Theory of Computation

Midterm Examination

CSIE210039

National Chi Nan University

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Problem 1 (20 points) Let $\bar{H}$ be $\{M; x | \ M(x)$ will not terminate$\}$. Show that $\bar{H}$ is not recursively enumerable.

Problem 2 (20 points) Show that there exists a Boolean function that cannot be represented by the conjunction of a set of Horn clauses. A Boolean function F is *represented* by the conjunction of a set of clauses C iff F and C take the same variables and the output of F coincides with the truth value of C for any appropriate assignments.

Problem 3 (20 points) Let L_1 and L_2 be recursive. Let

$$L_3 = \{xy| \ x \in L_1 \text{ and } y \in L_2\}.$$

Show that L_3 is recursive.

Problem 4 (20 points) Define $NOR(x, y) = \neg(x \vee y)$. Construct a valid expression (or tautology) in terms of NOR alone. (Note: Variables are also allowed, but constants $\top$ and $\perp$ are forbidden.)

Problem 5 (20 points) Explain why computer scientists employ big-O notation to analyze algorithms.