RWTH Aachen **SS 2014**
Lehrgebiet Theoretische Informatik Problem Set 4
Reidl—Rossmanith—Sánchez—Sikdar 06.11.2014

Parameterized Algorithms Tutorial

Tutorial Exercise T1

Consider the hereditary property $\Pi_{0,0,k}$ which states that we can add less than k edges to G and make a chordal graph. Prove that $\Pi_{0,0,k}$ has no finite forbidden set characterization.

Tutorial Exercise T2

Consider the following: you are given n points in the plane and an integer k. Your task is to find k lines that cover all of the n points or conclude that no such set of lines exists.
Design a quadratic kernel for this problem.

Tutorial Exercise T3

Let us look at the Unique Hitting Set problem which is defined as follows: Given is a universe set U and k sets $X_1, \ldots, X_k \subseteq U$. Is there are set $S \subseteq U$ such that for all $1 \leq i \leq k$ it holds that $|S \cap X_i| = 1$? Show by reducing to a kernel that this problem is in FPT when parameterized by the number of sets k.

Homework H1

Show that planarity is a hereditary property. Is the forbidden set finite or infinite? If your answer is "finite" then construct the forbidden set; if your answer is "infinite", then construct an infinite family $\mathcal{F}$ of non-planar graphs such that

- for all $G \in \mathcal{F}$, all proper subgraphs of G are planar;
- for all distinct $G_1, G_2 \in \mathcal{F}$, we have that G_1 is not an induced subgraph of G_2.

Homework H2

We consider the Cluster Editing problem: given a graph G and an integer k, decide whether one can add or delete up to k edges to turn G into a *cluster graph* (recall that a cluster graph is simply a collection of disjoint cliques).
Design a kernel with a quadratic number of vertices.

Hint: first prove that a graph is a cluster graph if and only if it does not contain an induced P_3, then design appropriate reduction rules.