



# Expander Families and Cayley Graphs: A Beginners Guide

*Mike Krebs, Anthony Shaheen*

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The theory of expander graphs is a rapidly developing topic in mathematics and computer science, with applications to communication networks, error-correcting codes, cryptography, complexity theory, and much more. *Expander Families and Cayley Graphs: A Beginners Guide* is a comprehensive introduction to expander graphs, designed to act as a bridge between classroom study and active research in the field of expanders. It equips those with little or no prior knowledge with the skills necessary to both comprehend current research articles and begin their own research. Central to this book are four invariants that measure the quality of a Cayley graph as a communications network—the isoperimetric constant, the second-largest eigenvalue, the diameter, and the Kazhdan constant. The book poses and answers three core questions: How do these invariants relate to one another? How do they relate to subgroups and quotients? What are their optimal values/growth rates? Chapters cover topics such as: DT Graph spectra DT A Cheeger-Buser-type inequality for regular graphs DT Group quotients and graph coverings DT Subgroups and Schreier generators DT Ramanujan graphs and the Alon-Boppana theorem DT The zig-zag product and its relation to semidirect products of groups DT Representation theory and eigenvalues of Cayley graphs DT Kazhdan constants The only introductory text on this topic suitable for both undergraduate and graduate students, *Expander Families and Cayley Graphs* requires only one course in linear algebra and one in group theory. No background in graph theory or representation theory is assumed. Examples and practice problems with varying complexity are included, along with detailed notes on research articles that have appeared in the literature. Many chapters end with suggested research topics that are ideal for student projects.

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