SEMINAR INFORMATION (Winter 2006)
Combinatorial Commutative Algebra

The aim of this seminar is to introduce the basic objects of combinatorial commutative algebra. We will meet once a week to talk about some results in this field. Whenever possible, we will work through the original research articles.

Organizer	Adam Van Tuyl
	Office: RB 2015
Time	Thursdays (time to be set)
Email	`avantuyl@sleet.lakeheadu.ca`
Webpage	`flash.lakeheadu.ca/~avantuyl/courses/2006_winter_seminar.html`

References. Instead of using only one textbook, we will make use of a wide variety of sources for this class, and in many cases, research articles. Below is our primary list of references:

Books:

(1) W. Bruns, J. Herzog, *Cohen-Macaulay rings.* Cambridge, 1993.
(2) D. Cox, J. Little, D. O'Shea, *Using Algebraic Geometry.* Springer, 1998.
(3) E. Miller, B. Sturmfels, *Combinatorial Commutative Algebra.* Springer, 2004.
(4) R. Stanley, *Combinatorics and commutative algebra.* Birkhaeuser 1983.
(5) R. Villarreal, *Monomial Algebras.* Marcel Dekker, 2001.

Research Articles:

(1) J. Eagon, V. Reiner, Resolutions of Stanley-Reisner rings and Alexander duality. Journal of Pure and Applied Algebra **130** (1998) 265-275.
(2) P. Frankl, A new short proof for the Kruskal-Katona Theorem. Discrete Mathematics **48** (1984) 327-329.
(3) S. Faridi, The facet ideal of a simplicial complex. Manuscripta Mathematica **109** (2005) 159-174.
(4) H.T. Hà, A. Van Tuyl, Splittable ideals and the resolutions of monomial ideals. Preprint (2005)
(5) S. Jacques, M. Katzman, The Betti numbers of forests. Preprint (2005)

Outline. A separate handout describing the topics is attached.

Course Requirements (Evaluation). You will be required to do two things: (1) you will required to give two lectures, and (2) some homework problems will be provided for you to work on. Each component will be worth 50%. We will meet once a week (time and place to be determined) for an hour to an hour and half to discuss a new topic.

Another skill I want you to learn is how to typeset mathematics. I will explain how to use LaTeX, and I want you to type up the lectures given in the seminar.

Combinatorial Commutative Algebra Seminar Schedule

Lecture 1	*Title:*	**Introduction to Simplicial Complexes**
	Topics:	Basic definitions and examples of simplicial complexes
	References:	Burns & Herzog, Miller & Sturmfels, Stanley
Lecture 2	*Title:*	**Kruskal-Katona's Theorem**
	Topics:	f-vectors and their classification
	References:	Frankl
Lecture 3	*Title:*	**Stanley-Reisner Correspondence**
	Topics:	Stanley-Reisner correspondence Hilbert functions and series f-vectors and h-vectors
	References:	Bruns & Herzog, Stanley
Lecture 4	*Title:*	**Cohen-Macaulay Rings I**
	Topics:	Definition of a Cohen-Macaulay rings Shellability
	References:	Bruns & Herzog
Lecture 5	*Title:*	**Cohen-Macaulay Rings II**
	Topics:	Continuation of Lecture 4
	References:	Bruns & Herzog
Lecture 6	*Title:*	**Edge and Facet Ideals**
	Topics:	Introduce facet ideals, an alternative correspondence
	References:	Faridi
Lecture 7	*Title:*	**Minimal Free Resolutions**
	Topics:	Minimal graded resolutions, graded Betti numbers Introduction to `CoCoA`, a computer program that computes Betti numbers
	References:	Cox, Little, & O'Shea
Lecture 8	*Title:*	**Reduced Simplicial Homology**
	Topics:	Brief introduction to reduced simplicial homology
	References:	(to be added)
Lecture 9	*Title:*	**Betti numbers of Stanley-Reisner rings**
	Topics:	Hochster's formula, Eagon-Reiner's formula
	References:	Eagon & Reiner
Lecture 10	*Title:*	**Splittable ideals and resolutions of trees**
	Topics:	splittable ideals, tress
	References:	Hà & Van Tuyl, Jacques & Katzman