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Symmetries in Tensor Spaces: An Introduction to Schur-Weyl Duality

Given a finite-dimensional vector space V , the groups S_n and $GL(V)$ both have natural actions on the tensor space $V^{\otimes n}$ which commute. Schur-Weyl Duality asserts the images of these two actions in $\text{End}(V^{\otimes n})$ are centralizers of each other. We discuss how the double centralizer theorem paired with this duality reveals a deep connection between the representation theory of the symmetric group and the general linear group, generalizing the well known decomposition $V \otimes V = \text{Sym}^2 V \oplus \text{Alt}^2 V$.