TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Theoretical Computer Science, Chair of Automata Theory

Introduction to Complexity Theory

Exercise Sheet 1

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Exercise 1

Let $\Sigma := \{1\}$ be an alphabet. Devise a deterministic Turing machine M that accepts all words $w = 1^n$ over Σ such that n is a power of 2.

Exercise 2

A *palindrome* is a word that reads the same backwards, e.g. 'reittier' or 'malayalam'. Find a k-tape DTM (for some self-chosen k) that works over the alphabet $\Sigma = \{a, b\}$ and decides whether its input is a palindrome. The first tape is the input tape (and thus cannot be modified). On every other tape, at most $\log_2(n)$ cells may be used, where n is the length of the input word. It suffices to describe the DTM on an intuitive level.

Exercise 3

Let $M = (\{q_0, q_1, q_+, q_-\}, \{a\}, \{a, \sqcup\}, \delta, q_0, q_+, q_-)$ be a 2-tape DTM where δ is defined as follows:

$$\begin{aligned}
\delta(q_0, \sqcup, \sqcup) &= (q_+, \sqcup, \sqcup, \rightarrow, \rightarrow) & \delta(q_1, \sqcup, \sqcup) &= (q_0, \sqcup, \sqcup, \rightarrow, \leftarrow)\\
\delta(q_0, \sqcup, a) &= (q_-, \sqcup, \sqcup, \rightarrow, \rightarrow) & \delta(q_1, \sqcup, a) &= (q_-, \sqcup, \sqcup, \rightarrow, \leftarrow)\\
\delta(q_0, a, \sqcup) &= (q_1, \sqcup, a, \rightarrow, \rightarrow) & \delta(q_1, a, \sqcup) &= (q_0, \sqcup, \sqcup, \rightarrow, \leftarrow)\\
\delta(q_0, a, a) &= (q_1, \sqcup, \sqcup, \rightarrow, \rightarrow) & \delta(q_1, a, a) &= (q_-, \sqcup, \sqcup, \rightarrow, \leftarrow)
\end{aligned}$$

Construct a 1-tape DTM M' that accepts the same language as M using the algorithm of the lecture.