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J.H. van Lint

Introduction to Coding Theory

Second Edition

Springer-Verlag
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J.H. van Lint
Eindhoven University of Technology
Department of Mathematics
Den Dolech 2, P.O. Box 513
5600 MB Eindhoven
The Netherlands

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Preface to the Second Edition

The first edition of this book was conceived in 1981 as an alternative to outdated, oversized, or overly specialized textbooks in this area of discrete mathematics—a field that is still growing in importance as the need for mathematicians and computer scientists in industry continues to grow.

The body of the book consists of two parts: a rigorous, mathematically oriented first course in coding theory followed by introductions to special topics. The second edition has been largely expanded and revised. The main editions in the second edition are:

(1) a long section on the binary Golay code;
(2) a section on Kerdock codes;
(3) a treatment of the Van Lint-Wilson bound for the minimum distance of cyclic codes;
(4) a section on binary cyclic codes of even length;
(5) an introduction to algebraic geometry codes.

Eindhoven
November 1991

J.H. van Lint

Preface to the First Edition

Coding theory is still a young subject. One can safely say that it was born in 1948. It is not surprising that it has not yet become a fixed topic in the curriculum of most universities. On the other hand, it is obvious that discrete mathematics is rapidly growing in importance. The growing need for mathematicians and computer scientists in industry will lead to an increase in courses offered in the area of discrete mathematics. One of the most suitable and fascinating is, indeed, coding theory. So, it is not surprising that one more book on this subject now appears. However, a little more justification and a little more history of the book are necessary. At a meeting on coding theory in 1979 it was remarked that there was no book available that could be used for an introductory course on coding theory (mainly for mathematicians but also for students in engineering or computer science). The best known textbooks were either too old, too big, too technical, too much for specialists, etc. The final remark was that my Springer Lecture Notes (#201) were slightly obsolete and out of print. Without realizing what I was getting into I announced that the statement was not true and proved this by showing several participants the book *Inleiding in de Coderingstheorie*, a little book based on the syllabus of a course given at the Mathematical Centre in Amsterdam in 1975 (M.C. Syllabus 31). The course, which was a great success, was given by M.R. Best, A.E. Brouwer, P. van Emde Boas, T.M.V. Janssen, H.W. Lenstra Jr., A. Schrijver, H.C.A. van Tilborg and myself. Since then the book has been used for a number of years at the Technological Universities of Delft and Eindhoven.

The comments above explain why it seemed reasonable (to me) to translate the Dutch book into English. In the name of Springer-Verlag I thank the Mathematical Centre in Amsterdam for permission to do so. Of course it turned out to be more than a translation. Much was rewritten or expanded, problems were changed and solutions were added, and a new chapter and several new proofs were included. Nevertheless the M.C. Syllabus (and the Springer Lecture Notes 201) are the basis of this book.

The book consists of three parts. Chapter 1 contains the prerequisite mathematical knowledge. It is written in the style of a memory-refresher. The reader who discovers topics that he does not know will get some idea about them but it is recommended that he also looks at standard textbooks on those topics. Chapters 2 to 6 provide an introductory course in coding theory. Finally, Chapters 7 to 11 are introductions to special topics and can be used as supplementary reading or as a preparation for studying the literature.

Despite the youth of the subject, which is demonstrated by the fact that the papers mentioned in the references have 1974 as the average publication year, I have not considered it necessary to give credit to every author of the theorems, lemmas, etc. Some have simply become standard knowledge.

It seems appropriate to mention a number of textbooks that I use regularly and that I would like to recommend to the student who would like to learn more than this introduction can offer. First of all F.J. MacWilliams and N.J.A. Sloane, *The Theory of Error-Correcting Codes* (reference [46]), which contains a much more extensive treatment of most of what is in this book and has 1500 references! For the more technically oriented student with an interest in decoding, complexity questions, etc. E.R. Berlekamp's *Algebraic Coding Theory* (reference [2]) is a must. For a very well-written mixture of information theory and coding theory I recommend: R.J. McEliece, *The Theory of Information and Coding* (reference [51]). In the present book very little attention is paid to the relation between coding theory and combinatorial mathematics. For this the reader should consult P.J. Cameron and J.H. van Lint, *Designs, Graphs, Codes and their Links* (reference [11]).

I sincerely hope that the time spent writing this book (instead of doing research) will be considered well invested.

Eindhoven J.H. van Lint
July 1981

Second edition comments: Apparently the hope expressed in the final line of the preface of the first edition came true: a second edition has become necessary. Several misprints have been corrected and also some errors. In a few places some extra material has been added.

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