Nathan Sobotka

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Education

Stanford — **Palo Alto, CA**
PhD Candidate | Computer Science — *2029*

University of Pennsylvania — **Philadelphia, PA**
Master of Science in Engineering | Computer and Information Science | GPA: 4.00/4.00 — *May 2024*
Bachelor of Science in Engineering | Computer Science, Minor: Mathematics | GPA: 3.98/4.00 — *May 2024*

Work

Robust Profile Guided Runtime Prefetch Generation (RPG2) — **Philadelphia, PA**
Research Assistant | Professor Devietti — *May 2023 – August 2023*

- Achieved up to 2.15x speedup on C/C++ binaries by dynamic insertion of cache prefetch instructions followed by systematic tuning of prefetch distances, under the guidance of Professor Joe Devietti
- Evaluated RPG2 on hundreds of benchmarks, scrutinizing speedup, MPKI, IPC, and comparing with APT-GET. Advanced prior work by retaining speedup and eliminating slowdown by dynamically disabling prefetching

NASA Langley Research Center | Safety Critical Avionics Systems Branch — **Hampton, VA**
Combinatorial and Property Based Testing Intern — *May 2023 – August 2023*

- Developed a Haskell library to enhance NASA's testing technology by combining static analysis with property based testing, identifying program inputs that are unlikely to be found with random or enumeration based testing
- Implemented software to address limitations found after reviewing multiple academic papers on testing techniques in functional programming languages. This included failings of symbolic execution and randomized testing

DeepSpec NSF Expedition: The Vellvm Project — **Philadelphia, PA**
Research Assistant | Professor Zdancewic — *May 2022 – January 2023*

- Developed a Coq monad library for public use by defining equivalence for the error, option, list, set, multiset, CPS, ID, and state monad. Also proved fundamental theorems true, including the monad laws, for ease of future use
- Tested VELLVM's memory model using unit tests written in LLVM and C and automated tests written in QuickChick. Proved LLVM compiler optimizations correct in Coq with Professor Zdancewic (GitHub: Vellvm)

University of Pennsylvania Computer and Information Science Department — **Philadelphia, PA**
TA (CIS-5710, CIS-2400) & Peer Tutor (MATH-3120, CIS-1600) — *Jan 2022 – Present*

- Taught 270 graduate students Computer Organization and Design, covering OOO multiprocessors, branch prediction, and caching, concluding by implementing a two-way five-stage superscalar pipelined processor in Verilog
- Taught 200 students computer architecture through Introduction to Computer Systems, covering transistors, basic hardware structures, an assembly language, and an introduction to C, followed by implementing a compiler
- Reinforced foundational concepts for seven students in Linear Algebra and Mathematical Foundations of CS

Publications

Robust Profile Guided Runtime Prefetch Generation — *April 2024*

- Yuxuan Zhang, Nathan Sobotka, Soyoon Park, Saba Jamilan, Tanvir Khan, Baris Kasikci, Gilles A Pokam, Heiner Litz, Joseph Devietti. Robust Profile Guided Runtime Prefetch Generation. In 2024 ASPLOS (conditionally accepted).

Projects

Search Engine | *Java* — *March 2023 – May 2023*
CIS-5550: Internet and Web Systems Project

- Employed Amazon AWS to host a highly distributed search engine with over 125-thousand results, utilizing a hand-built crawler to find pages, an indexer to compute pagerank / tf / idf values, and a frontend to display findings
- Implemented entire backend, including a webserver, KVS, and version of Apache Spark to maximize parallelizability

Operating System | *C* — *October 2022 – December 2022*
CIS-3800: Operating Systems Project

- Developed a UNIX-like operating system, complete with three level priority scheduling and a FAT file system
- Simulated using user threads to emulate OS context switches, along with a custom shell to interact with the OS
- Tested using a logging system to verify features like background processes, blocking, waiting, and CPU utilization

Technical Skills & Interests

Computer	C, C++, Python, Java, Coq, Haskell, Verilog, OCaml, SQL (mySQL, Oracle), MongoDB, OpenGL
Interests	Silicon Engineering, CPU and GPU Engineering, Functional Programming, Computer Systems
Coursework	Computer Architecture, Operating Systems, Data Structures, Algorithms, Computability & Complexity, AI, Web Systems, Graphics, Probability & Statistics, ODEs & PDEs, and Linear Algebra
Languages	English (fluent), German (intermediate)