SUPPLEMENTAL FINAL EXAM PRACTICE, CPSC 421/501, FALL 2023

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DOCUMENT UNDER CONSTRUCTION AND MAY BE INCOMPLETE

(1) Which of the following are true? Explain: explain why they are (always) true, or give a counterexample and explain why this is a counterexample.

  (a) If the Boolean formulas associated to an NP-complete language over the alphabet $\Sigma = \{T, F\}$ don't have polynomial size circuits, it follows that P $\neq$ NP.

  (b) If the Boolean formulas associated to an NP-complete language over the alphabet $\Sigma = \{T, F\}$ don't have polynomial size formulas, it follows that P $\neq$ NP.

  (c) As of November 2023, we know that PARTITION is NP-complete.

  (d) As of November 2023, it is possible that $a\{a,b\}^*b$ is NP-complete.

  (e) $\mathrm{Threshold}_{2,n}$ can be expressed by formulas of size $O(n \log_2 n)$.

  (f) $\mathrm{Threshold}_{2,n}$ can be expressed by circuits of size $O(n \log_2 n)$.

  (g) Parity_n can be expressed by formulas of size $O(n \log_2 n)$.

  (h) Parity_n can be expressed by formulas of size $O(n^2)$.

(2) Write a 3CNF formula that is satisfiable for all values of $x_1, \ldots, x_5 = T, F$ iff

$$(x_1) \wedge (x_2 \vee x_3 \vee x_4 \vee \neg x_5) = T;$$

(you may add additional variables).

(3) Is there a 3CNF formula in $x_1, \ldots, x_5$ that is equivalent to $x_2 \vee x_3 \vee x_4 \vee \neg x_5$? Explain.

(4) MORE PROBLEMS MAY BE ADDED LATER.

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Research supported in part by an NSERC grant.