Course Announcement - Spring 2016

Math 274: Tropical Geometry

Instructor: Bernd Sturmfels

Contact: bernd at math, 925 Evans, phone messages 642 6550

Office hours: Wednesdays 9:00-10:00am, or by appointment.
Questions on Homework etc: Fridays 12:00-2:00pm (in 939 Evans)

Lectures: Tuesdays and Thursdays, 2:00-3:30, 2 Evans

First Day of Class: Tuesday, January 19.
Last Day of Class: Thursday, April 28.
Term Papers Due: Thursday, May 12.

Prerequisites: Basics of commutative algebra, combinatorics and algebraic geometry.

Description: Tropical geometry is algebraic geometry over the min-plus algebra. It is a young subject that in recent years has both established itself as an area of its own right and unveiled its deep connections to numerous branches of pure and applied mathematics. From an algebraic geometric point of view, algebraic varieties over a field with non-archimedean valuation are replaced by polyhedral complexes, thereby retaining much information about the original varieties. This course offers a first introduction to tropical geometry.

Course text: Introduction to Tropical Geometry.
by Diane Maclagan and Bernd Sturmfels, Graduate Studies in Mathematics, AMS, 2015.

Click here for a book review by Michael Joswig, published in Jahresbericht der DMV.

Syllabus: We will study topics from all six chapters of the text book:
1 Tropical Islands, 2 Building Blocks, 3 Tropical Varieties, 4 Tropical Rain Forest, 5 Tropical Garden, 6 Toric Connections.
The sections to be covered in each lecture are listed below. Please read these before coming to class.

Grading: Grades will be based on weekly homework sets (50%) and the final term paper (50%).

Homework: There will be a weekly homework assignment, to be handed in on Tuesdays.
Late homework will not be accepted. The assignments, posted below, refer to the text book.
No homework after spring break, so you can work on the term papers.

Tropical Fridays: 939 Evans is reserved on Fridays, 12:00-2:00pm, for discussions.
This provides an informal setting to interact and collaborate with other students.

Final Project: Students will write a term paper on a topic related to the class. Papers by two authors are as welcome as
single-authored papers. A written proposal for your project is due on Tuesday, March 15. You will be invited to give a
lecture in the second half of April. The final version of your paper is due on Thursday, May 12. Hard copies much preferred.

DAILY SCHEDULE:
Jan 19: 1.3 Plane Curves, 1.4 Amoebas and Their Tentacles
Jan 21: 1.5 Implicitization, 1.7 Curve Counting, 1.8 Compactifications
Jan 26: 2.3 (JK) Polyhedral Geometry, (MB) the software polymake
Jan 28 (AS): 2.1 Fields, 2.2 Algebraic Varieties
Feb 2: 2.4 Gröbner Bases
Feb 4: 2.5 Gröbner Complexes, 2.6 Tropical Bases
Feb 9: 3.1 Hypersurfaces
Feb 11: 3.2 The Fundamental Theorem, 3.3 The Structure Theorem
Feb 16: 3.4 Multiplicities and Balancing
Feb 18: 3.5 Connectivity and Fans, the software Gfan
Feb 23: 4.1 Hyperplane Arrangements, 4.2 Matroids
Feb 25: 4.3 Grassmannians
Mar 1: 4.4 Linear Spaces
Mar 3: 4.5 Surfaces
Mar 8: 5.2 Tropical Convexity
Mar 10: 5.3 The Rank of a Matrix
Mar 15: 5.1 Eigenvalues and Eigenvectors
Mar 17: 3.6 Stable Intersections
Mar 29: (JK) 5.5 Monomials in Linear Forms
Mar 31: (ET) Eigenvectors of Tropical Tensors
Apr 5: 4.6 Complete Intersections

Student presentations:
April 7:
2:10 Qiao Zhou: Toric Connections I
2:50 Justin Chen: Toric Connections II

April 12:
2:10 Bryan Wang: Tropical Convexity and Tree Space
2:50 Bo Lin: Fermat-Weber Points

April 14:
2:10 Ashwin Iyengar: Tropical Surfaces and Manifolds
2:50 Thomas Blomme: The Correspondence Theorem

April 19:
2:10 Charlie Reid: Quartic Surface Polytopes
2:50 Liz Ferme: Hyperbolic Polynomials

April 21:
2:10 Lynn Chua: Elliptic Curves
2:50 Brandon Williams: Divisors and the Riemann-Roch Theorem

April 22 (939 Evans):
12:00 Julio Soldevilla: The Tropical Positive Grassmannian
12:40 Albert Zheng: Dynamic Programming
1:20 Eric Chen: Tropical Varieties in Representation Theory

April 28:
2:10 Madeline Brandt: Curves of Genus 2
2:50 Christopher Eur: Curves of Genus 3

April 29 (939 Evans):

12:00 Sophia Elia: Polytropes
12:40 Shiyu Li: Tropical Linear Programming
1:20 Nishant Pappireddi: Tropical Semiring and Newton Polytopes

Homework assignments:
due Jan 26: Chapter 1: 8,9,11,16,17,18,24,25,26,29
due Feb 2: Chapter 2: 2,3,7,8,10,11,27,28
due Feb 9: Chapter 2: 14,15,20,22,23,25,26
due Feb 16: Chapter 3: 1,2,4,9,11,13,14,16
due Feb 23: Chapter 3: 15,21,22,23,24,31,33,34
due Mar 1: Chapter 4: 2,4,7,12,13,15,17,22
due Mar 8: Chapter 4: 21,23,24,26,27,28,30
due Mar 15: Chapter 5: 3,6,7,8,9,10,14,16,17