VIR NARULA

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Education

University of Illinois at Urbana-Champaign *May 2024*

Master of Science in Computer Science (Thesis-based) GPA: N/A

Bachelor of Science in Computer Science (Concentrations: Machines, Big Data & Intelligence*)* *GPA: 3.8*

Relevant Coursework: ML for Compilers and Arch., Compiler Construction, Programming Languages, Operating Systems, AI, AI for Vision, Applied ML, Computer Architecture, Computer Organization, Algorithms & Models of Computation, Mobile Robotics

Work Experience

NVIDIA – SPIRV & CGC Compiler Team - *Software Engineering Intern* *May 2023 – August 2023*

- Developed fast SSA-based uninitialized variable analysis for SPIRV compiler (compiles graphics and ML for GPUs)
- Beat out traditional dataflow techniques by an order of complexity by leveraging novel dataflow techniques
- Combined dataflow techniques with program analysis subroutines to cover cases missed by industry standard (Clang)
- Implemented generalizable framework for supporting new frontends; Initiated process of applying for a utility patent

Apple – Compilers for CPU & Accelerators – *Software Engineering Intern* *May 2022 – August 2022*

- Leveraged ARM's vector instruction set & memory to optimize dot product operations on Apple's M2 architecture
- Reduced execution time by up to ~75% on microbenchmarks for vectors with large dimensions
- Created a static loop analysis tool to automate extraction and analysis of loops at scale with a focus on vectorization
- Integrated analysis tool with profiling functionality to find missed optimizations in performance-critical loops

NVIDIA – SPIRV & CGC Compiler Team - *Software Engineering Intern* *January 2022 - May 2022*

- Implemented matrix multiplication reordering optimization in the SPIR-V compiler to reduce computational complexity
- Achieved ~3.5% frame rate boost in key frames of production titles that contained optimizable patterns
- Added peak memory usage tracking to the GLSL (OpenGL Shading Language) compiler, furthering profiling ability
- Benchmarked the GLSL compiler peak memory usage across various compiler stages to inform future work

LLVM Research Group @ UIUC - *Undergraduate Researcher* *May 2020 – Present*

- Working under Professor Vikram Adve developing HPVM, a heterogenous and parallel compiler infrastructure
- Leveraged LLVM to create compiler for Hetero-C, which compiles to HPVM-IR, allowing for easy HPVM programming
- Reduced average program length by ~75% using interprocedural analysis, significantly improving programmability
- Ported OpenVINs (Intel's computer vision library) to Hetero-C++ with CPU acceleration as proof-of-concept
- Investigating generative/LLM-based techniques to improve compiler error reporting for master's thesis

Papers

A Survey of the State of the Art of Machine Learning in Compiler Technologies – *Senior Thesis* *Spring 2023*

- Examined papers proposing learned approaches to performance models, optimization strategies, & register allocation
- Investigated State-of-the-Art in code generation and program analysis using NMT, LSTMs, transformers, and LLMs

Projects

Deep Learning Games *August 2020 – August 2021*

- Created deep learning models using Keras to play games including Blackjack, Flappy Bird, and Snake
- Built a Chess AI using minimax, alpha-beta, and stochastic search to play optimal moves, looking *n* moves ahead

Awards and Honors

James Scholar, University of Illinois, Urbana-Champaign – Awarded to undergrads with high academic standing *2020 - 2022*

Runner-up Best Pitch at HackThis, HackIllinois - Awarded prize for second-best overall product & pitch *August 2020*

Skills and Interests

Programming Languages: *Proficient:* C/C++, Java, Python *Intermediate*: Haskell, Rust, GLSL, JavaScript

Interests: Compilers, Programming languages, Deep-Learning, Developer Tools, Distributed Systems

Languages: English (Native), Hindi (Fluent), French (Conversational)