HAUSDORFF RESEARCH INSTITUTE
FOR MATHEMATICS

UNIVERSITÄT BONN

Summer School on

"School on modern directions in discrete optimization"

September 13 - 17, 2021

organized by

Daniel Dadush (Amsterdam), Jesper Nederlof (Utrecht), Neil Olver (London), Laura Sanità (Eindhoven), László Végh (London)

Abstracts

Michał Pilipczuk (Warsaw University)

Introduction to parameterized algorithms and applications in discrete optimization

Abstract: The mini-course will provide a gentle introduction to the area of parameterized complexity, with a particular focus on methods connected to (integer) linear programming. We will start with basic techniques for the design of parameterized algorithms, such as branching, color coding, kernelization, and width-based dynamic programming. Later we move to problems and techniques closer to discrete optimization: LP-guided branching and kernelization, integer linear programming in fixed dimension (Lenstra's algorithm), and methods for solving structured ILPs based on Graver bases.

Aaron Sidford (Stanford University)

Introduction to interior point methods for discrete optimization

Abstract: TBA

Ngoc Mai Tran (UT Austin)

Tropical solutions to hard problems in auction theory and neural networks, semigroups and extreme value statistics

Abstract: Tropical mathematics is mathematics done in the min-plus (or max-plus) algebra. The power of tropical mathematics comes from two key ideas: (a) tropical objects are limits of classical ones, and (b) the geometry of tropical objects is polyhedral. In this course, I'll demonstrate how these two ideas are used to solve a variety of problems in different domains the last 10 years, from deep neural networks, semigroups theory, auction theory and extreme value statistics.

Rico Zenklusen (ETH Zürich)

Approximation algorithms for hard augmentation problems

Abstract: Augmentation Problems are a fundamental class of Network Design Problems. In short, the goal is to find a cheapest way to increase the (edge-)connectivity of a graph by adding edges from a given set of options. The Minimum Spanning Tree Problem is one of its most elementary examples, which can be interpreted as determining a cheapest way to increase the edge-connectivity of a graph from 0 to 1. It is a simple special case of the much harder task of increasing the edge-connectivity from some arbitrary value k to $k+1$. This leads to some well-known and heavily studied augmentation problems that enjoyed a surge of interest recently, including (unweighted and weighted) Tree Augmentation and, more generally, Connectivity Augmentation. We will discuss some recent approaches and advances in the field, which combine classical results and techniques in Combinatorial Optimization with a variety of new ideas.