Complexity / Složitost (SLOa) – 2022/2023
Homework assignment 1
Domácí úloha 1

1. Desigh a turing machine, which implements a reversion of the input string over the latin alphabet $\Sigma = \{A, \ldots, Z\}$.

   - The input is in the form $\Delta w \Delta^{\omega}$, where w is the input string
   - When the Turing machine halts, the first tape contains $\Delta w \# w^R \Delta^{\omega}$, where w^R is the reversion of w (e.g. for $w = HELLO$, $w^R = OLLEH$).
   - If you design a multitape machine, the content of other tapes is not important.
   - Estimate the upper bounds for its time and space complexity.

   3.5 points

2. Design a RAM program, which for the input vector $I = (min, max, n)$ computes the number k such that $min \leq (k*n) \leq max$. Let us assume, that all the input numbers are greater then zero, i.e., $min, max, n > 0$. After the $HALT$ instruction, the register r_0 will contain the number k or -1 if such a k does not exists. (Note: It is not necessary to implement an optimal algorithm.)

   - Analyze uniform time and space complexity and estimate upper bounds.
   - Analyze logarithmic time and space complexity and estimate upper bounds.

   Do not forget that time and space complexity of RAM program is estimated w.r.t. the size of its input (i.e. number of bits of the input vector (min, max, n)).

   3.5 points

3. Let L be a regular language (i.e. language accepted by a finite automaton). Estimate functions $f(n)$ and $g(n)$ such that $L \in DTIME(f(n))$ a $L \in DSPACE(g(n))$. Prove your proposition.

   3 points

It is not necessary to provide a detailed formal description of the TM and RAM program. Informal description is enough.

The homework can be worked out in English or in Czech.

Domácí úlohu můžete vypracovat v Češtině, nebo v Angličtině.