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Introduction

This volume consists of three distinct chapters, each corresponding to a mini-course given by the main speakers during the GABY24 conference. Each chapter addresses a different area of algebra, such as quantum groups, computational group theory, and branch groups.

In the first chapter, Andrea Appel provides an introduction to the theory of quantum groups, objects closely related to Hopf algebras. The author emphasizes the construction of the R-matrix, which provides a solution to the quantum Yang–Baxter equation. After covering the fundamental aspects of the theory, he examines the R-matrix in two key frameworks, namely Drinfeld–Jimbo quantum groups and Yangians.

In the second chapter, Melissa Lee presents a survey on computational group theory, the theory of designing and studying algorithms for dealing with groups, both finite and infinite. The author first introduces the three primary ways to represent a group on a computer, as a permutation group, a matrix group, or a finitely presented group, and then discusses algorithms for orbits and stabilizers, bases and strong generating sets, coset enumeration, and composition series, together with more recent developments in the subject and open problems.

The concluding chapter, written by Anitha Thillaisundaram, addresses the so-called branch groups, known for offering examples of groups with exotic properties, with the Burnside groups being the most notable, such as Grigorchuk group and the Gupta–Sidki groups. In the second part, attention shifts to maximal subgroups, specifically focusing on the study of their index. The chapter finishes by presenting open questions related to both variations of the Burnside problem and structural insights gained from studying maximal subgroups.

We hope these notes will serve as an inspiration to anyone interested in beginning their exploration of the related areas of algebra.

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