Graduate Seminar on Discrete Optimization (Summer 2021)

Randomized Algorithm with Approximation Ratio Better than 3/2 for Symmetric TSP

1. Maximum entropy distributions of spanning trees – Section 1.1 and Theorem 1.3 and its proof from Asadpour et al.
2. Strongly Raleigh measures and random spanning trees – Section 2.4 and sketch of Section 2.5 and Section 2.6
3. Main theorem - Structure of the proof – Sections 2.2 and 3.0 and 4.1 (proof of Theorem 1.1 using Theorem 3.1 and proof of Theorem 4.2)
4. Cuts crossed on both sides and polygons – Section 4.2 (proof of Theorem 3.1 using Theorem 4.6) and beginning of Section 4.3
5. Cuts crossed on one side and hierarchy of cuts – Rest of Section 4.3 up to 4.5 (proof of Theorem 4.6 using Theorem 4.33)
6. Gurvits Lemma – Sections 5.1 and 5.2
7. Good edges – Sections 5.3 and 5.4
8. Matching – Sections 6 and 7.0 (proof of Theorem 4.33 using Theorem 7.1)
9. Reduction and payment: good top edges – Section 7.1
10. Reduction and payment: increase for bottom edges – Section 7.2
11. Reducing Path TSP to TSP (I) – Traub et al., mainly Sections 3.2 and 5
12. Reducing Path TSP to TSP (II) – Traub et al., mainly Sections 3.3, 3.4, and 4

Literature:

- *Main source for talk 1:* An $O(\log n / \log \log n)$-approximation algorithm for the asymmetric traveling salesman problem (Asadpour, Goemans, Mądry, Oveis Gharan, Saberi), Operations Research 65 (2017), 1043–1061; short version in SODA 2010
- *Main source for talks 1–10:* A (slightly) improved approximation algorithm for metric TSP (Karlin, Klein, Oveis Gharan), arXiv:2007.01409
- *Main source for talks 11–12:* Reducing Path TSP to TSP (Traub, Vygen, Zenklusen), arXiv:1907.10376; short version in STOC 2020

See `http://www.or.uni-bonn.de/lectures/ss21/graduate_sem_ss21.html` for details.