Topics in additive combinatorics and incidence geometry, fall 2015

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Teacher: Tuomas Orponen

Scope: 5 cr

Type: Advanced studies

Teaching: Weeks 36-42, Monday and Friday 14-16 in room B321. First lecture on Friday Sept. 4th.

- No lectures on Monday the 21st of September and Friday the 25th of September.

Topics:

- Freiman's theorem,
- Plünnecke-Ruzsa inequalities and Ruzsa's triangle inequality
- Roth's theorem on 3-term arithmetic progressions,
- Sum-product theory, including Solymosi's "4/3" theorem on the real line, and the Bourgain-Katz-Tao theorem in prime fields,
- The polynomial method in incidence geometry
- The Szemerédi-Trotter incidence theorem in the plane + applications
- The Kakeya problem in finite fields, and the Joints problem
- The multilinear Kakeya problem

Prerequisites: The tools needed will be introduced on the go. There will be bits and pieces from Fourier analysis and algebraic geometry used, but most arguments are quite combinatorial and elementary. You can check out the draft lecture notes below to assess yourself.

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Course material
Registration
Course feedback

Course material

The following lecture notes will be updated, amended – and certainly corrected – several times during the course:

OrponenLectureNotes.pdf (Last update: 5/11/2015, added Laura's notes on multilinear Kakeya)

For additional reading, the most comprehensive text is

T. Tao and V. Vu: Additive Combinatorics, Cambridge University Press (2006)

For something freely available, you could try Ruzsa's lecture notes "Sumsets and structure", which you can easily find by googling.

Registration

No registration needed, just come to the first lecture.

Exercises

There will most likely be no official exercises. Instead, the students will be given individual topics – perhaps an article, or a book section – which they should study, write notes about, and present during the "exercise sessions", whose timetable will be discussed on the first lecture. This presentation will also be the means to get credit for the course (so if you don't need credit, you won't be required to prepare a presentation).

Exercise classes

Group	Day	Time	Room	Instructor
1.				

Course feedback

Course feedback can be given at any point during the course. Click here.