

Scott H. Murray Curriculum vitae

Faculty of Education, Science, Technology and Mathematics
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Education

Ph.D. University of Chicago, October 1995–August 2000.
Thesis: “Conjugacy classes in maximal parabolic subgroups of the general linear group.”
Advisor: Prof. J. L. Alperin.

S.M. (Master of Science). University of Chicago, October 1994–June 1995.

B.Sc.(Hons). Australian National University, January 1990–December 1993.
Major: Mathematics.
Thesis: “The Schreier-Sims algorithm.”
Advisor: Prof. E. A. O’Brien.

Research interests

Computation in Kac-Moody algebras and groups, and their applications to physics.

Computation in Lie type groups, algebraic groups, and finite matrix groups.

Representation theory of reductive algebraic groups.

Computation of orthogonal arrays, and their applications to statistics.

Academic positions

Assistant Professor (tenure track). University of Canberra, January 2010–present.
Leader of the Mathematics and Statistics Research Program, April 2016–present.
Research and teaching.

Senior Research Fellow. University of Sydney, August 2007–January 2010.
Research in computational Lie theory and group theory. Teaching of advanced undergraduates.

Sesquicentennial Postdoctoral Fellowship. University of Sydney,
August 2002–March 2003, April 2004–September 2004, and October 2005–July 2007.
Postdoctoral research in computational Lie theory and computational group theory.

Marie Curie Individual Fellowship. Eindhoven University of Technology,
April 2003–March 2004, and October 2004–September 2005.
Postdoctoral research in computational methods for groups of Lie type and design of
experiments (statistics).

Postdoctoral position. Eindhoven University of Technology, August 2001–July 2002.
Postdoctoral research in computational methods for finite groups of Lie type and auto-
mated deduction.

Visiting Scholarship. University of Sydney, August 2000–July 2001.
Postdoctoral research in computational Lie theory and computational group theory. De-
veloped a MAGMA package for computing in groups of Lie type.

Research assistant. University of Chicago, April 1999–August 2000.
Researched methods for generating random elements in groups with Prof. László Babai.
Supervised research by two undergraduate students.

Grants, Fellowships and Prizes

Academic Initiatives Program. Rutgers University, November 2012.
Joint project with Lisa Carbone.

Finalist for Vice Chancellor’s Award for Excellence. University of Canberra, June 2016.
For research supervision.

Vice Chancellor’s Award for Excellence. University of Canberra, June 2012.
Awarded for teaching Discrete Mathematics, a first year service unit for IT students.

Faculty Research Program in Information Modelling and Data Interpretation.
Faculty of Information Sciences and Engineering, University of Canberra, 2012 and 2013.
Primary author of the application for internal funding, and active member of the program.

Faculty Research Program in Symmetry, Geometry and Physics.
Faculty of Information Sciences and Engineering, University of Canberra, 2012 and 2013.
Primary author of the application for internal funding, Vice Chair and Acting Chair of
the program.

Marie Curie Individual Fellowship. European Commission,
April 2003–March 2004 and October 2004–September 2005.

Sesquicentennial Postdoctoral Fellowship. University of Sydney,
August 2002–March 2003, April 2004–September 2004, and October 2005–July 2007.

Fulbright Postgraduate Student Award. Australian-American Fulbright Commission,
September 1994–October 1999.

University Fellowship. University of Chicago, October 1994–October 1995.

University Medal. Australian National University, December 1993.

Hanna Neumann Prizes. Australian National University, December 1992 and 1993.

Visiting positions

Rutgers University, August–November 2014.

Ho Chi Minh City University of Technology (Viet Nam National University),
July 2014 and January 2013.

Ho Chi Minh City University of Economics, July 2014 and January 2013.

Hanoi University of Economics and Business (Viet Nam National University), January 2013.

Hong Kong Baptist University, April 2012.
Teaching the unit Business Statistics.

University of Auckland, June 2008 and January 2011.
Funded by Prof. Eamonn O'Brien's Marsden Grant, which I contributed to writing.

Rutgers University, May 2008 and May 2010.
Funded by Prof. Lisa Carbone's NSF grant DMS-0701176.

Honorary Fellowship at University of Sydney, January 2010–present.

University of Western Australia, January 2009.

Refereed research articles

Julio Romero and Scott H. Murray, “An algebraic and combinatorial approach to the construction of Experimental Designs,” accepted by *International Journal of Geotechnique, Construction Materials and Environment (GEOMATE): Special Edition in Sciences and Engineering* (2015).

Julio Romero and Scott H. Murray, “Enumeration of Strength Three Orthogonal Arrays and Their Implementation in Parameter Design,” *Journal of Applied Mathematics and Physics* **3** (2015), no. 1, 38–45.

Lisa Carbone, Scott H. Murray, and Hisham Sati, “Integral group actions on symmetric spaces and discrete duality symmetries of supergravity theories,” accepted by *Journal of Mathematical Physics* (2015), arXiv:1407.3370.

Tai Huu Pham and Scott H. Murray, “Australia and New Zealand: Potential impact on ASEAN growth,” accepted by *Vietnam Social Sciences Review*, Vietnam Academy of Social Sciences (2014).

Scott H. Murray and Man V. M. Nguyen, “Enumeration of strength 3 mixed orthogonal arrays,” *Southeast Asian Journal of Sciences* **1** (2012), no. 2, 155–168.

- Scott H. Murray and Colva M. Roney-Dougal, “Constructive homomorphisms for classical groups,” *J. Symbolic Comput.* **46** (2011), no. 4, 371–384.
- Lisa Carbone, Leigh Cobbs, and Scott H. Murray, “Fundamental domains for congruence subgroups of SL_2 in positive characteristic.” *J. Algebra* **325** (2011), 431–439.
- Sophie Ambrose, Scott H. Murray, Cheryl E. Praeger, and Csaba Schneider, “Constructive Membership Testing in Black-Box Classical Groups,” *Mathematical Software – ICMS 2010, Lecture Notes in Computer Science*, **6327** (2010) 54–57.
- Arjeh M. Cohen and Scott H. Murray, “An algorithm for Lang’s Theorem,” *J. Algebra* **322**(3) (2009) 675–702.
- Arjeh M. Cohen, Sergei Haller, and Scott H. Murray, “Computing in unipotent and reductive algebraic groups,” *LMS J. Comput. Math.* **11** (2008) 343–366.
- Arjeh M. Cohen, Jan Willem Knopper, and Scott H. Murray, “Automatic proof of graph non-isomorphism,” *Math. Comput. Sci.* **2**(2) (2008) 211–229.
- Scott H. Murray, “Representations of parabolic and Borel subgroups,” *Comm. Algebra* **35**(2) (2007) 455–459.
- Arjeh M. Cohen, Scott H. Murray, and D. E. Taylor, “Computing in groups of Lie type,” *Math. Comp.* **73** (2004) 1477–1498.
- Petra E. Holmes, Stephen A. Linton, and Scott H. Murray, “Product replacement in the Monster group,” *Experiment. Math.* **12**(1) (2003) 123–126.
- Arjeh M. Cohen, Scott H. Murray, Martin Pollet, and Volker Sorge, “Certifying solutions to permutation group problems,” *Automated Deduction—CADE-19*, F. Baader (ed), *Lecture Notes in Artificial Intelligence* **2741** (2003) 258–273.
- C. R. Leedham-Green and Scott H. Murray, “Variants of product replacement,” *Computational and Statistical Group Theory (Las Vegas, NV/Hoboken, NJ, 2001)*, *Contemp. Math.* **298** (2002) 97–104.
- Scott H. Murray, “Conjugacy classes in maximal parabolic subgroups of the general linear group,” *J. Algebra* **233** (2000) 135–155.
- Frank Celler, C. R. Leedham-Green, Scott H. Murray, Alice C. Niemeyer, and E. A. O’Brien, “Generating random elements of a finite group,” *Comm. Algebra* **23** (1995) 4931–4948.
- Scott H. Murray and E. A. O’Brien, “Selecting base points for the Schreier-Sims algorithm for matrix groups,” *J. Symbolic Comput.* **19** (1995) 577–584.

Book chapters

Chapters in *Handbook of Magma functions*, J. Cannon, W. Bosma (eds):

S. Murray and D. Taylor, “Introduction to Lie theory.”

S. Haller, S. Murray, and D. Taylor, “Coxeter systems.”
S. Haller, S. Murray, and D. Taylor, “Root data.”
S. Murray and D. Taylor, “Coxeter groups.”
S. Murray, D. Taylor, “Reflection groups.”
W. de Graaf, D. Roozmond, S. Haller, and S. Murray, “Lie algebras.”
S. Murray, S. Haller, and D. Taylor, “Groups of Lie type.”
D. Roozmond and S. Murray, “Representations of Lie groups and algebras.”

`magma.maths.usyd.edu.au/magma/handbook/authors`

Course lecture notes

Scott H. Murray, Ian Lisle, and Peter Vassiliou, “Discrete Mathematics,” course notes for a course given at the *University of Canberra* (2014).

Arjeh M. Cohen and Scott H. Murray, “An automated proof theory approach to computation with permutation groups,” course notes for a course given by Arjeh M. Cohen at the *Calculus Autumn School* (2002).

Scott H. Murray, “Classical groups and groups of Lie type,” course notes for a course given at the *University of Sydney* (2008).

Preprints and manuscripts

Lisa Carbone, Matt Kownacki, Scott H. Murray and Sowmya Srinivasan, “Root subsystems of rank 2 hyperbolic root systems,” preprint, arXiv:1506.05405.

Lisa Carbone and Scott H. Murray, *Chevalley bases for Kac–Moody algebras*, in preparation.

Lisa Carbone and Scott H. Murray, *Prenilpotent pairs in hyperbolic Kac–Moody root systems*, in preparation.

Arjeh M. Cohen, William M. Kantor, and Scott H. Murray, “Constructive Sylow Theorems for exceptional groups of Lie type,” in preparation (2014).

Sergei Haller and Scott H. Murray, “Computing conjugacy in finite classical groups,” in preparation (2014).

Sophie Ambrose, Scott H. Murray, Cheryl E. Praeger, and Csaba Schneider, Constructive membership testing in black-box classical groups, preprint (2010). arXiv:1006.5858

Arjeh M. Cohen, Scott H. Murray, and Sergei Haller, “Computing with root subgroups of twisted reductive groups,” preprint (2010).

Scott H. Murray and Neil Saunders, “Magma proof of strict inequalities for minimal degrees of finite groups,” preprint (2009). arXiv:0906.3574

Gene Cooperman and Scott H. Murray, “Computable subgroup chains and shadowing,” preprint (2002).

Software authored

(Only publically released software is listed.)

Conjugacy in classical groups. MAGMA. 2009.

Highest weight representations of Lie algebras and reductive algebraic groups. With Dan Roozmond. MAGMA. 2006.

Proof assistant for graph isomorphism. Jan Willem Knopper under my supervision. Java, GAP4, and nauty. 2004.

Constructing mixed orthogonal arrays. Man V. M. Nguyen under my supervision. GAP4, nauty, and S. 2003.

Galois cohomology and twisted forms of groups of reductive algebraic groups. With Sergei Haller. MAGMA. 2003.

Split reductive algebraic groups (groups of Lie type). With Sergei Haller. MAGMA. 2002.

Root systems, root data, and finite reflection groups. With Don Taylor; partly based on CHEVIE. MAGMA. 2001.

Subgroup chains and shadowing. GAP4. With Gene Cooperman. 2000.

Improved Schreier-Sims algorithm for matrix groups. C; incorporated into MAGMA with Bill Unger. 1993.

Plenary lectures

“Graphs of groups in Magma.” Plenary talk at the Special Day for John Cannon and Derek Holt, Groups St Andrews. Bath, August 2009.

Selected presentations

“Computing with algebraic groups.” Oberwolfach workshop on Groups Actions, June 2011.

“Computing with the Lie correspondence.” Matrix Group Recognition meeting of the International Centre for Mathematical Sciences. Edinburgh, July 2009.

“Applications of the Lie correspondence to matrix group recognition.” Group Theory, Combinatorics and Computation (in honour of Cheryl Praeger), Perth, January 2009.

“Algorithmic recognition of Lie algebras.” 51th Annual Meeting of the Australian Mathematical Society, Melbourne, September 2007.

“Recognition of Lie algebras.” EIDMA Seminar Combinatorial Theory, Technical University of Eindhoven, June 2007.

“Computing in linear algebraic groups.” 50th Annual Meeting of the Australian Mathematical Society, Sydney, September 2006.

- “Computing in soluble linear algebraic groups.” Groups St Andrews, St Andrews, July 2005.
- “Conjugacy and twisted conjugacy in classical groups.” International meeting on Geometry - Interactions with Algebra and Analysis, Auckland, February 2005.
- “Algorithm for Lang’s Theorem.” Victorian Algebra Conference, Melbourne, September 2004.
- “Computing in groups of Lie type.” Dutch-Belgian Mathematical Conference, Tilburg, April 2004
- “Computation in groups of Lie type.” Oberwolfach meeting on Computational group theory, July 2001.
- “Representations of Borel subgroups and parabolic subgroups.” Conference on Representation Theory and Computational Algebra, University of Georgia, May 2000.
- “Conjugacy classes in parabolic subgroups.” Conference on Group Theory and Computation, Sydney, December 1999.
- “Conjugacy classes in parabolic subgroups of general linear groups.” American Mathematical Society Eastern sectional meeting, Providence, Rhode Island, October 1999.
- “Quality of random elements in groups.” DIMACS conference on Groups and Computation, Colorado, Ohio, June 1999.
- “Conjugacy classes of parabolic subgroups.” University of Chicago group theory colloquium, Illinois, May 1999.
- “Constructing the sporadic simple groups.” Expository talk at Australian National University, Canberra, June 1993.

Lecturing and course design

Mathematical Methods. University of Canberra, 2016.

Convenor (lecturing and supervision of tutors) of first year service course for science and health students, with over 300 students each year. Redesigned flipped teaching with computer-based assessment. Significantly improves the pass rate and dropout rate of the course.

First Year Mastery Program. University of Canberra, 2013-14.

Leader of the program for Mathematics and Statistics and member of the planning committee for the Faculty of Education, Science, Technology & Mathematics. This was part of a university-wide program to convert all first year courses to a flipped teaching approach for on-campus students and online methods for distance learners, together with a mastery approach to assessment. Designed exercise sets in MyMathLab.

Discrete Mathematics. University of Canberra, 2010–15.

Convenor (lecturing and supervision of tutors) of first year service course for IT and software engineering students, with over 100 students each year. Redesigned the course to reflect changes in the needs of IT and also to significantly improve the number of students

passing the course on the first attempt. Subsequently redesigned to course for flipped teaching and recorded online podcast lectures.

Discrete Mathematics. University of Canberra College, 2010–14.

Supervisor and assessment moderator for this unit for non-English speaking students and students with poor educational backgrounds.

Discrete Mathematics. University of Canberra Accelerate Program. 2012.

Designed an Advanced Placement course for high school students, in collaboration with a senior high school teacher.

Mathematical Structures. University of Canberra, 2012–15.

Taught second year unit on abstract algebra with a focus on applications in software engineering. In the process of converting to flipped/online teaching.

Mathematical Perspectives. University of Canberra, 2012–15.

Designed and taught this third year unit on history and social context of mathematics. This is the final unit for our program for mathematics high school education.

Coding Theory. University of Canberra, 2010–12.

Convened course for third year undergraduates in mathematics and graduates in software engineering.

Business Statistics. Hong Kong Baptist University, 2012.

Taught first year University of Canberra course for overseas students in Hong Kong. Also helped redesign the unit in preparation for converting to a flipped mode of teaching.

Pure Mathematics Honours 6: Group Theory. University of Sydney, 2008.

Designed, taught and assessed the course covering structure theory of classical groups and introduced groups of Lie type.

An automated proof theory approach to computation with permutation groups. Technical University of Eindhoven, 2002.

With Arjeh Cohen, designed course notes for a course at the *Calculus Autumn School 2002*.

Mathematics 195–6: Mathematical methods for the Social sciences. University of Chicago, 1999.

Lectured, set exams, and designed webpages for this service course on linear algebra and multivariate calculus for economics majors.

Mathematics 131–3: Calculus and elementary functions.. University of Chicago, 1998.

Lectured, set exams, and supervised tutors for this course for students with no previous background in calculus.

Mathematics 151–3: Calculus. University of Chicago, 1997.

Lectured, developed syllabi, set exams, and designed webpages for this first year calculus unit.

Other teaching experience

Mentored and funded a scholarship for a foreign refugee studying IT at the University of Canberra. 2013.

Planned Pi day celebrations for high school students. 2012 and 2013.

With Judith Ascione and teaching staff of the University of Canberra High School.

Volunteer mathematics teacher. 1999.

Blue Gargoyle adult literacy program, Chicago, Illinois, USA.

Taught arithmetic and elementary algebra to adults studying for the GED (high school equivalency exam).

Volunteer mathematics teacher. 1998.

Explore and discover program, Fiske Elementary School, Chicago, Illinois, USA.

Planned and taught a “Math fun” program on symmetry and geometry for first and second grade students with low socio-economic backgrounds.

College fellow. September 1995–May 1996.

College of the University of Chicago, Illinois, USA.

Ran problem sessions, set exams and graded for Mathematics 161–3 (Honors calculus).

Tutor. February 1993–December 1993.

Australian National University and University of Canberra, Canberra, Australia.

Ran problem sessions and graded for courses on linear algebra, multivariate calculus, and differential equations.

Tutor. January 1993.

Australian Mathematics Summer School, Canberra, Australia.

Taught abstract algebra and Euclidean geometry to high school students.

Research supervision

My research students nominated me for a University of Canberra Vice Chancellor’s Excellence Award in Supervision of Higher Degree by Research Students in 2014.

Julio Romero Zapata, *Parameter design and enumeration of highly symmetric mixed orthogonal arrays*, Ph.D., University of Canberra, 2011–present.

Li Zhe, *The impact of privacy policies on consumer trust in an Australia context*, M.I.T. (Master of Information Technology) by research, University of Canberra, 2013–present.

Tai Huu Pham, *Methodology for Estimating the Economic Impact of An Free Trade Agreement on ASEAN Countries*. Ph.D., University of Canberra, 2012–present.

Sowmya Srinivasan (cosupervised with Lisa Carbone), *Kac-Moody root systems of rank 2*, M.Sc., Rutgers University, 2014–present.

Leo Shao, *Constructing Fractional Factorial designs with computer algebra*, Research project for coursework M.I.T. University of Canberra, 2012.

- Leigh Cobbs (cosupervised with Lisa Carbone), *Infinite descending chains of cocompact lattices in Kac-Moody groups*, Ph.D., Rutgers University, 2009.
- Sergei Haller, *Algorithms for Groups of Lie Type*, Postdoctoral project, Magma Computer Algebra Group, University of Sydney, 2006–7.
- Sergei Haller (cosupervised with Arjeh Cohen), *Computing Galois cohomology and forms of linear algebraic groups*, Ph.D., Technical University of Eindhoven, 2005.
- Nguyen Van Minh Man (cosupervised with Arjeh Cohen), *Computer-algebraic methods for the construction of designs of experiments*, Ph.D., Technical University of Eindhoven, 2005.
- Jan Willem Knopper (cosupervised with Arjeh Cohen), *Automatic Proofs of Graph Nonisomorphism*, Master of Science, Technical University of Eindhoven, 2005.
- Chris Krook (cosupervised with Arjeh Cohen), *Groups related to $E_7(q)$: A quest for distance-transitivity*, Masters of Science, Technical University of Eindhoven, 2003.
- Vincent Remie (cosupervised with Arjeh Cohen), *Graph isomorphism problem*, Undergraduate research project, Technical University of Eindhoven, 2003.
- Ben Chad, *Constructing finite subgroups of simple Lie groups*, Summer scholarship (Research experience for undergraduates), University of Sydney, 2003.
- Rebecca Virnig and Walter Kim (cosupervised with László Babai), *Random elements in finite groups*, Undergraduate research project, Department of Computer Science, University of Chicago, 2001.

Refereeing experience

- Reviewer for American Mathematical Society MathReviews.
- Referee for Bulletin of the Australian Mathematics Society, Journal of Algebra, Journal of Lie Theory, Journal of Symbolic Computation, and others.

Committee memberships

- Faculty Committee on the First Year Mastery Program. University of Canberra, 2013–14.
Program leader for Mathematics and Statistics.
- Committee for redesign and accreditation for Information Technology and Software Engineering. University of Canberra, 2013.
Representative for the Department of Mathematics and Statistics.
- Organiser of the Mathematics and Statistics research and pedagogy seminars.
University of Canberra, 2010–14.
- Faculty of Information Science and Engineering honours recruitment committee.
University of Canberra, 2011–12.

Honours Student Assessment Committee. University of Sydney, 2008.
Student chair in 1999 and 2000.

Graduate Student Advisory Committee. University of Chicago, 1998–2000.
Student chair in 1999 and 2000.

Graduate student Algebra III committee. University of Chicago, 2000.
Chaired this *ad hoc* committee formed to make suggestions on the new syllabus of a graduate level algebra course.

Student representative for third year honours students. Australian National University, 1992.

Professional society memberships

Australian Mathematical Society.

American Mathematical Society.

Mathematical Association of America.

Skills

Languages: Advanced Dutch, Intermediate French, Beginning German.

Computer languages and systems: MAGMA, GAP4, GAP, MyMathLab, Matlab, Mathematical, Maple, Traditional C, Linux.

References

Prof. Cheryl Praeger, AM. Fellow of the Australian Academy.
University of Western Australia, 35 Stirling Hwy, Crawley, WA 6009, Australia.
praeger@maths.uwa.edu.au, +61 8 3344-9380, +61 8 9380-1028 (fax).

Prof. Lisa Carbone.
Rutgers University, 110 Frelinghuysen Rd, Piscataway, NJ 08854-8019, USA.
carbone1@math.rutgers.edu, +1 732 445-1310, +1 732 445-5530 (fax).

Prof. E. A. O'Brien.
University of Auckland, Private bag 92019, Auckland, New Zealand.
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Dr. Judith Ascione (teaching referee).
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Judith.Ascione@canberra.edu.au, +61 2 6201 2044, +61 2 6201 5360 (fax).

Assoc. Prof. D. E. Taylor (teaching referee).
University of Sydney F07, Sydney, NSW, 2006, Australia.
don@maths.usyd.edu.au, +61 2 9351 5775, +61 2 9351 4534 (fax).