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Conjugacy classes in semisimple algebraic groups, by James E. Humphreys, Math. Surveys Monographs, vol. 43, Amer. Math. Soc., Providence, RI, 1995, xviii+196 pp., $59.00, ISBN 0-8218-0333-6

The theory of conjugacy classes in semisimple algebraic groups has been quite central for the last twenty years in areas connected with the representation theory of various groups connected with semisimple Lie groups; the techniques used are manifold, from algebraic geometry to invariant theory, representation theory and intersection homology. The theory is by no means complete at present, and so it is probably not ripe for a comprehensive treatment, but some of the basic algebraic geometric facts are now well established.

There are already in the literature some books which deal with aspects of this topic, notably: R. Carter, *Finite groups of Lie type*: *Conjugacy classes and complex characters*, Wiley-Interscience, New York, 1985; and D. H. Collingwood and W. M. McGovern, *Nilpotent orbit in semisimple Lie algebras*, Van Nostrand Reinhold, New York, 1993.

In order to avoid too much overlap with the previous books the author has set for himself two goals for this book:

1) To collect in a unified way information about the geometry of conjugacy classes and centralizers
2) To provide a survey of more advanced material

In particular the classification theory of Bala Carter is only sketched. Thus in the first six chapters we find (after a review of semisimple groups) detailed proofs on various foundational topics: conjugacy classes and centralizers (basic facts on orbits and their closures in groups and Lie algebras), semisimple elements (mostly on the connectedness of centralizers), the adjoint quotient (quotients and Richardson's Theorem), regular and subregular orbits (existence and structure theorems), parabolic subgroups and unipotent classes (Richardson elements and induction), the unipotent variety and the flag variety (Springer's resolution).

The last four chapters contain several examples and a discussion of various topics which would require a much longer treatment for any attempt at a complete account (some topics are still under investigation, such as: the Springer representation and the singularity theory of closures of conjugacy classes). Here we find a discussion of nilpotent orbits, finite groups of Lie type, and Springer's Weyl group representation with a guide to the literature.

Some topics which are connected to conjugacy classes and which are not treated in this book are the applications of conjugacy classes to the study of primitive ideals, intersection theoretic methods, and Lusztig theory of character sheaves.

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This book can be used mostly by specialists, in conjunction with the other books mentioned, as a source of basic information and as a guide to the literature and also by people wishing to get some introduction to the geometric aspects of the theory.

Claudio Procesi
Universita' Degli Studi di Roma "La Sapienza"
E-mail address: claudio@mat.uniroma1.it