

**J. H. CONWAY
N. J. A. SLOANE**

Volume 290

Grundlehren
der mathematischen
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A Series of
Comprehensive Studies
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SPHERE PACKINGS, LATTICES AND GROUPS

THIRD EDITION



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John Conway, Neil J. A. Sloane, 1998-12-07 The third edition of this definitive and popular book continues to pursue the question what is the most efficient way to pack a large number of equal spheres in n dimensional Euclidean space The authors also examine such related issues as the kissing number problem the covering problem the quantizing problem and the classification of lattices and quadratic forms There is also a description of the applications of these questions to other areas of mathematics and science such as number theory coding theory group theory analogue to digital conversion and data compression n dimensional crystallography dual theory and superstring theory in physics New and of special interest is a report on some recent developments in the field and an updated and enlarged supplementary bibliography with over 800 items

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Packings, Lattices and Groups John H. Conway, Neil J.A. Sloane, 2013-02-14 The main themes This book is mainly concerned with the problem of packing spheres in Euclidean space of dimensions 1 2 3 4 5 Given a large number of equal spheres what is the most efficient or densest way to pack them together We also study several closely related problems the kissing number problem which asks how many spheres can be arranged so that they all touch one central sphere of the same size the covering problem which asks for the least dense way to cover n dimensional space with equal overlapping spheres and the quantizing problem important for applications to analog to digital conversion or data compression which asks how to place points in space so that the average second moment of their Voronoi cells is as small as possible Attacks on these problems usually arrange the spheres so their centers form a lattice Lattices are described by quadratic forms and we study the classification of quadratic forms Most of the book is devoted to these five problems The miraculous enters the E_8 and Leech lattices When we investigate those problems some fantastic things happen There are two sphere packings one in eight dimensions the E_8 lattice and one in twenty four dimensions the Leech lattice A which are unexpectedly good and very 24 symmetrical packings and have a number of remarkable and mysterious properties not all of which are completely understood even today

Sphere Packings, Lattices and Groups John Conway, Neil J. A. Sloane, 2014-01-15

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Packings, Lattices and Groups John Conway, Neil J. A. Sloane, 2013-06-29 We now apply the algorithm above to find the 121 orbits of norm 2 vectors from the known norm 0 vectors and then apply it again to find the 665 orbits of norm 4 vectors from the vectors of norm 0 and 2 The neighbors of a strictly 24 dimensional odd unimodular lattice can be found as follows If a norm 4 vector $v \in \Lambda$ corresponds to the sum $25 \cdot 1$ of a strictly 24 dimensional odd unimodular lattice Λ and a dimensional lattice then there are exactly two norm 0 vectors of $\Lambda + 25 \cdot 1$ having inner product 2 with v and these norm 0 vectors correspond to the two even neighbors of Λ The enumeration of the odd 24 dimensional lattices Figure 17.1 shows the neighborhood graph for the Niemeier lattices which has a node for each Niemeier lattice If Λ and B are neighboring Niemeier lattices there are three integral lattices containing $\Lambda \cap B$ namely Λ , B and an odd unimodular lattice C of rank 4 An edge is drawn between nodes Λ and B in Fig 17.1 for each strictly 24 dimensional unimodular lattice arising in this way Thus there is a one to one correspondence between the strictly 24 dimensional odd unimodular lattices and the edges of our neighborhood graph The 156 lattices are shown in Table 17.1 Figure 17.1 also shows the corresponding graphs for dimensions 8 and 16

Sphere Packings, Lattices and Groups J. H. Conway, 2014-01-15 **Sphere Packings** Chuanming Zong, 2008-01-20 Sphere packings is one of the most fascinating and challenging subjects in mathematics In the course of centuries many exciting results have been obtained ingenious methods created related challenging problems proposed and many surprising connections with other subjects found This book gives a full account of this fascinating subject especially its local aspects discrete aspects and its proof methods The book includes both classical and contemporary results and provides a full treatment of the subject

CRC Concise Encyclopedia of Mathematics Eric W. Weisstein, 2002-12-12 Upon publication the first edition of the CRC Concise Encyclopedia of Mathematics received overwhelming accolades for its unparalleled scope readability and utility It soon took its place among the top selling books in the history of Chapman Hall CRC and its popularity continues unabated Yet also unabated has been the demand for *Perfect Lattices in Euclidean Spaces* Jacques Martinet, 2002-12-10 Lattices are discrete subgroups of maximal rank in a Euclidean space To each such geometrical object we can attach a canonical sphere packing which assuming some regularity has a density The question of estimating the highest possible density of a sphere packing in a given dimension is a fascinating and difficult problem the answer is known only up to dimension 3 This book thus discusses a beautiful and central problem in mathematics which involves geometry number theory coding theory and group theory centering on the study of extreme lattices i.e. those on which the density attains a local maximum and on the so called perfection property Written by a leader in the field it is closely related to though disjoint in content from the classic book by J. H. Conway and N. J. A. Sloane *Sphere Packings Lattices and Groups* published in the same series as vol. 290 Every chapter except the first and the last contains numerous exercises For simplicity those chapters involving heavy computational methods contain only few exercises It includes appendices on Semi Simple Algebras and Quaternions and Strongly Perfect Lattices

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