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The Combinatorial Inverse Eigenvalue Problem

Let $G = (V, E)$ be an undirected graph on n vertices, and let $S(G)$ be the set of all real symmetric $n \times n$ matrices whose nonzero off-diagonal entries occur in exactly the positions corresponding to the edges of G, i.e., for $i \neq j$, $a_{ij} \neq 0 \iff \{i, j\} \in E$. The combinatorial inverse eigenvalue problem asks:

Given a graph G on n vertices and real numbers $\lambda_1, \lambda_2, \ldots, \lambda_n$, is there a matrix in $S(G)$ with eigenvalues equal to $\lambda_1, \lambda_2, \ldots, \lambda_n$?

Previous results focus on solving the problem for trees. Another fairly large class of graphs for which it is possible to obtain general results is the class of minimum rank 2 graphs; for these all possible pairs of nonzero eigenvalues which are attainable for a rank 2 matrix in $S(G)$ are characterized. Time permitting, we will discuss properties of minimum rank matrices and the associated inverse inertia problem.