Topics in Algebra -- Math 651; Fall Semester 2002

Course Information

Course: Operads and the geometry of vertex operator algebras Times: MWF 12:50 - 1:40. **Required Text**: Two-Dimensional Conformal Geometry and Vertex Operator Algebras,Yi-Zhi Huang, Birkhauser, Progress in Mathematics, 1997. In addition, we will begin with several papers on operads. Optional Text: Operads in Topology and Physics, M. Markl, S. Schnider, J. Stasheff, Amer. Math. Soc.,Mathematical Surveys and Monographs, 2002. Instructor: Professor Katrina Barron Office: 106 Hayes-Healy Center **Phone:** 631-3981 Email: kbarron@nd.edu Office Hours: TBA

Course Description: The main objective of this course is to obtain an understanding of the notion of vertexoperator algebra by studying the geometry of conformal field theory.

Conformal field theory (or more specifically, string theory) and related theories such as superconformal fieldtheories are the most promising attempts at developing a physical theory that combines all fundamentalinteractions of particles, including gravity. The geometry of this theory extends the use of Feynman diagrams,describing the interactions of point particles whose propagation in time sweeps out a line in space-time, toone-dimensional ``particles" (strings) whose propagation in time sweeps out a two-dimensional surface. Fortwo-dimensional genus-zero holomorphic conformal field theory, algebraically, these interactions can be describedby products of vertex operators or more precisely, by vertex operator algebras.

The course will begin with an introduction to the notion of operad and several examples. Using these examplesand the notion of an algebra over an operad, we will construct different algebraic structures such as associativealgebras, commutative associative algebras, Lie algebras, etc. We will then study the (partial) operad of complexgenus-zero Riemann surfaces with tubes which gives the underlying geometry of conformal field theory, i.e., ofinteracting strings. Using this operad we will develop the notion of vertex operator algebra. As time permits, wewill construct examples, and possibly delve into superconformal field theory, the geometry of superstrings, andthe notion of vertex operator superalgebra.

I will be assuming a basic knowledge of algebra and complex analysis.

Last updated May 2002.