Brayden Goldstein-Gelb

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Research Interests: Quantum algorithms and complexity theory, quantum error correction, mathematical structures in quantum computing, distributed quantum computing

Education

Brown University Providence, RI

Sc.B Computer Science (Honors), Sc.B Mathematics 2021 – 2025

- GPA: 3.91/4.00, Magna Cum Laude
- Honors Thesis: Distributed Quantum Signal Processing. (External Advisor: Yuan Liu, NC State; Reader: Brenda Rubenstein, Brown; Department Advisor: James Tompkin, Brown)

Research Experience

Postbaccalaureate Researcher, QUEST Lab Remote

North Carolina State, advised by Prof. Yuan Liu Aug '25 – Present

- Part-time continuation of research focusing on distributed quantum algorithms.

Undergraduate Researcher Providence, RI

Brown University, advised by Prof. Yuan Liu (North Carolina State University) Aug '24 – May '25

- Led a multi-institutional collaboration spanning MIT, Yale, NC State, and QuEra developing COMPAS, a distributed quantum algorithm for multivariate trace estimation in constant depth.
- Wrote and developed core sections of the paper while coordinating contributions across the team.
- Co-designed an architecture and algorithm to reduce classical and quantum communication.
- Performed simulations on HPC clusters and derived analytical bounds to demonstrate performance.

Undergraduate Research Intern, SULI Program Oak Ridge, TN

Oak Ridge National Laboratory, advised by Dr. Phil Lotshaw May '23 – Jul '23

- Investigated methods for solving constrained optimization problems using the Quantum Approximate Optimization Algorithm (QAOA).
- Developed a procedural method to translate constraint equations into mixing Hamiltonians.
- Identified a graph-theoretic interpretation of these Hamiltonians and proved connectedness for a broad class of constraints, establishing QAOA convergence guarantees.

Undergraduate Researcher, Brown Visual Computing Lab Providence, RI

Brown University, advised by Prof. James Tompkin. May '22 – May '23

- **Decoupled Style Descriptors Project:** Built an interactive application for handwriting synthesis via a recurrent neural network.
- **Augmented Reality Label Visualization Project:** Designed and implemented real-time algorithms for adapting augmented reality content to dynamic environments using Unity shaders.

Publications and Presentations

Papers

- **Brayden Goldstein-Gelb**, Kun Liu, John M. Martyn, Hengyun Zhou, Yongshan Ding, Yuan Liu. COMPAS: A Distributed Multi-Party SWAP Test for Parallel Quantum Algorithms. *Accepted*, ASPLOS 2026. arXiv:2511.23434
- **Brayden Goldstein-Gelb**, Phillip C. Lotshaw. Convergence guarantee for linearly-constrained combinatorial optimization with a quantum alternating operator ansatz. *Under review*, ACM TQC. arXiv:2409.18829

Posters

- Ashley Kwon, Yuanbo Li, Eva Schiller, **Brayden Goldstein-Gelb**, James Tompkin. Environment Adaptive AR Label Visualization. Brown University Undergraduate Research Symposium, April 2023. Poster presentation.

Coursework

- **Computer Science:** An Algorithmist's Toolkit (grad.), Design and Analysis of Algorithms, Theory of Computation, Algorithmic Machine Learning, Applied Cryptography, Systems, Formal Proof and Verification, Computer Vision
- **Mathematics:** Four semesters of Algebra (two undergrad, two grad), Real Analysis, Complex Analysis, Graph Theory, Probabilities in Quantum Mechanics, Information Theory, Number Theory, Optimization and Stochastic Calculus, Calculus on Manifolds, Statistical Inference, Linear Algebra
- **Physics/Engineering:** Quantum Mechanics, Quantum Information, Dynamics and Vibrations, Mechanics

Technical Skills

- **Programming Languages:** Python, Java, HTML/CSS, JavaScript, C/C++, Julia, Pyret
- **Technologies:** Qiskit, Git, NumPy, Sklearn, Pandas, TensorFlow, PyTorch, SLURM/HPC, D3, Node.js

Teaching

Grader, Linear Algebra with Theory — Spring '25

- Graded problem sets for a proof-based linear algebra course

Teaching Assistant, Theory of Computation — Fall '24

- Created problem sets and example solutions, assisted in grading, held weekly office hours

Online Tutor, Wyzant Inc. — May '21 – Aug '23

- Over 350 hours of tutoring experience, working with 50+ students ranging from middle schoolers to executives.
- Maintained a five-star rating, helping students build confidence and mastery in Python, Java, Calculus, and Algebra.

Projects

Hackathon Projects, MIT iQuHack, Brown Quantum Hackathon, Hack@Brown — Spring '23 – Fall '24

- Won 2nd Place at Brown Quantum Hackathon
- Completed QuEra challenge at MIT's iQuHack quantum hackathon
- Created a space-themed game for Hack@Brown

Zero-Knowledge Proof for Graph 3-Coloring, Final Project, Applied Cryptography — Spring '24

- Implemented an interactive zero-knowledge protocol to prove graph 3-colorability without revealing the coloring. *View project report.*
- Built a terminal-based application with verifier/prover roles communicating over TCP sockets.

Quantum Mechanics Proofs Library, Final Project, Formal Proof and Verification — Fall '22

- Created a library in the Lean Theorem Prover to model quantum particles, measurements, and multi-particle states.
- Demonstrated the library's capabilities by constructing a formal proof of the no-cloning theorem.

More projects, additional details, and demos available at brayden-gg.github.io/projects.

Awards

- **Sigma Xi**, Scientific Research Honor Society
- **Audience Favorite Award**, Brown Undergraduate Research Symposium