Spring 2008 Theory Seminar

Spring 2008 Theory Seminar: Planar Graph Algorithms

Wednesdays 4-5, location 3405

Departing from our usual unfocused habit, this semester's theory seminar will focus on algorithms for planar graphs, including fundamental combinatorial results, planarity testing, embedding algorithms, separators and other graph decompositions, shortest paths, flows and cuts, approximation algorithms, and efficient algorithms for problems that are NP-hard for general graphs.

Students and external visitors are strongly encouraged to present their own new research results, even if they have nothing to do with planar graphs.

Schedule

Please volunteer! As usual, every theory student is expected to speak at least once, but non-theory students are also welcome to volunteer. Student speakers are encouraged to register for CS 491JE (as soon as it exists).

- January 16 - Jeff Erickson talked about basic structural properties of planar graphs, such as Euler's formula.
- January 23 - Kevin Milans talked about basic colorability results for planar graphs, including a proof that planar graphs are 5-colorable.
- January 30 - Nitish Korula gave a proof of Kuratowski's theorem: A graph is planar if and only if it contains a subdivision of $K_{5}$ or $K_{3,3}$.
- February 6 - Sungjin Im talked about planarity testing.
- February 13 - Aparna Sundar talked about how to embed planar graphs in the plane.
- February 20 - Deeparnab Chakrabarty gave a talk entitled "Steiner Trees - Geometry, Linear Programs and Algorithms"
- February 27 - Meeting with Alexander Razborov
- March 5 - Sariel Har-Peled talked about the Crossing Lemma and some Applications
- March 12 - Charles Blatti talked about the Planar Separator Theorem.
- March 19 - Spring Break!
- March 26 - Theory Seminar canceled; we met with visitor Piotr Indyk
- April 2 - Erin Chambers gave a talk about shortest paths
- April 9 - Ken Clarkson
- April 16 - Chandra Chekuri will talk about tree width
- April 23 - Olga Melenkovic
- April 30 - Hemanta Maji or Tracy Grauman will talk about subgraph isomorphism in planar graphs

Suggested papers/results

Most presentations will cover two or three related papers, but some particularly meaty results may require more than one presentation. Obviously, we won't have time to discuss all of these results in only 15 weeks.

Please edit this list! So far these are only Jeff's suggestions, and many links are missing.

- Structural results
  - Euler's formula: $V-E+F=2$
  - Pontryagin-Kuratowski-Wagner: A graph is planar if and only no minor is isomorphic to $K_5$ or $K_{3,3}$

- Plane embeddings of planar graphs
  - Fáry: straight line embedding
  - Tutte/Floater: convex embedding via springs
• Steinitz: 3-polytope skeleton = planar and 3-connected
• Marek Chrobak, Michael T. Goodrich, and Roberto Tamassia. Convex drawings of graphs in two and three dimensions. SOCG 1996.
• Koebe/Andreev/Thurston: planar = kissing graph of interior-disjoint disks
• Java program by Stefan Sechelmann
• Walter Schnyder. Embedding planar graphs on the grid. SODA 1990.

• Planar separators
• Dan Spielman and Shang-Hua Teng. Disk packings and planar separators. SOCG 1996.
• Dan Spielman. Spectral partitioning works: Planar graphs and finite element meshes. FOCS 1996.

• Planarity testing/embedding
• Ilan Newman and Yuri Rabinovich. A lower bound on the distortion of embedding planar metrics into Euclidean space. SOCG 2002.
• Ken-ichi Kawarabayashi and Bruce Reed. Computing crossing number in linear time. STOC 2007.

• Shortest paths
• Danny Chen and Jinhui Xu. Shortest path queries in planar graphs. STOC 2000.
• Mikkel Thorup. Compact oracles for reachability and approximate distances in planar digraphs, JACM, v.51 n.6, p.993-1024, November 2004
• Philip Klein. Multiple shortest-paths in planar graphs. SODA 2005.
• Sergio Cabello and Erin Chambers. Multiple shortest paths in a genus-g graph. SODA 2007.

• Maximum flows
• John Reif. Minimum s-t cut of a planar undirected network in O(n log² n) time. SIAM J. Computing 1983.

• Other exact algorithms

• Approximation algorithms
• Eyal Amir, Robert Krauthgamer, and Satish Rao. Stop minding your P’s and Q’s: A simplified O(1/n) planar embedding algorithm. SODA 1999.
• Philip N. Klein. Linear-time approximation scheme for TSP for planar weighted graphs. FOCS 2005.

Previous Semesters

• Fall 2007 Theory Seminar
• Spring 2007 Theory Seminar
• Fall 2006 Theory Seminar