Zackary Jorquera

Ph.D. Student at UCSC

Personal Information

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Education

09-2022 - Current **Doctor of Philosophy**, *University of California Santa Cruz*, Theoretical Computer Science
Advised by Prof. Alexandra Kolla

08-2018 - 05-2022 **Bachelor of Science in Computer Science**, *University of Colorado at Boulder*, Thesis Title: "Quantum Approximate Optimization Algorithm with Local Max-Cut", Graduated Summa Cum Laude
Minors: Applied Mathematics and Pure Mathematics

Workshops

06-2023 - 08-2023 **Summer Cluster on Quantum Computing**, *Simons Institute for the Theory of Computing*
I attended the 2023 Summer Cluster on Quantum Computing workshop at the Simons Institute for the Theory of Computing as a visiting graduate student.

Research

10-2024 **Monogamy of Entanglement Bounds and Improved Approximation Algorithms for Qudit Hamiltonians**, *With: Alexandra Kolla, Steven Kordonowy, Juspreet Singh Sandhu, Stuart Wayland*, Accepted as Poster at QIP 2025
arXiv:2410.15544

09-2023 **Approximation Algorithms for Quantum Max-d-Cut**, *With: Charlie Carlson, Alexandra Kolla, Steven Kordonowy, Stuart Wayland*, Accepted as Poster at QIP 2024
arXiv:2309.10957

04-2023 **A quantum advantage over classical for LocalMaxCut**, *With: Charlie Carlson, Alexandra Kolla, Steven Kordonowy*, Accepted as Poster at QIP 2024
arXiv:2304.08420

08-2020 - 05-2022 **Undergraduate Thesis**, *Alexandra Kolla*, With Committee: Joshua Combes, Joshua Grochow
I researched quantum advantages with the Quantum Approximate Optimization Algorithm (QAOA). We looked at if a quantum computer can find locally optimal solutions to the NP-hard optimization problem, max-cut, better than classical computers.

05-2021 - 08-2021 **Software Research Assistant**, *Prof. Jed Brown*

Worked to make rust-lang bindings for the scientific computating library PETSc. This consisted of systems-level FFI Rust code. Much of which was done individually. However, future work was done after I left the project.

Service

FOCS 2024 Subreviewer

SODA 2024 Subreviewer

Teaching

Teaching Assistant, *University of California, Santa Cruz*

- Computer Systems and C Programming - CSE 13S (Fall 2022)
- Introduction to Analysis of Algorithms - CSE 102 (Spring 2023)
- Mathematical Thinking for Computer Science - CSE 101M (Winter 2024, Fall 2024)

Undergraduate Course Assistant, *University of Colorado, Boulder*

- Linear Algebra with Computer Science Applications - CSCI 2820 (Spring 2021)
- Linear Algebra with Computer Science Applications - CSCI 2820 (Fall 2020)
- Computer Systems - CSCI 2400 (Spring 2020)
- Computer Systems - CSCI 2400 (Fall 2019)

Reading Groups Hosted

The PCP Theorem and Hardness of Approximation, *University of California, Santa Cruz*, Fall 2024

We looked at Dinur's proof of the PCP theorem in full and looked at applications of the PCP theorem and the Unique Games Conjecture to hardness approximation. In particular, we followed a combination of lecture notes by Venkatesan Guruswami and Ryan O'Donnell and lecture notes by Luca Trevisan. We also looked at Dinur's paper and Radhakrishnan's follow up paper for more context in the proofs.

Representation theory of the symmetric group with applications to TCS, *University of California, Santa Cruz*, Fall 2023

We learned the basics, including Maschke's Theorem, Schur's orthogonality relations, and Wedderburn's Theorem. Then we looked at the irreducible representations of the symmetric group. And finally we read papers on TCS applications such as expander graphs and functions over slices of boolean cubes.

Work Experience

Summers 2019, 2020, 2022 **Software Engineer Intern**, *Boulder Imaging Inc.*, Computer Vision

Most recently, I worked on Computer Vision solutions assessing the quality of US bills to be used in the bill sorting machines in the US federal reserve. Previously, I worked to train neural networks to identify endangered bird in wind-farms.

Projects And Extracurricular

The complexity of solving an NxNxN Rubik's Cube

I wrote a class paper on the complexity of solving an NxNxN Rubik's cube both optimally and approximately. This included reviewing the existing result that the optimal case is NP-Hard and conjecturing that the approximate case was APX-Complete.

3rd Place Overall all for HackCU, *For HackCU VI and HackCU 007*

In a group of four, we won 3rd place for two on the HackCU events.

- **Vido (For HackCU VI)**, It's video but shorter. It takes a 20 (ish) minute video and produces a 2-minute, summarized version using a variation on the knapsack problem. We won 3rd place overall in Hack CU VI.
- **Legal-Ease (For HackCU 007)**, Summarizes and simplifies legal documents into a short and more easily readable documents using machine learning and other techniques. We won 3rd place overall in Hack CU 007.

section.io Article Writer, https://www.section.io/engineering-education/authors/zack-jorquera/

I wrote five articles on a variety of topics, such as low-level programming, parallel programming, and computer vision algorithms.

2021 Putnam

I took the 2021 Putnam and scored a 4, which tied for third place overall at CU Boulder.

For Fun

Whitewater Kayaking — I got into whitewater kayaking during my undergrad. Since then, I have done Colorado classics such as Gore Canyon and Bailey Canyon. Both are class 5 stretches of water. In California I ran the Tobin section on the NF Feather (class IV-V-).

Skiing — I've skied my whole life in ski resorts throughout Colorado. During college, I also started backcountry skiing. Last season I did a Colorado front range classic, Dragontail Couloir. And this year I did Silvers Couloir, one of the 50 Classic descents of North America.

Skills

Programming Languages — Rust, C/C++, Python, Assembly, MatLab, Mathematica

General — Leadership, Teamwork, Communication, Problem Solving

Zackary Jorquera, 12/12/2024, Santa Cruz