Constructing Matrix Representations of Finite Groups

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Let G be a finite group. It is easy to compute the character of G corresponding to a given complex representation, but much more difficult to compute a representation affording a given character. In part this is due to the fact that a class of equivalent representations contains no natural canonical representation. Although there is a large literature devoted to computing representations, and methods are known for particular classes of groups, no general method has been proposed which is practical for any but very small groups.

In this talk we review the earlier works and we describe a new algorithm to compute an irreducible matrix representation R which affords a given character χ of a given group G. The algorithm uses properties of the structure of G which can be computed efficiently by a program such as GAP or MAGMA, theoretical results from representation theory, theorems from group theory (including the classification of finite simple groups), and linear algebra. The algorithm has been implemented in GAP and works well for a general group G when the character supplied has degree < 32.