Technische Universität München
Fakultät für Informatik
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Spring Semester 2014
Problem Set 5
May 19, 2014

Complexity Theory

Due date: May 26, 2014 **before** *class!*

Problem 1 (10 Points)

Show that $\mathbf{SPACE}(n) \neq \mathcal{NP}$. (Note that it is unknown if either class is contained in the other.)

Problem 2 (10 Points)

Define the class $\mathbf{E} = \bigcup_c \mathbf{DTIME}(2^{cn})$.

1. Is $\mathbf{E}$ closed under polynomial-time reductions?
2. Show that $\mathcal{P}^{\mathbf{E}} = \mathbf{EXP}$.

Problem 3 (10 Points)

1. Argue that at least one of the assumptions $\mathbf{L} \neq \mathcal{P}$ and $\mathcal{P} \neq \mathbf{PSPACE}$ is true.
2. Use padding to show that if $\mathcal{P} = \mathbf{L}$, then $\mathbf{EXP} = \mathbf{PSPACE}$.

Problem 4 (10 Points)

Consider the problem of checking a boolean formula's syntactical correctness. Show that this problem can be decided in log-space, even if we have no precedence relation between the boolean operators and force precedence behavior with parentheses, e.g. $(x \wedge y) \vee (\overline{z} \wedge x) \vee \overline{y} \vee z$ is a valid formula, as is $(x \wedge (y \vee \overline{z}) \wedge x) \vee \overline{y} \vee z$, while $x \wedge y \vee \overline{z} \wedge x \vee \overline{y} \vee z$ is not.