Geometry Seminar
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Room 613, Courant Institute
251 Mercer Street, New York

Discrete and Lexicographic Helly Theorems and Geometric Optimization

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Abstract

Helly's theorem says that if every $d+1$ elements of a given finite set of convex objects in $\mathbf{R}^d$ have a common point, then there is a point common to all of the objects in the set. We define three new types of Helly theorems: discrete Helly theorems - where the common point should belong to an a-priori given set, lexicographic Helly theorems - where the common point should not be lexicographically greater than a given point, and lexicographic-discrete Helly theorems. We obtain several new discrete and lexicographic Helly numbers.

Beyond the intrinsic interest in the different types of Helly theorems, we show that these new types of Helly theorems are useful for getting linear time solutions for various optimization problems. For this, we define a new framework, *DLP-type* (Discrete Linear Programming type), and provide algorithms that solve in randomized linear time fixed-dimensional DLP-type problems. We apply the DLP-type framework in order to improve the best known solutions for various problems in location theory, computational geometry and game theory.

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