

Logic/Set Theory: Combinatorial number theory (MAT6932/4930)

Time and Location

M W F Period 9, Building Room LIT 305.

Office Hours

M W Period 8, F Period 5, LIT 436, or by appointment.

Description and Goals

Combinatorial number theory is an exciting fast growing field where natural numbers (or more general semigroups) are treated with combinatorics. A multitude of methods from various disciplines can be applied to shed light from different angles, including finite combinatorics, algebra, dynamical systems (of ultrafilters), ergodic theory, probability, and non-standard analysis. We will cover Ramsey's theorem, van der Waerden's theorem (whenever we colour natural numbers by finitely many colours, one colour will contain arbitrarily long arithmetic progressions), its density version Szemerédi's theorem, Hindman's theorem on finite sums and a recently proved density version conjectured by Erdös: every set A of natural number of positive density contains infinite subsets B and C so that B+C is a subset of A. Along the way, we will mention related open problems.

Recommended Reading

Will appear here throughout the semester.

- N. Hindman and D. Strauss, Algebra in the Stone-Cech compactification, 1998 (second edition 2012)
- J. Nesetril, Ramsey theory, from the Handbook of Combinatorics (Volume 2), 1995
- S. Todorcevic, Introduction to Ramsey spaces, 2010

Course Requirements

There will be biweekly homework assigned here and one presentation during the semester. Homework will be worth 70% and presentation 30% of the grade.

Presentation topics

- 1. Reformulations, applications, and generalizations of Ramsey's theorem.
- 2. Multidimensional van der Waerden's theorem.
- 3. Szemerédi's theorem for arithmetic progressions of length 3.
- 4. Green-Tao's theorem on arithmetic progressions in primes.
- 5. Variations of Hindman's theorem and applications.
- 6. Dual Ramsey's theorem.
- 7. Erdös' sumset conjecture.



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