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 Turing machine M that accepts all words $w = 1^n$ 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 $M = (\{q_0, q_1\}, \{a\}, \{a, \sqcup\}, \delta, q_0, q_+, q_-)$ be a 2-tape DTM where δ is defined as follows:

$$\delta(q_0, \sqcup, \sqcup) = (q_+, \sqcup, \sqcup, \rightarrow, \rightarrow) \qquad \delta(q_1, \sqcup, \sqcup) = (q_0, \sqcup, \sqcup, \rightarrow, \leftarrow)$$
$$\delta(q_0, \sqcup, a) = (q_-, \sqcup, \sqcup, \rightarrow, \rightarrow) \qquad \delta(q_1, \sqcup, a) = (q_-, \sqcup, \sqcup, \rightarrow, \leftarrow)$$
$$\delta(q_0, a, \sqcup) = (q_1, \sqcup, a, \rightarrow, \rightarrow) \qquad \delta(q_1, a, \sqcup) = (q_0, \sqcup, \sqcup, \rightarrow, \leftarrow)$$
$$\delta(q_0, a, a) = (q_1, \sqcup, \sqcup, \rightarrow, \rightarrow) \qquad \delta(q_1, a, a) = (q_-, \sqcup, \sqcup, \rightarrow, \leftarrow)$$

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