

MA792 Infinite-Dimensional Lie Algebras and Vertex Algebras

Spring 2020

Time: Tue-Thu 4:30-5:45 PM, Winston Hall Rm. 209

Instructor: Dr. Bojko Bakalov, office SAS 3116, phone 513-7442,
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Prerequisite: MA720 Lie algebras

Course Description: This course is a follow-up to MA720 and is complementary to MA725.

Infinite-dimensional Lie algebras have connections and applications to diverse areas of mathematics and physics such as: combinatorics, group theory, number theory, soliton equations, quantum field theory, and string theory. The Lie algebras we will discuss include the Heisenberg, affine Kac-Moody and Virasoro algebras, as well as the Lie algebra of infinite matrices. We will investigate their representations and characters, and point out connections to combinatorial identities and modular functions.

Vertex algebras are algebraic objects that formalize the concepts of vertex operators and operator product expansion from two-dimensional conformal field theory. Vertex algebras arose naturally in the representation theory of infinite-dimensional Lie algebras and in the construction of the “moonshine module” for the Monster finite simple group. This course will provide an elementary introduction to vertex algebras. It is suitable for graduate students because it provides a quick path to some of the latest and most active mathematical research.

Text: *Bombay Lectures on Highest Weight Representations of Infinite Dimensional Lie Algebras*, V.G. Kac, A.K. Raina, and N. Rozhkovskaya, 2nd ed., World Scientific, 2013, ISBN 978-9814522199

Homework will be assigned regularly and graded. Collaboration on the homework is allowed but all students should write their own solutions.

Presentation: At the end of the course every student will have to give a presentation and write a short paper on a topic related to but not covered in the lectures. The topics will be chosen about a month in advance with the help of the instructor.

Grade will be based on the homework (50%), presentation (40%), and attendance (10%).