Arjun Bhamra

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EDUCATION

Georgia Institute of Technology Atlanta, GA
Bachelor of Science in Computer Science, GPA: 3.87 *May 2026*
Relevant Coursework: Design of Algorithms, Operating Systems, Graph Theory, Compilers, Advanced Computer Organization, Processor Design

EXPERIENCE

IBM Research May 2025 – August 2025
Research Intern *Yorktown Heights, NY*
- Designed a new qubit-efficient quantum algorithm for solving the Traveling Salesman Problem
- Leveraged permutation encoding and Pauli Correlation Encoding, along with a K-Means path slicing strategy to reduce qubit overhead by 10x, paving the way for solving utility scale problems on quantum hardware

IBM Research May 2024 – August 2024
Software Engineering Intern *Yorktown Heights, NY*
- Developed key components for IBM's Rust-based hardware-level production Quantum Assembly (QASM) quantum compiler that improved speed by 7x and memory usage by 3.5x
- Spearheaded the development of a 85x faster data parsing and caching API for quantum hardware configuration information and waveform data through binary (de)serialization
- Implemented the compiler's intermediate representations (IRs) at the pulse calibration level

Quantinuum May 2023 – August 2023
Software Engineering Intern *Broomfield, CO*
- Created a Pythonic Domain Specific Language (DSL) to aid internal theory team in parsing code to Quantum Intermediate Representation (QIR) with a 30% improvement in workflow efficiency
- Leveraged the Python Abstract Syntax Tree (AST) to build a high level compiler from custom language to LLVM IR that enables conditional branching on quantum measurements and dynamic circuits
- Added constant folding, constant propagation, method inlining and loop unrolling optimizations which reduced output QIR by 15% for faster compilation

RESEARCH

Quantum Programming Languages Researcher July 2023 – Present
Georgia Tech CRNCH-TINKER Lab - Dr. Tom Conte *Atlanta, GA*
- Aided in the design and implementation of Qwerty, a quantum programming language that moves away from gate-based quantum computing and towards higher abstractions
- Engineered custom ASTs and optimization passes for the Qwerty compiler using the Python AST, C++, and custom MLIR dialects and rewrite passes
- Placed 2nd at the CGO Student Research Competition for **"Type Inference for Qwerty"** by implementing Hindley Milner type inference via a Rust-based AST
- Austin J. Adams, Sharjeel Khan, **Arjun S. Bhamra**, Ryan R. Abusaada, Jeffrey S. Young, and Thomas M. Conte. **"Qwerty: A Basis-Oriented Quantum Programming Language"** *IEEE International Conference on Quantum Computing and Engineering (QCE25).*
- Austin J. Adams, Sharjeel Khan, **Arjun Bhamra**, Ryan Abusaada, Anthony M. Cabrera, Cameron Hoechst, Jeffrey S. Young, and Thomas M. Conte. **"ASDF: A Compiler for Qwerty, a Basis-Oriented Quantum Programming Language"** *2025 IEEE/ACM International Symposium on Code Generation and Optimization (CGO '25).*

PROJECTS

Verified Randomized Maxcut Approximation Algorithm | *Lean*
- Designed data structures and proof objects to represent MaxCut instances induced by randomized vertex selection
- Created lemmas and theorems to prove random vertex partitions create a $\frac{1}{2}$-approximation in expectation

Open Source Contributor to Quantum repositories | *Rust, Python, unittest, Git*
- Added necessary quality of life changes for the IBM Rustworkx repository, a Rust-based Python graph library
- Added major feature support for the IBM OpenQASM 3 Parser, a performant parser based on rust-analyzer