Boyang Huang

Contact Information

University of California San Diego
Department of Computer Science and Engineering

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Research Interests

Theoretical computer science and mathematics, specifically computational complexity theory and the design and analysis of algorithms.

Education

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

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

Publications

The Computational Complexity of Factored Graphs, with Shreya Gupta, Russell Impagliazzo, Stanley Woo, and Christopher Ye.
16th Innovations in Theoretical Computer Science Conference (ITCS 2025).
arXiv:2407.19102 (2024)

Preprints

The Greedy Coin Change Problem, with Shreya Gupta and Russell Impagliazzo.
arXiv:2411.18137 (2024)

Research Experience

Demystifying the Hardness of Attention, UCSD
with 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.
- Proposed sub-quadratic approximation algorithms when d is small ($O(1)$).
- Established (conditional) quadratic lower bounds via fine-grained subquadratic reductions for larger values of d ($\Omega(2^{\log^* n})$).

The Greedy Coin Change Problem, UCSD
with Professor Russell Impagliazzo. September 2024 - Present

- Defined a decision version of the *greedy coin change problem* to study the computational complexity of *simulating* the greedy strategy on the coin change problem.
- Proved that the problem is **P**-complete under log-space reductions.
- Explored succinct representations for the input coin denomination values.

The Computational Complexity of Factored Graphs, UCSD
with Professor Russell Impagliazzo. October 2023 - September 2024

- Initiated the study of the computational complexity of *factored graphs*, which are defined as graphs given as formulas that combine smaller graphs using graph operations.
- Established various (parameterized) complexity results for natural graph problems defined on factored graph inputs.

Research Experience outside of Theory

Digital Cell Image Analysis Pipeline for Nuclei Segmentation, UM
with Professor Wei Lu. May 2022 - August 2022

- Applied various deep learning models for the computer vision task of cell image segmentation, focusing on weakly supervised learning techniques and addressing the challenges of small, real-world datasets in medical image analysis.

Machine Learning in Cardiovascular Medicine, UM
with Professor Mohammed Saeed. September 2020 - April 2021

- Implemented Fully Convolution Network and Support Vector Machine with wavelet transform preprocessing to detect atrial fibrillation in ECG signals.
- Presented this work at the 2021 UROP Spring Research Symposium.

Honors and Awards

Outstanding Achievement in Mathematics Award	2023	University of Michigan
Mathematics Merit Scholarship	2022	University of Michigan
Evelyn O. Bychinsky Award	2022	University of Michigan
Sumner B. Myers Award in Analysis	2022	University of Michigan
EECS Scholar	2022	University of Michigan
James B. Angell Scholar	2021-2024	University of Michigan
University Honors	2019-2023	University of Michigan

Talks

The Computational Complexity of Factored Graphs.
Advised by Professor Russell Impagliazzo.
Presentation, ITCS 2025. Columbia University, Jan 2025, to appear.
Poster, EnCORE Industry Day. UC San Diego, 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 Algorithms
- ❑ Intro. to Machine Learning
- ❑ Intro. to Artificial Intelligence
- ❑ Computer Vision
- ❑ Web Systems
- ❑ Foundations of Computer Science
- ❑ Intro. to Distributed Systems
- ❑ Intro. to Operating Systems
- ❑ Intro. to Computer Organization
- ❑ Intro. to Computer Security

Mathematics

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

Teaching Experience

CSE 101 Design and Analysis of Algorithms	TA	Winter 2025	UCSD
CSE 202 Algorithm Design and Analysis	TA	Fall 2024	UCSD
CSE 105 Theory of Computation	TA	Spring 2024, Summer 2024	UCSD
MATH 396 Honors Multivariable Analysis II	TA	Winter 2023	UM
MATH 395 Honors Multivariable Analysis I	TA	Fall 2022	UM
MATH 297 Honors Intro. to Real Analysis	TA	Winter 2022	UM
MATH 412 Intro. to Abstract Algebra	TA	Fall 2021	UM
MATH 217 Linear Algebra	Tutor	Fall 2020, Winter 2021, Fall 2021	UM

Relevant Skills

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