Advanced Network Algorithms
## Fall semester, 2020-2021

Lectures: Mondays 4-6, via Zoom (link).

Lecturer: Boaz Patt-Shamir, boaz@tau.ac.il.

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. We believe that the these skills are essential for anyone doing research, *particularly MSc students.*
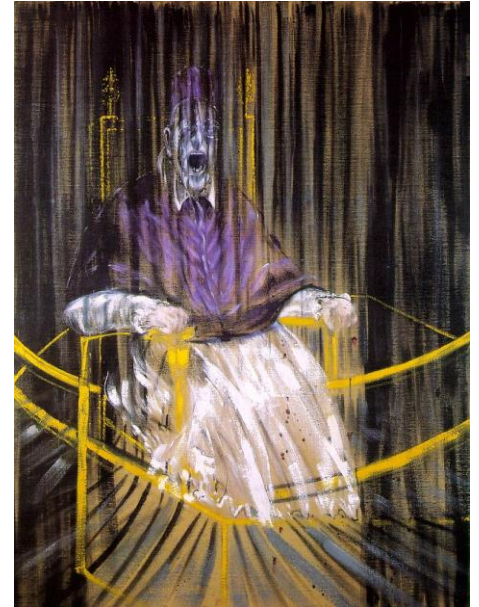
Topics. This year we focus on the following main topics:
- Buffer overflow management in switches
- Clock synchronization
- The Congested Clique model

Requirements. Each student will be responsible to studying a research paper and presenting it to the others, as well as come up with a question or two about the material. Aside from that, all students are required to attend all meetings. The grade will be given based on the following components:
- Reading comprehension (25%)
- Presentation (25%)
- Command of the subject (40%)
- Class participation (10%)

Tentative Schedule

Date	Topic	Papers	Presenter
19.10.20	Buffer Overflows: Intro	[1]	Boaz Patt-Shamir
26.10.20	Clock Synchronization: Intro	[7,8]	Boaz Patt-Shamir
2.11.20	Congested Clique: Intro	[11,12,13]	Boaz Patt-Shamir
9.11.20	Competitive overflows in a single buffer	[2]	
16.11.20	Avoiding overflows on a line and grids	[3]	
23.11.20	Minimizing losses with fragmented packets	[4]	
30.11.20	Minimizing space with restricted adversary	[5,6]	
7.12.20	Gradient clock synchronization: Lower bound	[9]	
14.12.20	Gradient clock synchronization: upper bound	[10]	
21.12.20	APSP in the Congested Clique	[14]	
28.12.20	Algebraic methods in the clique	[15]	
4.1.21	Minimum Spanning Tree	[16]	
11.1.21	Conclusion		

Bibliography

1. Alexander Kesselman, Zvi Lotker, Yishay Mansour, Boaz Patt-Shamir, Baruch Schieber, and Maxim Sviridenko: *Buffer Overflow Management In QoS Switches*. SIAM Journal On Computing, Vol. 33, No. 3, pp. 563–583.

2. Nikhil Bansal, Lisa Fleischer, Tracy Kimbrel, Mohammad Mahdian, Baruch Schieber, Maxim Sviridenko: *Further Improvements in Competitive Guarantees for QoS Buffering*. ICALP 2004: 196-207.

3. Guy Even, Moti Medina, Boaz Patt-Shamir. *Better Deterministic Online Packet Routing on Grids*. SPAA 2015: 284-293.

4. Yuval Emek, Magnús M. Halldórsson, Yishay Mansour, Boaz Patt-Shamir, Jaikumar Radhakrishnan, Dror Rawitz. *Online set packing and competitive scheduling of multi-part tasks*. PODC 2010: 440-449.

5. Avery Miller, Boaz Patt-Shamir: *Buffer Size for Routing Limited-Rate Adversarial Traffic*. DISC 2016: 328-341.

6. Boaz Patt-Shamir, Will Rosenbaum: T*he Space Requirement of Local Forwarding on Acyclic Networks*. PODC 2017: 13-22.

7. Boaz Patt-Shamir, Sergio Rajsbaum. *A theory of clock synchronization*. STOC 1994: 810-819.

8. Jennifer Lundelius, Nancy A. Lynch. *An Upper and Lower Bound for Clock Synchronization*. Inf. Control. 62(2/3): 190-204 (1984).

9. Rui Fan, Nancy A. Lynch. *Gradient clock synchronization*. Distributed Comput. 18(4): 255-266 (2006).

10. Christoph Lenzen, Thomas Locher, Roger Wattenhofer. *Tight bounds for clock synchronization.* PODC 2009: 46-55.

11. Zvi Lotker, Elan Pavlov, Boaz Patt-Shamir, David Peleg. *MST construction in O(log log n) communication rounds*. SPAA 2003: 94-100.

12. Christoph Lenzen. *Optimal Deterministic Routing and Sorting on the Congested Clique.* PODC 2013: 42-50.

13. Andrew Drucker, Fabian Kuhn, Rotem Oshman. *On the power of the congested clique model.* PODC 2014: 367-376.

14. Stephan Holzer, Nathan Pinsker. *Approximation of Distances and Shortest Paths in the Broadcast Congest Clique.* OPODIS 2015: 6:1-6:16.

15. Keren Censor-Hillel, Petteri Kaski, Janne H. Korhonen, Christoph Lenzen, Ami Paz, Jukka Suomela. *Algebraic methods in the congested clique.* Distributed Comput. 32(6): 461-478 (2019)

16. James W. Hegeman, Gopal Pandurangan, Sriram V. Pemmaraju, Vivek B. Sardeshmukh, and Michele Scquizzato. *Toward optimal bounds in the congested clique: Graph connectivity and MST.* PODC 2015: 91-100.