Topics in Cluster algebras, Fall 2016

Professor: Lauren Williams

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Time and place: MW 11:40am-12:55pm, 520 Mathematics building

Website for course: https://math.berkeley.edu/~ williams/Columbia-CA.html

Office Hours: Room 512, Mathematics building, by appointment.

Course description and prerequisites:

This course will survey one of the most exciting recent developments in algebraic combinatorics, namely Fomin and Zelevinsky's theory of cluster algebras. Cluster algebras are a class of combinatorially defined commutative rings that provide a unifying structure for phenomena in a variety of algebraic and geometric contexts. Introduced in 2000, cluster algebras have already been shown to be related to a host of other fields of math, such as quiver representations, Teichmuller theory, Poisson geometry, total positivity, and integrable systems.

I will not assume prior knowledge of cluster algebras, but I will assume that the students have a solid background in graduate-level algebra. Familiarity with root systems will be helpful for a few of the lectures.

Course goals:

The goal is for students to gain a concrete understanding of cluster algebras and some of the basic techniques for working with them.

References:

S. Fomin, L. Williams, and A. Zelevinsky, Introduction to cluster algebras, Chapters 1-3, http://front.math.ucdavis.edu/1608.05735.

L. Williams, Cluster algebras: an introduction, Bulletin of the AMS, 2014.

S. Fomin and A. Zelevinsky, Cluster algebras I, II, IV.

Course requirements and grading: Students will be required to write a final paper. The final grade will be based on this paper.

Weekly breakdown of topics:

Date	Topics
Week 1	Total positivity
Week 2	Mutation
Week 3	Cluster algebras of geometric type
Week 4	The Laurent phenomenon
Week 5	Rank 2 cluster algebras
Week 6	Cluster algebras from surfaces and Teichmuller theory
Week 7	Finite type classification of cluster algebras; folding
Week 8	Cluster structures in coordinate rings
Week 9	Cluster structures on Grassmannians
Week 10	Total positivity for Grassmannians
Week 11	Quantum cluster algebras
Week 12	TBD
Week 12	TBD

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