MA431 Paper Report and Presentation

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Expectations: We expect you to

- choose one of the papers listed below **(due March 25)**,
- write an 8-10 page long report on the topic (typed, 12pt font, 1.5in margins) **(due May 3)**,
- give a 20-minute talk on the paper **(May 6, 10am-12pm, 32L.G.17)**.

Remember, this is worth 100% of your final grade.

Choosing the paper: Once you decide on the paper, please *confirm* it by us to make sure that no one else has taken the paper. You may of course pick a paper outside the list, but you will need our confirmation. If you need help with choosing the paper, do not hesitate to talk to us. We are more than happy to give you an overview of the paper. i

The presentation: In 20 minutes, we expect you to motivate the topic of the paper to the general audience, put it in context, explain the results, and give some technical details about the paper. If you are not comfortable with giving talks, or you have not had enough practice, it is definitely better to use the projector rather than the board. It is not easy to cover everything in 20 minutes using the board. We expect you to attend all the talks.

The report: The paper should be typed in 12pt font with 1.5in margins (this is the LaTeX default setting for 12pt; this document follows that setting). In 8-10 pages, we expect you to put the paper in context, give a broad overview of the results of the paper, prove some of the results of the paper (so that we know you have understood more or less what the paper is about), and add your own concluding thoughts on the results, how the paper was written, what you think should be done in the future, etc.

Colin de Verdiére graph invariant

1. van der Holst, Lovász, Schrijver. The Colin de Verdiére graph parameter. Bolyai Soc. Math. Stud. **7**, 29–85 (1999)

2. Lovász. Steinitz Representations of Polyhedra and the Colin de Verdiére Number. Journal of Combinatorial Theory, Ser. B, **82**(2), 223–236 (2001)

3. Lovász and Schrijver. A Borsuk theorem for antipodal links and a spectral characterization of linklessly embeddable graphs. Proc. of AMS **126**(5), 1275–1285 (1998)

Ramanujan graphs and expanders

1. Lubotzky, Phillips, Sarnak. Ramanujan graphs. Combinatorica **8**, 261–277 (1988)

2. Lubetzky and Sly. Explicit Expanders with Cutoff Phenomena. Electron. J. Probab. **16**: 419–435 (2011)

3. Lubetzky and Peres. Cutoff on all Ramanujan graphs. Geometric and Functional Analysis **26**, 1190–1216 (2016)

4. Marcus, Spielman, Srivastava. Interlacing families I: Bipartite Ramanujan graphs of all degrees. Annals of Mathematics **182**, 307–325 (2015)

5. Marcus, Spielman, Srivastava. Interlacing families II: Mixed characteristic polynomials and the Kadison-Singer problem. Annals of Mathematics **182**, 327–350 (2015)

Laplacian solvers and graph sparsification

1. Spielman and Srivastava. Graph Sparsification by Effective Resistances. SIAM J. Comput. **40**. Available at arXiv:0803.0929 (2011)

2. Spielman and Teng. Spectral Sparsification of Graphs. SIAM Journal on Computing, **40**, 981–1025 (2011)

3. Kyng and Sachdeva. Approximate Gaussian Elimination for Laplacians Fast, Sparse, and Simple. FOCS 2016. Full version available at arXiv:1605.02353 (2016)

4. Kelner, Orecchia, Sidford and Allen Zhu. A Simple, Combinatorial Algorithm for Solving SDD Systems in Nearly-Linear Time. STOC 2013. Full version available at arXiv:1301.6628 (2013)

Applications to approximation algorithms

1. Asadpour, Goemans, Mądry, Oveis Gharan and Saberi. An $O(\log n/\log\log n)$-Approximation Algorithm for the Asymmetric Traveling Salesman Problem. Operations Research. **65**(4) (2017)

2. Oveis Gharan and Saberi. The Asymmetric Traveling Salesman Problem on Graphs with Bounded Genus. SODA 2011. Full version available at arXiv:0909.2849 (2011)

3. Lau and Zhou. A Spectral Approach to Network Design. Available at arXiv:2003.07810 (2020)