Lie Groups, Lie Algebras, and Representations: An Elementary Introduction (Graduate Texts in Mathematics)

By Brian Hall

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This textbook treats Lie groups, Lie algebras and their representations in an elementary but fully rigorous fashion requiring minimal prerequisites. In particular, the theory of matrix Lie groups and their Lie algebras is developed using only linear algebra, and more motivation and intuition for proofs is provided than in most classic texts on the subject.

In addition to its accessible treatment of the basic theory of Lie groups and Lie algebras, the book is also noteworthy for including:

- a treatment of the Baker–Campbell–Hausdorff formula and its use in place of the Frobenius theorem to establish deeper results about the relationship between Lie groups and Lie algebras
- motivation for the machinery of roots, weights and the Weyl group via a concrete and detailed exposition of the representation theory of sl(3;$\mathbf{C}$)
- an unconventional definition of semisimplicity that allows for a rapid development of the structure theory of semisimple Lie algebras
- a self-contained construction of the representations of compact groups, independent of Lie-algebraic arguments

The second edition of *Lie Groups, Lie Algebras, and Representations* contains many substantial improvements and additions, among them: an entirely new part devoted to the structure and representation theory of compact Lie groups; a complete derivation of the main properties of root systems; the construction of finite-dimensional representations of semisimple Lie algebras has been elaborated; a treatment of universal enveloping algebras, including a proof of the Poincaré–Birkhoff–Witt theorem and the existence of Verma modules; complete proofs of the Weyl character formula, the Weyl dimension formula and the Kostant multiplicity formula.

Review of the first edition:

This is an excellent book. It deserves to, and undoubtedly will, become the

standard text for early graduate courses in Lie group theory ... an important addition to the textbook literature ... it is highly recommended.

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Editorial Review

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From the reviews: "This is an excellent book. It deserves to, and undoubtedly will, become the standard text for early graduate courses in Lie group theory . It is clearly written . A reader of this book will be rewarded with an excellent understanding of Lie groups . Hall s book appears to be genuinely unique in both the organization of the material and the care in which it is presented. This is an important addition to the textbook literature . It is highly recommended." (Mark Hunacek, The Mathematical Gazette, March, 2005) "The book is written in a systematic and clear way, each chapter ends with a set of exercises. The book could be valuable for students of mathematics and physics as well as for teachers, for the preparation of courses. It is a nice addition to the existing literature." (EMS-European Mathematical Society Newsletter, September, 2004) "This book differs from most of the texts on Lie Groups in one significant aspect. it develops the whole theory on matrix Lie groups. This approach will be appreciated by those who find differential geometry difficult to understand. each of the eight chapters plus appendix A contain a good collection of exercises. I believe that the book fills the gap between the numerous popular books on Lie groups is a valuable addition to the collection of any mathematician or physicist interested in the subject." (P.K. Smrz, The Australian Mathematical Society Gazette, Vol. 31 (2), 2004) "This book addresses Lie groups, Lie algebras, and representation theory. the author restricts attention to matrix Lie groups and Lie algebras. This approach keeps the discussion concrete, allows the reader to get to the heart of the subject quickly, and covers all the most interesting examples. This book is sure to become a standard textbook for graduate students in mathematics and physics with little or no prior exposure to Lie theory." (L Enseignement Mathematique, Vol. 49 (3-4), 2003) "Though there exist already several excellent text books p

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About the Author
Brian Hall is Professor of Mathematics at the University of Notre Dame, IN.

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