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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

8 *The Eigenvalues of Hyperoctahedral Descent Operators and Applications to Card-Shuffling*, Electron. J. Combin., 29 (2022), no. 4, Paper No. 1.32.

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

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

10/2009 *Hopf Algebras and Representation Theory*
03/2009 Graduate Student Colloquium, Stanford University
         Part III seminar, University of Cambridge

Teaching

at Hong Kong Baptist University:

2016 – present Math 2207, Linear Algebra (including three weeks of recordings, two semesters online, two semesters in hybrid mode)
2019 – present Math 3407, Advanced Linear Algebra (including one semester in hybrid mode)
2022 – present Math 2225, Calculus II (one semester online)
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:

2021-2022	*Counting Distinct Coloring Combinations By Polya's Theorem*
2021-2022	*A More Intuitive Way to look into Topology*
2021-2022	*Learning mathematics behind the games of Eulerian graph and Hamiltonian graph*
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