Yuwei Zhao

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Education

Peking University | School of Computer Science | Ph.D. Student 2024.09 – Present
Advisor: Prof. Yingfei Xiong

Peking University | School of Electronics Engineering and Computer Science | B.S. 2020.09 – 2024.06
Major: Information and Computing Science | Thesis: Automatic Synthesis of Dynamic Programming Algorithms via Abstract Interpretation

Research Profile

My research focuses on **LLM-based automated code performance optimization**: using language models to understand programs, identify optimization opportunities, and generate verifiable high-performance implementations. I combine program analysis, synthesis, rule/example guidance, and performance testing, emphasizing gains, reliability, and transferability across languages and large-scale projects.

Publications

- **Multi-Source and Cross-Scenario Strategy-Guided Code Optimization**
  Yuwei Zhao, Qianyu Xiao, Ye Cui, Yijun Yu, Yingfei Xiong **Under Review, 2026**
  - **Approach:** Proposed MoST, a multi-source and cross-scenario strategy-transfer framework that clusters and transfers evidence to generate static-analysis rules, overcoming single-source knowledge and cross-language reuse limitations.
  - **Historical optimization reproduction:** Reproduced developer patches on 151 C/C++, 150 Python, and 50 Rust historical optimization tasks, yielding 21.88%–180.00% more successful reproductions than SemOpt.
  - **Real-world optimization:** Discovered and applied previously unseen optimizations in 15 projects, achieving 19.72%–717.42% maximum and 4.44%–258.17% average improvements. Outperformed SemOpt and Codex on maximum gains in 15/15 projects and average gains in 14/15.
- **SemOpt: LLM-Driven Code Optimization via Rule-Based Analysis**
  Yuwei Zhao, Yuan-An Xiao, Qianyu Xiao, Zhao Zhang, Yingfei Xiong **TOSEM (CCF-A), 2026**
  - **Approach:** Proposed an LLM- and static-analysis-rule-driven optimization framework that distills strategies from historical commits and generates Semgrep rules, addressing the inability of syntax-based retrieval to match semantically equivalent optimizations.
  - **Historical optimization reproduction:** Reproduced developer patches on 151 C/C++ and 150 Python historical optimization tasks. Successful reproductions were 1.38–28× and 4.60–6.33× those of the baselines, respectively.
  - **Real-world optimization:** Discovered and applied previously unseen optimizations in 10 large-scale projects, achieving 5.04%–479.90% maximum and 1.68%–143.25% average improvements.
- **Superfusion: Eliminating Intermediate Data Structures via Inductive Synthesis**
  Ruyi Ji, **Yuwei Zhao**, Nadia Polikarpova, Yingfei Xiong, Zhenjiang Hu **PLDI (CCF-A), 2024**
  - **Summary:** SuFu uses inductive program synthesis to eliminate intermediate data structures in functional programs, solving 264 of 290 tasks.
- **Decomposition-Based Synthesis for Applying Divide-and-Conquer-Like Algorithmic Paradigms**
  Ruyi Ji, **Yuwei Zhao**, Yingfei Xiong, Di Wang, Lu Zhang, Zhenjiang Hu **TOPLAS (CCF-A), 2024**
  - **Summary:** AutoLifter decomposes synthesis through component and variable elimination, automatically applies six divide-and-conquer paradigms, and solves 82 of 96 tasks.

Awards

Kunpeng Ascend KADC Rising Star Pioneer Award	2026
Jiukun Scholarship, School of Computer Science, Peking University	2025
Merit Student, Peking University	2025, 2023, 2021
Beijing Outstanding Graduate	2024
Outstanding Graduate, Peking University	2024
Third-Class Scholarship, Peking University	2023, 2021
Academic Excellence Award, Peking University	2022