Harmonic Analysis, Number theory and Dynamics

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Lecture 1: Introduction to Szemeredi's theorem

- Background and history

- The idea: randomness vs. structure

- Discrete Fourier analysis

- Proof of Roth's theorem

Lecture 2: Szemeredi's theorem for $k > 3$

- Higher order uniformity, Gowers norms

- Nonuniformity and polynomial correlations

- Inverse theorems: weak and strong

- Quadratic Fourier analysis

Lecture 3: The Green-Tao theorem

- Background and history

- The transference principle for the primes

- The main decomposition: random and almost periodic components

- The Furstenberg tower (energy increment argument)

Lecture 4: Further developments

- Hypergraphs and the multidimensional Szemeredi theorem

- The Bergelson-Leibman and Tao-Ziegler theorems

- The Green-Tao work on the Dickson conjecture

- Quadratic Fourier analysis, apres Gowers

- more, if time permits