# Analytical Combinatorics

Combinatorics is one of the oldest and most fundamental topics in mathematics with formal origins going back, at least, to the works of the earliest Indian mathematicians on counting structures defined by sets of simple rules. In particular one often finds in this subject problems that are easy to state even to the mathematically unsophisticated but challenging to solve even to the mathematically sophisticated. At the other end of the *time line* combinatorics is of ever increasing relevance not just in mathematics (number theory, geometry, probability theory, …) but also in a broad range of applications to other disciplines including computer science, statistics, network analysis, genetics & computational biology.

Over the centuries other branches of mathematics have been brought to bear on the challenging problems of combinatorics. Among these, tools of analysis have proven to be particularly (and often seemingly magically) effective in addressing the challenging problems of combinatorics, especially those that deal with asymptotic questions of enumerating larger and larger families of combinatorial objects. The bridge between combinatorics and analysis is the *generating function*. Some of our most recent research has been to develop methods that provide a kind of *dictionary* that translates between the analytic properties of generating functions and the asymptotic enumeration of the associated combinatorial class. These RTG lectures will illustrate this connection in a number of simple cases that we hope will lead those who are interested to some promising research projects.