Graduate Seminar on Discrete Optimization

Approximation Algorithms for Vehicle Routing

Summer term 2026

How the Seminar runs

Each talk shall run as follows:

1. Part 1 (10–20 minutes)
   Introduce the topic.
   What will be the main results?
   Why are they important and interesting?
   Embed your topic into a broader context, e.g., by showing connections to other talks in this seminar or related results in the literature.
2. Questions to the audience
   Ask one or two (multiple-choice) questions to check whether the audience has understood the key concepts.
   This is also a good opportunity for the audience to ask questions.

How the Seminar runs

Each talk shall run as follows:

1. Part 1 (10–20 minutes)
2. Questions to the audience
3. Part 2 (55–65 minutes)
   Explain proofs, but focus on the main ideas rather than detailed calculations.
4. Discussion (15 minutes)
   Questions of the audience to the speaker. Everyone should participate in the discussion!

The two parts of the talk together must not exceed 75 minutes.
If you use definitions or proofs from previous talks, remind the audience by repeating relevant things briefly.

What we expect from you

- Understand every aspect of your topic
- Prepare your talk on the assigned topic carefully, including questions to the audience.
- Prepare a 1- or 2-page summary of your talk, with the most important definitions and results. Distribute hardcopies of this before your talk to the audience.
- Give a rehearsal talk about 2–3 weeks before your main talk.
- Participate actively in the discussions in the seminar.

Besides the text assigned to you, it is usually necessary and always helpful to study further sources (e.g., read other papers).

Assignment of topics and registration

If you want to participate in this seminar, send an e-mail to Ulrich Brenner (brenner@dm.uni-bonn.de) with your name and your favorite topics no later than

Tuesday, February 10, before 14:00.

A few days later we will inform you by e-mail about the assignment of the topics.

After the assignment you have one week for the final registration. After that we may give your place to another student.

In addition, you have to register in BASIS in early April (before the seminar begins).

Each participant will be assigned an advisor (usually one of our PhD students) who can help with questions.

Main Sources

TV V. Traub, J. Vygen : Approximation Algorithms for Traveling Salesman Problems. Cambridge University Press 2025

BBCM N. Bansal, A. Blum, S. Chawla, A. Meyerson: Approximation algorithms for deadline-TSP and vehicle routing with time-windows. Proceedings of STOC 2004, 166–174

NR V. Nagarajan, R. Ravi: The directed orienteering problem. Algorithmica 60 (2011), 1017–1030

BM J. Blauth, R. Mousavi: A constant-factor approximation for directed latency. arXiv:2512.15473

BTV J. Blauth, V. Traub, J. Vygen: Improving the approximation ratio for capacitated vehicle routing. Mathematical Programming 197 (2023), 451–497

FMRS Z. Friggstad, R. Mousavi, M. Rahgoshay, M.R. Salavatipour: Improved approximations for capacitated vehicle routing with unsplittable client demands. Proceedings of IPCO 2022, 251–261

FGM Z. Friggstad, F. Grandoni, R. Mousavi: Breaching the 2-approximation barrier for Euclidean capacitated vehicle routing. Proceedings SODA 2026, 2644–2668

MZ C. Mathieu, H. Zhou: A PTAS for capacitated vehicle routing on trees. ACM Transactions on Algorithms 19 (2023), Article 17

FM Z. Friggstad, T. Mömke: Approximating multiple-depot capacitated vehicle routing via LP rounding. arXiv:2510.05321 (to appear in IPCO 2026)

GHNR A. Gupta, M. Hajiaghayi, V. Nagarajan, R. Ravi: Dial a ride from k-forest. ACM Transactions on Algorithms (2010), Article 41

Topics of the Talks

Read before: Approximation algorithms for TSP, tour splitting [TV, Chapter 1, Section 17.6]

1. TSP with time windows [BBCM]
2. $O(\log n)$-approximation for directed orienteering [NR]
3. An LP for directed latency [BM, Sections 2,3,4]
4. Rounding the directed latency LP [BM, Sections 2,5,6]
5. Reduction to vehicle routing with target groups [BTV, Sections 2–3]
6. LP-based algorithm for target groups [BTV, Section 5–6]
7. Better tour splitting for unsplittable instances: the δ-tank lemma [FMRS]
8. Euclidean capacitated vehicle routing 1 [FGM, Sections 1–2]
9. Euclidean capacitated vehicle routing 2 [FGM, Sections 3–4]
10. Vehicle routing on trees [MZ]
11. Multi-depot capacitated vehicle routing [FM]
12. Dial-a-ride problem [GHNR]