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Complexity Theory

SS 2016

Class Handout 6

Exercise 1:
Show that the class co-**NP** is not the set-theoretic complement of **NP**, that is

$$\text{co-}\mathbf{NP} \neq \mathcal{P}\big(\{0,1\}^*\big) \setminus \mathbf{NP} \ .$$

Exercise 2:
Consider the definition of the Turing machines with input tape and the definition of space complexity for such TMs. Furthermore, recall the following language:

$$L = \left\{ w \in \{0,1\}^* \;\middle|\; \exists z \in \{0,1\}^* : w = zz^R \right\} \ ,$$

where z^R is the reverse of z (i.e. if $z = z_1 \dots z_n$, then $z^R = z_n \dots z_1$).
Construct a TM with input tape which decides L in space $\mathcal{O}(\log(n))$. (That is $L \in \mathbf{L}$.)

Exercise 3:
For our previous definition of Turing machines and their space complexity it holds

$$\mathbf{DSPACE}\big(s(n)\big) \subseteq \mathbf{DTIME}\big(2^{O(s(n))}\big) \ .$$

Find and prove a similar relation for the TMs with input tape. Consider in particular $s(n) = o\big(\log(n)\big)$.