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Title: Symmetric polynomials, combinatorics, and mathematical physics.

Brief overview: An n-variable polynomial $f(x_1, \ldots, x_n)$ is called *symmetric* if it does not change by any permutation of its variables. Some simple examples of symmetric polynomials are the power sums $p_\ell = x_1^\ell + \cdots + x_n^\ell$ and the elementary symmetric functions $e_\ell = \sum_{1 \leq i_1 < \cdots < i_\ell \leq n} x_{i_1} \cdots x_{i_\ell}$.

Clearly the symmetric polynomials on n variables form a ring. The ring of symmetric polynomials has profound connections with algebra and geometry. For example, a distinguished family of symmetric polynomials called *Schur polynomials*, that are indexed by combinatorial objects called *Young diagrams*, describe the character theory of the group S_n (symmetric group on n letters). The Schur polynomials and their generalizations (e.g., Jack and Macdonald polynomials) are related to geometric objects such as symmetric spaces and flag varieties. There is also an interesting connection to quantum physics: the Jack polynomials are the eigenstates of the Hamiltonian of the *quantum n-body problem*.

The goal of the proposed project is to answer questions about Jack polynomials and their variants. Some of the questions can lead to research papers that are publishable in peer-reviewed journals.

Students with a strong background in basic undergraduate algebra (e.g., grade of A or A+ in MAT2143 – Algebraic Structures) are encouraged to apply.