

Exercise 2

Task 1. Prove statement 3 of Lemma 2 (slide 9).

Task 2. Show that the following languages are in **L** by constructing Turing machines for these languages.

1. $L_1 = \{a^n b^n c^n \mid n \geq 1\}$
2. $L_2 = \{v\$v \mid v \in \Sigma^*\}$

Task 3. Prove the statement on slide 22.

Task 4 (Nondeterministic Logspace). A directed graph $G = (V, E)$ is called *strongly connected*, if for all pairwise distinct nodes v_i, v_j there is a directed path from v_i to v_j .

Does the problem

Input: A directed graph $G = (V, E)$.

Question: Is G strongly connected?
belong to the complexity class **NL**?

Task 5 (Deterministic Logspace). Does the problem

Input: An integer $N \in \mathbb{N}$ in *unary* encoding.

Question: Is N a prime number?
belong to the complexity class **L**?