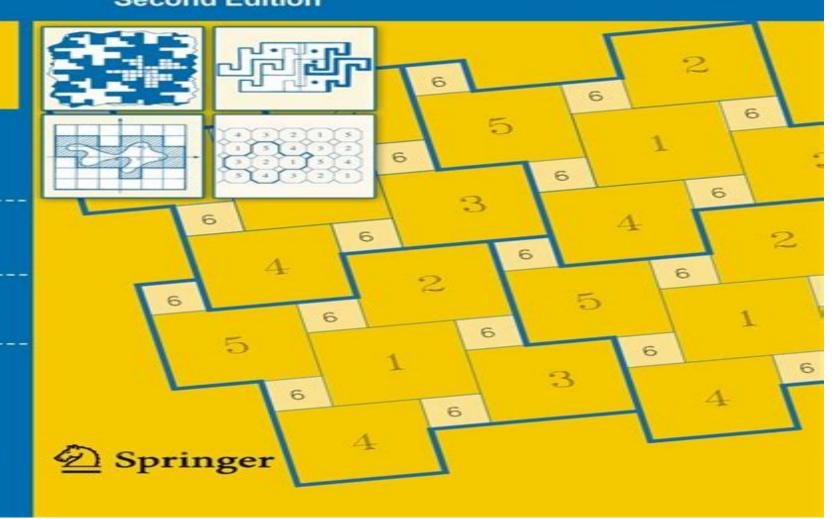
# **Alexander Soifer**

# Geometric Etudes in Combinatorial Mathematics



# **Geometric Etudes In Combinatorial Mathematics**

Solomon W. Golomb

#### **Geometric Etudes In Combinatorial Mathematics:**

Geometric Etudes in Combinatorial Mathematics Alexander Soifer, 2010-06-03 A mathematician like a painter or a poet is a maker of patterns If his patterns are more permanent than theirs it is because they are made with ideas A painter makes patterns with shapes and colours a poet with words A painter may embody an idea but the idea is usually commonplace and unimportant In poetry ideas count for a great deal more but as Housman insisted the importance of ideas in poetry is habitually exaggerated A mathematician on the other hand has no material to work with but ideas and so his patterns are likely to last longer since ideas wear less with time than words The mathematician s patterns like the painter s or the poet s must be beautiful the ideas like the colors or the words must t together in a harmonious way Beauty is the rst test there is no permanent place in the world for ugly mathematics G H Hardy A Mathematician's Apology 1940 Har pp 24 25 I grew up on books by Isaac M Yaglom and Vladimir Bolty ski I read their books as a middle and high school student in Moscow During my college years I got to know Isaak Moiseevich Yaglom personally and treasured his passion for and expertise in geometry and ne art In the midst of my xxv xxvi Preface college years a group of Moscow mathematicians including Isaak Yaglom signed a letter protesting the psychiatric prisonment of the famous dissident Alexander Esenin Volpin **Geometric Etudes in Combinatorial Mathematics** Alexander Soifer, 2010-06-15 Geometric Etudes in Combinatorial Mathematics is not only educational it is inspirational This distinguished mathematician captivates the young readers propelling them to search for solutions of life's problems problems that previously seemed hopeless Review from the first edition. The etudes presented here are not simply those of Czerny but are better compared to the etudes of Chopin not only technically demanding and addressed to a variety of specific skills but at the same time possessing an exceptional beauty that characterizes the best of art Keep this book at hand as you plan your next problem solving seminar The American Mathematical Monthly

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and also in discrete geometry including polytopes It is also appropriate for survey type courses in Banach space theory convex analysis differential geometry and applications of measure theory Solutions to all exercises are available to instructors who adopt the text for coursework Most chapters use the same structure with the first part presenting theory and the next containing a healthy range of exercises Some of the exercises may even be considered as short introductions to ideas which are not covered in the theory portion Each chapter has a notes section offering a rich narrative to accompany the theory illuminating the development of ideas and providing overviews to the literature concerning the covered topics In most cases these notes bring the reader to the research front The text includes many figures that illustrate concepts and some parts of the proofs enabling the reader to have a better understanding of the geometric meaning of the ideas An appendix containing basic and geometric measure theory collects useful information for convex geometers Mathematical Olympiad: The Third Decade and Further Explorations Alexander Soifer, 2017-04-27 Now in its third decade the Colorado Mathematical Olympiad CMO founded by the author has become an annual state wide competition hosting many hundreds of middle and high school contestants each year This book presents a year by year history of the CMO from 2004 2013 with all the problems from the competitions and their solutions Additionally the book includes 10 further explorations bridges from solved Olympiad problems to real mathematics bringing young readers to the forefront of various fields of mathematics This book contains more than just problems solutions and event statistics it tells a compelling story involving the lives of those who have been part of the Olympiad their reminiscences of the past and successes of the present I am almost speechless facing the ingenuity and inventiveness demonstrated in the problems proposed in the third decade of these Olympics However equally impressive is the drive and persistence of the originator and living soul of them It is hard for me to imagine the enthusiasm and commitment needed to work singlehandedly on such an endeavor over several decades Branko Gr nbaum University of Washingtonp ppiAfter decades of hunting for Olympiad problems and struggling to create Olympiad problems he has become an extraordinary connoisseur and creator of Olympiad problems The Olympiad problems were very good from the beginning but in the third decade the problems have become extraordinarily good Every brace of 5 problems is a work of art The harder individual problems range in quality from brilliant to work of genius The same goes for the Further Explorations part of the book Great mathematics and mathematical questions are immersed in a sauce of fascinating anecdote and reminiscence If you could have only one book to enjoy while stranded on a desert island this would be a good choice ii i psup supp ppiLike Gauss Alexander Soifer would not hesitate to inject Eureka at the right moment Like van der Waerden he can transform a dispassionate exercise in logic into a compelling account of sudden insights and ultimate triumph ii i pp Cecil Rousseau Chair USA Mathematical Olympiad Committee ppiA delightful feature of the book is that in the second part more related problems are discussed Some of them are still unsolved ii i pp Paul Erd s ppiThe book is a gold mine of brilliant reasoning with special emphasis on the power and beauty of coloring proofs Strongly recommended

to both serious and recreational mathematicians on all levels of expertise i p Martin Gardner The Mathematics of Paul Erdős II Ronald L. Graham, Jaroslav Nešetřil, Steve Butler, 2013-08-04 This is the most comprehensive survey of the mathematical life of the legendary Paul Erd s 1913 1996 one of the most versatile and prolific mathematicians of our time For the first time all the main areas of Erd's research are covered in a single project Because of overwhelming response from the mathematical community the project now occupies over 1000 pages arranged into two volumes These volumes contain both high level research articles as well as key articles that survey some of the cornerstones of Erd s work each written by a leading world specialist in the field A special chapter Early Days rare photographs and art related to Erd's complement this striking collection A unique contribution is the bibliography on Erd s publications the most comprehensive ever published This new edition dedicated to the 100th anniversary of Paul Erd's birth contains updates on many of the articles from the two volumes of the first edition several new articles from prominent mathematicians a new introduction and more biographical information about Paul Erd's with an updated list of publications The second volume contains chapters on graph theory and combinatorics extremal and Ramsey theory and a section on infinity that covers Erd s research on set theory All of these chapters are essentially updated particularly the extremal theory chapter that contains a survey of flag algebras a new technique for solving extremal problems Mathematics as Problem Solving Alexander Soifer, 2009-04-29 This book joins several other books available for the preparation of young scholars for a future that involves solving mathematical pr lems This training not only increases their tness in competitions but may also help them in other endeavors they may engage in the future The book is a diversi ed collection of problems from all areas of high school mathematics and is written in a lively and engaging way The introductory explanations and worked problems help guide the reader without turning the additional problems into rote repe tions of the solved ones The book should become an essential tool in the armamentarium of faculty involved with training future competitors Branko Grunbaum Professor of Mathematics University of Washington June 2008 Seattle Washington Foreword This was the rst of Alexander Soifer's books I think preceding How Does One Cut a Triangle by a few years It is short on anecdote and reminiscence but there is charm in its youthful brusqueness and let get right to business muscularity And mainly there is a huge lode of problems very good ones worked out and very good ones left to the reader to work out The Colorado Mathematical Olympiad and Further Explorations Alexander Soifer, 2011-04-13 This updated printing of the first edition of Colorado Mathematical Olympiad the First Twenty Years and Further Explorations gives the interesting history of the competition as well as an outline of all the problems and solutions that have been created for the contest over the years Many of the essay problems were inspired by Russian mathematical folklore and written to suit the young audience for example the 1989 Sugar problem was written in a pleasant Lewis Carroll like story Some other entertaining problems involve olde Victorian map colourings King Authur and the knights of the round table rooks in space Santa Claus and his elves painting planes football for 23 and even the Colorado Springs subway system

**Competitions for Young Mathematicians** Alexander Soifer, 2017-06-15 This book gathers the best presentations from the Topic Study Group 30 Mathematics Competitions at ICME 13 in Hamburg and some from related groups focusing on the field of working with gifted students Each of the chapters includes not only original ideas but also original mathematical problems and their solutions The book is a valuable resource for researchers in mathematics education secondary and college mathematics teachers around the globe as well as their gifted students Introduction to Combinatorial Methods in Geometry Alexander Kharazishvili, 2024-05-07 This book offers an introduction to some combinatorial also set theoretical approaches and methods in geometry of the Euclidean space Rm The topics discussed in the manuscript are due to the field of combinatorial and convex geometry. The author's primary intention is to discuss those themes of Euclidean geometry which might be of interest to a sufficiently wide audience of potential readers Accordingly the material is explained in a simple and elementary form completely accessible to the college and university students At the same time the author reveals profound interactions between various facts and statements from different areas of mathematics the theory of convex sets finite and infinite combinatorics graph theory measure theory classical number theory etc All chapters and also the five Appendices end with a number of exercises These provide the reader with some additional information about topics considered in the main text of this book Naturally the exercises vary in their difficulty Among them there are almost trivial standard nontrivial rather difficult and difficult As a rule more difficult exercises are marked by asterisks and are provided with necessary hints The material presented is based on the lecture course given by the author The choice of material serves to demonstrate the unity of mathematics and variety of unexpected interrelations between distinct mathematical branches

Engaging Young Students In Mathematics Through Competitions - World Perspectives And Practices: Volume Ii - Mathematics Competitions And How They Relate To Research, Teaching And Motivation Robert Geretschlager, 2020-04-15

The two volumes of Engaging Young Students in Mathematics through Competitions present a wide scope of aspects relating to mathematics competitions and their meaning in the world of mathematical research teaching and entertainment Volume II contains background information on connections between the mathematics of competitions and the organization of such competitions their interplay with research teaching and more It will be of interest to anyone involved with mathematics competitions at any level be they researchers competition participants teachers or theoretical educators The various chapters were written by the participants of the 8th Congress of the World Federation of National Mathematics Competitions in Austria in 2018

Solutions Manual to Accompany Geometry of Convex Sets I. E. Leonard, J. E. Lewis, 2016-04-25 A Solutions Manual to accompany Geometry of Convex Sets begins with basic definitions of the concepts of vector addition and scalar multiplication and then defines the notion of convexity for subsets of n dimensional space Many properties of convex sets can be discovered using just the linear structure However for more interesting results it is necessary to introduce the notion of distance in order to discuss open sets closed sets bounded sets and compact sets

The book illustrates the interplay between these linear and topological concepts which makes the notion of convexity so interesting Thoroughly class tested the book discusses topology and convexity in the context of normed linear spaces specifically with a norm topology on an n dimensional space Geometry of Convex Sets also features An introduction to n dimensional geometry including points lines vectors distance norms inner products orthogonality convexity hyperplanes and linear functionals Coverage of n dimensional norm topology including interior points and open sets accumulation points and closed sets boundary points and closed sets compact subsets of n dimensional space completeness of n dimensional space sequences equivalent norms distance between sets and support hyperplanes Basic properties of convex sets convex hulls interior and closure of convex sets closed convex hulls accessibility lemma regularity of convex sets affine hulls flats or affine subspaces affine basis theorem separation theorems extreme points of convex sets supporting hyperplanes and extreme points existence of extreme points Krein Milman theorem polyhedral sets and polytopes and Birkhoff's theorem on doubly stochastic matrices Discussions of Helly's theorem the Art Gallery theorem Vincensini's problem Hadwiger's theorems theorems of Radon and Caratheodory Kirchberger's theorem Helly type theorems for circles covering problems piercing problems sets of constant width Reuleaux triangles Barbier's theorem and Borsuk's problem Geometry of Convex Sets is a useful textbook for upper undergraduate level courses in geometry of convex sets and is essential for graduate level courses in convex analysis An excellent reference for academics and readers interested in learning the various applications of convex geometry the book is also appropriate for teachers who would like to convey a better understanding and appreciation of the field to students I E Leonard PhD was a contract lecturer in the Department of Mathematical and Statistical Sciences at the University of Alberta The author of over 15 peer reviewed journal articles he is a technical editor for the Canadian Applied Mathematical Quarterly journal J E Lewis PhD is Professor Emeritus in the Department of Mathematical Sciences at the University of Alberta He was the recipient of the Faculty of Science Award for Excellence in Teaching in 2004 as well as the PIMS Education Prize in 2002 **Polyominoes** Solomon W. Golomb, 2020-06-30 Inspiring popular video games like Tetris while contributing to the study of combinatorial geometry and tiling theory polyominoes have continued to spark interest ever since their inventor Solomon Golomb introduced them to puzzle enthusiasts several decades ago In this fully revised and expanded edition of his landmark book the author takes a new generation of readers on a mathematical journey into the world of the deceptively simple polyomino Golomb incorporates important recent developments and poses problems inviting the reader to play with and develop an understanding of the extraordinary properties of polyominoes Geometry of Convex Sets I. E. Leonard, J. E. Lewis, 2015-10-19 A gentle introduction to the geometry of convex sets in n dimensional space Geometry of Convex Sets begins with basic definitions of the concepts of vector addition and scalar multiplication and then defines the notion of convexity for subsets of n dimensional space Many properties of convex sets can be discovered using just the linear structure However for more interesting results it is necessary to introduce the notion of distance in order to

discuss open sets closed sets bounded sets and compact sets The book illustrates the interplay between these linear and topological concepts which makes the notion of convexity so interesting Thoroughly class tested the book discusses topology and convexity in the context of normed linear spaces specifically with a norm topology on an n dimensional space Geometry of Convex Sets also features An introduction to n dimensional geometry including points lines vectors distance norms inner products orthogonality convexity hyperplanes and linear functionals Coverage of n dimensional norm topology including interior points and open sets accumulation points and closed sets boundary points and closed sets compact subsets of n dimensional space completeness of n dimensional space sequences equivalent norms distance between sets and support hyperplanes Basic properties of convex sets convex hulls interior and closure of convex sets closed convex hulls accessibility lemma regularity of convex sets affine hulls flats or affine subspaces affine basis theorem separation theorems extreme points of convex sets supporting hyperplanes and extreme points existence of extreme points Krein Milman theorem polyhedral sets and polytopes and Birkhoff's theorem on doubly stochastic matrices Discussions of Helly's theorem the Art Gallery theorem Vincensini s problem Hadwiger s theorems theorems of Radon and Caratheodory Kirchberger s theorem Helly type theorems for circles covering problems piercing problems sets of constant width Reuleaux triangles Barbier's theorem and Borsuk's problem Geometry of Convex Sets is a useful textbook for upper undergraduate level courses in geometry of convex sets and is essential for graduate level courses in convex analysis An excellent reference for academics and readers interested in learning the various applications of convex geometry the book is also appropriate for teachers who would like to convey a better understanding and appreciation of the field to students I E Leonard PhD was a contract lecturer in the Department of Mathematical and Statistical Sciences at the University of Alberta The author of over 15 peer reviewed journal articles he is a technical editor for the Canadian Applied Mathematical Quarterly journal J E Lewis PhD is Professor Emeritus in the Department of Mathematical Sciences at the University of Alberta He was the recipient of the Faculty of Science Award for Excellence in Teaching in 2004 as well as the PIMS Education Prize in 2002 Classical Geometry I. E. Leonard, J. E. Lewis, A. C. F. Liu, G. W. Tokarsky, 2014-04-14 Features the classical themes of geometry with plentiful applications in mathematics education engineering and science Accessible and reader friendly Classical Geometry Euclidean Transformational Inversive and Projective introduces readers to a valuable discipline that is crucial to understanding bothspatial relationships and logical reasoning Focusing on the development of geometric intuitionwhile avoiding the axiomatic method a problem solving approach is encouraged throughout The book is strategically divided into three sections Part One focuses on Euclidean geometry which provides the foundation for the rest of the material covered throughout Part Two discusses Euclidean transformations of the plane as well as groups and their use in studying transformations and Part Three covers inversive and projective geometry as natural extensions of Euclidean geometry In addition to featuring real world applications throughout Classical Geometry Euclidean Transformational Inversive and Projective includes Multiple

entertaining and elegant geometry problems at the end of each section for every level of study Fully worked examples with exercises to facilitate comprehension and retention Unique topical coverage such as the theorems of Ceva and Menalaus and their applications. An approach that prepares readers for the art of logical reasoning modeling and proofs. The book is an excellent textbook for courses in introductory geometry elementary geometry modern geometry and history of mathematics at the undergraduate level for mathematics majors as well as for engineering and secondary education majors The book is also ideal for anyone who would like to learn the various applications of elementary geometry **How Does One Cut a Triangle?** Alexander Soifer, 2009-08-25 This second edition of Alexander Soifer's How Does One Cut a Triangle demonstrates how different areas of mathematics can be juxtaposed in the solution of a given problem. The author employs geometry algebra trigonometry linear algebra and rings to develop a miniature model of mathematical research **Bodies of Constant** Width Horst Martini, Luis Montejano, Déborah Oliveros, 2019-03-16 This is the first comprehensive monograph to thoroughly investigate constant width bodies which is a classic area of interest within convex geometry. It examines bodies of constant width from several points of view and in doing so shows surprising connections between various areas of mathematics Concise explanations and detailed proofs demonstrate the many interesting properties and applications of these bodies Numerous instructive diagrams are provided throughout to illustrate these concepts An introduction to convexity theory is first provided and the basic properties of constant width bodies are then presented The book then delves into a number of related topics which include Constant width bodies in convexity sections and projections complete and reduced sets mixed volumes and further partial fields Sets of constant width in non Euclidean geometries in real Banach spaces and in hyperbolic spherical and further non Euclidean spaces The concept of constant width in analysis using Fourier series spherical integration and other related methods Sets of constant width in differential geometry using systems of lines and discussing notions like curvature evolutes etc Bodies of constant width in topology hyperspaces transnormal manifolds fiber bundles and related topics. The notion of constant width in discrete geometry referring to geometric inequalities packings and coverings etc Technical applications such as film projectors the square hole drill and rotary engines Bodies of Constant Width An Introduction to Convex Geometry with Applications will be a valuable resource for graduate and advanced undergraduate students studying convex geometry and related fields Additionally it will appeal to any mathematicians with a general interest in geometry Excursions into Combinatorial Geometry Vladimir Boltyanski, Horst Martini, P.S. Soltan, 2012-12-06 siehe Werbetext Spatial Complexity Fivos Papadimitriou, 2020-11-02 This book delivers stimulating input for a broad range of researchers from geographers and ecologists to psychologists interested in spatial perception and physicists researching in complex systems How can one decide whether one surface or spatial object is more complex than another What does it require to measure the spatial complexity of small maps and why does this matter for nature science and technology Drawing from algorithmics geometry topology probability and informatics and with examples from everyday life

the reader is invited to cross the borders into the bewildering realm of spatial complexity as it emerges from the study of geographic maps landscapes surfaces knots 3D and 4D objects The mathematical and cartographic experiments described in this book lead to hypotheses and enigmas with ramifications in aesthetics and epistemology The New Mathematical Coloring Book Alexander Soifer, 2024-03-11 The New Mathematical Coloring Book TNMCB includes striking results of the past 15 year renaissance that produced new approaches advances and solutions to problems from the first edition A large part of the new edition Ask what your computer can do for you presents the recent breakthrough by Aubrey de Grey and works by Marijn Heule Jaan Parts Geoffrey Exoo and Dan Ismailescu TNMCB introduces new open problems and conjectures that will pave the way to the future keeping the book in the center of the field TNMCB presents mathematics of coloring as an evolution of ideas with biographies of their creators and historical setting of the world around them and the world around us A new thing in the world at the time TMCB I is now joined by a colossal sibling containing more than twice as much of what only Alexander Soifer can deliver an interweaving of mathematics with history and biography well seasoned with controversy and opinion Peter D Johnson Jr Auburn University Like TMCB I TMCB II is a unique combination of Mathematics History and Biography written by a skilled journalist who has been intimately involved with the story for the last half century The nature of the subject makes much of the material accessible to students but also of interest to working Mathematicians In addition to learning some wonderful Mathematics students will learn to appreciate the influences of Paul Erd s Ron Graham and others Geoffrey ExooIndiana State University The beautiful and unique Mathematical coloring book of Alexander Soifer is another case of good mathematics containing a lot of similar examples it is not by chance that Szemer di s Theorem story is included as well and presenting mathematics as both a science and an art Peter Mih kMathematical Reviews MathSciNet A postman came to the door with a copy of the masterpiece of the century I thank you and the mathematics community should thank you for years to come You have set a standard for writing about mathematics and mathematicians that will be hard to match Harold W KuhnPrinceton University I have never encountered a book of this kind The best description of it I can give is that it is a mystery novel I found it hard to stop reading before I finished in two days the whole text Soifer engages the reader's attention not only mathematically but emotionally and esthetically May you enjoy the book as much as I did Branko Gr nbaumUniversity of Washington I am in absolute awe of your 2008 book Aubrey D N J de Grey LEV Foundation

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