Computational Complexity
Exam (Theory Test)
5.02.2019

.....
your name & index number

For each question, give answer: YES, NO, or NOT KNOWN. The third possibility means that the current state of knowledge allows for both possibilities. All questions are equally valued, there are no negative points for wrong answer. You should assume that completeness is defined using log-space reductions.

1. Given a deterministic Turing machine M and an input word w, is it decidable whether M accepts w in space $15 \cdot |w|^{100}$?

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2. Is the following implication true for all complexity classes C, D (i.e. for all sets of languages that are closed under log-space reductions): if $\mathsf{C} \subseteq \mathsf{D}$ then $\mathsf{coD} \subseteq \mathsf{coC}$?

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3. Does Reachability $\in \mathsf{coNL}$?

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4. Does $\mathsf{NP} \subseteq \mathsf{DTIME}(n^{2019})$?

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5. Does QBF $\in \mathsf{NP}$ (where QBF = "quantified Boolean formula")?

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6. Does there exist languages L and O such that L can be recognized in polynomial time by a non-deterministic Turing machine with oracle O, but L cannot be recognized in polynomial time by a deterministic Turing machine with oracle O?

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7. Is it true that for every complexity class C (i.e. for every set of languages that is closed under log-space reductions) there exists a C-complete problem?

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8. Is the following implication true for every language L: if L can be recognized by a sequence of circuits of exponential size, then $L \in \mathsf{EXPTIME}$?

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9. Does $\mathsf{L} \subseteq \mathsf{u\text{-}AC}^2$ (where $\mathsf{u\text{-}AC}^2$ = "log-space uniform AC^2")?

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10. Does $\mathsf{RP} \subseteq \mathsf{P/poly}$?

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11. Is the following implication true for every problem X with a parameter k: if X has an $O(7^{8^k + 9 \ln n})$-time algorithm, then X (with parameter k) is in FPT?

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12. Does $\mathsf{NPSPACE} \subseteq \mathsf{IP}$?

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