DM898 Parameterized Algorithms
Fall 2025

Exercise Sheet 3

Complete before class on Friday, September 26th

Exercise 1. In the Point Line Cover problem, we are given a set of n points in the plane and an integer k, and the goal is to check if there exists a set of k lines on the plane that contain all the input points. Give a kernel for this problem with $O(k^2)$ points.
Hint: What can you say if more than k points lie on one line?

Exercise 2. Using the preprocessing rules from the lecture, simplify the following integer linear program as much as possible.

$$\begin{aligned} \min x_1 + 3x_2 - x_3 + 3x_4 & \\ x_1 - x_3 + 3x_4 &\leq 6 \\ x_3 + x_4 &\leq 2 \\ 2x_2 + 3x_4 &\geq 4 \\ x_2, x_4 &\in \{0, 1\} \\ x_1, x_3 &\in \mathbb{Z}_{\geq 0} \end{aligned}$$

Exercise 3. In the d-Set Packing problem we are given a family of sets $\mathcal{A}$ over universe U, each of cardinality at most d, and a number $k \in \mathbb{N}$. Our goal is to find k disjoint sets $S_1, \ldots, S_k$. Use the sunflower lemma to derive a kernel for this problem with $f(d)k^d$ sets, where f is an arbitrary function.
Hint: Consider a $(kd + 2)$-sunflower. You can remove any of the sets in the sunflower without changing the answer to the problem. Why?