2nd ABCD Workshop on Algorithms and Mathematical Optimization: New Trends

Date: July 14, 2025
Location: Seminargebäude (106), Universitätsstr. 37, University of Cologne

The goal of this afternoon workshop is to bring together researchers at all levels — from professors to PhD students — from the Aachen-Bonn-Cologne-Dortmund area (and beyond!) who are working on algorithms and mathematical optimization. The aim is to exchange ideas and challenges and to initiate possible future collaborations.

Participation is free of charge, but please register in advance (by **Sunday, June 29, 2025**) by sending an email to Annette Koenen.

Schedule

- **13:00** – Check-in
- **13:15–15:00** – Talks
  - **Nithin Varma (Cologne)**
    Sublinear Nearest Neighbor Data Structures in the Ultra High Dimensional Setting

    Abstract: In high-dimensional machine learning and data-analysis settings, the sheer dimensionality d often surpasses the dataset size n, making traditional nearest-neighbor structures impractical due to their linear or superlinear dependence on d.
    This talk presents a data structure that achieves sublinear dependence on d both in space and query complexity. Specifically, we construct a nearly optimal $(1+\varepsilon)$-approximate nearest neighbor data structure for ultra-high dimensions ($d \gg n$) under the ℓ_1 and ℓ_2 metrics, using only $\mathcal{O}(n \log d/\text{poly}(\varepsilon))$ space and supporting queries in $\tilde{\mathcal{O}}(n/\text{poly}(\varepsilon))$ time.
    Joint work with: Martin Herold, Danupon Na Nongkai, Joachim Spoerhase, and Zihang Wu (SoCG 2025).
  - **Kevin Buchin (Dortmund)**
    Recent Advances in Geometric TSP Variants and Spanner Construction

    Abstract: We give an overview of recent work on two types of optimization problems on geometric graphs: route planning and network construction.
    First, we present results on the geometric TSP and the orienteering problem with time windows: selecting a maximum-profit walk under a length budget, subject to visiting points within specified time intervals. We survey tractable cases when the underlying graph is simple (e.g., a path or cycle), including polynomial-time algorithms and approximation schemes.
    Then, we shift to geometric spanners: sparse graphs that approximately preserve dis-

tances. We highlight results on oriented spanners, including the first algorithm to build sparse oriented spanners of constant dilation in fixed dimensions.

- **Petra Mutzel (Bonn)**
  Computational Analytics

  Abstract: Our research group focuses on the computer-based analysis of large and complex data sets that can be modeled as graphs or networks.

  In the first part of my talk, I will introduce our DFG funded research unit FOR 5361: Algorithmic Data Analytics for Geodesy (AlgoForGe, jointly with the PIs A. Driemel, J.-H. Haunert, J. Kusche, H. Röglin, M. Schmidt, and C. Sohler). This interdisciplinary initiative addresses core algorithmic challenges arising in geodetic applications, with a focus highlight recent contributions from our group within this project on triangulation problems motivated by applications such as sea level prediction and map aggregation. (Joint work with A. Beines, L. Blank, D. Eppstein, J.-H. Haunert, H. Haverkort, M. Kaibel, B. Kolbe, P. Mayer, A. Naumann, J. Sauer).

  Another line of our research focuses on Integer Linear Programming (ILP). In particular, we explore both existing and novel ILP formulations for the Graph Edit Distance (GED) problem, a fundamental and widely used measure of similarity between graphs. Given two labeled graphs G and H, the GED is defined as the minimum-cost sequence of node and edge edit operations (insertions, deletions, substitutions) required to transform G into H. (Joint work with F. Rossi, A. D.'Ascenzo, J. Meffert).

- **15:00–15:30** – Coffee Break
- **15:30–17:15** – Talks

  - **Anne Driemel (Bonn)**
    Finding Complex Patterns in Trajectory Data

    Abstract: We consider two algorithmic problems that are fundamental when dealing with curves in the form of trajectory and time series data: clustering and proximity searching. The Fréchet distance provides a natural way to measure the similarity of curves under varying continuous reparametrizations. However, its mathematical simplicity disguises its computational complexity since it does not naturally behave like a doubling space. I will give a brief overview of recent data structure techniques for different variants of proximity searching under the Fréchet distance. The input is a set of polygonal curves and the query is a polygonal curve and should return the input curves that are closest to the query curve. In the second part of my talk I will review variants of clustering problems using the Fréchet distance measure. Subtrajectory clustering is a variant of the trajectory clustering problem, where the start and endpoints of trajectory patterns within the collected trajectory data are not known in advance. We study this problem in the form of a set cover problem for a given polygonal curve: find the smallest number k of representative curves such that any point on the input curve is contained in a subcurve that has Fréchet distance at most a given r to a representative curve.

  - **Martin Hoefer (Aachen)**
    Designing Exploration Contracts

    Abstract: We propose a model for contract design in which a principal delegates a sequential search task to an agent. The agent explores n options (e.g., boxes with unknown prizes), pays a cost per inspection, and selects one prize. Both agent and principal derive value from the selected prize.
    The principal influences the agent's decisions by offering contracts — payments based

on discovered outcomes. This problem generalizes the Pandora's Box model. We present algorithms for optimal linear contracts (in polynomial time), and also for optimal general contracts in special cases: when agents have no individual value, prizes are aligned in value, or distributions are i.i.d.

– **Kevin Schewior (Cologne)**
Recent Advances on Stochastic Boolean Function Evaluation

Abstract: The Stochastic Boolean Function Evaluation (SBFE) problem involves evaluating a Boolean function defined on independent Boolean random variables with known distributions and inspection costs.
This talk surveys recent approximation algorithms for computing optimal adaptive and non-adaptive policies for SBFE, and discusses remaining open questions in this area of stochastic combinatorial optimization.

- **17:15** – Check-out
- **18:00** – Biergarten / Restaurant (self-organized)

Organizers

Anja Fischer (Dortmund), Britta Peis (Aachen), Heiko Röglin (Bonn), Frank Vallentin (Cologne)

Link to 1st ABCD Workshop