

Date: 2025-05-21 Version: 2025-05-20 17:37

Exercise Sheet 2 for Advanced Algorithms, Summer 2025

Hand In: Until 2025-05-28 18:00, on ILIAS.

Problem 1

30 + 30 + 30 points

For each of the following problems, either sketch a pseudopolynomial algorithm for solving the problem (proving that the problem is only weakly NP-hard), or show that the problem is strongly NP-hard.

For integer-input problems with numbers in \mathbb{Z} , MaxInt of an instance is the largest *absolute value* occurring in the input.

a) PARTITION

Given: A sequence of integers $x_1, \ldots, x_n \in \mathbb{N}$.

Question:
$$\exists I \subseteq [n]$$
 : $\sum_{i \in I} x_i = \sum_{i \in [n] \setminus I} x_i$?

b) Subset Sum

Given: $x_1, \ldots, x_n \in \mathbb{Z}$. Question: $\exists I \subseteq [n] : I \neq \emptyset \land \sum_{i \in I} x_i = 0$?

c) 0/1 Integer Programming

Given: Integer linear program (ILP): $A \in \mathbb{Z}^{m \times n}$, $b \in \mathbb{Z}^m$ and $c \in \mathbb{Z}^n$ and $k \in \mathbb{Z}$ **Question:** Is there $x \in \{0, 1\}^n$ with $Ax \leq b$ and $c^T x \geq k$?