MAT979 Seminar on Combinatorics and Geometry

HS24

NO SEMINAR ON 16.09, the first seminar takes place on 23.09.
The seminar on the 23.09 will be an introduction given by Yuriy, regular talks will start on the 30th.

1 Possible talk topics

This is a list of possible topics, in (approximate) chronological order. The precise schedule will depend on the participants' preferences.

- Catalan numbers, Ref: T. Davis, "Catalan numbers"

Integer points in polytopes:

- Pick's theorem, Ref: T. Davis, "Pick's Theorem"
- Ehrhart's polynomial, Ref: Beck-Robbins §2

Convex geometry:

- Convex sets, Radon's theorem, Ref: Matoušek §1.2-1.3
- Helly's & Carathéodory's theorems and applications, Ref: Matoušek §1.3-1.4

Lattices:

- Definitions and Minkowski's theorem, Ref: Matoušek §2.1-2.2
- Applications of Minkowski's theorem in number theory, Ref: Matoušek §2.3, Barvinok §8

Wallpaper groups:

- Symmetries of the plane, Ref: Felikson §1.1
- Orbifold notation and the magic theorem, Ref: CBGS §2-3
- From wallpapers to orbifolds, Ref: CBGS §6,9
- Orbifolds and their Euler characteristics: proof of the magic theorem, Ref: CBGS §6, M. Davis §1-2

More topological tools:

- The game HEX, Ref: BMZ §1
- Fair division problems, Ref: Su

Suggestions for applied topics:

- Applications of Voronoi diagrams and Delaunay triangulations: https://ics.uci.edu/~eppstein/gina/voronoi.html
- Applications of minimal spanning trees: https://ics.uci.edu/~eppstein/gina/mst.html
- Many more interesting applications of combinatorial and computational geometry listed at https://ics.uci.edu/~eppstein/geom.html

References

- Alexander Barvinok, "Combinatorics, Geometry and complexity of integer points", https://dept.math.lsa.umich.edu/~barvinok/latticenotes669.pdf
- Matthias Beck & Sinai Robins, "Computing the Continuous Discretely", https://matthbeck.github.io/papers/ccd.pdf
- Björner, Matoušek, Ziegler, "Using Brouwer's fixed point theorem", https://arxiv.org/pdf/1409.7890
- Conway, Burgiel, Goodman-Strauss, "The Symmetries of Things"
- Mike Davis, "Lectures on Orbifolds", https://people.math.osu.edu/davis.12/papers/lectures%20on%20orbifolds.pdf
- Tom Davis, "Catalan numbers", http://www.geometer.org/mathcircles/catalan.pdf
- Tom Davis, "Pick's Theorem", http://www.geometer.org/mathcircles/pick.pdf
- Anna Felikson, "Geometry", https://www.maths.dur.ac.uk/users/anna.felikson/Geometry/Geometry22/notes.pdf
- Jiří Matoušek, "Lecture notes on discrete geometry"
- Francis Edward Su, "Rental harmony: Sperner's Lemma in fair division", https://www.cs.cmu.edu/~arielpro/15896s15/docs/paper11a.pdf

2 Organisation

- The seminar takes place on Mondays 15.15-17.00 in H25. The first seminar takes place on the 23rd September, there is no seminar on the 16th September.
- Each talk should be 90 minutes long, including some time for short exercises (see next point)
- Each talk should include two (easy!) 3-5 min. exercises on the topic integrated somewhere during the talk.
- We should meet briefly around 2 weeks before the talk to discuss what to include, and again at the latest on the Wednesday before the talk where you show me the plan for your talk.
- The deadline for the report is two weeks after the talk.

3 Tips for giving a seminar talk

Content

- Don't just copy the reference word for word - understand what it says, then put it away and try to present the material in a way that makes the most sense to you.
- Don't make the talk too technical! Prioritise intuition and ideas over proofs and try to avoid long computations.
- The more pictures the better (at least in geometry).
- Examples are always helpful! Choosing an example that is both sufficiently simple and sufficiently representative can be hard - often what works is to start with the simplest example you can think of, and then doing a more complex one.
- Point out the things that are particularly interesting and unexpected.

- It is much better to present a smaller amount of material in a way that the audience can understand than a larger amount of material so quickly that nobody can follow.
- Making connections to previous talks is good.

Presentation

- Try to talk to the audience rather than to the board.
- Try to keep the board organised, and cycle the boards you are using so you're not immediately erasing/hiding what you just wrote. If there is a key definition or formula or something else you'll need to refer to throughout the talk, you could leave it up somewhere it's visible and not erase it.
- It can be helpful to pause regularly and ask the auidence for questions.
- Practice your talk and pay attention to the timing - and don't forget to keep track of the time during the talk itself.