Jacob Hegna

EDUCATION

Ph.D. Mathematics Expected 2023
University of Minnesota, Twin Cities.

B.S. Mathematics, B.S. Computer Science August 2015 – May 2019
University of Kansas (Honors College).

First place in options market-making at the 2019 UChicago Trading Competition.

EXPERIENCE

***Google**, Ph.D. Software Engineering Intern* Summer 2021

- Designed and open-sourced a model for LLVM's `-Oz` inlining pass. Compared to LLVM's shipped `-Oz`, The model reduces output binary size by 20% and increases execution speed by 20%. This model is being used in the Fuchsia and Pigweed toolchains, two open-source embedded operating systems.
- Designed a project to adapt LLVM register allocation models to the long-tail of internal Google cycle consumers, eliminating 2% of (profile-weighted) load and store instructions in $400k$ object files at Google.
- Built a data pipeline that increased corpus size from $20k$ LLVM IR modules to over 2.5 million by leveraging Google's internal MapReduce tools and build infrastructure.
- Scaled ML-in-LLVM training from a single datacenter to arbitrarily many, leading to a successful request to nearly double the resource allocation to the ML compiler optimization team.

***Google**, Ph.D. Software Engineering Intern* Summer 2020

- Designed natural language processing models for clang ASTs. We produced novel Transformer-based architectures for AST subtrees and new graph-learning techniques for training.
- Built a data generation pipeline that produced AST corpora from billions of lines of internal Google `C++` code.
- Integrated the neural code completion models for `C++` within internal IDEs by adapting clangd to interface with a model inference grpc server.

***Tower Research Capital**, Quantitative Trading Intern* Summer 2019

- Converted latency-sensitive `C++` logging logic to `constexpr` context.
- Developed a suite of internal data visualization web-tools to monitor attributes of internal marketdata systems; contributed to the internal frontend/library for the `python` scientific stack.

***Cboe/BATS**, `C++` Software Engineering Intern* Summer 2018

- Implemented the SEC rule 605 reporting for BATS equity markets, entirely replacing the existing contractor.
- Wrote a type-safe `constexpr` `printf` format-string builder using variadic templates, `type-traits`, and internal `constexpr` strings, which eliminated a 3% (`perf`-reported) bottleneck in the above process.

MATH RESEARCH

My math research interests are in *stable homotopy theory.* I study power operations for highly structured commutative ring spectra, which generalize the Steenrod squares for the mod p cohomology of spaces. I also study chromatic homotopy theory, and enjoy algebraic geometry.

SKILLS

Communication & Teamwork: Top speaker at the National Debate Tournament, semifinalist at the National Debate Tournament, invitee to the Dartmouth Round Robin, ranked in the top-10 collegiate debate partnerships nationally.

Technology: `C++17/20`, `LLVM/clang`, `perf`, `python`, `grpc/protobuf`, `CapnProto`, `gdb`, Boost, `GTest`, `google-benchmark`, Linux, LaTeX