CAMBRIDGE

Cambridge University Press 978-1-108-48580-7 — Games of No Chance 5 Edited by Urban Larsson Frontmatter <u>More Information</u>

> This book surveys the state of the art in the theory of combinatorial games, that is, games not involving chance or hidden information. Enthusiasts will find a wide variety of exciting topics, from a trailblazing presentation of scoring to solutions of three piece ending positions of bidding chess. Theories and techniques in many subfields are covered, such as universality, Wythoff Nim variations, misère play, partizan bidding (a.k.a. Richman games), loopy games, and the algebra of placement games. Also included are an updated list of unsolved problems, extremely efficient algorithms for Taking and Breaking games, a historical exposition of binary numbers and games by David Singmaster, chromatic Nim variations, renormalization for combinatorial games, and a survey of temperature theory by Elwyn Berlekamp, one of the founders of the field.

Mathematical Sciences Research Institute Publications

70

Games of No Chance 5

© in this web service Cambridge University Press

Mathematical Sciences Research Institute Publications

- 1 Freed/Uhlenbeck: Instantons and Four-Manifolds, second edition
- 2 Chern (ed.): Seminar on Nonlinear Partial Differential Equations
- 3 Lepowsky/Mandelstam/Singer (eds.): Vertex Operators in Mathematics and Physics
- 4 Kac (ed.): Infinite Dimensional Groups with Applications
- 5 Blackadar: K-Theory for Operator Algebras, second edition
- 6 Moore (ed.): Group Representations, Ergodic Theory, Operator Algebras, and Mathematical Physics
- 7 Chorin/Majda (eds.): Wave Motion: Theory, Modelling, and Computation
- 8 Gersten (ed.): Essays in Group Theory
- 9 Moore/Schochet: Global Analysis on Foliated Spaces, second edition
- 10-11 Drasin/Earle/Gehring/Kra/Marden (eds.): Holomorphic Functions and Moduli
- 12-13 Ni/Peletier/Serrin (eds.): Nonlinear Diffusion Equations and Their Equilibrium States
 - 14 Goodman/de la Harpe/Jones: Coxeter Graphs and Towers of Algebras
 - 15 Hochster/Huneke/Sally (eds.): Commutative Algebra
 - 16 Ihara/Ribet/Serre (eds.): Galois Groups over Q
 - 17 Concus/Finn/Hoffman (eds.): Geometric Analysis and Computer Graphics
 - 18 Bryant/Chern/Gardner/Goldschmidt/Griffiths: Exterior Differential Systems
 - 19 Alperin (ed.): Arboreal Group Theory
 - 20 Dazord/Weinstein (eds.): Symplectic Geometry, Groupoids, and Integrable Systems
 - 21 Moschovakis (ed.): Logic from Computer Science
 - 22 Ratiu (ed.): The Geometry of Hamiltonian Systems
 - 23 Baumslag/Miller (eds.): Algorithms and Classification in Combinatorial Group Theory
 - 24 Montgomery/Small (eds.): Noncommutative Rings
 - 25 Akbulut/King: Topology of Real Algebraic Sets
 - 26 Judah/Just/Woodin (eds.): Set Theory of the Continuum
 - 27 Carlsson/Cohen/Hsiang/Jones (eds.): Algebraic Topology and Its Applications
 - 28 Clemens/Kollár (eds.): Current Topics in Complex Algebraic Geometry
 - 29 Nowakowski (ed.): Games of No Chance
 - 30 Grove/Petersen (eds.): Comparison Geometry
 - 31 Levy (ed.): Flavors of Geometry
 - 32 Cecil/Chern (eds.): Tight and Taut Submanifolds
 - 33 Axler/McCarthy/Sarason (eds.): Holomorphic Spaces
 - 34 Ball/Milman (eds.): Convex Geometric Analysis
 - 35 Levy (ed.): The Eightfold Way
 - 36 Gavosto/Krantz/McCallum (eds.): Contemporary Issues in Mathematics Education
 - 37 Schneider/Siu (eds.): Several Complex Variables
 - 38 Billera/Björner/Green/Simion/Stanley (eds.): New Perspectives in Geometric Combinatorics
 - 39 Haskell/Pillay/Steinhorn (eds.): Model Theory, Algebra, and Geometry
 - 40 Bleher/Its (eds.): Random Matrix Models and Their Applications
 - 41 Schneps (ed.): Galois Groups and Fundamental Groups
 - 42 Nowakowski (ed.): More Games of No Chance
 - 43 Montgomery/Schneider (eds.): New Directions in Hopf Algebras
 - 44 Buhler/Stevenhagen (eds.): Algorithmic Number Theory: Lattices, Number Fields, Curves and Cryptography
 - 45 Jensen/Ledet/Yui: Generic Polynomials: Constructive Aspects of the Inverse Galois Problem
 - 46 Rockmore/Healy (eds.): Modern Signal Processing
 - 47 Uhlmann (ed.): Inside Out: Inverse Problems and Applications
 - 48 Gross/Kotiuga: Electromagnetic Theory and Computation: A Topological Approach
 - 49 Darmon/Zhang (eds.): Heegner Points and Rankin L-Series
 - 50 Bao/Bryant/Chern/Shen (eds.): A Sampler of Riemann-Finsler Geometry
 - 51 Avramov/Green/Huneke/Smith/Sturmfels (eds.): Trends in Commutative Algebra
 - 52 Goodman/Pach/Welzl (eds.): Combinatorial and Computational Geometry
 - 53 Schoenfeld (ed.): Assessing Mathematical Proficiency
 - 54 Hasselblatt (ed.): Dynamics, Ergodic Theory, and Geometry
 - 55 Pinsky/Birnir (eds.): Probability, Geometry and Integrable Systems
 - 56 Albert/Nowakowski (eds.): Games of No Chance 3
 - 57 Kirsten/Williams (eds.): A Window into Zeta and Modular Physics
 - 58 Friedman/Hunsicker/Libgober/Maxim (eds.): Topology of Stratified Spaces
 - 59 Caporaso/M^CKernan/Mustață/Popa (eds.): Current Developments in Algebraic Geometry
 - 60 Uhlmann (ed.): Inverse Problems and Applications: Inside Out II
 - 61 Breuillard/Oh (eds.): Thin Groups and Superstrong Approximation
 - 62 Eguchi/Eliashberg/Maeda (eds.): Symplectic, Poisson, and Noncommutative Geometry
 - 63 Nowakowski (ed.): Games of No Chance 4
 - 64 Bellamy/Rogalski/Schedler/Stafford/Wemyss: Noncommutative Algebraic Geometry
 - 65 Deift/Forrester (eds.): Random Matrix Theory, Interacting Particle Systems, and Integrable Systems
 - 66 Corvino (ed.): Aspects of Mathematical Relativity
- 67–68 Eisenbud/Iyengar/Singh/Stafford/Van den Bergh (eds.): Commutative Algebra and Noncommutative Algebraic Geometry
 - 70 Larsson (ed.): Games of No Chance 5

Games of No Chance 5

Urban Larsson

Technion - Israel Institute of Technology



CAMBRIDGE

Cambridge University Press 978-1-108-48580-7 — Games of No Chance 5 Edited by Urban Larsson Frontmatter <u>More Information</u>

> Urban Larsson urban031@gmail.com

Silvio Levy (Series Editor) Mathematical Sciences Research Institute levy@msp.org

The Mathematical Sciences Research Institute wishes to acknowledge support by the National Science Foundation and the *Pacific Journal of Mathematics* for the publication of this series.

CAMBRIDGE UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom One Liberty Plaza, 20th Floor, New York, NY 10006, USA 477 Williamstown Road, Port Melbourne, VIC 3207, Australia 314-321 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi - 110025, India 79 Anson Road, #06-04/06, Singapore, 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org Information on this title: www.cambridge.org/9781107129542

© Mathematical Sciences Research Institute 2019

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2019

A catalogue record for this publication is available from the British Library. Library of Congress Cataloging-in-Publication data

ISBN 9781108485807 Hardback 9781108713658 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

CAMBRIDGE

Cambridge University Press 978-1-108-48580-7 — Games of No Chance 5 Edited by Urban Larsson Frontmatter <u>More Information</u>

> Games of No Chance 5 MSRI Publications Volume **70**, 2017

Contents

About this book URBAN LARSSON	1
Temperatures of games and coupons ELWYN BERLEKAMP	21
Wythoff visions	35
ERIC DUCHÊNE, AVIEZRI FRAENKEL, VLADIMIR GURVICH, NHAN HO, Clark Kimberling, and Urban Larsson	
Scoring games: the state of play URBAN LARSSON, RICHARD NOWAKOWSKI AND CARLOS PEREIRA DOS SANTOS	89
Restricted developments in partizan misère game theory REBECCA MILLEY AND GABRIEL RENAULT	113
Unsolved problems in combinatorial games	125
Richard Nowakowski	
Misère games and misère quotients	169
AARON SIEGEL	
An historical tour of binary and tours	207
DAVID SINGMASTER	
A note on polynomial profiles of placement games J. I. BROWN, D. COX, A. HOEFEL, NEIL MCKAY, REBECCA MILLEY, RICHARD NOWAKOWSKI, AND ANGELA A. SIEGEL	243
A PSPACE-complete graph nim	259
Kyle Burke and Olivia George	
A nontrivial surjective map onto the short Conway group ALDA CARVALHO AND CARLOS PEREIRA DOS SANTOS	271
Games and complexes I: Transformation via ideals	285
Sara Faridi, Svenja Huntemann and Richard Nowakowski	
Games and complexes II: Weight games and Kruskal–Katona type bounds SARA FARIDI, SVENJA HUNTEMANN AND RICHARD NOWAKOWSKI	297
Chromatic nim finds a game for your solution MIKE FISHER AND URBAN LARSSON	313

viii	CONTENTS	
Take-away games on Beatty's theore AVIEZRI FRAENKEL AND URE		333
Geometric analysis of a generalized Eric Friedman, Scott M. (Adam S. Landsberg and U	GARRABRANT, ILONA PHIPPS-MORGAN,	343
Searching for periodicity in Officers J.P. GROSSMAN		373
Good pass moves in no-draw Hyper RYAN HAYWARD	Hex: two proverbs	387
Conjoined games: Go-Cut and Sno- MELISSA HUGGAN AND RICH		395
Impartial games whose rulesets proc URBAN LARSSON AND MIKE		403
Endgames in bidding chess URBAN LARSSON AND JOHAN	n Wastlund	421
Phutball draws Sucharit Sarkar		439
Scoring play combinatorial games FRASER STEWART		447
Generalized misère play MIKE WEIMERSKIRCH		469
Retrospective index		479