REU Talks

Wednesday, August 8, 2012

Joshua Bosshardt: *The Classification of Simple Complex Lie Algebras*

A Lie group is a smooth manifold with a compatible group structure. A Lie group induces an associated Lie algebra consisting of its tangent space at the identity equipped with a bracket operation. In contrast to the colossal project constituting the classification of finite simple groups, the task of describing simple Lie groups is greatly simplified by first considering simple Lie algebras. The talk will outline the classification of simple complex Lie algebras. We introduce the root space decomposition of semisimple Lie algebras and discuss the geometry of root systems, noting that a root system completely characterizes its associated Lie algebra. Since root systems satisfy restrictive combinatorial and elementary geometric properties, they can be classified with relative ease. By unwinding the equivalences we achieve a classification of simple complex Lie algebras and, consequently, a first step in describing simple Lie groups.

Jun Hou Fung: *The Cohomology of Lie Groups*

We will first explain how spectral sequences – a tool in algebraic topology used for calculations – work. The main body of the talk will then consist of examples: using the Serre spectral sequence, we will compute the cohomology rings of $SU(n)$ (in $\mathbb{Z}$ coefficients), $SO(n)$ (in $\mathbb{F}_2$ coefficients), and G_2 (in $\mathbb{Z}$ coefficients).

Abhinav Shrestha: *An Introduction to the Block Theory and Fusion Systems*

We explore failure of Mashcke's Theorem for representations over positive characteristic fields via examples that we know and love. In the absence of complete reducibility, we have indecomposable representations, which we can begin to understand via the technique introduced by Brauer, specifically the Brauer morphism and Brauer pairs. The talk will culminate in a demonstration of the use of fusion systems of blocks and a result on the inner automorphisms of the symmetric group.

Shankara Pailoor: *Riemann Surface Structures on Compact Simply Connected Surfaces*

We know that compact simply connected surfaces are topologically equivalent to the sphere. That being said, in this presentation we will answer the question of how many different Riemann Surface structures we can place on the sphere.

Andrew Ding: *Using Projection to Solve a Multivariate Algebraic Equation*

This purpose of this talk is to demonstrate the interplay between algebra and geometry. As motivation, I will find all integer solutions to $X^2 + Y^2 = Z^2$, which is an algebraic question, using a geometric method, projection. Afterwards, I will discuss possible generalizations of this method.