Freie Universität Berlin
Institut für Mathematik
Discrete Mathematics

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Seminar Topics

Talk 1 and 2
Zhao Section 0.1 (**Two Talks for collaboration**)

- Hypergraph Ramsey's Theorem (Two generalisations of the graph Ramsey Theorem from the Extremal Course)
- Applications
  - Schur's Theorem
  - Fermat's Theorem mod p
  - Happy Ending Theorem (Lecture Notes)

Talk 3 Lecture Notes (**Optional Talk**)

- Canonical Ramsey Theorem

Talk 4 Zhao Section 1.1-1.3

- Mantel's Theorem (already known from previous semester)
- Turán's Theorem (up to four proofs)
- Turán Density and Supersaturation

Talk 5 Zhao Section 1.4-1.5

- KST Theorem
- Erdős-Stone-Simonovits Theorem
- Hypergraph KST
- (Optional: Application to Erdős Unit Distance Problem)

Talk 6 Zhao Section 1.6-1.7

- Forbidding cycles
- Forbidding bipartite graphs with fixed maximum degree
- Dependent Random Choice

Talk 7 Zhao Section 1.8-1.10 ($K_{3,3}$-free) **Optional Talk**

- Lower Bound Constructions
- Randomised Construction for arbitrary H
- Algebraic Constructions for $K_{2,2}$ and $K_{3,3}$.

Talk 8 Zhao Section 2.1

- Definitions (Edge Density, ε-regular pair, ε-regular partition)
- Szemerédi's Graph Regularity Lemma (without proof) and comments

Talk 9 Zhao Section 2.2-2.3

- Triangle Counting Lemma
- Triangle Removal Lemma
- Application to diamond-free graphs

Talk 10 Zhao Section 2.4-2.5

- Roth's Theorem on 3-AP-free sets
- Behrend's Construction for 3-AP-free sets

Talk 11 Zhao Section 2.1

- Proof of Szemerédi's Graph Regularity Lemma