

# Willow Ahrens

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## EDUCATION

### MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PH.D. COMPUTER SCIENCE, ADVISED BY SAMAN AMARASINGHE  
Cum. GPA: 4.9 / 5.000 | Started Sept. 2016 | Cambridge, MA

### UNIVERSITY OF CALIFORNIA, BERKELEY

BS IN ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, MINOR IN MATHEMATICS  
Cum. GPA: 3.825 / 4.000 | May 2016 | Berkeley, CA

## PUBLICATIONS

- Willow Ahrens, Daniel Donenfeld, Fredrik Kjolstad, and Saman Amarasinghe. Looplets: A Language for Structured Coiteration. In *Proceedings of the 21st ACM/IEEE International Symposium on Code Generation and Optimization*, pages 41–54. Association for Computing Machinery, February 2023. ISBN 9798400701016. URL <https://dl.acm.org/doi/10.1145/3579990.3580020>
- Willow Ahrens, Fredrik Kjolstad, and Saman Amarasinghe. Autoscheduling for sparse tensor algebra with an asymptotic cost model. In *Proceedings of the 43rd ACM SIGPLAN International Conference on Programming Language Design and Implementation*, pages 269–285. Association for Computing Machinery, June 2022. ISBN 978-1-4503-9265-5. URL <https://doi.org/10.1145/3519939.3523442>
- Willow Ahrens. Contiguous Graph Partitioning For Optimal Total Or Bottleneck Communication. *arXiv:2007.16192 [cs]*, June 2021. URL <http://arxiv.org/abs/2007.16192>
- Suzanne Mueller, Willow Ahrens, Stephen Chou, Fredrik Kjolstad, and Saman Amarasinghe. Sparse Tensor Transpositions: Brief Announcement. In *Proceedings of the 32nd ACM Symposium on Parallelism in Algorithms and Architectures*, pages 559–561. Association for Computing Machinery, July 2020. ISBN 978-1-4503-6935-0. URL <https://doi.org/10.1145/3350755.3400245>
- Willow Ahrens, James Demmel, and Hong Diep Nguyen. Algorithms for Efficient Reproducible Floating Point Summation. *ACM Trans. Math. Softw.*, 46(3):22:1–22:49, July 2020. URL <https://doi.org/10.1145/3389360>
- Willow Ahrens and Erik G. Boman. On Optimal Partitioning For Sparse Matrices In Variable Block Row Format. *arXiv:2005.12414 [cs]*, May 2020. URL <https://arxiv.org/abs/2005.12414>
- Fredrik Kjolstad, Willow Ahrens, Shoaib Kamil, and Saman Amarasinghe. Tensor Algebra Compilation with Workspaces. In *2019 IEEE/ACM International Symposium on Code Generation and Optimization (CGO)*, pages 180–192, February 2019. URL <https://doi.org/10.1109/CGO.2019.8661185>
- Willow Ahrens. *A Parallel Fill Estimation Algorithm for Sparse Matrices and Tensors in Blocked Formats*. Thesis, Massachusetts Institute of Technology, 2019. URL <https://dspace.mit.edu/handle/1721.1/121653>
- Willow Ahrens, John Feser, and Robin Hui. LATE Ain'T Earley: A Faster Parallel Earley Parser. *arXiv:1807.05642 [cs]*, July 2018a. URL <https://arxiv.org/abs/1807.05642>
- W. Ahrens, H. Xu, and N. Schiefer. A Fill Estimation Algorithm for Sparse Matrices and Tensors in Blocked Formats. In *2018 IEEE International Parallel and Distributed Processing Symposium (IPDPS)*, pages 546–556, May 2018b. URL <https://doi.org/10.1109/IPDPS.2018.00064>
- R. Tumblin, W. Ahrens, S. Hartse, and R. Robey. Parallel Compact Hash Algorithms for Computational Meshes. *SIAM J. Sci. Comput.*, 37(1):C31–C53, January 2015. URL <https://epubs.siam.org/doi/10.1137/13093371X>

## SELECTED COURSEWORK

### CS C267 APPLICATIONS OF PARALLEL COMPUTING

A | Spring 2015 | UC Berkeley

### CS 270 COMBINATORIAL ALGORITHMS AND DATA STRUCTURES

A | Spring 2016 | UC Berkeley

### 6.854 ADVANCED ALGORITHMS

A | Fall 2016 | MIT

### 6.856 RANDOMIZED ALGORITHMS

B+ | Spring 2017 | MIT

### 18.335 INTRODUCTION TO NUMERICAL METHODS

A | Spring 2017 | MIT

## **6.820** FOUNDATIONS OF PROGRAM ANALYSIS

A | Fall 2017 | MIT

## **18.085** COMPUTATIONAL SCIENCE AND ENGINEERING

A | Fall 2017 | MIT

## **6.863** NATURAL LANGUAGE PROCESSING

A | Spring 2018 | MIT

## **12.850** COMPUTATIONAL OCEAN MODELING

A | Spring 2018 | MIT

## **12.823** MODELING THE BIOLOGY AND PHYSICS OF THE OCEAN

A | Spring 2019 | MIT

## EXPERIENCE

### **MIT COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE LAB** | RESEARCH ASSISTANT

Sep 2016 – Present | Cambridge, MA

- Currently advised by **Saman Amarasinghe**, investigating compilers for sparse and structured linear algebra. Developing algorithms to autotune compilers to adapt to inputs at runtime.
- Previously advised under **Alan Edelman**, developed abstractions for scientific computing in the Julia programming language.

### **MIT GLASS LAB** | GLASSBLOWING INSTRUCTOR

Feb 2019 – Present | Cambridge, MA

- Supervised and instructed pairs of beginner students one at a time for weekly two-hour sessions. Kept students safe, explained critical techniques, and walked beginners through their first interactions with molten glass.

### **SANDIA NATIONAL LABORATORY** | CSGF PRACTICUM INTERN

May 2019 – Aug 2019 | Albuquerque, NM

- Worked with **Erik Boman**, to develop algorithms that reorganize sparse matrix nonzeros into dense blocks. Proposed the 1D-VBR sparse matrix format. Julia.

### **LOS ALAMOS NATIONAL LABORATORY** | RESEARCH INTERN

May 2016 – Aug 2016 | Los Alamos, NM

- Worked with **Justin Lietz**, **Stephanie Lauber**, and **Hai Ah Nam** to parallelize a coupled cluster doubles nuclear physics simulation to run on Wolf cluster. Used a static scheduling algorithm to balance work across processors. C++/MPI.

### **BERKELEY BENCHMARKING AND OPTIMIZATION GROUP** | UNDERGRAD RESEARCHER

Jan 2014 – May 2016 | Berkeley, CA

- Worked with **Diep Nguyen** and **Prof James Demmel** to create a reproducible linear algebra library in C (ReproBLAS) (<http://bebop.cs.berkeley.edu/reproblas/index.php>).
- Created new algorithms to handle exceptional values and preserve accuracy, proved their correctness.
- Wrote autotuned code generator in Python for ReproBLAS routines

### **NVIDIA** | SOFTWARE ENGINEERING INTERN

June 2014 – Aug 2014 | Santa Clara, CA

- Worked in a team to create a CPU profiler, intercepting dll calls and sampling using signal handlers. Created a small real-time system to handle stack traces and process them into various types of call graphs.
- Fixed bugs. Tested. Wrote a test for cuda-gdb.

### **CENTER FOR ACCESS TO ENGINEERING EXCELLENCE** | TUTOR

Jan 2014 – May 2014 | Berkeley, CA

- Tutored groups of around 2-5 students at a time.
- Lower-Division Computer Science, Math, Physics.

## AWARDS

2017		DOE Computational Science Graduate Fellow
2016		Warren Y. Dere Design Award, UC Berkeley
2016		Electrical Engineering and Computer Science Honors, UC Berkeley
2013	1 <sup>st</sup> /77	CS61C Image Convolution Optimization Contest, UC Berkeley
2012	1 <sup>st</sup> /10	CS61A Scheme Recursive Art Contest (see left), UC Berkeley

## REVIEWING

- 2022 Parallel Computing (PARCO)
- 2021 ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)
- 2021 IEEE Transactions on Parallel and Distributed Systems (TPDS)
- 2021 International Symposium on Code Generation and Optimization (CGO)
- 2021 SIAM Symposium on Algorithm Engineering and Experiments (ALENEX22)
- 2019 IEEE Transactions on Parallel and Distributed Systems (TPDS)
- 2019 IEEE Transactions on Computers (TC)