

Fredrik Berg Kjolstad

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Academic Positions

2020–present **Assistant Professor**, *Stanford University*.

Education

February 2020 **Ph.D., Computer Science**, *Massachusetts Institute of Technology*.

Thesis: Code Generation for Sparse Computation

Adviser: Saman Amarasinghe

Award: First Place MIT EECS George M. Sprowls PhD Thesis Award in Computer Science, 2020

August 2011 **M.S. Computer Science**, *University of Illinois at Urbana-Champaign*.

Thesis: Refactoring Transformations for Maintainable, Scalable and Efficient Parallelism

Adviser: Marc Snir

Award: Best Poster Award at the UIUC Grad Expo (M.S. and Ph.D.).

June 2005 **B.E., Computer Science**, *Norwegian University of Science and Technology in Gjøvik*.

Bachelor project: Stopmotion

Awards: Rosing Student Award from the Norwegian Computer Society and Eureka Award from the Norwegian University of Science and Technology in Gjøvik.

Publications

Conference and Journal Publications

PLDI 2023 Indexed Streams: A Formal Intermediate Representation for the Fused Execution of Contraction Operations. Scott Kovach, Praneeth Kolichala, Timothy Guo, and Fredrik Kjolstad. *Architectural Support for Programming Languages and Operating Systems*, 2023.

PLDI 2023 Mosaic: An Interoperable Compiler for Tensor Algebra. Manya Bansal, Olivia Hsu, Kunle Olukotun, and Fredrik Kjolstad. *Architectural Support for Programming Languages and Operating Systems*, 2023.

ASPLOS 2023 The Sparse Abstract Machine. Olivia Hsu, Maxwell Strange, Ritvik Sharma, Jaeyeon Won, Kunle Olukotun, Joel Emer, Mark Horowitz, and Fredrik Kjolstad. *Architectural Support for Programming Languages and Operating Systems*, 2023.

CGO 2023 Looplets: A Language For Structured Coiteration. Willow Ahrens, Daniel Donenfeld, Fredrik Kjolstad, and Saman Amarasinghe. *International Symposium on Code Generation and Optimization (accepted)*, 2023.

- TECS 2023 Aha: An agile approach to the design of coarse-grained reconfigurable accelerators and compilers. Kalhan Koul, Jackson Melchert, Kavya Sreedhar, Leonard Truong, Gedeon Nyengele, Keyi Zhang, Qiaoyi Liu, Jeff Setter, Po-Han Chen, Yuchen Mei, Maxwell Strange, Ross Daly, Caleb Donovan, Alex Carsello, Taeyoung Kong, Kathleen Feng, Dillon Huff, Ankita Nayak, Raj Setaluri, James Thomas, Nikhil Bhagdikar, David Durst, Zachary Myers, Nestan Tsiskaridze, Stephen Richardson, Rick Bahr, Kayvon Fatahalian, Pat Hanrahan, Clark Barrett, Mark Horowitz, Christopher Torng, Fredrik Kjolstad, and Priyanka Raina. *ACM Transactions on Embedded Computing Systems*, 2023.
- TACO 2022 Unified Buffer: Compiling Image Processing and Machine Learning Applications to Push-Memory Accelerators. Qiaoyi Liu, Jeff Setter, Dillon Huff, Maxwell Strange, Kathleen Feng, Mark Horowitz, Priyanka Raina, and Fredrik Kjolstad. *ACM Transactions on Architecture and Code Optimization*, 2022.
- SC 2022 SpDISTAL: Compiling Distributed Sparse Tensor Computations. Rohan Yadav, Alex Aiken, and Fredrik Kjolstad. *ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, 2022.
- TACO 2022 Compiler Support for Sparse Tensor Computations in MLIR. Aart J.C. Bik, Penporn Koanantakool, Tatiana Shpeisman, Nicolas Vasilache, Bixia Zheng, and Fredrik Kjolstad. *ACM Transactions on Architecture and Code Optimization*, 2022.
- PLDI 2022 DISTAL: The Distributed Tensor Algebra Compiler. Rohan Yadav, Alex Aiken, and Fredrik Kjolstad. *ACM SIGPLAN Conference on Programming Language Design and Implementation*, 2022.
- PLDI 2022 Autoscheduling for Sparse Tensor Algebra with an Asymptotic Cost Model. Peter Ahrens, Fredrik Kjolstad, and Saman Amarasinghe. *ACM SIGPLAN Conference on Programming Language Design and Implementation*, 2022.
- OOPSLA 2021 Copy-and-Patch Compilation. Haoran Xu and Fredrik Kjolstad. *Proceedings of the ACM on Programming Languages, Volume 5, Issue OOPSLA (Distinguished Paper Award)*, 2021.
- OOPSLA 2021 Compilation of Sparse Array Programming Models. Rawn Henry, Olivia Hsu, Rohan Yadav, Stephen Chou, Kunle Olukotun, Saman Amarasinghe, and Fredrik Kjolstad. *Proceedings of the ACM on Programming Languages, Volume 5, Issue OOPSLA*, 2021.
- OOPSLA 2020 A Sparse Iteration Space Transformation Framework for Sparse Tensor Algebra. Ryan Senanayake, Changwan Hong, Ziheng Wang, Amalee Wilson, Stephen Chou, Shoaib Kamil, Saman Amarasinghe, and Fredrik Kjolstad. *Proceedings of the ACM on Programming Languages, Volume 4, Issue OOPSLA*, 2020.
- DAC 2020 Rick Bahr, Clark Barrett, Nikhil Bhagdikar, Alex Carsello, Ross Daly, Caleb Donovan, David Durst, Kayvon Fatahalian, Kathleen Feng, Pat Hanrahan, Teguh Hofstee, Mark Horowitz, Dillon Huff, Fredrik Kjolstad, Taeyoung Kong, Qiaoyi Liu, Makai Mann, Jackson Melchert, Ankita Nayak, Aina Niemetz, Gedeon Nyengele, Priyanka Raina, Stephen Richardson, Raj Setaluri, Jeff Setter, Kavya Sreedhar, Maxwell Strange, James Thomas, Christopher Torng, Leonard Truong, Nestan Tsiskaridze, and Keyi Zhang. Creating an Agile Hardware Design Flow. *Design Automation Conference*, 2020.
- PLDI 2020 Stephen Chou, Fredrik Kjolstad, and Saman Amarasinghe. Automatic Generation of Efficient Sparse Tensor Format Conversion Routines. *ACM SIGPLAN Conference on Programming Language Design and Implementation*, 2020.
- CGO 2019 Fredrik Kjolstad, Peter Ahrens, Shoaib Kamil, and Saman Amarasinghe. Sparse Tensor Algebra Optimization with Workspaces. *International Symposium on Code Generation and Optimization*, 2019.

- OOPSLA 2018 Stephen Chou, Fredrik Kjolstad, and Saman Amarasinghe. Format Abstraction for Sparse Tensor Algebra Compilers. *Proceedings of the ACM on Programming Languages, Volume 2, Issue OOPSLA*, 2018.
- OOPSLA 2017 Fredrik Kjolstad, Shoaib Kamil, Stephen Chou, David Lugato, and Saman Amarasinghe. The Tensor Algebra Compiler. *Proceedings of the ACM on Programming Languages, Volume 1, Issue OOPSLA (Distinguished Paper Award)*, 2017.
- TOG 2016 Fredrik Kjolstad, Shoaib Kamil Jonathan Ragan-Kelley, David I.W. Levin, Shinjiro Sueda, Desai Chen, Etienne Vouga, Danny M. Kaufman, Gurtej Kanwar, Wojciech Matusik, and Saman Amarasinghe. Simit: A Language for Physical Simulation. *ACM Transactions on Graphics (TOG, presented at SIGGRAPH)*, 2016.
- EuroMPI 2013 Timo Schneider, Fredrik Kjolstad, and Torsten Hoefer. MPI Datatype Processing using Runtime Compilation. *The 20th European MPI Users' Group Meeting (EuroMPI) (Best Paper Award)*, 2013.
- ICSE 2011 Fredrik Kjolstad, Danny Dig, Gabriel Acevedo, and Marc Snir. Transformation for Class Immutability. *33rd International Conference on Software Engineering*, 2011.

Short Papers and Workshop Publications

- SPAA Brief 2020 Suzanne Mueller, Peter Ahrens, Stephen Chou, Fredrik Kjolstad, and Saman Amarasinghe. Sparse Tensor Transpositions. *ACM Symposium on Parallelism in Algorithms and Architectures (SPAA brief announcement)*, 2020.
- AVANCÉES 2018 David Lugato, Fredrik Kjolstad, Stephen Chou, Saman Amarasinghe, and Shoaib Kamil. Taco: compilation et génération de code d'expressions tensorielles. *AVANCÉES No. 12*, 2018.
- ASE Tools 2017 Fredrik Kjolstad, Stephen Chou, David Lugato, Shoaib Kamil, and Saman Amarasinghe. 32th IEEE/ACM International Conference on Automated Software Engineering. *taco: A Tool to Generate Tensor Algebra Kernels*, 2017.
- TOG Perspective 2016 Gilbert Bernstein, and Fredrik Kjolstad. *ACM Transactions on Graphics. Why New Programming Languages for Simulation?*, 2016.
- PPoPP Short 2012 Fredrik Kjolstad, Torsten Hoefer, and Marc Snir. Automatic Datatype Generation and Optimization. *17th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP short paper)*, 2012.
- CAP 2010 Fredrik Kjolstad, Danny Dig, and Marc Snir. Bringing the HPC Programmer's IDE into the 21st Century through Refactoring. *SPLASH 2010 Workshop on Concurrency for the Application Programmer*, 2010.
- WPPP 2010 Fredrik Kjolstad and Marc Snir. Ghost Cell Pattern. *2nd Annual Workshop on Parallel Programming Patterns*, 2010.

Awards

- 2022 NSF CAREER Award
- 2021 Distinguished Paper Award at the Object-Oriented Programming, Systems, Languages & Applications Conference (OOPSLA).
- 2021 Google Research Scholar
- 2020 First Place MIT EECS George M. Sprowls PhD Thesis Award in Computer Science
- 2020 Robert N. Noyce Faculty Fellow, Stanford University School of Engineering

- 2017 Distinguished Paper Award at the Object-Oriented Programming, Systems, Languages & Applications Conference (OOPSLA).
- 2016 Adobe Fellowship.
- 2013 Best Paper Award at the 20th European MPI Users' Group Meeting (EuroMPI).
- 2011 Best Poster Award from the University of Illinois at Urbana-Champaign Spring Grad Expo.
- 2006 Rosing Award for best national IT-related student work in 2005 and 2006 from the Norwegian Computer Society.
- 2005 Eureka Award for best bachelor project from the Norwegian University of Science and Technology in Gjøvik.

Teaching

- 2020–present **CS343d Domain-Specific Programming Models and Compilers**, *Stanford University*.
- 2020–present **CS143 Compilers**, *Stanford University*.

Service

- Program Committees
 - ASPLOS 2024 Program Committee
 - OOPSLA 2024 Review Committee
 - PLDI 2023 Program Committee
 - PPOPP 2023 Program Committee
 - IPDPS 2023 Program Committee
 - CGO 2022 Program Committee
 - PPOPP 2021 Program Committee
 - PLDI 2021 Program Committee
 - SPLASH 2021 Student Research Competition Committee 2021
 - PPOPP 2020 Program Committee
 - CGO 2020 Program Committee
 - PLDI Student Research Competition Committee 2020
 - PLDI External Review Committees 2020
 - ASPLOS External Review Committees 2020
- Chairs **PPoPP 2023** Publications Chair
- Journal Reviews
 - ACM TACO** 2019, 2021, 2022
 - ACM TOMS** 2021
 - ACM TOPC** 2020
 - ACM TOG** 2017
 - IEEE Computer Architecture Letters** 2022, 2023
 - IEEE TPDS** 2017, 2021
 - Springer JPDC** 2022
- Organizer
 - Invited Workshop on Compiler Techniques for Sparse Tensor Algebra** (2019)
Invited workshop that brought together leading researchers on sparse tensor algebra compilation and computing from 11 universities, 6 companies and 3 national labs.
 - Third and fourth MIT Programming Languages Offsite Retreat** (2012 and 2013)
Attended by seven CSAIL professors and their research groups. Re-organized program around many short talks, hosted panels, invited external speakers, and gave opening remarks.

Panels **NSF Review Panel** (2021,2022)

PLDI PL Mentoring Workshop (June, 2020)

Invited Talks

Sparse Tensor Algebra Compilation

- Nov. 2022 Sparse Tensor Algebra Compilation Tutorial. *NVIDIA*, Virtual Event.
- Oct. 2022 Portable Compilation for Sparse Computation. *UC Berkeley Sky Seminar*, Berkeley, CA.
- Oct. 2022 Software and Hardware for Sparse ML. *Meta AI HW/SW Codesign Team*, Menlo Park, CA.
- Oct. 2022 Portable Compilation of Sparse Computation. *LCPC Invited Talk*, Chicago, IL.
- Aug. 2022 Software and Hardware for Sparse ML. *MLSys Chips & Compilers Symposium*, San Jose, CA.
- Jun. 2022 Why you would want a compiler in your sparse library. *NVIDIA*, Virtual Event.
- Apr. 2022 Sparse Tensor Algebra Compilation. *Meta PyTorch Team*, Menlo Park, CA.
- Oct. 2021 Compiling Sparse Array Programming Languages. *Industry-Academia Partnership MIT/Harvard Cloud Workshop*, Virtual Event
- Sep. 2021 Sparse Tensor Algebra Compilation. *Amazon Labs*, Cupertino, CA.
- Jul. 2021 Fast Compilation and Sparse Compilation. *Google Brain Hardware*, Virtual Event.
- Jun. 2021 Sparse Compilation and Fast Compilation. *Intel Research Overview*, Virtual Event.
- Apr. 2021 Sparse Tensor Algebra Compilation. *Mathworks*, Virtual Event.
- Mar. 2021 Sparse Tensor Algebra Compilation and Sparse Computation. *Accenture Labs Distinguished Researcher Talk*, Virtual Event.
- Jan. 2020 Sparse Tensor Algebra Compilation. *SIAM Conference on Parallel Processing for Scientific Computing, invited talk*, Seattle, WA.
- Jan. 2020 Sparse Tensor Algebra Optimization. *SIAM Conference on Parallel Processing for Scientific Computing, invited talk*, Seattle, WA.
- Dec. 2019 Tensor Algebra Compilation with Workspaces. *Google Compilers and ML Reading Group*, Virtual Event.
- Oct. 2019 Optimization in the Sparse Tensor Algebra Compiler. *LCPC Invited Talk*, Atlanta, GA.
- Aug. 2019 The Sparse Tensor Algebra Compiler. *Norwegian University of Science and Technology AI Seminar*, Trondheim, Norway.
- Jul. 2019 The Sparse Tensor Algebra Compiler. *MIT Fast Code Seminar*, Cambridge, MA
- Jun. 2019 Abstraction without Friction. *NSF Workshop on Future Directions for Parallel and Distributed Computing*, Phoenix, AZ
- May 2019 The Sparse Tensor Algebra Compiler. *MIT Graphics Group Seminar*, Cambridge, MA
- Apr. 2019 The Sparse Tensor Algebra Compiler. *Cornell CS, Invited Seminar*, Ithaca, NY.
- Apr. 2019 The Sparse Tensor Algebra Compiler. *Stanford CS, Invited Seminar*, Stanford, CA.
- Mar. 2019 The Sparse Tensor Algebra Compiler. *Georgia Tech CSE, Invited Seminar*, Atlanta, GA.
- Feb. 2019 The Sparse Tensor Algebra Compiler. *Innovations in Software Engineering Conference, Invited Talk*, Pune, India
- Jan. 2019 The Sparse Tensor Algebra Compiler. *UT Austin ECE*, Austin, TX.
- Sep. 2018 The Tensor Algebra Compiler. *University of Texas*, Austin, TX.
- Jun. 2018 The Sparse Tensor Algebra Compiler. *Adobe Research*, Seattle, WA.
- Jun. 2018 The Sparse Tensor Algebra Compiler. *NVIDIA*, Redmond, WA.
- Jun. 2018 The Sparse Tensor Algebra Compiler. *University of Washington*, Seattle, WA.
- Jun. 2018 The Sparse Tensor Algebra Compiler. *Facebook AI*, Menlo Park, CA.
- May 2018 The Sparse Tensor Algebra Compiler. *Stanford*, Stanford, CA.

- May 2018 The Sparse Tensor Algebra Compiler. *UC Berkeley*, Stanford, CA.
- May 2018 The Sparse Tensor Algebra Compiler. *Google Brain*, Mountain View, CA.
- Apr. 2018 The Tensor Algebra Compiler. *Industry-Academia Partnership MIT Cloud Workshop*, Cambridge, MA.
- Mar. 2018 The Tensor Algebra Compiler. *SIAM Conference on Parallel Processing for Scientific Computing*, Tokyo, Japan
- Nov. 2017 The Tensor Algebra Compiler and Simit. *University of Illinois*, Urbana-Champaign, IL.
- Oct. 2017 The Tensor Algebra Compiler. *Microsoft Research*, Redmond, WA.
- Sep. 2016 Simit: A Language for Computing on Sparse Systems. *Intel Research*, Hudson, MA.
- Aug. 2016 Simit: A Language for Computing on Sparse Systems. *Microsoft Research*, Redmond, WA.
- Oct. 2015 Simit: A Language for Computing on Sparse Systems. *MIT Computer Graphics Group Annual Retreat*, Beverly, MA.
- Oct. 2008 Performance Optimization of Embedded 3D Graphics Applications. *ARM Developer's Conference*, Santa Clara, CA.

Industry Experience

- 2007-2009 **ARM Ltd.**, *Graphics Software Engineer*.
Developed SDK Tools and OpenGL ES 1.1/2.0 3D Graphics Driver for the ARM Mali GPUs.
- 2006 **Accenture Technology Solutions**, *Programmer*.
Designed parts of the pension web applications for the Norwegian government.