Nicholas W. Breitling

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EDUCATION

Northwestern University, *Evanston, IL* · 4.0 GPA *Sep. 2024 - Present*

- Pursuing Bachelor of Science in Computer Science
- Coursework: Programming Languages, Dynamics of Programming Languages, Proving Properties of Programs with Mechanized Logic, Intro to Type Systems, DSA, Computer Systems, Operating Systems
- Awards and Honors: Tau Beta Pi Inductee, Summer Undergraduate Research Grant, High Honors Dean's List

Northeastern University, *Boston, MA* · 4.0 GPA *Sep. 2023 - Apr. 2024*

- Coursework: Accel. Fundamentals of Computer Science 1 and 2, Accel. Discrete Structures, Intensive Math Reasoning, Logic & Computation

RESEARCH AND PROJECTS

Programming Languages Research Intern, Northwestern Univ., *Evanston, IL* *Jan. 2025 - Present*

- Awarded Summer Undergraduate Research Grant to design and conduct a Rational Programmer (RP) experiment investigating the pragmatics of software contracts in the context of testing
- Investigate the space of strategies for replacing a tests with contracts while maintaining test suite effectiveness
- Encode replacement strategies using rational programmers, autonomous agents that use input from language features (mutation score, code coverage, etc) to transform programs in a large program corpus. Implement RPs based on test suite reduction literature, in addition to dependency-based and random strategies
- Design and implement infrastructure for large-scale experimentation, including efficient mutation score collection in an exponential configuration space
- Evaluate RPs by performing mutation analysis on their resulting testing suites, providing actionable feedback on the programming strategies they embody

Compilers Research Intern, Czech Technical University, *Prague, CZ* *Jan. 2024 - Sep. 2024*

- Collaborated on the development of a new infrastructure for just-in-time compilation of R language
- Aided in transition from C++ to Java compile server, focusing on RDS serializer implementation. Added full support for R s-expressions, including closures, promises, environments, vectors, lists, symbols, and builtins.
- Implemented bytecode serialization in the GNU R bytecode format, entailing a mapping from our bytecode to the GNU R standard and cycle-aware constant pool serialization
- Verified correctness with a roundtrip test utility, deserializing each function in the R standard library and serializing it back to RDS
- Integrated serializer as a communication protocol between C++ frontend and Java backend
- Constructed large-scale integration tests using new communication protocol, comparing server and client-side bytecode to expose numerous inconsistencies

Student Researcher, Minnetonka Research, *Minnetonka, MN* *Sep. 2022 - May 2023*

- Developed a new fluid rendering algorithm, utilizing ray-marching as a means of sphere blending
- Using Vulkan and Rust, implemented both ray-marched and mesh-based fluid renderers, using the marching cubes algorithm for mesh generation
- Experimentally compared algorithm performance, finding that ray-marching performed better than marching cubes in all benchmarks
- Awarded blue ribbon (first place in Systems Software category), purple ribbon (advancement to State), and Stockholm Junior Water Prize at Twin Cities Regional Science Fair

Other projects *(full list at github.com/breitnw)*

- *mndco11age.xyz:* Portfolio website and webserver; developed with Rust and OpenSSL
- *rhyolite:* Vulkan-based mesh rendering engine, developed with Rust and GLSL
- *micromusic:* Apple Music miniplayer and queue manager, developed with Rust, C, and SDL2

OTHER EXPERIENCE

Peer Mentor, Northwestern University, *Evanston, IL* *Sep. 2025 - Present*

- Host office hours (5 hours/week), mentoring students in COMP_SCI 321: Programming Languages
- Guide students through problems in interpreter and compiler implementation, building their understanding of course concepts as well as essential design patterns such as pattern matching and recursion
- Meet weekly with course leadership to discuss and address student needs

Camp Counselor, Code Ninjas, *Chanhassen, MN* *Summers 2021 - 2023*

- Lead counselor for weekly camps throughout summer. Provided one-on-one and presentational instruction to guide campers through curriculum and difficult concepts related to programming and application development
- Planned and implemented supplemental lessons in Lua and Scratch programming, 3D modeling, music distribution, and more, fostering an engaging environment for advanced campers

Full-Stack Development Intern, The Humanity Alliance, *Victoria, MN* *May 2021 - May 2023*

- Developed full-stack administration dashboard, aiding in delivery of meals to food-insecure families
- Bridged meal request and route assignment APIs with an interactive map, greatly reducing manual entry time by automating route calculation and assignment
- Used Python and Redis for data processing, Flask for web service, and Jinja for templating
- Collaborated regularly with organization leadership to address needs for administration, user permissions and security

EXTRACURRICULARS

Volunteer CS Educator, Evanston-Skokie School District 65 *Jan. 2025 - Present*

- Teach weekly computer science classes to 5th graders at Oakton Elementary School as part of education research conducted by Northwestern's TIDAL and tiilt labs
- Introduce students to concepts such as loops, variables, and debugging while fostering self-expression through use of TunePad, a Python-based music production tool

Embedded Software Developer, Northwestern Baja SAE *Oct. 2024 - Present*

- Implement platform-agnostic, immediate-mode GUI library in C, enabling users to compose and customize layouts using binary trees and functional programming idioms
- Use said library to develop customizable heads-up display, informing driver of engine, fuel, and other metrics
- Develop ESP32 microcontroller software for eCVT (electronic continuously-variable transmission) in C++, configuring and tuning hall-sensor and linear encoder PID inputs to maintain optimal output RPM

Curriculum Developer, StemOUT *Jan. 2024 - Apr. 2024*

- Developed an educational curriculum for elementary (K-5) schoolers with the goal of "teaching AI without computers", including interactive lessons on history, functions, and ethics. Taught this curriculum and others at public libraries.

Captain, FIRST Robotics Team 3082 *Sept. 2019 - May 2023*

- Oversaw electronics and programming subteams; led the development of an OpenCV-based stereoscopic vision system, physically-modeled robot simulation, Swerve drivetrain, inverse-multiplexed button board, and other subsystems
- Won Innovation in Control award, progressed to FRC World Championship during 2023 season

Other: Scouts BSA, Eagle Rank; Tonka Hacks Hackathon, 1st place; NHS; Symphonic Band

SKILLS

Programming Languages and Frameworks

- *Functional:* Racket, Agda, Haskell, Nix, Emacs Lisp
- *Systems:* Rust, C, x86 Assembly, C++, GNU/Linux, Vulkan
- *General/Other:* Java, JavaScript, Python, Flask, Jinja, SQLite, Redis, LaTeX