

Graduate Seminar on Discrete Optimization

Maximum Flow and Minimum-Cost Flow in Almost Linear Time

Topic of the Seminar

Main source:

Li Chen, Rasmus Kyng, Yang P. Liu, Richard Peng, Maximilian Probst Gutenberg, and Sushant Sachdeva [2022]:

Maximum Flow and Minimum-Cost Flow in Almost-Linear Time.

Theorem ([CKLPGS, 2022])

There is an algorithm that, given

- *a graph $G = (V, E)$ with m edges,*
- *vertex demands, upper/lower edge capacities, and edge costs, all integral with capacities bounded by U and costs bounded by C ,*

computes an exact min-cost flow in $m^{1+o(1)} \log U \log C$ time with high probability.

How the Seminar works

Each seminar session is structured as follows:

1. First part of the talk (10-20 minutes)

Introduce the topic of the talk.

Explain what the main goal or main result will be.

Give some motivation – why is the result interesting/relevant?

Provide some context, e.g., relation to other talks, relevance for the overall min-cost flow algorithm, related results in the literature.

2. Questions for the audience

One or two (multiple-choice) questions from the speaker to the audience.

A good opportunity for the audience to ask questions.

How the Seminar works

Each seminar session is structured as follows:

1. First part of the talk (10-20 minutes)
2. Questions for the audience
3. Second part of the talk (55–65 minutes)
Present proofs, but focus on the main ideas rather than detailed calculations.
4. Discussion
Questions from the audience to the speaker.

Parts 1 and 3 must not take more than 75 minutes in total.

Recall definitions and results from previous talks when you use them.

What we expect

- Read the introduction of the paper that will be the main source for the seminar and watch a talk by Rasmus Kyng on this topic. (Links available on the website.)
- Prepare a talk on your assigned topic, including questions for the audience.
- Prepare a 1–2 pages summary containing the most important results and definitions.
- Give an approval talk approximately 2–3 weeks before your talk.
- Participate actively in the discussions during the seminar.

In addition to reading the assigned sections, it might be necessary to look into other parts of the paper or other sources.

Assignment of Topics and Registration

If you would like to participate in the seminar, send an email to Ulrich Brenner (brenner@or.uni-bonn.de) indicating your name and topic preferences by

Thursday, January 26, at 1 pm.

We will inform you by email about the assignment of topics. Every participant will also be assigned a supervisor that can help with questions.

After the assignment of topics, you have 1 week to sign your binding registration.

In addition, all participants must register via BASIS in early April.

Topics of the individual talks

- ① **Potential Reduction Interior Point Method** (1 talk)
- ② **Expander Decompositions** (1 talk)
- ③ **Decremental Spanners with Embedding**
 - ③a The Algorithm (1 talk)
 - ③b Implementing the Sparsification procedure (1 talk)
- ④ **Low Stretch Spanning Trees** (1 talk)
- ⑤ **Link-Cut Trees** (1 talk)
- ⑥ **Data Structure Chain** (1 talk)
- ⑦ **Routing and Cycle Quality Bounds** (2 talks)
- ⑧ **Rebuilding Data Structure Levels** (1 talk)