Advanced Topics in Network Algorithms

510.7435

Lectures: Mondays 6-8. Tochna 106.

Lecturer: Boaz Patt-Shamir, boaz@tau.ac.il. Office: Tochna 213. Coordinate meetings by email.

Prerequisite: Introduction to Network Algorithms.

Objective of the Course. We study algorithms that run on multiple processors connected by communication links. We will review some recent and not-so-recent research in this area, as presented in conferences and scientific journals. The objective of the course is twofold: One is the usual goal of learning: know more about the subject matter. The second goal is more methodological: get a first-hand experience with reading research papers and communicating its main points to others. Specifically, every student will be assigned a paper to read and present.

Topics. This year we focus on network decompositions. Decompositions are a central algorithmic tool to localize network problems. We shall look at decompositions for wide-link networks (the LOCAL model) and for limited-bandwidth networks (a la CONGEST).

Tentative schedule.

Date	Topic	Papers	Presenter
24.10.22	Introduction. Subpolynomial algorithms for decomposition	AGLP'89 [2]	BPS
31.10.22	Sub-polynomial algorithms (cont.)	PS'93 [11]	BPS
7.11.22	Randomized algorithms for decomposition	LS'91 [10]	BPS
14.11.22	Polylogarithmic deterministic algorithms 1	VR'21 [13]	
21.11.22	Polylogarithmic deterministic algorithms 2	GGR'22 [5]	
28.11.22	**NO CLASS**		
5.12.22	Approximating distance with tree ensemble	FRT'03 [4]	BPS
12.12.22	Decomposition for congestion: Oblivious routing	R'08 [12]	
19.12.22	Traffic Engineering by oblivious routing	KYYFKLLS'18 [9]	
26.12.22	Oblivious routing with hop bound	GHZ'21 [6]	
2.1.23	*k*-connected spanning subgraphs	D'18 [3]	
9.1.23	Congestion-routing in dynamic graphs	GRST'21 [8]	
16.1.23	Conclusion		BPS

Bibliography.

See here for instructions on how to access text.

1. Matthew Andrews. Approximation Algorithms for the Edge-Disjoint Paths Problem via Raecke Decompositions. DOI**:** doi.org/10.1109/FOCS.2010.33
2. B. Awerbuch, M. Luby, A. V. Goldberg and S. A. Plotkin. Network decomposition and locality in distributed computation, *30th Annual Symposium on Foundations of Computer Science*, 1989, pp. 364-369, doi: 10.1109/SFCS.1989.63504.
3. Michal Dory. Distributed Approximation of Minimum k-edge-connected Spanning Subgraphs. https://doi.org/10.1145/3212734.3212760
4. Jittat Fakcharoenphol, Satish Rao, and Kunal Talwar. A tight bound on approximating arbitrary metrics by tree metrics.https://doi.org/10.1016/j.jcss.2004.04.011
5. Mohsen Ghaffari, Christoph Grunau and V´aclav Rozhoˇn. Improved deterministic network decomposition. https://epubs.siam.org/doi/abs/10.1137/1.9781611976465.173
6. Mohsen Ghaffari, Bernhard Haeupler and Goran Zuzic. Hop-Constrained Oblivious Routing. https://doi.org/10.1145/3406325.3451098
7. Mohsen Ghaffari, Christoph Grunau, Bernhard Haeupler, Saeed Ilchi and Václav Rozhoň. Improved Distributed Network Decomposition, Hitting Sets, and Spanners, via Derandomization. arXiv:2209.11669
8. Gramoz Goranci, Harald Räcke, Thatchaphol Saranurak, and Zihan Tan. The Expander Hierarchy and its Applications to Dynamic Graph Algorithms. DOI:https://doi.org/10.1137/1.9781611976465.132
9. Praveen Kumar, Yang Yuan, Chris Yu, Nate Foster, Robert Kleinberg, Petr Lapukhov, Chiun Lin Lim and Robert Soulé. Semi-oblivious traffic engineering: the road not taken. https://dl.acm.org/doi/10.5555/3307441.3307455, pdf
10. Nathan Linial and Michael Saks. Low diameter graph decompositions. https://doi.org/10.1007/BF01303516
11. Alessandro Panconesi and Aravind Srinivasan. Improved distributed algorithms for coloring and network decomposition problems. https://doi.org/10.1145/129712.129769
12. Harald Raecke. Optimal Hierarchical Decompositions for Congestion Minimization in Networks. https://doi.org/10.1145/1374376.1374415
13. V´aclav Rozhoˇn and Mohsen Ghaffari. Polylogarithmic-Time Deterministic Network Decomposition and Distributed Derandomization.https://doi.org/10.1145/3357713.3384298