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*Rational decompositions of graphs*

Given a graph  $G$ , an  $H$ -decomposition of  $G$  is a partition with its edge set into subgraphs isomorphic to  $H$ . A rational  $H$ -decomposition of  $G$  is a nonnegative rational weighting of the copies of  $H$  in  $G$  such that the total weight on any edge of  $G$  equals 1. The study of graph decompositions plays an important role in graph theory and combinatorics and has numerous applications. We will present a proof of the fact that any sufficiently large circulant (under several mild conditions) admits a rational decomposition into copies of any non-trivial graph on at most  $k$  vertices. This proof will showcase a linear algebraic connection between decomposition of these graphs and families with dominant differences.