

Expander graphs

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Expander graphs are well connected graphs and are therefore very useful in communication networks. Additional applications in mathematics and computer science include:

- Extremal problems in graph theory
- Embedding finite metric spaces in Euclidean spaces
- Construction of error correcting codes
- Derandomization algorithms
- Construction of hash functions in cryptography
- Probabilistically checkable proof

Definition: A graph G with n vertices is called a k expander if for every set U of m vertices (with m being at most $n/2$), the number of edges with one vertex in U and the other not in U is at least km .

Examples:

- a. If k is smaller than $\frac{1}{2}$ and G is a bipartite graph whose parts have kn and $n-kn$ vertices, then G is a k expander.
- b. If G is a d regular graph and c is the second smallest eigenvalue of its adjacency matrix in absolute value, then G is a $(d-c)/2c$ expander.

In the project we will discuss spectral properties of expander graphs.

Prerequisite: Linear algebra and basic concepts in graph theory.