

CO739 Analytic and Algorithmic Combinatorics

Instructor: Stephen Melczer

Course Webpage: <https://melczer.ca/739/>

This course presents an introduction to the theory of analytic combinatorics and computational techniques for enumeration. Topics will be tailored to student interest, including

- computer algebra tools for sequences and generating functions
- rational, algebraic, D-finite, and differentially-algebraic functions, and their algebraic/analytic/arithmetical properties
- effective analytic methods for asymptotics
- algorithmic transcendence proofs and transcendence of constants vs functions
- computability and complexity questions in enumeration and connections to formal languages
- rigorous numerical analytic continuation of (generating) functions
- limit theorems of combinatorial objects
- analytic methods for multivariate generating functions

Further examples of course topics, and some interactive applications, can be found on the course webpage.

References: The main reference for the course is the textbook

- [An Invitation to Analytic Combinatorics](#) by S. Melczer. Springer, 2021.

Additional references include

- [Generatingfunctionology](#) by H. Wilf. Academic Press, 1990.
- [Analytic Combinatorics](#) by P. Flajolet and B. Sedgewick. Cambridge University Press, 2009.

All references have manuscripts are freely available at the above links.

Prerequisites: Students should be comfortable with the basics of real analysis (sequences and series) and ideally will have previous exposure to basic algebra (rings and fields) and complex analysis (analytic functions, Cauchy residue theorem). Short background lessons will be provided for students wanting to review (or needing to catch up on) some of the necessary background material. Interested students unsure of their background should email the instructor for more information. Students are not expected to have previous exposure to computer algebra.