Exercise 1

Let $A = (\{1, 2, 3\}, \{a, b, c\}, \{1\}, \Delta, \{3\})$ be the deterministic finite one-way automaton defined by the following transition relation.

Using the construction from Theorem 2.8 in the lecture construct a formula $\varphi$ in first-order logic with DTC such that $L(\varphi) = L(A)$.

Exercise 2

Give a two-way 2-head automaton that accepts the language $L_m$ from the lecture.

Exercise 3

A multihead automaton is called one-way if the heads are not allowed to move to the left, i.e. $\Delta \subseteq Q \times (\Sigma \cup \{>, <\})^k \times Q \times \{0, 1\}^k$. Give non-deterministic one-way multihead automata that accept the complements of the following languages.

a) $L_m$ as defined in the lecture

b) $\{w\overline{w} \mid w \in \{a, b\}^*\}$

Exercise 4

Let $A$ be a deterministic k-head automaton that accepts a language $L(A)$. Show that there is a deterministic k-head automaton $\overline{A}$ that accepts $\overline{L(A)}$.

What happens if we add the requirement that both $A$ and $\overline{A}$ should be one-way?