

## CO 430/630 — Algebraic Enumeration

This course introduces some of the standard techniques in algebraic enumeration, which we will apply to a wide variety of examples.

### Topics:

- **Formal power series and formal laurent series:** Algebraic properties, Lagrange's implicit function theorem, identities.
- **Ordinary and exponential generating series:** Weight functions,  $q$ -analogues, formalism of species, species variants.
- **Sieving methods:** Inclusion/exclusion, Möbius inversion, sign reversing involutions, virtual species, the cyclic sieving phenomenon.
- **Counting with automorphisms:** Pólya enumeration, cycle index functions.
- Time permitting, additional topics may include: Applications of  $\mathfrak{sl}_2$ , the transfer matrix method, matching enumeration, asymptotic methods.

### References:

- *Enumerative Combinatorics, Volume 1*, Richard P. Stanley. Cambridge University Press, 1997.
- *Introduction to the Theory of Species of Structures*, François Bergeron, Gilbert Labelle, and Pierre Leroux. (Available online.)
- *Combinatorial Enumeration*, David M. Jackson and Ian P. Goulden, John Wiley & Sons, 1983. (Republished by: Dover Publications, 2004.)
- *CO 330 course notes*, David G. Wagner. (Available from Media.Doc)

**Prerequisites:** If you have no prior experience with ordinary generating functions, you should at minimum read Ch. 1–6 of the CO 330 course notes, and do some of the practice problems. These topics will be reviewed, but the expectation is that students have had at least some previous exposure to elementary counting and ordinary generating function techniques. It would also help to be familiar with basic concepts of abstract algebra (e.g. what is a group, ring, ideal, etc.).