

Kai Fong Ernest Chong

CURRICULUM VITAE

Information Systems Technology and Design (ISTD) pillar
Singapore University of Technology and Design (SUTD)
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EDUCATION

Ph.D. in Mathematics, Cornell University, August 2015.

Thesis Title: Face vectors and Hilbert functions

Thesis Advisor: Edward Swartz

M.S. in Mathematics, Cornell University, May 2013.

B.A. in Mathematics, Cornell University, May 2009.

Summa cum laude, distinction in all subjects. (Accelerated graduation in 3 years.)

Dean's List in 6 out of 6 semesters; Undergraduate Cumulative GPA: 3.97/4.00

CURRENT AND PAST EMPLOYMENT HISTORY

Period	Organization	Designation/Position
Sep 2018–present	Singapore University of Technology and Design	Assistant Professor
Nov 2015–Aug 2018	Nanyang Technological University	Adjunct Assistant Professor
Sep 2015–Aug 2018	Institute for Infocomm Research, A*STAR	Research Scientist
Aug 2012–Dec 2012	Cornell University (Dept. of Mathematics)	Teaching Assistant
Jul 2009–Jul 2010	Institute for Infocomm Research, A*STAR	Research Officer
Jun 2007–Jul 2007	Institute for Infocomm Research, A*STAR	Intern (Research Attachment)
Apr 2006–Jun 2007	Institute for Infocomm Research, A*STAR	Intern (Research Attachment)

RESEARCH GRANTS

2017–2020 NRF–ISF Singapore–Israel Joint Research Grant NRF2015-NRF-ISF001-2528 (PI),
“Fundamental Enumerative Aspects of Flag Complexes” (SGD 219,300).¹

PRIZES, AWARDS, HONORS

- National Science Scholarship, Agency for Science, Technology and Research, 2003–present.
Full funding for both undergraduate and PhD studies. I was awarded this scholarship as the grand winner of the Singapore National Science Talent Search in 2003, a research-based science competition in areas including Physics, Chemistry, Biology, Computer Science, and Mathematics. I was the first grand winner in Singapore's history to win with a math research project (see Publications Section).
- Eleanor Norton York Award, 2013–2014
Every year, one graduate student in Cornell's Department of Mathematics receives this award for outstanding performance.
- Elected into Phi Beta Kappa academic honor society, 2009.

¹National Research Foundation (NRF) and Israel Science Foundation (ISF) are Singapore's and Israel's respective equivalents of the National Science Foundation (NSF) in the United States.

- William Lowell Putnam Mathematical Competition, Cornell Putnam team member (team consisting of 3 members), 2007 (team 14th) and 2008 (team 16th).
- Rochester Math Olympiad, Individual 2nd (regional), 2007.
- William Lowell Putnam Mathematical Competition, top 250, 2006.
- Represented Singapore as Observer for the International Mathematical Olympiad 2006, held in Ljubljana, Slovenia.
- Singapore National Science Talent Search, Grand Winner, 2003 (comes with \$10,000 prize).
- Singapore Science and Engineering Fair, Gold Award, 2003.
- Represented Singapore as team member for the International Mathematical Olympiad 2003, held in Tokyo, Japan. Awarded honorable mention.

RESEARCH INTERESTS

- Algebraic, geometric, topological and enumerative combinatorics
- Combinatorial and computational commutative algebra
- Machine learning (especially theoretical and computational aspects of deep learning)

RESEARCH PUBLICATIONS AND PREPRINTS

1. **K. F. E. Chong**, and T. S. Tay, “The face numbers of homology spheres,” *preprint*. arXiv:1706.03322
2. **K. F. E. Chong**, “Generalized Macaulay representations and the flag f -vectors of generalized colored complexes,” *preprint*. arXiv:1306.1787
3. **K. F. E. Chong**, “An application of liaison theory to the Eisenbud–Green–Harris conjecture,” *J. Algebra*, vol. 445, pp. 221–231, 2016. arXiv:1311.0939
4. **K. F. E. Chong**, “Hilbert functions of colored quotient rings and a generalization of the Clements–Lindström theorem,” *J. Algebraic Combinatorics*, vol. 42, no. 1, pp. 1–23, 2015. arXiv:1403.3158
5. E. Kurniawan, **K. F. E. Chong**, S. Sun, and K. Yen, “Application of FASTAR Code in Multimedia Broadcast Multicast Service,” *Proceedings of IEEE 73rd Vehicular Technology Conference (VTC) Spring 2011*, pp. 1-5, May 2011.
6. E. Kurniawan, **K. F. E. Chong**, S. Sun, and K. Yen, “Outage analysis of Joint Channel-Network Coding and its dependence on the interleaver pattern,” *Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC), 2011*, pp. 2000-2005, Mar 2011.
7. E. Kurniawan, S. Sun, K. Yen, and **K. F. E. Chong**, “Application of Network Coding in Rateless Transmission over Wireless Relay Networks,” *IEEE Transactions on Communications*, vol. 59, no. 2, pp. 507-517, Feb 2011.
8. E. Kurniawan, S. Sun, K. Yen, and **K. F. E. Chong**, “Improving error performance of Joint Channel and Network Coding in Multiple Access Relay Channel,” *Proceedings of the International Symposium on Information Theory and its Applications (ISITA), 2010*, pp. 145-150, Oct 2010.
9. **K. F. E. Chong**, E. Kurniawan, S. Sun, and K. Yen, “Fountain codes with varying probability distributions,” *Proceedings of the 6th International Symposium on Turbo Codes and Iterative Information Processing (ISTC), 2010*, pp. 176-180, Sep 2010. arXiv:1001.1798
10. E. Kurniawan, S. Sun, K. Yen, and **K. F. E. Chong**, “Network Coded Transmission of Fountain Codes over Cooperative Relay Networks,” *Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC), 2010*, pp. 1-6, Apr 2010.

OTHER RESEARCH PAPERS

1. **K. F. E. Chong**, and K. S. R. Poh, “On Riemann Zeta Function and Twin Prime Conjecture,” *Proceedings of the 15th Science Research Congress*, organized by Faculty of Science, National University of Singapore and Gifted Education Branch, Ministry of Education, Singapore, March 18-19, 2003. (Winning research paper (grand prize) at the Singapore National Science Talent Search 2003; written as a high school student.) [Available: http://staff.science.nus.edu.sg/~scilooe/srp2002/sci_paper/Maths/research_paper/Chong%20Kai%20Fong%20Ernest.pdf]
2. **K. F. E. Chong**, “The Weak Order of Coxeter Systems and the Combinatorial Properties of Descent Sets,” *Senior Thesis*, May 2009, Cornell University, Department of Mathematics, Thesis Supervisor: Prof. Edward Swartz. (Written as an undergraduate student.) [Available: <http://www.math.cornell.edu/m/sites/default/files/imported/Research/SeniorTheses/2009/chongKFEThesis.pdf>]

INVITED TALKS AT CONFERENCES, WORKSHOPS AND SEMINARS

- **Topological Combinatorics in Shantou**, “Stress algebras on simplicial complexes”, Shantou, Guangdong, China, August 12–18, 2018.
- **Singapore University of Technology and Design (SUTD) Seminar**, “Geometric combinatorics and its guises”, Singapore, April 2018.
- **3rd Pacific Rim Mathematical Association (PRIMA) Congress**, “Face enumeration of homology spheres”, *Special Session on Algebraic and Enumerative Combinatorics*, Oaxaca, Mexico, August 2017.
- **Cornell University Discrete Geometry and Combinatorics Seminar**, “Beyond the g -theorem”, Ithaca, NY, December 2016.
- **2016 Canadian Mathematical Society Winter Meeting**, “Beyond the g -theorem”, *Special Session on Recent Advances in Commutative Algebra*, Niagara Falls, ON, Canada, December 2–5, 2016.
- **Yale-NUS College Mathematics, Computer Science and Statistics (MCS) Seminar**, “An intersection of topological combinatorics, commutative algebra, and extremal graph theory”, Singapore, March 2016.
- **2016 Joint Mathematics Meetings**, “Face enumeration and Kruskal–Katona-type theorems”, *AMS Special Session on Algebraic and Topological Methods in Combinatorics*, Seattle, WA, January 6–9, 2016.
- **National University of Singapore (NUS) Mathematics Seminar**, “An intersection of topological combinatorics, commutative algebra, and extremal graph theory”, Singapore, November 2015.
- **Nanyang Technological University (NTU) Mathematical Sciences Seminar**, “An intersection of topological combinatorics, commutative algebra, and extremal graph theory”, Singapore, October 2015.
- **Graduate Student Combinatorics Conference**, “Kruskal–Katona-type theorems”, University of Kentucky, Lexington, KY, March 27–29, 2015.
- **Cornell University Computational and Commutative Algebra Seminar**, “Macaulay-Lex Rings and the Hilbert functions of colored quotient rings”, Ithaca, NY, March 2015.
- **AMS Spring 2015 Eastern Sectional Meeting**, “Macaulay-Lex Rings and the Hilbert functions of colored quotient rings”, *AMS Special Session on Algebra and Representation Theory*, Georgetown University, Washington, DC, March 7–8, 2015.

- **Cornell University Discrete Geometry and Combinatorics Seminar**, “Kruskal–Katona-type theorems”, Ithaca, NY, January 2015.
- **University of Washington Combinatorics Seminar**, “Flag f -vectors of completely balanced Cohen–Macaulay complexes”, Seattle, WA, November 2014.
- **Syracuse University Algebra Seminar**, “Macaulay–Lex rings and the Hilbert functions of colored quotient rings”, Syracuse, NY, October 2014.
- **Route 81 Conference 2014**, “An application of liaison theory to the Eisenbud–Green–Harris conjecture”, Cornell University, Ithaca, NY, September 27, 2014.
- **AMS Spring 2014 Central Sectional Meeting**, “An application of liaison theory to the Eisenbud–Green–Harris conjecture”, *AMS Special Session on Interactions between Commutative Algebra and Algebraic Geometry*, Texas Tech University, Lubbock, TX, April 11–13, 2014.
- **AMS Spring 2014 Southeastern Sectional Meeting**, “A numerical characterization of the flag f -vectors of completely balanced Cohen–Macaulay complexes”, *AMS Special Session on Geometric and Algebraic Combinatorics*, University of Tennessee, Knoxville, TN, March 21–23, 2014.
- **Cornell University Computational and Commutative Algebra Seminar**, “The Eisenbud–Green–Harris Conjecture”, Ithaca, NY, March 2014.
- **Cornell University Discrete Geometry and Combinatorics Seminar**, “A numerical characterization of the flag f -vectors of completely balanced Cohen–Macaulay complexes”, Ithaca, NY, March 2014.
- **2014 Joint Mathematics Meetings**, “Macaulay decomposability and the flag f -vectors of generalized colored complexes”, *AMS Session on Geometric Applications of Combinatorics and K -Theory*, Baltimore, MD, January 15–18, 2014.
- **Workshop on Syzygies**, “The growth of Hilbert functions and the colored Kruskal–Katona theorem”, Cornell University, Ithaca, NY, November 9–11, 2012.
- **Binghamton University Combinatorics Seminar**, “A generalization of the colored Kruskal–Katona theorem”, Binghamton, NY, May 2012.
- **Cornell University Discrete Geometry and Combinatorics Seminar**, “A generalization of the colored Kruskal–Katona theorem”, Ithaca, NY, January 2012.
- **Cornell University Olivetti Club**, “Why Bruhat is not weak” (talk on the combinatorics of Coxeter groups), (Graduate Student Seminar), Ithaca, NY, March 2011
- **6th International Symposium on Turbo Codes and Iterative Information Processing (ISTC)**, “Fountain codes with varying probability distributions”, Brest, France, September 6–10, 2010.

POSTER SESSIONS

- **ALGECOM 10**, “Hilbert Functions of Colored Quotient Rings and a Generalization of the Clements–Lindström theorem”, University of Illinois at Urbana-Champaign, Urbana, IL, May 2014.

INVENTION DISCLOSURES

- **K. F. E. Chong**, “A deep learning scheme with stochastic dropping configurations for edge analytics applications”, TD2017086, Nov 2017.
- **K. F. E. Chong**, E. Kurniawan, S. Sun, and K. Yen, “Fountain code prefix designs for communication systems”, TD2010014, Apr 2010.

INDUSTRY RESEARCH EXPERIENCE

- Sep 2015–Aug 2018 Institute for Infocomm Research, Singapore.
Conduct research in data analytics, with a focus on algorithm design. Highlights include designing a new modified deep learning algorithm with 97.8% reduction in computational cost while only having a 2.34% drop in prediction accuracy.
- Jul 2009–Jul 2010 Institute for Infocomm Research, Singapore.
Conducted research in coding theory, specifically on fountain codes (rateless erasure-correcting codes) and their applications to multi-user communication systems.
- Jun 2007–Jul 2007 Institute for Infocomm Research, Singapore.
Continued previous work on bounds for q -ary error-correcting codes.
- Apr 2006–Jun 2006 Institute for Infocomm Research, Singapore.
Conducted research in coding theory. Highlights include new use of combinatorial methods to obtain bounds for q -ary error-correcting codes.

TEACHING EXPERIENCE

- MH2800 (Linear Algebra and Multivariable Calculus), Academic Year 2016-2017, Semester 2, Nanyang Technological University.
Course instructor. Conducted lectures; prepared quizzes, tests and final examination.
- MH2800 (Linear Algebra and Multivariable Calculus), Academic Year 2015-2016, Semester 2, Nanyang Technological University.
Course instructor. Conducted lectures; prepared quizzes, tests and final examination.
- Math 4410 (Introduction to Combinatorics I), Fall 2012, Cornell University.
Teaching assistant. Conducted office hours, graded homework sets, and wrote solution sets.
- Singapore IMO National Team Training, Oct 2005 - Jul 2006, National University of Singapore.
Official trainer for the Singapore National Team in preparation for the International Mathematical Olympiad in 2006. Conducted weekly problem-solving discussion sessions, prepared lecture notes, gave lectures and graded tests. Singapore was unofficially ranked 27th in the world for IMO 2006.
- High School Mathematical Olympiad Training, Feb 2006 - May 2006, Singapore.
Conducted weekly problem-solving discussion sessions, prepared lecture notes, and gave lectures to talented young minds in two of the top five high schools in Singapore, teaching problem-solving techniques and some college-level math material, geared towards the level of the yearly Singapore Mathematical Olympiad.

PROFESSIONAL MEMBERSHIP

- American Mathematical Society

SERVICE, OUTREACH, AND MISCELLANEOUS

- Refereeing and Reviewing: Combinatorica, Discrete & Computational Geometry.
- Singapore International Mathematics Challenge (SIMC), May 2018.
Invited judge of an international biennial team-based math competition for high school students, where each team has 4 days to answer proof-based math questions, as well as build mathematical models to several scenario questions. Graded submitted solutions and evaluated mathematical models presented by teams from Hungary, Iran, and Japan.

- Science Mentorship Program (SMP) Project Judging, September 2017.
Chief judge for projects in Category B (Math, Physics, Computer Science). Evaluated students' project reports (submitted prior to the event) and presentations (given at the event). Background: Organized by the Ministry of Education (MOE), Singapore. The SMP is a 6-month-long scientific research program for teams of 3rd and 4th year secondary school students, which culminates in the SMP project judging event, where teams take turns presenting their projects to their peers and to a panel of invited judges.
- Math Explorer's Club, Spring 2015.²
An NSF supported outreach program for middle- and high-school students (Grades 8–12). Designed and conducted a module that introduces combinatorics to students through interactive games and activities.
- Cornell Mathematical Contest in Modeling, 2011–12.
Judging committee member of a mathematical modeling contest for Cornell undergraduates, which involves building a mathematical model of a “real-world” problem and proposing a feasible solution, all within 4 days. Evaluated models and solutions proposed by the contestants, and decided on the winners of the contest, who subsequently represented Cornell University at the International Mathematical Contest in Modeling (MCM) 2012.
- Singapore National Science Challenge, 2006.
Technical committee member of a nationally televised high school science competition. Proposed math questions for the competition, and selected final round math questions that were aired on television.

MENTORING EXPERIENCE

Current PhD students (at SUTD):

- Jingyi Xu
- Junhua Liu (co-supervised with Prof. Kristin Wood)
- Zihan Chen (SUTD–NUS, co-supervised with Prof. Tony Quek)

Past research attachment students (at Institute for Infocomm Research):

- Ruohan Pu, Jul–Aug 2018 (University of Cambridge)
Project deals with hyperparameter tuning of deep neural networks.
- Boon Hou Derek Khu, Aug 2016–Feb 2017 (University of Oxford)
Project deals with mathematical aspects of deep learning, with focus on computational cost reduction.

Last Updated: October 11, 2018

²News coverage: <http://www.news.cornell.edu/stories/2015/04/math-club-connects-cornell-students-local-teens>