Nathan Sobotka

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Education

University of Pennsylvania | Philadelphia, PA *Expected 05/24*

M.S.E & B.S.E. Computer and Information Science, Minor: Mathematics | GPA: 3.98/4.00

- Coursework in data structures, algorithms, computer architecture, computability & complexity, operating systems, AI, web systems, graphics, probability & statistics, ODEs & PDEs, and linear algebra

Work

NASA Langley Research Center **Hampton, VA**

Combinatorial and Property Based Testing *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
- Researched and reviewed multiple academic papers, gaining insight into the limitations of other testing methodologies such as symbolic execution. Subsequently developed a tool to address those limitations

Robust Profile Guided Runtime Prefetch Generation (RPG2) **Philadelphia, PA**

Research Assistant *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. Advances prior work by retaining speedup and eliminating slowdown by dynamically disabling prefetching

DeepSpec NSF Expedition: The Vellvm Project **Philadelphia, PA**

REU Intern *May 2022 – January 2023*

- Compiler verification with the Vellvm Project under Professor Steve Zdancewic (GitHub: Vellvm)
- 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, followed by automated tests written using QuickChick. Proved LLVM compiler optimizations correct (or incorrect) through the Coq Proof Assistant

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 students Computer Organization and Design, covering topics such as OOO multiprocessors, branch prediction, and caching, concluding by implementing a 2 way 5 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 7 students in Linear Algebra and Mathematical Foundations of CS

Publications

ASPLOS *April 2024*

- "Robust Profile Guided Runtime Prefetch Generation," *ASPLOS (Under Review).*
- Co-authored as second author during my time as a research assistant under Professor Joe Devietti at UPenn

Projects

Search Engine | *Java* *March 2023 – May 2023*

CIS-5550: Internet and Web Systems Project

- Developed a search engine by writing a webserver, KVS, and version of Apache Spark to maximize parallelizability
- Optimized my own crawler to avoid spider traps and crawl a healthy variety of pages, developed an indexer to compute pagerank, tf, and idf values, as well as a frontend to display search results in a pleasing way
- Over 125 thousand results were searchable through the search engine, which was hosted on Amazon AWS

Community & Leadership

Balloon Team Software Lead | *Aerospace Club* *September 2020 – May 2023*

- Lead 7 person software team in collection, analysis, and website development for live balloon tracking at 70k feet

Tennis | *Penn Club Tennis (PCT) | Fred Wells Tennis and Education Center | SPA* *August 2016 – Present*

- Treasurer for PCT, managing the budget for a 120 person club engaged in local events and national tournaments
- Community Service Lead for PCT, organizing free tennis lessons for children in Philadelphia

Technical Skills & Interests

Computer Languages	C, C++, Python, Java, Coq, Haskell, Verilog, OCaml, SQL (mySQL, Oracle), MongoDB
Interests	English (fluent), German (intermediate)
	Silicon Engineering, CPU and GPU Engineering, Functional Programming, Aerospace Engineering