Boyang Huang

Contact Information

University of California San Diego
Department of Computer Science and Engineering

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Research Interests

Computational complexity theory and algorithm design.

Education

University of California San Diego (UCSD) September 2023 - Present
M.S. in Computer Science and Engineering. GPA: 4.0/4.0.

University of Michigan Ann Arbor (UM) September 2019 - April 2023
B.S. in Computer Science and in Honors Mathematics. GPA: 4.0/4.0.

Research Experience

Demystifying the Hardness of Attention UCSD
Advised by Professor Barna Saha August 2024 - Present

- Studied the computational complexity of the attention mechanism in transformer architectures based on input sequence length n and model dimension d.
- Designed sub-quadratic algorithms for attention computation when d is small ($O(1)$).
- Established conditional lower bounds for larger d via fine-grained subquadratic reductions.

Greedy Coin Change Problem UCSD
Advised by Professor Russell Impagliazzo July 2024 - Present

- Defined and studied the complexity of the *greedy coin change problem*, where the goal is to compute the greedy set of coins in a change-making process.
- Proved that the problem is P-complete under log-space reduction.
- Showed a succinct input representation via matrix tensor product by arranging the bit-string encodings of coins into rows of a matrix.

The Computational Complexity of Factored Graphs UCSD
Advised by Professor Russell Impagliazzo October 2023 - September 2024

- Initiated the study of computational complexity on *factored graphs*, which are defined as graphs given as a formula of graph products and unions of smaller graphs.
- Established upper and lower bound results (fixed parameter tractability) for the factored version of various natural graph problems.

Digital Cell Image Analysis Pipeline for Nuclei Segmentation UM
Advised by Professor Wei Lu May 2022 - August 2022

- Studied the application of various deep learning architectures for the task of cell image segmentation in computer vision.
- Focused on weakly supervised learning techniques and the challenges of small datasets using real-world data.

Publications

The Computational Complexity of Factored Graphs, with Shreya Gupta, Russell Impagliazzo, Stanley Woo, Christopher Ye.
To appear in ITCS 2025 [ArXiv]

Honors and Awards

2023	Outstanding Achievement in Mathematics Award	University of Michigan
2023	James B. Angell Scholar	University of Michigan
2022	Mathematics Merit Scholarship	University of Michigan
2022	Evelyn O. Bychinsky Award	University of Michigan
2022	Sumner B. Myers Award in Analysis	University of Michigan
2022	EECS Scholar	University of Michigan

Presentations

The Computational Complexity of Factored Graphs, with Shreya Gupta, Russell Impagliazzo, Stanley Woo, Christopher Ye.
To appear in ITCS 2025 (Jan 2025)
UC San Diego Encore Industry Day (Sep 2024).

Coursework at UCSD

- ❑ Quantum Complexity Theory
- ❑ Advanced Algorithms
- ❑ Lattice Algorithms and Applications
- ❑ Modern Cryptography
- ❑ Algorithm Design and Analysis
- ❑ Principles of AI

Coursework at UM

$*$ indicates graduate level coursework

Computer Science

- ❑ Intro. to Artificial Intelligence
- ❑ Intro. to Computer Security
- ❑ Intro. to Distributed Systems
- ❑ Web Systems
- ❑ Intro. to Algorithms
- ❑ Intro. to Machine Learning
- ❑ Computer Vision
- ❑ Intro. to Operating Systems
- ❑ Foundations of Computer Science
- ❑ Intro. to Computer Organization
- ❑ Data Structures and Algorithms

Mathematics

- ❑ Analysis II (Real)$*$
- ❑ Analysis I (Complex)$*$
- ❑ Honors Algebra II (Ring/Galois Theory)
- ❑ Honors Algebra I (Group Theory)
- ❑ Honors Multivariable Analysis II
- ❑ Honors Multivariable Analysis I
- ❑ Discrete State Stochastic Processes$*$
- ❑ Probability Theory$*$
- ❑ Honors Intro. to Real Analysis
- ❑ Intro. to Abstract Algebra
- ❑ Linear Algebra

Teaching Experience

Fall 2024	Teaching Assistant	CSE 202 Algorithm Design and Analysis	UCSD
Summer 2024	Teaching Assistant	CSE 105 Theory of Computation	UCSD
Spring 2024	Teaching Assistant	CSE 105 Theory of Computation	UCSD
Winter 2023	Course Assistant	MATH 396 Honors Multivariable Analysis II	UM
Fall 2022	Course Assistant	MATH 395 Honors Multivariable Analysis I	UM
Winter 2022	Course Assistant	MATH 297 Honors Intro. to Real Analysis	UM
Fall 2021	Course Assistant	MATH 412 Intro. to Abstract Algebra	UM
Fall 2021	Tutor	MATH 217 Linear Algebra	UM
Winter 2021	Course Assistant	MATH 412 Intro. to Abstract Algebra	UM
Winter 2021	Tutor	MATH 217 Linear Algebra	UM
Fall 2020	Tutor	MATH 217 Linear Algebra	UM

Relevant Skills

Languages:	Mandarin (native), English (fluent)
Programming Languages:	LaTeX, C++, C, Python, Go Lang, JavaScript SQL, R, Java, MATLAB, HTML