MATH 799 (Directed Reading)
Toric ideals of graphs and Gröbner Bases
Course Outline for Winter 2018

Course Description. This course is designed for graduate students in the Department of Mathematics and Statistics, McMaster University. It will focus on the toric ideals associated with graphs and their Gröbner bases. The goal of this course is two-fold: 1) learn the algebraic and combinatorial background to work with toric ideals, and 2) work on a new research problem related to this topic. Students are expected to familiar with the basics of commutative algebra and algebraic geometry (e.g., Math 701 and Math 702). This course gives students the experience of independent research and provides an introduction to research-level mathematics. Students will be expected to give lectures and work collaboratively on a research project.

Class Time and Location Information.

Time: Weekly meetings of 3 hours (time to be agreed upon)
Place: (TBD)

Instructor Information.

Instructor: Adam Van Tuyl
Office: Hamilton Hall 419
Phone: x27016
Office Hours: Drop By!
Email: `vantuyl@math.mcmaster.ca`

The best way to contact me is via email. I have office hours, but you can drop by at anytime.

Textbook Information. There is no required textbook for this course. We will be using a number of original research articles and research textbooks to learn the material. Textbooks can be found in the library or online. The following sources will be used (this list is non-exhaustive).

1. Bernd Sturmfels, *Gröbner Bases and Convex Polytopes*.
2. Viviana Ene, Jürgen Herzog, *Gröbner Bases in Commutative Algebra*.
3. Alessio D'Alì, Toric ideals associated with gap-free graphs. J. Pure Applied Algebra 219 (2015) 3362–3872.
4. Jennifer Biermann, Augustine O'Keefe, Adam Van Tuyl, Bounds on the regularity of toric ideals of graphs. Advances in Applied Mathematics 85 (2017) 84–102.

Course Objectives. The students in this course will work collaboratively to produce a draft of a research article on a topic related to toric ideals and Gröbner bases. Our initial objective is to consider the ideals studied in D'Alì's paper and determine if we can bound any of the graded Betti numbers of these ideals. This specific project will be used as a way to learn the relevant background. By the end of the course, the students will have a better understanding of some current research problems in commutative algebra. Students will also have had the chance to improve their speaking/teaching skills, will learn how to use computer algebra systems to formulate examples, and will learn about writing research articles.

Evaluation. The course will be marked on a PASS/FAIL basis. Students will be expected to attend all classes, prepare a number of lectures, and to contribute to the research problem.

Academic Integrity. You are expected to exhibit honesty and use ethical behavior in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behavior can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: Grade of F assigned for academic dishonesty), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at: `http://www.mcmaster.ca/academicintegrity` The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not ones own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

Attention is drawn to the "Statement on Academic Ethics" and "Senate Resolutions on Academic Dishonesty" as found in the Senate Policy Statements distributed at Registration and available in the Senate Office. Any student who infringes on one of these resolutions will be treated according to the published policy. In particular, it is expected that the assignments shall be done and submitted as individual work. Students may discuss general problems or approaches, but the final solution must be a result of the student' own effort. The Faculty of Science is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact their Department Chair, the Sexual Harassment Office or the Human Rights Consultant, as soon as possible.