

Preface

This book is a revised and expanded version of the material that the first author presented in a mini-course given at IMPA, about the same topics, on the occasion of the *30º Colóquio Brasileiro de Matemática* (July 2015), and is largely based on the collaboration with the second author and Inna Scherbak. It aims at introducing and advertising the notion of *Hasse–Schmidt derivation on a Grassmann algebra*, which we propose as a natural language to put many seemingly unrelated subjects into a unified framework.

The broadened perspective it offers is able to capture, for example, a generalization of the Cayley–Hamilton theorem, the theory of linear ODEs and their generalized Wronskians, the exponential of a matrix with indeterminate entries (another reading of Putzer’s method dating back 1966), the characterization of decomposable tensors in an exterior power of a free abelian group and the bosonic expressions of the vertex operators generating the so-called free fermionic vertex superalgebra.

The latter comes from the representation theory of the *oscillator Heisenberg algebra*, which is one of the fancy terms scattered throughout the text, other such being *bosonic and fermionic Fock spaces*, *boson–fermion correspondence*, *vertex operators*, *vertex algebra* and *KP hierarchy*, to name a few. We believe that the common formalism underpinning the aforementioned subjects proves interesting for its own sake. At the same time we wish to stress, once and for all, that this book is about none of them. Readers are not assumed to have any prior familiarity with such a language, for which we point out throughout the text many existing and excellent references.

The book is suited for Ph.D. students wishing to learn additional features of exterior algebras in connection with more advanced topics. It is our hope, however, that diverse scholars, both algebraic geometers and not, will profit from it: we tried

to illustrate material that may not belong to everybody's field of research – or taste – but at the same time has the subtle potential of appealing to many, due to its far-reaching breadth.

Torino, Italy

Letterio Gatto

São José do Rio Preto, Brazil

Parham Salehyan

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Gatto, L.; Salehyan, P.

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