \cup \{1^i \ : \ i \equiv 0 \bmod 5\}.$$

3. Give a counterexample to show that the following construction fails to prove the closure of the class of languages accepted by NFA under the star operation.

Let $N_1 = (Q_1, \Sigma, \delta_1, q_1, F_1)$ recognize A_1. Construct $N = (Q_1, \Sigma, \delta, q_1, F)$ as follows. N is supposed to recognize A_1^*.

(a) The states of N are the states of N_1.

(b) The start state of N is the same as the start state of N_1.

(c) $F = \{q_1\} \cup F_1$.
The accept states F are the old accept states plus its start state.

(d) Define δ so that for any $q \in Q_1$ and any $a \in \Sigma_\varepsilon$,

$$\delta(q, a) = \begin{cases} \delta_1(q, a) & q \notin F_1 \text{ or } a \neq \varepsilon \\ \delta_1(q, a) \cup \{q_1\} & q \in F_1 \text{ and } a = \varepsilon \end{cases}$$

4. *(From 2024 Midterm)* Let L_1 and L_2 be languages accepted by the automata in Figure 2, respectively. Construct a *DFA* accepting $L_1 \cup L_2$.

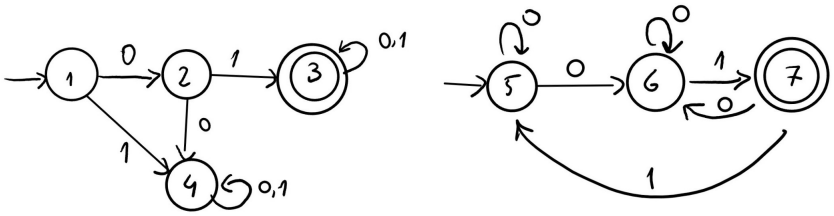

FIGURE 2

5. *(From 2024 Midterm)* Let L be a regular language. Define the language L^R as consisting of all strings of L but each taken in revere. For example, $a10bs2 \in L$ if and only if $2sb01a \in L^R$. Prove that L^R is also regular.