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14. Exercises for the Course „Complexity and Logic“

Exercise 58:

Prove Theorem 5.16 from the lecture: a language L is NP-complete iff its complement $\overline{L}$ is coNP-complete.

Exercise 59:

(CORRECTED) Complete the proof of Theorem 5.24 from the lecture by showing the following:

(a) $\mathrm{NP}^{P^{\Sigma_k^p}} = \mathrm{NP}^{\Sigma_k^p}$

(b) $P^{P^{\Sigma_k^p}} = P^{\Sigma_k^p}$

Exercise 60:

Show that the following problem is contained in Π_2^p:

$$\mathsf{Min} := \{\varphi \mid \varphi \text{ is a minimal propositional formula }\}.$$

Exercise 61:

Complete the proof of Theorem 5.27 by showing the following by induction on i:

$$\text{if } \Sigma_k^p = \Sigma_{k+1}^p, \text{ then } \Sigma_k^p = \Sigma_{k+i}^p \text{ for all } i \geq 0.$$

Exercise 62:

Complete the proof of Theorem 5.29 by showing that

$$\mathrm{NP}^{\mathrm{PSPACE}} \subseteq \mathrm{PSPACE}^{\mathrm{PSPACE}} = \mathrm{PSPACE}.$$

Exercise 63:

Complete the proof of yet another throrem, which is Theorem 5.30. To do this, show that

$$A \leq_p B \text{ and } B \in \Sigma_k^p \text{ implies } A \in \Sigma_k^p.$$