Computational Complexity - Homework IV

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1 Instructions

- 1. The homework is due on May 8.
- 2. Each question is worth 4 points.
- 3. Attempt as many problems as you can. You will be given partial credit, as per the policy discussed in class.

2 Problems

- 1. Consider the following variant of SAT called HARSHSAT: You are given a 3CNF formula and the goal is to check if there exists an assignment such that at least two literals from each clause are satisfied. What is the complexity of HARSHSAT?
- 2. The following problem is called THRESHOLD2SAT: You are given a 2CNF formula ϕ , and an integer t. The goal is to check if there exists a satisfying assignment for ϕ such that at most t variables are set to **true**. What is the complexity of THRESHOLD2SAT?
- 3. Consider the following two variants of the Halting problem:
 - (a) ALL-HALTING: You are given the source code of a program Π and you required to determine if Π halts on all inputs.
 - (b) ZERO-HALTING: You are given the source code of a program Π and you required to determine if Π halts on 0.

Are the above problems decidable?

- 4. In class, we discussed and detailed the standard Turing machine. Consider the following variant of the Turing machine, in which the machine can insert and delete squares onto the tape. Argue that this additional power does not change the set of languages accepted by the Turing machine, i.e., if a language is accepted by the Turing machine variant, then it can be accepted by a standard Turing machine.
- 5. Consider the PARENTHESIS-MATCHING-NESTING problem. Here you are given a string of left and right parentheses. Your goal is to check if the parentheses are properly nested and matched. Argue that this problem is in the complexity class L.