

LONDON MATHEMATICAL SOCIETY LECTURE NOTE SERIES

Managing Editor: Professor M. Reid, Mathematics Institute,
 University of Warwick, Coventry CV4 7AL, United Kingdom

The titles below are available from booksellers, or from Cambridge University Press
 at www.cambridge.org/mathematics

- 285 Rational points on curves over finite fields, H. NIEDERREITER & C. XING
- 286 Clifford algebras and spinors (2nd Edition), P. LOUNESTO
- 287 Topics on Riemann surfaces and Fuchsian groups, E. BUJALANCE, A.F. COSTA & E. MARTÍNEZ (eds)
- 288 Surveys in combinatorics, 2001, J.W.P. HIRSCHFELD (ed)
- 289 Aspects of Sobolev-type inequalities, L. SALOFF-COSTE
- 290 Quantum groups and Lie theory, A. PRESSLEY (ed)
- 291 Tits buildings and the model theory of groups, K. TENT (ed)
- 292 A quantum groups primer, S. MAJID
- 293 Second order partial differential equations in Hilbert spaces, G. DA PRATO & J. ZABCZYK
- 294 Introduction to operator space theory, G. PISIER
- 295 Geometry and integrability, L. MASON & Y. NUTKU (eds)
- 296 Lectures on invariant theory, I. DOLGACHEV
- 297 The homotopy category of simply connected 4-manifolds, H.-J. BAUES
- 298 Higher operads, higher categories, T. LEINSTER (ed)
- 299 Kleinian groups and hyperbolic 3-manifolds, Y. KOMORI, V. MARKOVIC & C. SERIES (eds)
- 300 Introduction to Möbius differential geometry, U. HERTRICH-JEROMIN
- 301 Stable modules and the D(2)-problem, F.E.A. JOHNSON
- 302 Discrete and continuous nonlinear Schrödinger systems, M.J. ABLOWITZ, B. PRINARI & A.D. TRUBATCH
- 303 Number theory and algebraic geometry, M. REID & A. SKOROBOGATOV (eds)
- 304 Groups St Andrews 2001 in Oxford I, C.M. CAMPBELL, E.F. ROBERTSON & G.C. SMITH (eds)
- 305 Groups St Andrews 2001 in Oxford II, C.M. CAMPBELL, E.F. ROBERTSON & G.C. SMITH (eds)
- 306 Geometric mechanics and symmetry, J. MONTALDI & T. RATIU (eds)
- 307 Surveys in combinatorics 2003, C.D. WENSLEY (ed.)
- 308 Topology, geometry and quantum field theory, U.L. TILLMANN (ed)
- 309 Corings and comodules, T. BRZEZINSKI & R. WISBAUER
- 310 Topics in dynamics and ergodic theory, S. BEZUGLYI & S. KOLYADA (eds)
- 311 Groups: topological, combinatorial and arithmetic aspects, T.W. MÜLLER (ed)
- 312 Foundations of computational mathematics, Minneapolis 2002, F. CUCKER *et al* (eds)
- 313 Transcendental aspects of algebraic cycles, S. MÜLLER-STACH & C. PETERS (eds)
- 314 Spectral generalizations of line graphs, D. CVETKOVIĆ, P. ROWLINSON & S. SIMIĆ
- 315 Structured ring spectra, A. BAKER & B. RICHTER (eds)
- 316 Linear logic in computer science, T. EHRHARD, P. RUET, J.-Y. GIRARD & P. SCOTT (eds)
- 317 Advances in elliptic curve cryptography, I.F. BLAKE, G. SEROUSSI & N.P. SMART (eds)
- 318 Perturbation of the boundary in boundary-value problems of partial differential equations, D. HENRY
- 319 Double affine Hecke algebras, I. CHEREDNIK
- 320 L-functions and Galois representations, D. BURNS, K. BUZZARD & J. NEKOVÁŘ (eds)
- 321 Surveys in modern mathematics, V. PRASOLOV & Y. ILYASHENKO (eds)
- 322 Recent perspectives in random matrix theory and number theory, F. MEZZADRI & N.C. SNAITH (eds)
- 323 Poisson geometry, deformation quantisation and group representations, S. GUTT *et al* (eds)
- 324 Singularities and computer algebra, C. LOSSEN & G. PFISTER (eds)
- 325 Lectures on the Ricci flow, P. TOPPING
- 326 Modular representations of finite groups of Lie type, J.E. HUMPHREYS
- 327 Surveys in combinatorics 2005, B.S. WEBB (ed)
- 328 Fundamentals of hyperbolic manifolds, R. CANARY, D. EPSTEIN & A. MARDEN (eds)
- 329 Spaces of Kleinian groups, Y. MINSKY, M. SAKUMA & C. SERIES (eds)
- 330 Noncommutative localization in algebra and topology, A. RANICKI (ed)
- 331 Foundations of computational mathematics, Santander 2005, L.M. PARDO, A. PINKUS, E. SÜLI & M.J. TODD (eds)
- 332 Handbook of tilting theory, L. ANGELERI HÜGEL, D. HAPPEL & H. KRAUSE (eds)
- 333 Synthetic differential geometry (2nd Edition), A. KOCK
- 334 The Navier–Stokes equations, N. RILEY & P. DRAZIN
- 335 Lectures on the combinatorics of free probability, A. NICA & R. SPEICHER
- 336 Integral closure of ideals, rings, and modules, I. SWANSON & C. HUNEKE
- 337 Methods in Banach space theory, J.M.F. CASTILLO & W.B. JOHNSON (eds)
- 338 Surveys in geometry and number theory, N. YOUNG (ed)

- 339 Groups St Andrews 2005 I, C.M. CAMPBELL, M.R. QUICK, E.F. ROBERTSON & G.C. SMITH (eds)
 340 Groups St Andrews 2005 II, C.M. CAMPBELL, M.R. QUICK, E.F. ROBERTSON & G.C. SMITH (eds)
 341 Ranks of elliptic curves and random matrix theory, J.B. CONREY, D.W. FARMER, F. MEZZADRI & N.C. SNAITH (eds)
 342 Elliptic cohomology, H.R. MILLER & D.C. RAVENEL (eds)
 343 Algebraic cycles and motives I, J. NAGEL & C. PETERS (eds)
 344 Algebraic cycles and motives II, J. NAGEL & C. PETERS (eds)
 345 Algebraic and analytic geometry, A. NEEMAN
 346 Surveys in combinatorics 2007, A. HILTON & J. TALBOT (eds)
 347 Surveys in contemporary mathematics, N. YOUNG & Y. CHOI (eds)
 348 Transcendental dynamics and complex analysis, P.J. RIPON & G.M. STALLARD (eds)
 349 Model theory with applications to algebra and analysis I, Z. CHATZIDAKIS, D. MACPHERSON, A. PILLAY & A. WILKIE (eds)
 350 Model theory with applications to algebra and analysis II, Z. CHATZIDAKIS, D. MACPHERSON, A. PILLAY & A. WILKIE (eds)
 351 Finite von Neumann algebras and masas, A.M. SINCLAIR & R.R. SMITH
 352 Number theory and polynomials, J. MCKEE & C. SMYTH (eds)
 353 Trends in stochastic analysis, J. BLATH, P. MÖRTERS & M. SCHEUTZOW (eds)
 354 Groups and analysis, K. TENT (ed)
 355 Non-equilibrium statistical mechanics and turbulence, J. CARDY, G. FALKOVICH & K. GAWEDZKI
 356 Elliptic curves and big Galois representations, D. DELBOURGO
 357 Algebraic theory of differential equations, M.A.H. MACCALLUM & A.V. MIKHAILOV (eds)
 358 Geometric and cohomological methods in group theory, M.R. BRIDSON, P.H. KROPHOLLER & I.J. LEARY (eds)
 359 Moduli spaces and vector bundles, L. BRAMBILA-PAZ, S.B. BRADLOW, O. GARCÍA-PRADA & S. RAMANAN (eds)
 360 Zariski geometries, B. ZILBER
 361 Words: Notes on verbal width in groups, D. SEGAL
 362 Differential tensor algebras and their module categories, R. BAUTISTA, L. SALMERÓN & R. ZUAZUA
 363 Foundations of computational mathematics, Hong Kong 2008, F. CUCKER, A. PINKUS & M.J. TODD (eds)
 364 Partial differential equations and fluid mechanics, J.C. ROBINSON & J.L. RODRIGO (eds)
 365 Surveys in combinatorics 2009, S. HUCZYNSKA, J.D. MITCHELL & C.M. RONEY-DOUGAL (eds)
 366 Highly oscillatory problems, B. ENGQUIST, A. FOKAS, E. HAIRER & A. ISERLES (eds)
 367 Random matrices: High dimensional phenomena, G. BLOWER
 368 Geometry of Riemann surfaces, F.P. GARDINER, G. GONZÁLEZ-DIEZ & C. KOUROUNIOTIS (eds)
 369 Epidemics and rumours in complex networks, M. DRAIEF & L. MASSOULIÉ
 370 Theory of p -adic distributions, S. ALBEVERIO, A.YU. KHRENNIKOV & V.M. SHELKOVICH
 371 Conformal fractals, F. PRZYTYCKI & M. URBAŃSKI
 372 Moonshine: The first quarter century and beyond, J. LEPOWSKY, J. MCKAY & M.P. TUIE (eds)
 373 Smoothness, regularity and complete intersection, J. MAJADAS & A. G. RODICIO
 374 Geometric analysis of hyperbolic differential equations: An introduction, S. ALINHAC
 375 Triangulated categories, T. HOLM, P. JØRGENSEN & R. ROUQUIER (eds)
 376 Permutation patterns, S. LINTON, N. RUŠKUC & V. VATTER (eds)
 377 An introduction to Galois cohomology and its applications, G. BERHUY
 378 Probability and mathematical genetics, N. H. BINGHAM & C. M. GOLDIE (eds)
 379 Finite and algorithmic model theory, J. ESPARZA, C. MICHAUX & C. STEINHORN (eds)
 380 Real and complex singularities, M. MANOEL, M.C. ROMERO FUSTER & C.T.C. WALL (eds)
 381 Symmetries and integrability of difference equations, D. LEVI, P. OLVER, Z. THOMOVA & P. WINTERNITZ (eds)
 382 Forcing with random variables and proof complexity, J. KRAJÍČEK
 383 Motivic integration and its interactions with model theory and non-Archimedean geometry I, R. CLUCKERS, J. NICAISE & J. SEBAG (eds)
 384 Motivic integration and its interactions with model theory and non-Archimedean geometry II, R. CLUCKERS, J. NICAISE & J. SEBAG (eds)
 385 Entropy of hidden Markov processes and connections to dynamical systems, B. MARCUS, K. PETERSEN & T. WEISSMAN (eds)
 386 Independence-friendly logic, A.L. MANN, G. SANDU & M. SEVENSTER
 387 Groups St Andrews 2009 in Bath I, C.M. CAMPBELL *et al* (eds)
 388 Groups St Andrews 2009 in Bath II, C.M. CAMPBELL *et al* (eds)
 389 Random fields on the sphere, D. MARINUCCI & G. PECCATI
 390 Localization in periodic potentials, D.E. PELINOVSKY
 391 Fusion systems in algebra and topology M. ASCHBACHER, R. KESSAR & B. OLIVER

Cambridge University Press
978-1-107-60109-3 — Surveys in Combinatorics 2011
Edited by Robin Chapman
Frontmatter
[More Information](#)

London Mathematical Society Lecture
Note Series: 392

Surveys in Combinatorics 2011

Edited by
ROBIN CHAPMAN
University of Exeter



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press
978-1-107-60109-3 — Surveys in Combinatorics 2011
Edited by Robin Chapman
Frontmatter
[More Information](#)

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
103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

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/9781107601093

© Cambridge University Press 2011

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 2011

A catalogue record for this publication is available from the British Library

ISBN 978-1-107-60109-3 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.

Contents

<i>Preface</i>	<i>page</i>	vii
1 Counting planar maps, coloured or uncoloured		1
<i>Mireille Bousquet-Mélou</i>		
2 A survey of PPAD-completeness for computing Nash equilibria		51
<i>Paul W. Goldberg</i>		
3 Hypergraph Turán problems		83
<i>Peter Keevash</i>		
4 Some new results in extremal graph theory		141
<i>V. Nikiforov</i>		
5 The cyclic sieving phenomenon: a survey		183
<i>Bruce Sagan</i>		
6 Order in building theory		235
<i>Koen Thas</i>		
7 Graphs, colours, weights and hereditary properties		333
<i>Andrew Thomason</i>		
8 Random geometric graphs		365
<i>Mark Walters</i>		
9 Transversals in latin squares: a survey		403
<i>Ian Wanless</i>		

Preface

The Twenty-Third British Combinatorial Conference was organised by the University of Exeter. It was held in Exeter in July 2011. The British Combinatorial Committee had invited nine distinguished combinatorialists to give survey lectures in areas of their expertise, and this volume contains the survey articles on which these lectures were based.

In compiling this volume I am indebted to the authors for preparing their articles so accurately and professionally, and to the referees for their rapid responses and keen eye for detail. I would also like to thank Roger Astley, Silvia Barbina and Clare Dennison at Cambridge University Press for their advice, assistance and patience. Finally, without the previous efforts of editors of earlier *Surveys* and the guidance of the British Combinatorial Committee, the preparation of this volume would have been quite impossible.

Robin Chapman

University of Exeter

January 2011