Vidush Singhal

+1-862-324-1823 | singhav@purdue.edu | vidsinghal.github.io
vidush-singhal | vidsinghal | Google Scholar |
707 N 5th St, Lafayette, IN, 47901

Objective

I am a 5th year PhD. student with 5+ years of experience working on compilers research and industry projects via my internships. I have significant experience working with the LLVM compiler, the Gibbon compiler among others. My interests lie broadly in compilers, programming languages, compilers for GPUs, SIMD vectorization, automatic parallelization, and data layout optimization.

Experience

- **Microsoft Research [🌐]** *May 2025 - August 2025*
  Research Intern Redmond, WA, USA
  - Developed **a LLVM based transpiler** to verify memory correctness of C code.
  - Implemented the transpiler as a **clang to clang** based transformer written in C++ (**~7K loc**)
  - The transpiler **C2Pulse** generates Pulse code from programmer annotated C code subsequently verified by FStar.
  - Conducted analysis via the compiler by **verifying simple programs** and generating a benchmark suite.
  - **Verified parts of DPE (Dice Protection Environment)** by writing the protocol implementation in C.
- **Lawerence Livermore National Labs [🌐]** *May 2024 - August 2024*
  Computing Scholar Intern Livermore, CA, USA
  - Engineered a new pass to **optimize layout of bytes** in an alloca in the LLVM Attributor.
  - By optimizing the layout of bytes, the program **benefits from spatial locality.**
  - Wrote the pass in **LLVM IR**, which included eliminating dead bytes and re-ordering accessed bytes.
  - Optimized the performance of the **LLVM GPU sanitizer** by hoisting checks out of loops.
  - Observed a **6% improvement in runtime** on the XS Bench framework.
  - Wrote an LLVM pass to permute order of basic blocks in LLVM IR to see performance variation.
- **Nod.ai labs [🌐]** *May 2022 - August 2022*
  Machine Learning Compiler Engineering Intern Santa Clara, CA, USA
  - Worked on **Torch-MLIR** a framework to provide compiler support from **PyTorch eco-system to MLIR.**
  - Implemented Kernels for various **pytorch operators.**
  - Worked on providing **support for the facebook DLRM** recommendation model.
  - Researched on **improving the ILP solver** central to the scheduling of the ALPA framework.
- **Astrome Technologies Private Limited [🌐]** *March 2019 - August 2019*
  Engineering Intern Bengaluru, Karnataka, India
  - Integrated an EMMC IP with an Axilite to Wishbone IP via a wrapper around the IP in system verilog.
  - Performed behavioral simulations of the IPs on Vivado software to verify correctness.
  - Developed XSLT files for data stored in XML files for custom data representation.
  - Developed code in Python to output the XML data as HTML on a private webpage used by the company.
  - Implemented a fast Convolution Encoding and Viterbi Decoding algorithm in C for error correction and detection.
  - The resulting binary was an **order of magnitude** faster than the python implementation.
- **Purdue University [🏛]** *May 2021 - present*
  Graduate Research Assistant West Lafayette, IN, USA
  - **Gibbon Compiler**
    - Optimizing layout of data types for better spatial locality.
    - Observed speedups of **1.14x to 54x** over best prior work.
    - Implemented a transformation similar to structure of arrays for better vectorization.
    - This transformation can help with accelerating AI workloads written in Haskell.
    - Observed **10x speedup** for manually written initial experiments.
  - **Orchard Compiler**
    - Developed a compiler framework to automatically fuse and parallelize tree traversals.
    - Observed speedups ranging from **1-5x** over baseline tree traversals.
  - **Copse Compiler**
    - A framework to evaluate FHE decision trees in a vectorized fashion.
    - Developed a compiler framework to automatically fuse and parallelize tree traversals.

- **Cornucopia**
  - A framework for generating a corpus of binaries for a source file by utilizing compiler optimizations.
  - Developed a framework that uses fuzzing to generate a database of binaries using llc's optimization flags.
  - Discovered various bugs with the LLVM compiler's optimization passes.
  - Uncovered bugs in Angr, Ghidra etc. that failed to de-compile Cornucopia generated binaries.
  - Developed a framework that stores ground truth meta-data in the binary to test against BATs.

- **Senior Design Project, SoCET Team [🏛]** *July 2020 - Spring 2021*
  Worked with Dr. Mark Johnson and Prof. Samuel Midkiff West Lafayette, IN, USA
  - Developed a compiler tool for proprietary RISCV hardware using the LLVM framework.
  - The compiler's objective was to optimize C programs for sparsity.
  - Modified the LLVM RISCV backend by writing multiple machine IR passes.
  - The passes identified sparse regions and annotated them for the hardware to identify them at runtime and perform runtime checks.

Education

- **Purdue University**, West Lafayette, IN, USA
  Ph.D. in Electrical and Computer Engineering May 2021 – Aug 2027
- **Purdue University**, West Lafayette, IN, USA
  M.S. in Electrical and Computer Engineering May 2021 – May 2023
- **Purdue University**, West Lafayette, IN, USA
  B.Sc. in Computer Engineering Aug 2017 – May 2021

Publications

C=Conference, J=Journal, T=Thesis

[C.1] Raghav Malik, **Vidush Singhal**, Benjamin Gottfried, Milind Kulkarni *"Vectorized Secure Evaluation of Decision Forests"* in *PLDI 2021* [ACM DL]

[C.2] **Vidush Singhal**, Akul Abhilash Pillai, Charitha Saumya, Milind Kulkarni, Aravind Machiry *"Cornucopia: A Framework for Feedback Guided Generation of Binaries"* in *ASE 2022* [ACM DL]

[C.3] **Vidush Singhal**, Chaitanya Koparkar, Joseph Zullo, Artem Pelenitsyn, Michael Vollmer, Mike Rainey, Milind Kulkarni *"Optimizing Layout of Recursive Datatypes with Marmoset"* in *ECOOP 2024* [LIPIcs]

[J.1] **Vidush Singhal**, Laith Sakka, Kirshanthan Sundararajah, Ryan Newton, Milind Kulkarni *"Orchard: Heterogeneous Parallelism and Fine-grained Fusion for Complex Tree Traversals"* in *TACO 2024* [ACM DL]

[C.4] Chaitanya S. Koparkar, **Vidush Singhal**, Aditya Gupta, Mike Rainey, Michael Vollmer, Artem Pelenitsyn, Sam Tobin-Hochstadt, Milind Kulkarni, Ryan R. Newton *"Garbage Collection for Mostly Serialized Heaps"* in *ISMM 2024* [ACM DL]

Coursework

- **Compilers Courses:** Compiler Code Generation and Optimization, Compilers for GPUs, Intro to Compilers and Translation Engineering
- **Data Structures and Algorithms:** Computation Models and Methods, Applied Algorithms, Data Structures in C
- **Math Courses:** Discreet Math, Graph Theory, Category Theory, Random Variables
- **AI Courses:** Intro to Artificial Intelligence, Python for Data Science
- **Systems Courses:** Computer Architecture, Programming Parallel Machines, Microprocessors and micro-controllers, Digital Design
- **PL courses:** Reasoning about programs, Formal Languages, Computability, and Parallelization, Programming Languages, Advanced C Programming, Object Oriented Programming in C++
- **Other Courses:** Holistic Software Security, Intro to Quantum Computing

Skills

- **Programming Languages:** C, C++, Haskell, Python, Java, Bash, Assembly (ARM, X86), MATLAB, System Verilog, CUDA, Coq, Dafny, Pulse
- **Web Technologies:** HTML, CSS
- **Database Systems:** PostgreSQL
- **Data Science & Machine Learning:** PyTorch, TensorFlow
- **Operating Systems:** Unix/Linux, Windows
- **Version Control:** GIT
- **Other Tools & Technologies:** LLVM, GCC, AFL++, Gem5, OpenCilk, Intel TBB, Pthreads, OpenMP, Intel Cilk Tools, MPI, NumPy, CUDA, GDB
- **IDEs:** Visual Studio Code, Vim, Notepad++, Kate, Clion
- **Soft Skills:** A calm minded, inclusive, and humble individual who believes in good communication skills and teamwork.

Teaching Experience

- **Teaching Assistant**, Prof. Milind Kulkarni, Intro to Data Science, Purdue University *Fall 2025*
- **Teaching Assistant**, Prof. Milind Kulkarni, Intro to Data Science, Purdue University *Spring 2023*
- **Undergraduate Teaching Assistant**, Prof. Cheng Kok Koh, ECE 368, Purdue University *Spring 2020*
- **Student Grader for Signals and Systems**, Prof. Chih-Chun Wang, ECE 301, Purdue University *Spring 2020*

Honors and Awards

- **Received a travel grant**, LLVM developers meeting *October 2024*
- **Semester Honors**, Purdue University *Fall 2019 - Spring 2020*
- **Deans's List and Semester Honors**, Purdue University *Fall 2017 - Spring 2018*

Leadership Experience

- **Seminar Co-Coordinator**, Purdue Programming Languages and Systems Research Group (PurPL) *Fall 2025 - present*

Review Experience

- **Member of the Artifact Evaluation Committee (AEC)**, POPL 2026 *Fall 2025*
- **Member of the Artifact Evaluation Committee (AEC)**, CGO 2026 *Fall 2025*
- **Member of the Artifact Evaluation Committee (AEC)**, ICFP 2025 *Summer 2025*
- **Member of the Artifact Evaluation Committee (AEC)**, PLDI 2025 *Spring 2025*
- **Collaborative Reviewer with Advisor (Milind Kulkarni)**, CGO 2025 *Spring 2025*
- **Member of the Artifact Evaluation Committee (AEC)**, CGO 2025 *Fall 2024*
- **Member of the Artifact Evaluation Committee (AEC)**, PPoPP 2024 *Spring 2024*
- **Member of the Artifact Evaluation Committee (AEC)**, PPoPP 2023 *Spring 2023*

Volunteer Experience

- **Talk moderator**, LLVM developers meeting 2024 *Fall 2024*
- **Student Volunteer**, ECOOP/ISSTA 2024 *Spring 2024*
- **Student Volunteer**, SPLASH 2021 *Fall 2021*

Professional Memberships

- **Eta Kappa Nu**, Purdue Electrical and Computer Engineering Honors Society *Fall 2018 - Present*

Mentoring

- **Peter A Kaya Gretchikha**, Undergrad @ Purdue *Fall 2024 - Fall 2025*
- **Mikah Kainen**, Undergrad @ Purdue *Fall 2023*
- **Qingyuan (Peter) Li**, Undergrad @ Purdue, SURF summer research mentor *Spring 2023 - Fall 2023*