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The Erdős-Ko-Rado Theorem: an algebraic perspective

The Erdős-Ko-Rado (EKR) Theorem is a major result in extremal set theory. It gives the exact size and structure of the largest system of sets that has the property that any two sets in the system have non-trivial intersection. There are many extensions of this theorem to combinatorial objects other than set systems, such as vectors subspaces over a finite field, integer sequences, partitions, and recently, there have been several results that extend the EKR theorem to permutations.

I will describe an algebraic method that can be used to prove the EKR theorem for several of these combinatorial objects. Using the eigenvalues of the adjacency matrix of an appropriately defined graph we can often bound the size of the largest intersecting set of objects. Further, by considering the structure of the eigenspace we can also determine the structure of these sets. I will present several examples where this works and show some open problems.