Stanford Math Directed Reading Program Colloquium
Spring 2019

Tuesday, June 4th, 6:30pm–8:30pm
Sloan Mathematics Center, room 384H (fourth floor)
Dinner available at 6:15pm

The Musical Dodecagon

Nolan Miranda
Mentor: Jonathan Love

Most of our music is based on the 12-tone system. Taking these 12 tones to be equivalence classes, we can analyze the action of the dihedral group D_{12} as analogs to musical operations such as transposition and inversion (not in the usual group theoretic sense). This allows us to investigate musical forms as geometric and algebraic structures.

Birth-and-Death Processes

Daniel Gurza
Mentor: Mark Perlman

A birth-and-death process is a continuous-time Markov chain which only changes state by +/- 1. In this talk, I will define continuous-time Markov chains and some of their properties, and then use the birth-and-death process as a model for a fast-growing population and show that such a population becomes infinite in finite time.

Representations of $sl(3;\mathbb{C})$ and the Weyl Group

Eric Frankel
Mentor: Jimmy He

Lie groups, or groups that also have differentiable manifold structure with smooth group operations, are objects that lie in the intersection of algebra and geometry. We will look at the basic definitions and results of Lie groups, Lie algebras, and basic representation theory to build towards understanding representations of $sl(3;\mathbb{C})$. We will finish by showing that the Weyl group is a symmetry of the weights of any finite-dimensional representation of $sl(3;\mathbb{C})$.

Roth's Theorem on Arithmetic Progressions

Nitya Mani

Mentor: Xiaoyu He

We give some background and prove the famous theorem of Roth that all subsets of the integers from 1 to n with $\Omega(n/\log\log n)$ elements contain a three term arithmetic progression.

Forcing and Independence of the Continuum Hypothesis

Harry Sha

Mentor: Joseph Helfer

Gödel's first incompleteness theorem guarentees the existence of statements that can neither be proved nor refuted in any consistent and axiomatizable theory of mathematics. One such example is the continuum hypothesis (CH). Gödel (1940) showed that ZFC does not refute CH. 23 years later, Cohen (1963) showed that ZFC does not prove CH by devising a new proof technique known as forcing. I will present the method of forcing by way of boolean valued models, and its application in proving that ZFC does not prove the continuum hypothesis.

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