Mike (Deyuan) He

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Education

Princeton University, Princeton, NJ 2022 – Est. 2027

Ph.D. in Computer Science, GPA: N/A
Advisors: Prof. Aarti Gupta & Prof. Sharad Malik
Fields of study: Compilers; Domain-specific Languages; Formal Methods; Software Systems

University of Washington, Seattle, WA 2018 – 2022

B.S. in Computer Science, GPA: 3.89/4.0 (ranking N/A)
Advisors: Prof. Zachary Tatlock & Dr. Steven Lybomirsky
Selected Honor: CRA Outstanding Undergraduate Researcher Award, Honorable Mention (2022)

Experience

Taichi Graphics, Remote June. 2022 – Sep. 2022

Compiler R&D Intern (Graphics/Compiler/**C++**/**Python**)

Focusing on IR optimizations for Taichi Language, including:

- Refactoring and implementing local matrices for Frontend and CHI IR of Taichi Language
- Extending IR optimizations (e.g. **dead code elimination**) to support the new matrix operations
- Enabling large matrices and optimizations (e.g. **SIMD**) for matrix operations
- Conducting experiments on performance gains; implementing fallback strategies to avoid performance regression on backends that do not support SIMD

Intel Labs, Hillsboro, OR Mar. 2022 – June. 2022

Formal Verification Research Intern (Formal Methods/**Python**/**Dafny**)

Developed the **Py***rope* framework for **correct-by-construction** hardware modeling.

- Enabled **proof-driven development** purely in Python
- Encoded the correctness proof of (multi-)montgomery reduction algorithm in Python and verified successfully by compiling to Dafny
- Unified "sources of truth" for correctness proofs and hardware model implementations

Semiconductor Research Corporation, Remote Sep. 2019 – Mar. 2022

Research Scholar (MLSys/Formal Methods/**Rust**/**Python**/**C++**)

Participated research projects funded by SRC, including Dynamic Tensor Rematerialization (DTR) and 3LA and collaborated on papers submitted to ICLR'21 and LATTE'21 (a Workshop of ASPLOS).

- Contributed to the evaluation infrastructure and submission artifact for DTR
- Implemented flexible matching algorithm for 3LA, which applies equality saturation to explore accelerator offloading for Deep Neural Networks
- Participated ADA Center Annual Fall Symposium
- Presented flexible matching at ADA Center liaison meeting

Publications

- Marisa Kirisame*, Steven Lyubomirsky*, Altan Haan*, Jennifer Brennan, **Mike He**, Jared Roesch, Tianqi Chen, and Zachary Tatlock. *Dynamic Tensor Rematerialization*, 2021
- Bo-Yuan Huang*, Steven Lyubomirsky*, Thierry Tambe*, Yi Li, **Mike He**, Gus Smith, Gu-Yeon Wei, Aarti Gupta, Sharad Malik, and Zachary Tatlock. *From DSLs to Accelerator-rich Platform Implementations: Addressing the Mapping Gap*, 2021

- Bo-Yuan Huang*, Steven Lyubomirsky*, Yi Li, **Mike He**, Thierry Tambe, Gus Henry Smith, Akash Gaonkar, Vishal Canumalla, Gu-Yeon Wei, Aarti Gupta, Sharad Malik, and Zachary Tatlock. *Application-Level Validation of Accelerator Designs Using a Formal Software/Hardware Interface*, 2022

Skills

- **Languages:** C/C++, Python, Rust, OCaml, Coq, Dafny, etc. (Open to other languages)
- **Compiler & Applied PL:** Equality Saturation, Static Analysis, Computer-aided Reasoning, SMT
- **PL Theory:** Formal Verification, Type Theory, Mathematical Logic
- **Systems:** Distributed Systems, Machine Learning Systems, Data Center Systems
- **Others:** Computer Graphics, Design and Implementation of Algorithms and Data Structures

Related Projects & Open-source Contributions

- Taichi: contributed to matrix representations refactor and optimizations. **C++**, **Python**, LLVM
- veripy: an experimental auto-active verification framework for Python. **Python**, Z3
- dtlc: an implementation of dependently-typed lambda calculus with MLTT. **OCaml**, Menhir
- FlexMatch: implemented flexible offloading for deep learning accelerators. **Rust**, **Python**, TVM
- Glenside: contributed to unifying Glenside and TVM Relay programs. **Rust**, TVM
- Sager: a demonic graph structure synthesizer for wrost-case algorithm analysis. **Racket**, Rosette

Talks & Presentations

- Towards correct-by-construction hardware modeling in Python/HeteroCL at Intel (June. 2022)
- Correct & Flexible Compiler Support for Custom Accelerators at SRC ADA Center (Sep. 2021)
- From DSLs to Accelerator-rich Platform Implementations: Addressing the mapping gap at Intel (Sep. 2021, jointly presented with Dr. Steven Lybomirsky)

Teaching

University of Washington, Seattle, WA

- Principle of Programming Languages (CSE 505)

Academic Service

- Artifact Evaluation, MICRO'21