CS244 Theory of Computation
Homework 5

Due: Sunday, Dec 20, 2020 at 11:59pm

Name - ID

You may discuss this assignment with other students and work on the problems together. However, your write-up should be your own individual work and you should indicate in your submission who you worked with, if applicable. You should use the LaTeX template provided by us to write your solution and submit the generated PDF file into Gradescope.

I worked with: (Name, ID), (Name, ID), …

Problem 1

Let $EQ_{\mathsf{BP}} = \{\langle B_1, B_2 \rangle \mid B_1 \text{ and } B_2 \text{ are equivalent branching programs}\}$. Show that EQ_{BP} is coNP-complete.

Problem 2

(a) Show that $A_{\mathsf{LBA}} = \{\langle B, w \rangle \mid B \text{ is an } \mathsf{LBA} \text{ that accepts input } w\}$ is PSPACE-complete.

(b) Show that $E_{\mathsf{DFA}} = \{\langle A \rangle \mid A \text{ is a } \mathsf{DFA} \text{ and } L(A) = \emptyset\}$ is NL-complete.

Problem 3

Say that two Boolean formulas are ***equivalent*** if they have the same set of variables and are true on the same set of assignments to those variables (i.e., they describe the same Boolean function). A Boolean formula is ***minimal*** if no shorter Boolean formula is equivalent to it. (For definiteness, say that the length of a Boolean formula is the number of symbols it has.) Let $MIN\_FORMULA$ be the collection of minimal Boolean formulas.

Show that $MIN\_FORMULA \in$ PSPACE.

Problem 4

Let B be the language of properly nested parentheses and brackets. For example, ([()()]()[]) is in B but ([)] is not.Show that B is in L.

Problem 5

Describe a deterministic, polynomial-time SAT-oracle Turing machine M^{SAT} that takes as input a directed graph G and nodes s and t, and outputs a Hamiltonian path from s to t if one exists. If none exist, then M^{SAT} outputs **No Hamiltonian path**.