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British citizen, Hong Kong permanent resident

Research Interests

Algebraic structures on combinatorial objects (e.g. symmetric functions, combinatorial Hopf algebras/monoids, dual graded graphs, Solomon's descent algebra), and their interaction with Markov chains.

Employment

2016 - present Assistant Professor, Hong Kong Baptist University, Hong Kong
2014 - 2016 CRM-ISM postdoctoral fellow, Laboratoire de Combinatoire et d'Informatique Mathématique (LaCIM), Université du Québec à Montréal (UQAM), Canada
2015 Course Lecturer (part time), McGill University, Montreal, Canada

Education

2014 PhD in Mathematics, Stanford University, USA (*Advisor: Persi Diaconis; dissertation title: Hopf Algebras and Markov Chains*)
2009 Certificate of Advanced Study in Mathematics ('Part III') with distinction, Trinity Hall, University of Cambridge, UK
2008 BA in Mathematics with first class honours, Trinity Hall, University of Cambridge, UK

Awards

2019 Faculty/School/Academy Performance Award in Early Career Teaching

Research Grants

2018-2020 RGC-ECS: *Markov Chains driven by Permuted and Hyperoctahedral Descent Operators on Combinatorial Hopf Algebras.*

Publications

- 7 [Lumpings of Algebraic Markov Chains arise from Subquotients](#), J. Theoret. Probab., 32 (2019), no. 4, 1804–1844.
- 6 (with M. Josuat-Vergès) [Subalgebras of Solomon's Descent Algebra based on Alternating Runs](#), J. Combin. Theory Ser. A, 158 (2018), 36–65.
- 5 [Card-Shuffling via Convolutions of Projections on Combinatorial Hopf Algebras](#), 27th Annual International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2015), 49–60, Discrete Math. Theor. Comput. Sci. Proc., Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2015.
- 4 (with P. Diaconis, A. Ram) [Hopf Algebras and Markov Chains: Two Examples and a Theory](#), J. Algebraic Combin., 39 (2014), no. 3, 527–585.
- 3 [A Hopf-power Markov chain on Compositions](#), 25th Annual International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2013), 499–510, Discrete Math. Theor. Comput. Sci. Proc., AS, Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2013.

- 2 (with 27 others) [Supercharacters, Symmetric Functions in Noncommuting variables, and related Hopf Algebras](#), Adv. Math. 229 (2012), no. 4, 2310–2337.
- 1 (with 27 others) [Supercharacters, symmetric functions in noncommuting variables \(extended abstract\) and related Hopf Algebras](#), 23rd Annual International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2011), 3-14, Discrete Math. Theor. Comput. Sci. Proc., AO, Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2011.

Preprints

(with N. Bergeron, R. S. González D'León, S. X. Li, Y. Vargas) [Hopf algebras of parking functions and decorated planar trees](#) <http://arxiv.org/abs/2109.05434>

[The Eigenvalues of Hyperoctahedral Descent Operators and Applications to Card-Shuffling](#)
arxiv.org/abs/2108.09097

[Markov Chains from Descent Operators on Combinatorial Hopf Algebras](#)
arxiv.org/abs/1609.04312

[Hopf Algebras and Markov Chains](#) (thesis) arxiv.org/abs/1412.8221

Presentations

Invited Talks

- 09/2021 *Card-shuffling and other Markov chains from Hopf algebras*, Noncommutative Algebra, Probability and Analysis in Action, online.
- 06/2021 *Markov Chains from Linear Operators and Hopf Algebras*, Algebraic and Combinatorial Perspectives in the Mathematical Sciences (seminar series), online.
- 06/2021 [Monomial Bases for Combinatorial Hopf Algebras](#), Algebraic Combinatorics Virtual Expedition, online.
- 03/2018 *Lumpings of Algebraic Markov Chains arise from Subquotients*, Hong Kong Probability Seminar
- A Uniform Analysis of Combinatorial Markov Chains using Hopf Algebras*,
 10/2016 Department of Stat. Seminar, Chinese University of Hong Kong
- 01/2016 Department of Math. Colloquium, Hong Kong Baptist University
- 01/2016 Numerical Methods and Applied Analysis Seminar, University of Hong Kong
- 10/2015 *A Hopf-Algebraic Lift of the Down-Up Markov Chain on Partitions to Permutations*, Special Session on Hopf Algebraic Combinatorics, AMS Sectional Meeting, Chicago, USA.
- Card Shuffling and Convolutions of Projections on graded Hopf Algebras*,
 01/2015 Applied Algebra Seminar, York University
- 09/2014 Combinatorics Seminar, LaCIM
- 12/2014 *Card Shuffling, Tree-Pruning and Convolutions of Projections on graded Hopf Algebras*, CRM-ISM Probability Seminar
- Card Shuffling and other Hopf-Power Markov Chains*,
 06/2014 Combinatorics Seminar, LaCIM
- 01/2014 Combinatorics Seminar, University of Michigan
- 08/2013 Algebra/Geometry/Topology Seminar, University of Melbourne
- 03/2013 Algebra and Combinatorics Seminar, Loyola University Chicago
- 02/2014 *Markov Chains from Combinatorial Hopf Algebras*, Probability Seminar, Cornell University

Other Research Presentations

- 01/2021 *A Universal Construction of Monomial Bases on Hopf Algebras*, Hopf meeting, online.
- 06/2019 *Deformations of Comonoids-in-Species, Coalgebras, Hopf Algebras and their Quasisymmetric Invariants (8-minute flash talk on work-in-progress)*, *New Directions in Algebraic Combinatorics*, San Diego, USA.
- 05/2018 *Markov Chains and Descent Subalgebras*, HKBU-NCKU Joint Workshop on Mathematical Sciences, National Cheng Kung University, Taiwan.
- 07/2015 [Card-Shuffling via Convolutions of Projections on Combinatorial Hopf Algebras](#), 27th International Conference on Formal Power Series and Algebraic Combinatorics, Daejeon, South Korea.
- 03/2015 *Card Shuffling and Markov Chains on Combinatorial Hopf Algebras*, Probability Seminar, University of Ottawa
- 01/2015 *Card Shuffling and Convolutions of Projections on graded Hopf Algebras*, *Combinatorial Algebra meets Algebraic Combinatorics*, Kingston, Canada.
- 07/2013 *A Hopf-power Markov chain on Compositions (poster)*, 25th International Conference on Formal Power Series and Algebraic Combinatorics, Paris, France.
- 04/2012 *Ribbon Characters, Garsia-Reutenauer idempotents and a Biased Amazing Matrix??*, Student Probability and Related Fields Seminar, Stanford University
- 05/2011 *Kolmogorov's Rock-Breaking and Related Walks on Species*, Student Probability and Related Fields Seminar, Stanford University

Expository Presentations

- 03/2014 *What is a Combinatorial Hopf Algebra?* Graduate Student Colloquium, Stanford University
- 05/2011 *Card Games and Crystals*, Graduate Student Colloquium, Stanford University
- 04/2010 *The Art Gallery Problem*, Stanford University Mathematics Organisation
- Hopf Algebras and Representation Theory*
- 10/2009 Graduate Student Colloquium, Stanford University
- 03/2009 Part III seminar, University of Cambridge

Teaching

at Hong Kong Baptist University:

- 2016 - present Math 2207, Linear Algebra (including three weeks of recordings, one semester online, two semesters in hybrid mode)
- 2019 - present Math 3407, Advanced Linear Algebra (including one semester in hybrid mode)
- 2017 Math 2205, Multivariate Calculus

Course Lecturer at McGill University:

- 2015 Math 141, Integral Calculus

Guest Lecturer at Université du Québec à Montréal (3 lectures):

- 2015 Mat 995B, Research Seminar on Combinatorics: Descent Algebras

Teaching Assistant at Stanford University (leading recitations):

- 2013 Math 41A, Accelerated Differential Calculus
- 2010 - 2013 Math 51, Linear Algebra and Multivariable Calculus

Course Assistant at Stanford University (office hours, grading):

- 2012 Math 19, Differential Calculus
- 2012 Math 110, Applied Number Theory and Field Theory

2011 Math 210B, Graduate Algebra
2010 Math 113, Linear Algebra and Matrix Theory
2009 Math 120, Introduction to Abstract Algebra

Administrative Teaching Assistant at Stanford University:

2014 Math 51, Linear Algebra and Multivariable Calculus (200 students)

Teaching Assistant at Stanford University Mathematics Camp:

2009 - 2010 Program I, Abstract Algebra and Number Theory

Teaching Assistant at Enrichment Program for Young Mathematical Talents, Chinese University of Hong Kong:

2007 Non-Euclidean Geometry

Student Supervision

PhD supervision, Hong Kong Baptist University:

2019-present *Quasisymmetric Power Sums* (working title)

Undergraduate research final year projects, Hong Kong Baptist University:

2019-2020 *Free Dual Graded Graphs*

2019-2020 *The Hopf Algebra of Bicoloured Complete Graphs*

2018-2019 *Cocycles on Graphs*

2017-2018 *A Remove-and-Reattach Markov Chain on Planar Binary Trees*

2017-2018 *A Vertex Deletion Markov Chain on Graphs*

2017-2018 *A Vertex Deletion Markov Chain on Ordered Trees*

2017-2018 *The Catalan Hopf Algebra*

Undergraduate expository final year projects, Hong Kong Baptist University:

2020-2021 *Reinterpretation of Basic Category Theory Concepts*

2018-2019 *Sim and Ramsey Theory*

2016-2017 *Around Sylow's Theorems*

2016-2017 *Partition Bijections*

Summer undergraduate research fellowship, Hong Kong Baptist University:

2018 *Comonoids on finite vector spaces*

Conference and Workshop Participation

Research

07/2020 24th International Conference on Formal Power Series and Algebraic Combinatorics, online
06/2020 Algebraic Combinatorics Virtual Expedition, online
04/2020 Algebraic Combinatorics Online Workshop, online
05/2018 SIAM Conference on Applied Linear Algebra, Hong Kong
08/2017 3rd International Congress in Algebras and Combinatorics, Hong Kong
12/2016 Joint UM-HKBU Workshop on Mathematics and Statistics, Macau
06/2016 4th Institute of Mathematical Statistics Asia Pacific Rim Meeting, Hong Kong
12/2015 Canadian Mathematical Society Winter Meeting, Montreal, Canada
08/2015 BIRS workshop on Positivity in Algebraic Combinatorics, Banff, Canada
06/2015 SageDays65, Chicago, USA
04/2015 SageDays67, Montreal, Canada
2011 - 2014 Bay Area Discrete Mathematics Days, USA
02/2014 Lie Groups, Lie Algebras and Their Representations, Stanford, USA
01/2013 Algebraic Groups and Representation Theory - a Conference in Memory of Tonny A. Springer, Hong Kong

07/2012 24th International Conference on Formal Power Series and Algebraic Combinatorics, Nagoya, Japan

Teaching

2019-present Teaching and Learning Experience Sharing – co-facilitated one session and attended 20+ sessions on online teaching, at HKBU

07/2021 Teaching and Learning Expo, Chinese University of Hong Kong, Hong Kong

06/2021 Online Teaching by STEM Teachers: Opportunities and Challenges, HKTEA, online

07/2020 Teaching and Learning Expo, Chinese University of Hong Kong, Hong Kong

07/2019 Symposium on Emerging Innovations and Evaluation of Technology Enhanced Active Learning Pedagogies in Tertiary Education, Hong Kong Polytechnic University, Hong Kong

06/2018 Mini Symposium on Technology Enhanced Active Learning in Tertiary STEM Education, Hong Kong Polytechnic University, Hong Kong

Service

Academic

2014 - present Journal referee, J. Alg. Combi.; J. Combin. Theory Ser. A; Ann. Comb.; Random Structures Algorithms; J. Alg. Appl.

2018 Program committee member, 28th International Conference on Formal Power Series and Algebraic Combinatorics

Departmental

2018 - present HKBU coordinator, Simon Marais Mathematics Competition

2021 - present Undergraduate project organiser, HKBU Math Department

2019 - present Interviewer, exchange to McGill University from HKBU Computer Science Department

2018,

2020 - 2021 Interviewer, year 1 entry to HKBU Science Faculty

2017 - 2020 Interviewer, year 3 direct entry to HKBU Math Department

2017 - 2019 Library coordinator, HKBU Math Department

2017 - 2019 Science faculty representative, Advisory Committee for Language Enhancement Program (HKBU)

2011 - 2013 Co-organiser, Stanford Women in Math

2010 - 2011 Co-organiser, Stanford Graduate Student Colloquium