

Representations of Semisimple Lie Algebras in the BGG Category $mathscr {O}$ (Graduate Studies in Mathematics)

By James E. Humphreys

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This is the first textbook treatment of work leading to the landmark 1979 Kazhdan-Lusztig Conjecture on characters of simple highest weight modules for a semisimple Lie algebra $mathfrak{g}$ over $mathbb {C}$. The setting is the module category $mathscr {O}$ introduced by Bernstein-Gelfand-Gelfand, which includes all highest weight modules for $mathfrak{g}$ such as Verma modules and finite dimensional simple modules. Analogues of this category have become influential in many areas of representation theory. Part I can be used as a text for independent study or for a mid-level one semester graduate course; it includes exercises and examples. The main prerequisite is familiarity with the structure theory of $mathfrak{g}$. Basic techniques in category $mathscr {O}$ such as BGG Reciprocity and Jantzen's translation functors are developed, culminating in an overview of the proof of the Kazhdan-Lusztig Conjecture (due to Beilinson-Bernstein and Brylinski-Kashiwara). The full proof however is beyond the scope of this book, requiring deep geometric methods: D-modules and perverse sheaves on the flag variety. Part II introduces closely related topics important in current research: parabolic category $mathscr {O}$, projective functors, tilting modules, twisting and completion functors, and Koszul duality theorem of Beilinson-Ginzburg-Soergel.

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"One of the goals Humphreys had in mind was to provide a textbook suitable for graduate students. This has been achieved by keeping prerequisites to a minimum, by careful dealing with technical parts of the proofs, and by offering a large number of exercises." ---- Mathematical Reviews

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