Yunming Zhang

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Overview

- **Performance Engineering:** 6+ years of experience in profiling and optimizing the performance of large-scale data analytics applications on multi-core CPUs, 1+ year of implementing high-performance sparse graph applications on GPUs, and 2+ years of improving the efficiency of distributed MapReduce systems. My tech blog on performance engineering and related topics has 50k+ views/year.
- **Compiler:** Created and led the development of an open-source domain-specific language and compiler, *GraphIt*, with 9 contributors, used by Nvidia, UW, Cornell, and currently evaluated by Intel for production.
- **Publications:** Multiple first-author publications in top Programming Languages, Compilers, and Big Data conferences with one *best student paper* award.
- **Programming Languages:** Experienced with C++, C, Python, and Java. Familiar with Go and MATLAB.

Education

Massachusetts Institute of Technology   June 2014 - May 2020 (Expected)
Doctor of Philosophy in Computer Science, Cumulative GPA: **5.0/5.0**
Advisors: Prof. Saman Amarasinghe, Julian Shun
Focus: High-Performance Systems and Compilers for Large-Scale Graph Analytics and Sparse Computations

Rice University, Houston, Texas   May 2013 - May 2014
Master of Science in Computer Science, Cumulative GPA: **4.0/4.33**
Advisors: Prof. Vivek Sarkar, Alan L. Cox
Focus: Optimizing Multi-Core Performance for Distributed MapReduce Runtime Systems

Rice University, Houston, Texas   Aug 2009 - May 2013
Bachelor of Science in Computer Science
Cumulative GPA: **3.99/4.33, Magna Cum Laude, Distinction in Research and Creative Work**

Research and Work Experience

Massachusetts Institute of Technology Computer Science Department   June 2014 – Present
Research Assistant   **Advisors: Prof. Saman Amarasinghe, Julian Shun**

- Created and led the design and implementation of *GraphIt*, a domain-specific language for writing high-performance graph analytics. GraphIt achieved up to 4.8x speedup over the fastest CPU and GPU graph processing frameworks for ordered and unordered graph algorithms. GraphIt is currently used by University of Washington, Cornell University, NVIDIA for the development of domain-specific accelerators and evaluated by Intel graph analytics team for production.
- Led the development of *PriorityGraph* extensions to GraphIt for supporting high-performance ordered parallelism for applications such as Shortest Paths queries, Nearest Neighbor Search, KCore, and SetCover.
- Led the development of new cache optimizations, Graph Reordering and CSR segmenting (cache blocking for graphs). We implemented the techniques in a library, *Cagra*, and later integrated into GraphIt.
- Worked on using GraphIt to generate high-performance GPU implementations of graph algorithms.
- Worked on high-performance Sparse Linear Algebra kernels for SpMV on multi-core CPUs.

Rice University Computer Science Department   Aug 2012 – May 2014
Research Assistant, Habanero Multi-Core Software Group   **Advisor: Prof. Vivek Sarkar**

- Designed and implemented the *HJ-Hadoop* MapReduce runtime, which integrates Habanero Java's shared memory model into Hadoop MapReduce's distributed memory model. HJ-Hadoop enables efficient data sharing among different tasks and improves the performance of data analytics applications by up to 3x.

- Worked on high-performance parallel betweenness centrality algorithms with Habanero C.

IBM Research Lab, Austin   **May 2013 – Aug 2013**
Research Intern, Distributed High performance Key-Value Store   **Mentor: Dr. Juan Rubio**

- Designed and implemented a query API for a distributed key-value store and integrated it into the application.
- Worked on integrating consistent hashing into the distributed key-value store.

Microsoft, Redmond   **May 2012 – Aug 2012**
Software Developer Engineering Intern, Azure Data Market Team   **Manager: David Shiflet**

- Improved search functionalities on the website with NLP libraries to better match user interest with data or application offered by Azure Data Market.

Publications

PriorityGraph: A Unified Programming Model for Optimizing Ordered Graph Algorithms
<u>**Yunming Zhang**</u>, Ajay Brahmakshatriya, Xinyi Chen, Laxman Dhulipala, Shoaib Kamil, Saman Amarasinghe, Julian Shun

- International Symposium on Code Generation and Optimization (***CGO***) 2020

Tiramisu: A Polyhedral Compiler for Expressing Fast and Portable Code
Riyadh Baghdadi, Jessica Ray, Malek Ben Romdhane, Emanuele Del Sozzo, Abdurrahman Akkas, <u>**Yunming Zhang**</u>, Patricia Suriana, Shoaib Kamil, Saman Amarasinghe

- International Symposium on Code Generation and Optimization (***CGO***) 2019

GraphIt – A High-Performance DSL for Graph Analytics
<u>**Yunming Zhang**</u>, Mengjiao Yang, Riyadh Baghdadi, Shoaib Kamil, Julian Shun, Saman Amarasinghe

- Object-oriented Programming, Systems, Languages, and Applications (***OOPSLA***) 2018
- **Project Page:** https://graphit-lang.org/, **Github:** https://github.com/GraphIt-DSL/graphit

Making Caches Work for Graph Analytics
<u>**Yunming Zhang**</u>, Vladimir Kiriansky, Charith Mendis, Matei Zaharia, Saman Amarasinghe

- IEEE International Conference on Big Data (***BigData***) 2017 <u>*Best Student Pap*</u>*er*

Optimizing Indirect Memory References with Milk
Vladimir Kiriansky, <u>**Yunming Zhang**</u>, Saman Amarasinghe

- International Conference on Parallel Architectures and Compilation Techniques (***PACT***) 2016

HJ-Hadoop: An Optimized MapReduce Runtime for Multi-core Systems.
<u>**Yunming Zhang**</u>, Alan Cox, Vivek Sarkar.
- 5th USENIX Workshop on Hot Topics in Parallelism (***HotPar*** '13). June 2013. [poster with paper]

Awards and Honors

- Best Student Paper, BigData 17 (2017)
- Third place, Undergraduate, ACM Student Research Competition at SPLASH 13 (2013)
- Research Fellowship for Master of Science in Computer Science (2013)

Talks

- "Writing High-Performance Graph Applications with GraphIt", Facebook Boston, 2019
- "Writing High-Performance Graph Applications with GraphIt",Google NY, 2019
- "GraphIt: A Domain-Specific Language for Writing High-Performance Graph Applications", MIT Fast Code Seminar, MIT Graphics Seminar 2019, MIT *Algorithm Engineering (6.886) 2019*
- *"Compiling Sparse Graphs and Tensors",* University of Texas at Austin ICES Seminar 2018
- "GraphIt: A DSL for Writing High-Performance Graph Applications", SRC TECHCON 2018
- "Optimizing Cache Performance for High-Performance Graph Analytics", MIT *Graph Analytics (6.886)* 2018

Teaching and Mentorship Experience

Teaching Assistants at MIT and Rice

- MIT: TA for *Performance Engineering of Software Systems (6.172)* in Fall 2016
- Rice: TA for *Fundamentals of Parallel Computing* (COMP 322) for 2 semesters. *Advanced Object Oriented Computing* (COMP 310), *Computational Thinking* (COMP 140). (From 2010 to 2013)

Mentoring Master and Undergraduate Students at MIT

- Mengjiao Yang, Master of Engineering, (coauthor of GraphIt paper at OOPSLA 2018)
- Xinyi Chen, Undergraduate Researcher, (coauthor of PriorityGraph at CGO 2020, SuperUROP award)
- Tugsbayasgalan Manlaibaatar, Master, Undergraduate Researcher (High-Performance Graph Algorithms)

Service

- International Conference on Very Large Data Bases **(VLDB)** 2020 External Reviewer
- Transaction on Parallel and Distributed Systems **(TPDS)** 2019 Reviewer
- Symposium on Parallelism in Algorithms and Architectures (**SPAA**) 2018 Reviewer
- ACM Computing Surveys 2017 Reviewer