Chin Wa (Ken) Lau

Curriculum Vitae

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Education

2020-Present **Doctor of Philosophy in Information Engineering**, *The Chinese University of Hong Kong*, GPA: 3.932 / 4.000, Advisor: Prof. Chandra Nair.

- Research interests: Network Information Theory, Information Inequality, Non-convex Optimization, Combinatorics
- Investigate relationship between inequalities in additive combinatorics and information theory.
- Develop tools for solving families of non-convex optimization problems involving auxiliary random variables and upper concave envelopes.
- Show uniqueness of local maximizers and develop efficient algorithms for solving certain non-convex optimization problems in information theory.

2016-2020 **Bachelor of Science in Mathematics and Information Engineering**, *The Chinese University of Hong Kong*, GPA: 3.875 / 4.000, *Rank*:1.

Honours and Awards

2020-Present **Hong Kong PhD Fellowship Scheme**, *University Grant Committee*.

2020 **The Charles Kao Top Performance Award**, *Information Engineering Department*, The Chinese University of Hong Kong.

2020 **The Final Year Project Award**, *Information Engineering Department*, The Chinese University of Hong Kong.

2019-2020 **The KJ & HK Trust Academic Scholarship**, *New Asia College*, The Chinese University of Hong Kong.

2017-2020 **Dean's List**, *Faculty of Engineering*, The Chinese University of Hong Kong.

2016-2020 **Head's List (Merit)**, *New Asia College*, The Chinese University of Hong Kong.

2019 **Leung Pui Han Scholarship**, *The Chinese University of Hong Kong*.

2018 **Kai Chong Tong Scholarships**, *The Chinese University of Hong Kong*.

2017 **Talent Development Scholarship**, *The Chinese University of Hong Kong*.

2016-2017 **Dean's List**, *Faculty of Science*, The Chinese University of Hong Kong.

2016 **Honours at Entrance**, *The Chinese University of Hong Kong*.

Teaching

2022 Teaching Assistant for Discrete Mathematics for Engineers

2021 Teaching Assistant for Fourier Analysis with Engineering Applications

Publications

2024 ***An entropic inequality in finite Abelian groups analogous to the unified Brascamp-Lieb and Entropy Power Inequality***, *K. Lau and C. Nair*, Will be presented at 2024 IEEE International Symposium on Information Theory.

Summary: This paper develops a technique to prove the extremality of Haar distributions for a family of discrete entropic inequalities in finite Abelian groups, which is an analogy to a family of differential entropic inequalities that unifies the Entropy Power Inequality and the Brascamp-Lieb inequalities.

2023 ***A mutual information inequality and some applications*** , *K. Lau, C. Nair, and D. Ng*, Published at 2023 IEEE Transactions on Information Theory, vol. 69, no. 10, pp. 6210-6220.

Summary: This paper derives an inequality relating linear combinations of mutual information between subsets of mutually independent random variables and an auxiliary random variable, and it states some new results and generalizations and new proofs of known results.

2023 ***Information inequalities via ideas from additive combinatorics***, *K. Lau and C. Nair*, Presented at 2023 IEEE International Symposium on Information Theory, pp. 2452-2457.

Summary: This paper establishes formal equivalences between some families of inequalities in additive combinatorics and entropic ones, and provides an information-theoretic characterization of the magnification ratio in the graph theory.

2022 ***Uniqueness of local maximizers for some non-convex log-determinant optimization problems using information theory***, *K. Lau, C. Nair, and C. Yao*, Presented at 2022 IEEE International Symposium on Information Theory, pp. 432-437.

Summary: This paper shows that a family of non-convex optimizations involving linear combinations of log-determinants of positive definite matrices has a unique local maximizer, which is related to the capacity region of the vector Gaussian broadcast channel.

2022 ***A mutual information inequality and some applications***, *K. Lau, C. Nair, and D. Ng*, Presented at 2022 IEEE International Symposium on Information Theory, pp. 951-956.

Summary: This paper derives an inequality relating linear combinations of mutual information between subsets of mutually independent random variables and an auxiliary random variable, and it states some new results and generalizations and new proofs of known results.

2021 ***Concavity of output relative entropy for channels with binary inputs***, *Q. Ding, K. Lau, C. Nair, and Y. Wang*, 2021 IEEE International Symposium on Information Theory, pp. 2738-2743.

Summary: This paper generalizes a convexity result due to Wyner and Ziv to channels with binary inputs and arbitrary outputs. This results in a convex reformulation of some non-convex optimization problems that arise naturally in multi-user information theory.

Course Projects

2019-2020 **A Visual Block Programming Approach for TensorFlow with Google Blockly**, *Developed for: CocoRobo Ltd., Supervisor: Prof. S. C. Liew*, Department of Information Engineering, The Chinese University of Hong Kong.

- Develop a front-end application that generates machine learning code from an abstract syntax tree (AST) created using Google Blockly
- Users can execute the code on the client-side and experience real-time interaction.

2019 **Scalable Voting System**, *Department of Information Engineering*, The Chinese University of Hong Kong.

- Develop a scalable voting system by using Docker and Amazon cloud services.

2018 **Simulation for Queuing in Peer-to-Peer Storage Systems**, *Supervisor: Prof. P. Vontobel*, Department of Information Engineering, The Chinese University of Hong Kong.

- Develop a probabilistic model using real-world peer-to-peer storage datasets.
- Implement and compare the performance of different download strategies.

Industrial Experience

2019 **Ahsay Systems Corporation Limited**, *Summer internship*.

- Provide level-2 support for diagnosing and fixing data corruption issues.
- Propose an OpenAPI specification to enhance API documentation.
- Develop Postman scripts for automated API testing.

2017-2018 **Tin Ka Ping Secondary School**, *Part-time Technician*.

- Deploy backup servers with RAID 5 configuration and develop automated backup scripts.
- Design and develop a student information management system in full-stack.

Technical Skills

Programming	Bash, C, C#, Python, Java, JavaScript/TypeScript, Matlab/Octave
Front-end Development	Angular
Back End Development	Laravel, Nest.JS

Coursework

Mathematics	Advanced Calculus, Linear Algebra, Matrix Analysis and Computations, Discrete Mathematics, Real Analysis, Complex Variables with Applications, Theory of Probability, Simulation and Statistical Analysis, Foundations of Optimization, Advanced Stochastic Models
Info. Theory	Information Theory, Special Topics in Information Theory, Network Information Theory
Comm. Engineering	Basic Analog and Digital Circuits, Signals and Systems, Principles of Communication Systems, Digital Communications
Computer Science	Data Structures, Design and Analysis of Algorithms, Computer Networks, Information and Software Engineering Practice, Microcontrollers and Embedded Systems, Image and Video Processing, Web Programming and Security, Cloud Computing Security

Languages

Cantonese	Native
Putonghua	Native
English	Fluent