roife

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Education

Nanjing University 2023.09 - 2026.06 (expected)

Master's Degree in *Computer Science and Technology* | <u>PASCAL Lab</u>. Tutor: Li | Focus on **PL** and **Program Analysis**.

TA: Principles and Techniques of Compilers (Spring 2024)

Beihang University 2019.09 - 2023.06

Bachelor's Degree in *Computer Science and Technology* | GPA 3.84/4.00, qualified for postgraduate recommendation.

TA: Programming in Practice (Fall 2020), Object-oriented Design and Construction (Fall 2021, Spring 2022 | S.T.A.R. team)

Work Experience

NVIDIA 2025.02 - Present

OCG (Optimizing Code Generator) team

GPU Compiler LLVM Backend Intern

- Participating in unifying the load-store instruction vectorizer between NVIDIA GPU graphics compiler and NVVM, ensuring the graphics compiler's vectorizer aligns with LLVM upstream:
 - Designed an encoding scheme for multi-address graphic memory instructions for LLVM's memory-access instructions vectorizer, implementing vectorization for multiple GPU graphic memory instructions while minimizing divergence from upstream;
 - Added several GPU memory instruction vectorization optimizations, including support for irregular memory access sequence
 vectorization and integer address vectorization; participated in implementing a new memory instruction alignment width
 inference pass, improving vectorizer performance while reducing codebase coupling;

Rust Foundation Fellowship Program

2024.09 - 2025.09

Rust Foundation Fellowship (about 20 people globally)

Project Fellow

- As a member of the **Rust-lang Organization** (rust-analyzer-contributors-team) and one of the <u>rust-lang/rust-analyzer</u> (official Rust IDE) **maintainers**, ranked in the **top 1**% of contributors; participated in issues handling and PR reviews across most project modules; also contributed to other projects in the Rust language community, such as <u>rust-lang/rust-clippy</u>
- Implemented features like control flow highlighting, snapshot test updates, and participated in numerous bug fixes, enhancing IDE capabilities in code understanding and auto-generation;
- Wrote a SIMD implementation for the unicode line breaking module for ARM NEON, achieving a 6.5x speedup;
- Emergency incident response for v0.3.1992: 4 hours after release, the community discovered a critical bug causing resource
 exhaustion. I identified the issue in 3 hours and designed a new algorithm as fix. This emergency fix controlled the incident's
 impact.

Awards

- 2022 **National Scholarship** (ranked 1/195 in the major), **Outstanding Graduate** of Beihang University;
- First Prize in the 2021 <u>NSCSCC Compilation System Design Competition</u> (Huawei Bisheng Cup), ranking 2nd overall;
- First Prize in the Lanqiao Cup C++ Programming Contest (Beijing Division) and Third Prize in the National Finals;
- Additionally awarded over ten provincial and university-level awards and scholarships.

T Projects

Vizsla (WIP)

Modern IDE for Chip Frontend Design · Master's Thesis Project

Rust / SystemVerilog

- Implemented a semantic analysis framework and IDE infra for SV, aiming to equip chip design with modern IDE features;
- Based on an incremental computation architecture, designed and implemented an incremental analysis IR and specialized passes for efficient and accurate on-demand analysis;
- Project achieves industry-leading standards in functionality, performance, and usability: completed dozens of modern IDE features for SystemVerilog including code navigation, semantic refactoring, and completion with millisecond-level latency;
- Based on the Language Server Protocol, ensuring compatibility with VS Code, Emacs, NeoVim, and other mainstream editors.

Ailurus Qroife/ailurus (WIP)

Experimental Programming Language and Toolchain Design \cdot Personal Interest Project

Rust

Based on Martin-Löf type theory, supporting dependent types, dependent pattern matching, and inductive datatypes. Implements propositional equality and uses Normalization by Evaluation for equivalence checking, enabling simple theorem proving;

Features typeclass-based ad-hoc polymorphism with operator overloading for flexible code reuse;

- Implemented a module system for namespace management and encapsulation, addressing code organization in large projects;
- Serves as an experimental platform to explore collaborative design architectures for modern programming language toolchains (compilers, IDEs), aiming to enhance development efficiency and maintainability.

Ayame

No-SF-Work/ayame Java / LLVM-IR / ARM

Compiler from SysY (C subset) to ARMv7 · Bisheng Cup Competition Project

- Collaborative project, primarily responsible for backend optimizations on Machine IR, including iterative register coalescing, instruction scheduling, dead code elimination, and peephole optimizations. Also contributed to syntax tree visitor;
- Handled project testing and DevOps, setting up workflows with Docker and GitLab CI, and writing Python for automated testing;
- The project, built from scratch, featured a complete compiler pipeline (parsing to code generation) with extensive SSA IR and Machine IR optimizations. It ranked **2nd overall** in the competition, achieving **1st place in nearly half of the testcases** and outperforming gcc -03 and clang -03 on 1/3 of the examples.

LLVM-Lite Quotient
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Lightweight Edge-side Compiler for Neural Network Operators · Undergraduate Thesis Project

C++ / LLVM-IR

- Aimed to utilize known shape information from edge inference devices for secondary optimization of deep learning operators, reducing runtime spatial and temporal overhead;
- Included a lightweight compiler on inference devices and trimming work of the LLVM Codegen module. For target workloads, implemented optimizations such as SCCP and DCE, minimize overhead while maximizing results;
- Received excellent evaluation for the thesis. Successfully reduced inference time by 6% and binary file size by 38% for convolution
 and softmax operators; implemented parse-time optimizations that reduced compilation time by 60% and memory usage by
 60%.

Other Personal Projects

- Caniformia/HangGai (Vue/RoR / SwiftUI, collaborative) Learning app for courses in BUAA, available on the App Store
- Qroife/firefly (Rust) A simple neural network training/inference framework, implementing convolution, fully connected layers and other operators, with MNIST dataset classification implemented;
- <u>Qroife/mole</u> (Verilog / MIPS) A five-stage pipelined CPU, implementing **50**+ instructions with **forwarding** and **stalling** mechanisms; also implemented coprocessor CP0 to handle **interrupts** and **exceptions**;
- <u>Oroife/mos</u> (C / MIPS) An OS kernel with an **exokernel** design, implementing modules for memory mapping, process management, file system, system calls, and a shell;

P Open Source Contributions

- **®** Rust Organization (<u>rust-analyzer contributors team</u>) member, primarily maintaining <u>Orust-lang/rust-analyzer</u> also contributed to <u>Orust-lang/rust</u>, <u>Orust-lang/rust-clippy</u>, <u>Orust-lang/rustup</u>, <u>Orust-lang/rust-mode</u>
- Olivm/Ilvm-project, Oclangd/vscode-clangd, OMikePopoloski/slang, Ogoogle/autocxx, Oyuin/goldmark, Omoonbit-lang/tree-sitter-moonbit, more projects on GitHub.

Skills

- **Programming Languages**: Not tied to any specific language. Especially proficient in C, C++, Rust, Java, Python, JavaScript/TypeScript, Verilog/SystemVerilog, and EmacsLisp; have also worked with Ruby, Swift, OCaml, Haskell, Coq, Agda, etc.
- **Programming Language Theory**: Familiar with type theory, formal semantics, and the theory of computation; experienced with **interactive theorem provers**. Knowledge of the theory and implementation of **type systems** (e.g., Hindley-Milner, Dependent Types).
- Static Analysis: Familiar with static analysis algorithms (e.g., CFA, IFDS, pointer analysis with varying sensitivities).
- Compiler Design: 3 YoE, proficient in the full compiler pipeline, with an emphasis on compiler optimizations:
 - Experience implementing PL features across multiple paradigms, such as bidirectional type checking and module systems.
 - Familiar with various IRs (e.g., SSA, MLIR, etc.) and optimizations across stages (e.g., Mem2Reg, SCEV, register allocation, etc.).
 - In-depth knowledge of LLVM and LLVM-IR; have implemented several analysis and optimization passes.
- **IDE Development**: **2 YoE**. Familiar with IDE architectures based on **incremental computation** (esp. rust-analyzer and clangd); versed in the LSP and plugin development for VS Code, Emacs, and other editors.
- Computer Architecture: Familiar with ARM, x86, etc.; understanding of OoO execution, etc.; knowledgeable about NVIDIA GPU.
- Application Development: Proficient with web backend frameworks (Ruby on Rails, Django), frontend (Vue.js), and iOS
 (SwiftUI) development. Experienced with database design (PostgreSQL, Redis) and DevOps (Docker, CI/CD).
- Development Environment: Proficient in Emacs and VS Code; comfortable with macOS and Linux; adept at leveraging GenAI.

■ Misc

- Club: Served as President of the Beihang OpenAtom Open Source Club, organizing multiple technical sharing and exchange events;
- Blog: roife.github.io mainly focused on theoretical computer science;
- Languages: Chinese (native), English.