Dear colleagues and students,

Discrete Optimization is the key to solving many problems from a broad spectrum of industrial and other applications. Moreover, Discrete Optimization is also linked to the recently flourishing area of Machine Learning. Efficient decomposition techniques as well as sophisticated combinatorial algorithms have been key ingredients to the success of the applicability of Discrete Optimization to real-world problems. Problem instances that, years ago, were judged intractable due to their size and the complexity of the underlying problem can now be solved.

During the workshop, internationally recognized leading scientists will introduce to state-of-the art techniques from different areas of Discrete Optimization and discuss recent advances as well as challenges. In addition to traditional approaches from scheduling and Dantzig-Wolfe decomposition there will be presentations about the interconnection between Discrete Optimization and Machine Learning.

The objective of the Felix Klein Academy autumn workshop is to introduce to important techniques, stipulate research and to discuss applications as well as the impact on real-world problems.

S. Krumke K.-H. Küfer

Venue

Auditorium at Fraunhofer Institute
for Industrial Mathematics ITWM
Room I 0.01/I 0.05
Fraunhofer-Platz 1
67663 Kaiserslautern

Participation

Everybody interested in the subjects is cordially invited to the lectures. Registration is not required. Admission free.

Contact

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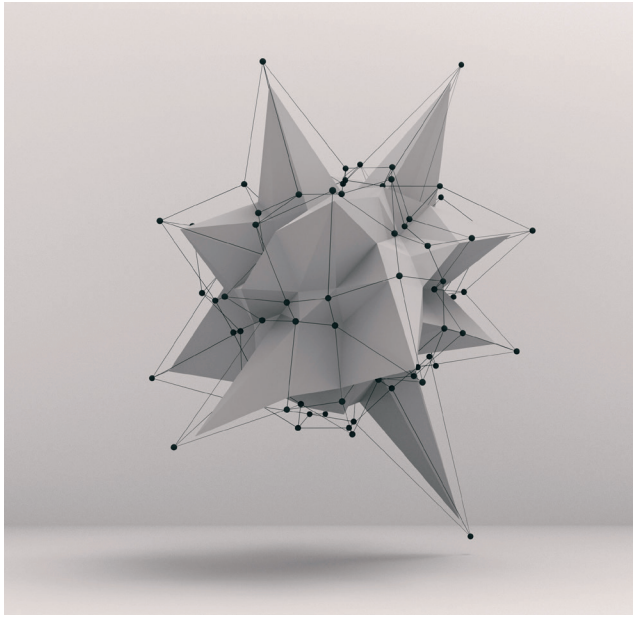

Felix Klein Academy – Autumn Workshop

Discrete Optimization

September 25th – 27th, 2019
Fraunhofer Institute for Industrial Mathematics ITWM
Fraunhofer-Platz 1, Kaiserslautern

FELIX KLEIN
ZENTRUM FÜR
MATHEMATIK

Prof. Sebastian Pokutta,
ZIB and TU Berlin

Wednesday, September 25th, 9:00 am to 12:30pm

9:00 **Discrete Optimization and Machine Learning**
The session will provide a high-level introduction to DO, ML, and their interfacing. We will recall general perspectives that are prevalent in the respective areas, highlighting current challenges, and why progress at the interface of DO and ML is necessary to make progress towards integrated Artificial Intelligence systems.

10:30 coffee break

11:00 **Current Challenges at the Interface of Discrete Optimization and Machine Learning**
We will discuss two specific approaches: online learning over discrete decisions and smooth convex optimization over polytopes, both of which are natural interpolations between discrete decision making and learning. We will go through the basics, the underlying theory, applications, and computational examples. Finally, we will briefly discuss reinforcement learning as a zero-order learning method that has shown promise for certain types of problems in terms of combining learning and (discrete) decision-making.

S. Pokutta is the Vice President of the Zuse Institute Berlin and a Professor of Mathematics at TU Berlin with a research focus on AI, Optimization and combining ML with DO techniques as well as the Theory of Extended Formulations, exploring the limits of computation in alternative models of complexity.

Prof. Marco Lübbecke,
RWTH Aachen University

Thursday, September 26th, 9:00 am to 12:30pm

9:00 **Branch-Price-and-Cut for the Impatient**
This talk is an introduction to reformulating an integer program via Dantzig-Wolfe reformulation, solving the resulting (restricted) master problem by column generation, strengthening the relaxation by additional cutting planes, and embedding everything in a branch-and-bound algorithm.

10:30 coffee break

11:00 **Automating Branch-Price-and-Cut: Structure is Everything**
Branch-Price-and-Cut has been (more and more) successfully applied to solve (discrete) optimization problems in a vast variety of applications in science and practice. In this talk we speak about detecting model structure that needs to be known in order to perform a Dantzig-Wolfe reformulation on a model, and about the underlying graph problems that need to be solved. We give examples using the GCG code.

M. Lübbecke is a full professor and chair of operations research at RWTH Aachen University. His research and teaching interests are in computational integer programming and discrete optimization, covering the entire spectrum from fundamental research and methods development to industry scale applications.

Prof. René Sitters,
Vrije Universiteit, Amsterdam

Friday, September 27th, 9:00 am to 12:30pm

9:00 **Complexity and Approximation of Scheduling Problems**
The first lecture gives an introduction in approximation algorithms for scheduling problems. We will discuss techniques like LP-rounding, α-point scheduling, dynamic programming, and cutting plane methods.

10:30 coffee break

11:00 **Problem of Minimizing AverageJob Completion Time**
The lecture will highlight current research and will show some challenging open problems. I will focus on the problem of minimizing average job completion time and show how a new and simple decomposition technique improves the approximability of several fundamental scheduling problems as well as other optimization problems, e.g., the traveling repairman problem (which is the TSP with average completion time objective).

R. Sitters is associate professor at the Vrije Universiteit, Amsterdam, department of Operations Research and Econometrics. His main research interest is complexity and approximation of routing and scheduling problems.