Extremal graph theory studies problems that seek to characterize graphs that are maximal or minimal with respect to some global parameter and possess certain properties. For example, graphs on \( n \) vertices with a maximum number of edges that do not contain a cycle of length \( k \).

In this course, we will discuss many important aspects of the extremal graph theory, including Turán’s theorem, Zarankiewicz problem, Erdős-Stone theorem, or some Ramsey-related facts. In addition, we will study some exciting recent developments in the theory. In particular, we will discuss many facets of the regularity method, including quasi-randomness of Gowers, the spectral proof of the Szemerédi’s lemma by Tao, or the regularity lemma of Frieze and Kannan.

The course is based on material from a few advanced textbooks and research papers and there is no single book that we will rely on. Grades will be determined entirely on in-class presentations of papers assigned during the course.

The course is directed to graduate students in mathematics and computer science who have interest in graph theory or combinatorics.