MATH 620X: Lie Algebras and their Representations
Spring 2020

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Description. This course is an introduction to Lie theory, a beautiful and rich area of mathematics with applications to a wide range of fields. We will cover the classical objects including real and complex Lie groups, Lie algebras and enveloping algebras; their relationships, structure theorems, classification theorems, and a basic introduction to representation theory.

Prerequisites. MATH 504. Corequisite: MATH 505/507/510.

Main text. A. Kirillov Jr., *An Introduction to Lie Groups and Lie Algebras* (Cambridge Studies in Advanced Mathematics 113), Cambridge University Press, 2008.

Topics covered.
- Differentiable manifolds (immersions, covering spaces, vector fields)
- Lie groups (real and complex, connected, simply-connected, compact)
- Lie algebras (Levi decomposition; nilpotent and solvable Lie algebras, Engel's and Lie's Theorem; semi-simple Lie algebras and the Killing form)
- Classification of semi-simple Lie algebras (root systems and the Weyl group, Cartan matrices and Dynkin diagrams)
- Representation theory (Schur's lemma, Weyl's Theorem, Peter-Weyl Theorem, universal enveloping algebras, PBW theorem, highest weight theory)

Assessment. An exercise is assigned each lecture and due the following lecture. In addition there will be ∼ 4 longer homework assignments.