# Jiajia Li

*Curriculum Vitæ*

## RESEARCH INTEREST

High performance computing with a focus on the interaction between applications, numerical algebra, data structures, algorithms, automatic performance tuning, and computer architectures. I am eager to pursue high performance sparse (multi-)linear algebra, solvers, and tensor decompositions for large-scale data analytics and domain applications on diverse computer architectures.

## EDUCATION

2013 – 2018 **Ph.D.**, *Georgia Institute of Technology*, High Performance Computing, Advisor: Prof. Richard Vuduc.

2008 – 2013 **Doctor of Engineering**, *University of Chinese Academy of Sciences (UCAS)*, Computer Architecture, Advisors: Prof. Mingyu Chen and Guangming Tan.

2005 – 2008 **Bachelor of Sciences**, *Dalian University of Technology*, Information and Computing Science, As an Accelerated Student.

## PUBLICATIONS

TR **Jiajia Li**, Yuchen Ma, Xiaolong Wu, Ang Li, Kevin Barker. PASTA: A Parallel Sparse Tensor Algorithm Benchmark Suite. Technical Report. 2019. (Under review).

TR **Jiajia Li**, Bora Ucar, Umit Catalyurek, Kevin Barker, Richard Vuduc. Efficient and Effective Sparse Tensor Reordering. Technical Report. 2019. (Under review).

TR Jeffrey S. Young, Eric Hein, Srinivas Eswar, Patrick Lavin, **Jiajia Li**, Jason Riedy, Richard Vuduc, Thomas M. Conte. A Microbenchmark Characterization of the Emu Chick. Technical Report. 2019.

TR Eric Hein, Srinivas Eswar, Abdurrahman Yasar, **Jiajia Li**, Jeffrey S. Young, Tom Conte, Umit V. Catalyurek, Rich Vuduc, Jason Riedy, Bora Ucar. Programming Strategies for Irregular Algorithms on the Emu Chick. Technical Report. 2019.

PPoPP19 Ke Meng, **Jiajia Li**, Guangming Tan. A Pattern Based Algorithmic Autotuner for Graph Processing on GPUs. Principles and Practice of Parallel Programming. PPoPP'19. (Accepted, **Best Paper Award Finalist**)

IPDPS19 Israt Nisa, **Jiajia Li**, Aravind Sukumaran Rajam, Richard Vuduc, P. (Saday) Sadayappan. Load-balanced sparse MTTKRP on GPUs. IEEE International Parallel & Distributed Processing Symposium. 2019. (Accepted).

TOPC Junhong Liu, Guangming Tan, Yulong Luo, **Jiajia Li**, Zeyao Mo, Ninghui Sun. An Autotuning Protocol to Rapidly Build Autotuners. ACM Transactions on Parallel Computing. 2019.

THESIS **Jiajia Li**. Scalable Tensor Decompositions in High Performance Computing Environments. PhD Dissertation. Georgia Institute of Technology, Atlanta, GA, USA. July 2018.

SC18 **Jiajia Li**, Jimeng Sun, Richard Vuduc. HiCOO: Hierarchical Storage of Sparse Tensors. ACM/IEEE International Conference for High-Performance Computing, Networking, Storage, and Analysis. SC'18. (**Best Student Paper Award**)

JPDC Yuchen Ma, **Jiajia Li**, Xiaolong Wu, Chenggang Yan, Jimeng Sun, Richard Vuduc. Optimizing Sparse Tensor Times Matrix on GPUs. Journal of Parallel and Distributed Computing (Special Issue on Systems for Learning, Inferencing, and Discovering). 2018.

IPDPSW18 Eric Hein, Tom Conte, Jeffrey Young, Srinivas Eswar, **Jiajia Li**, Patrick Lavin, Richard Vuduc, Jason Riedy. An Initial Characterization of the Emu Chick. 2018 IEEE International Parallel and Distributed Processing Symposium Workshops. IPDPSW. 2018.

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PPoPP18 Yue Zhao, **Jiajia Li**, Chunhua Liao, Xipeng Shen. Bridging the Gap between Deep Learning and Sparse Matrix Format Selection. 23rd ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming. PPoPP'18.

TOMS Guangming Tan, Junhong Liu, **Jiajia Li**. Design and Implementation of Adaptive SpMV Library for Multicore and Manycore Architecture. ACM Transactions on Mathematical Software. 2018.

IPDPS17 **Jiajia Li**, Jee Choi, Ioakeim Perros, Jimeng Sun, Richard Vuduc. Model-Driven Sparse CP Decomposition for Higher-Order Tensors. 31st IEEE International Parallel & Distributed Processing Symposium. IPDPS. 2017.

PPoPP17 Xiuxia Zhang, Guangming Tan, Shuangbai Xue, **Jiajia Li**, Keren Zhou, Mingyu Chen. Understanding the GPU Microarchitecture to Achieve Bare-Metal Performance Tuning. PPoPP'17.

SC16-IA3 **Jiajia Li**, Yuchen Ma, Chenggang Yan, Richard Vuduc. Optimizing Sparse Tensor Times Matrix on multi-core and many-core architectures. The sixth Workshop on Irregular Applications: Architectures and Algorithms (IA^3), co-located with SC. 2016.

SC15 **Jiajia Li**, Casey Battaglino, Ioakeim Perros, Jimeng Sun, Richard Vuduc. An Input-Adaptive and In-Place Approach to Dense Tensor-Times-Matrix Multiply. The International Conference for High Performance Computing, Networking, Storage and Analysis (SC) 2015

SC15-EduHPC B. Neelima, **Jiajia Li**. Introducing high performance computing concepts into engineering undergraduate curriculum: a success story. Proceedings of the Workshop on Education for High-Performance Computing (EduHPC), co-located with SC. 2015

TR Casey Battaglino, **Jiajia Li**, Ioakeim Perros, Jimeng Sun, Richard Vuduc. Tensors in Data Analysis: Methods, Applications, and Software. Technical Report. 2015.

TR **Jiajia Li**, Zhonghai Zhang, Guangming Tan, David Bader. SMAT: A Cross-Platform Input Adaptive Auto-Tuner for Sparse Matrix-Vector Multiplication. Technical Report. 2014

THESIS **Jiajia Li**. Research on Sparse Matrix Vector Multiplication Auto-tuning Method. PhD Thesis. The University of Chinese Academy of Sciences, Beijing, China. 2013

PLDI12 **Jiajia Li**, Guangming Tan, Mingyu Chen, Ninghui Sun. SMAT: An Input Adaptive Auto-Tuner for Sparse Matrix-Vector Multiplication. Programming Language Design and Implementation (PLDI) 2013

ICS12 **Jiajia Li**, Xingjian Li, Guangming Tan, Mingyu Chen, Ninghui Sun. An Optimized Large-Scale Hybrid DGEMM Design for CPUs and ATI GPUs. International Conference on Supercomputing (ICS) 2012

JCRD **Jiajia Li**, Xiuxia Zhang, Guangming Tan, Mingyu Chen. The Study of Choosing the Best Storage Format of Sparse Matrix Vector Multiplication, Journal of Computer Research and Development. (IN CHINESE) 2012

HPCChina11 **Jiajia Li**, Xiuxia Zhang, Guangming Tan, Mingyu Chen. Algebraic Multi-grid Optimization Study on GPU. HPC China (IN CHINESE) 2011

ICPADS10 **Jiajia Li**, Guangming Tan, Mingyu Chen. Automatically Tuned Dynamic Programming with an Algorithm-by-Blocks. 16th International Conference on Parallel and Distributed Systems (ICPADS) 2010

## SOFTWARE

PASTA **A Parallel Sparse Tensor Algorithm Benchmark Suite**, [Link].

ParTI! **A Parallel Tensor Infrastructure for Data Analysis**, [Link].

AdaTM **Adaptive Tensor Memoization Algorithm for CP Decomposition**, [Link].

InTensLi **Input-Adaptive and In-Place Dense Tensor-Times-Matrix Multiply**, [Link].

SMAT **SpMV Auto-Tuner**, [Link].

HDGEMM **A Hybrid DGEMM library on a Heterogeneous CPU-AMD GPU Architecture**, [Link].

## PROFESSIONAL EXPERIENCE

Aug 2018-Now **Research Scientist**, *HPC Group, Pacific Northwest National Laboratory (PNNL)*, Richland, WA.
Research topics:
- Optimize sparse tensor algorithms on new computer architectures, including Nvidia and AMD GPUs, FPGAs, and Emu, supported by "CENATE: The Center for Advanced Technology Evaluation" project. (Published PPoPP'19, IPDPS'19, and three Technical Reports)
- Build a sparse tensor operation benchmark suite, supported by CENATE project. (Published a Technical Report)
- Accelerate sparse tensor kernels for quantum Chemistry, supported by NWChemEx project.

Dec 2014 - Aug 2018 **Graduate Research Assistant**, *HPC Garage, Georgia Institute of Technology*, Atlanta, GA. Advisor: Prof. Richard Vuduc.
Research topics:
- Proposed a sparse tensor format (HiCOO) for CP decompositions on multicore CPUs. (Published in SC'18.)
- Built a sparse tensor operation library (ParTI!) for tensor decompositions on multicore CPUs and GPUs with MATLAB interface. (Part of this work has been published in JPDC, IA^3 @ SC'16 and Tensor-Learn @ NeurIPS'16.)
- Optimized matricized tensor times Khatri-Rao product (MTTKRP) and CP decomposition for high-order sparse tensors on multicore CPUs by proposing a novel memoization algorithm. (Published in IPDPS'17)
- Collected sparse tensors from real-world applications to build a sparse tensor dataset FROSTT, collaborating with UMN, IBM, and Intel.
- Built an input-adaptive and in-place approach to dense tensor-times-matrix multiply (InTensLi) by eliminating data transformation, and achieved 4-13× speedups over state-of-the-art libraries. (Published in SC'15)

May-Aug 2016 **Research Intern**, *IBM Thomas J. Watson Research Center*, Mentors: Dr. Jee Choi and Dr. Dong Chen.
Research topics:
- Implemented distributed sparse CP-APR algorithm for non-negative **sparse** tensors using MPI, achieved 90× speedup on 320 IBM Power8 cores.

May-Jul 2015 **Research Intern**, *Intel Parallel Computing Research Lab*, Mentor: Dr. Mikhail Smelyanskiy.
Research topics:
- Studied the memory behavior of sparse tensor decompositions.

Aug 2013 - Dec 2014 **Graduate Research Assistant**, *HPC LAB, Georgia Institute of Technology*, Atlanta, GA. Advisor: Prof. David Bader.
Research topics:
- Extended the SMAT framework to GPU and Intel Xeon Phi platforms.
- Optimized Breadth-First Search on Intel Xeon Phi.

Aug 2008 - Jul 2013 **Graduate Research Assistant**, *CARCH, Institute Of Computing Technology Chinese Academy Of Sciences*, Atlanta, GA. Advisors: Prof. Guangming Tan and Prof. Mingyu Chen.
Research topics:
- Designed an application- and architecture-aware auto-tuner (SMAT) for sparse matrix-vector multiply (SpMV). Extracted a set of parameters to represent SpMV's performance characteristics according to the observations of 2373 matrices in UF sparse matrix collection. Applied a machine learning method to formulate a decision tree prediction model to search for the optimal SpMV kernel. (Published in PLDI'13)
- Accelerated Algebraic Multigrid (AMG) method using optimized SpMV. (Published in HPCChina'11)
- Developed a new software pipelining for the DGEMM kernel running on CPU-GPU heterogeneous architecture. (Published in ICS'12)
- Proposed an algorithm-by-blocks for dynamic programming, a computational kernel in combinatorial optimization application and accelerate it by an automatically tuned system. (Published in ICPADS'10)

## HONORS AND AWARDS

2019 Rising Stars in Computational and Data Sciences. [Link]

2018 ACM/IEEE International Conference for High-Performance Computing, Networking, Storage, and Analysis (SC'18) **Best Student Paper Award**.[Link][Link]

2018 SIAM ALA'18 Student Travel Grant.

2018 GaTech CoC Graduate Student Council Travel Grant.

2017 **IBM PhD Fellowship** for 2017-2018. [Link]

2017 Travel grant from ATIP Workshop, co-located with SC'17 [Link]

2017 Travel grant from IPAM for Big Data Meets Computation Workshop 2017 [Link]

2016 Selected students to attend IEEE-WIE Women's Leadership Summit 2016

2013 ZhuLiYueHua Award for the Excellent PhD Students of Chinese Academy of Sciences (Top 0.2%)

2011 Xia Peisu Scholarship of Institute of Computing Technology (Top 1%)

2011 Outstanding Research Assistant of the Computer Architecture Laboratory at UCAS

2010 Outstanding Student of the Computer Architecture Laboratory at UCAS

## INVITED TALKS AND PRESENTATIONS

2019 **Sparse Tensor Algebra and its Relations to Matrix and Graph Problems**, *(Invited). SIAM Conference on Computational Science and Engineering (SIAM-CSE19)*, Spokane, WA, February, 2019.

**A Sparse Tensor Format and a Benchmark Suite**, *(Invited). Workshop on Compiler Techniques for Sparse Tensor Algebra*, Cambridge, MA, January, 2019.

2018 **HiCOO: Hierarchical Storage of Sparse Tensors**, *(Paper). ACM/IEEE International Conference for High-Performance Computing, Networking, Storage, and Analysis (SC18)*, Dallas, TX, November, 2018.

**Scalable Tensor Decompositions in High Performance Computing Environments**, *Ph.D. Thesis Defense*, Atlanta, GA, July, 2018.

**ParTI!: A Parallel Tensor Infrastructure on HPC Platforms**, *(Invited). The 8th edition of the multidisciplinary conference on ThRee-way methods In Chemistry And Psychology (TRICAP18)*, Angel Fire, NM, June, 2018.

**Parallel Sparse Tensor Decompositions using HiCOO Format**, *(Invited). SIAM Conference on Applied Linear Algebra (SIAM-ALA18)*, Hong Kong, May, 2018.

**HiCOO: Hierarchical Storage of Sparse Tensors**, *(Invited). SIAM Conference on Parallel Processing for Scientific Computing (SIAM-PP18)*, Tokyo, Japan, March, 2018.

2017 **HiCOO: A Hierarchical Sparse Tensor Format for Tensor Decompositions**, *(Poster). The International Conference for High Performance Computing, Networking, Storage and Analysis (SC17)*, Denver, CO, November, 2017..

**ParTI!: A Parallel Tensor Infrastructure**, *The International Conference for High Performance Computing, Networking, Storage and Analysis (SC17) ATIP workshop on International Exascale and Next-Generation Computing Programs*, Denver, CO, November, 2017.

**Model-Driven Sparse CP Decomposition for Higher-Order Tensors**, *(Invited). SIAM Annual Meeting (SIAM-AN17)*, Pittsburgh, PA, July, 2017.

**Model-Driven Sparse CP Decomposition for Higher-Order Tensors**, *(Paper). The 31st IEEE International Parallel & Distributed Processing Symposium (IPDPS17)*, Orlando, FL, May, 2017.

**Non-negative Sparse Tensor Decomposition on Distributed Memory Systems**, *(Poster). SIAM Conference on Computational Science and Engineering (SIAM-CSE17)*, Atlanta, GA, February, 2017.

**ParTI!: A Parallel Tensor Infrastructure for Data Analysis**, *(Poster). Institute for Pure & Applied Mathematics Big Data Meets Computation Workshop (IPAM-DMC17)*, Los Angeles, CA, January, 2017.

2016 **Optimizing Sparse Tensor Times Matrix on Multi-core and Many-core Architectures**, *(Paper)*. *The International Conference for High Performance Computing, Networking, Storage and Analysis (SC16), the sixth Workshop on Irregular Applications: Architectures and Algorithms (IA^3)*, Salt Lake City, UT, November, 2016.

**ParTI!: A Parallel Tensor Infrastructure for Data Analysis**, *The Conference on Neural Information Processing Systems, the Workshop on Learning with Tensors: Why Now and How? (NeurIPS16 Tensor-Learn)*, Barcelona, Spain, December, 2016.

**An Input-Adaptive and In-Place Approach to Dense Tensor-Times-Matrix Multiply**, *(Invited)*. *SIAM Conference on Parallel Processing for Scientific Computing (SIAM-PP16)*, Paris, France, April, 2016.

2015 **An Input-Adaptive and In-Place Approach to Dense Tensor-Times-Matrix Multiply**, *(Paper)*. *The International Conference for High Performance Computing, Networking, Storage and Analysis (SC15)*, . Austin, TX, November, 2015.

## ORGANIZATION ACTIVITIES

Mar 2019 As a Proceeding Chair of the Emerging Parallel and Distributed Runtime Systems and Middleware Workshop (IPDRM), held in conjunction with IEEE/ACM International Conference on High Performance Computing, Networking, Storage and Analysis (SC'19)

Feb 2019 As a Finance Chair of the Principles and Practice of Parallel Programming 2020 (PPoPP'20)

Nov 2018 As a Co-Chair of the 25th International European Conference on Parallel and Distributed Computing (Euro-Par'19)

Oct 2018 As the Web Chair of International Conference on Parallel Architectures and Compilation Techniques (PACT'19)

Sep 2018 As a Co-Chair of The First International Workshop on the Intersection of High Performance Computing and Machine Learning (HPCaML'19), held in conjunction with International Symposium on Code Generation and Optimization (CGO'19) http://hpc.pnl.gov/hpcaml19/

Aug 2018 As a Co-Organizer of SIAM Conference on Computational Science and Engineering (SIAM CSE'19) Minisymposium "High Performance Sparse Matrix, Tensor, and Graph Kernels" http://hpc.pnl.gov/siamcse19/

## COMMITTEE ACTIVITIES

Mar 2019 As a Program Committee Member of the Workshop on Tensor Methods for Emerging Data Science Challenges (TMEDSC), held in conjunction with the 25th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD'19)

Mar 2019 As a Program Committee Member of the 25th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP'20)

Mar 2019 As a Technical Program Committee Member of the Algorithms track of the 26th IEEE International Conference on High Performance Computing, Data, and Analytics (HiPC'19)

Jun 2018 As an external PC member of The 32nd ACM International Conference on Supercomputing (ICS'18)

Oct 2017 As a PC member of Student Research Competition (SRC) of The 23rd ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS'18).

Aug 2017 As a Program Committee Member of the 33rd IEEE International Parallel & Distributed Processing Symposium (IPDPS'18)

2013-2018 As a PC member of Parallel Algorithm Track of "National Annual Conference on High Performance Computing (HPC China)"

2014-Now As a Reviewer of Parallel Computing Journal (PARCO), CCF Transactions on High Performance Computing (THPC), The Transactions on Parallel and Distributed Systems(TPDS), the Frontiers of Computer Science, IEEE Transactions on Neural Networks and Learning Systems(TNNLS), Algorithmica Journal, The 32nd ACM International Conference on Supercomputing (ICS'18), Journal of Low Power Electronics and Applications, Journal of Parallel and Distributed Computing (JPDC), The 47th International Conference on Parallel Processing (ICPP'18), the 21st IEEE International Conference on Parallel and Distributed Systems (ICPADS'15)

## OTHER ACTIVITIES

2014-2018 As an organizer of Hot CSE seminar, a PhD academic seminar in GT CSE.

2013-2017 As a volunteer librarian of Repetitive Stress Injury (RSI) Lending Library of GT College of Computing.

Apr 2016 As a volunteer judge for Undergraduate Research Opportunities Program 11th Annual Undergraduate Research Spring Symposium.

2013-2015 As a volunteer reviewer of "President's Undergraduate Research Awards (PUMA)" and "National Center for Women & IT (NCWIT) Award"

2008-2009 Vice Minister of Academic Study of Student Union at UCAS

## MENTORING EXPERIENCE

Ph.D. Israt Nisa, the Ohio State University, USA. 2018-Now

Candidates Ke Meng, Institute of Computing Technology Chinese Academy of Sciences, China. 2018-Now
Srinivas Eswar, Georgia Institute of Technology, USA. 2017-2018
Yue Zhao, North Carolina State University, USA. 2017-2018
Junhong Liu, Institute of Computing Technology Chinese Academy of Sciences, China. 2016
Xiuxia Zhang, Institute of Computing Technology Chinese Academy of Sciences, China. 2016
Subramanya Dulloor, Georgia Institute of Technology, USA. 2015

Masters Junghyun Kim, Georgia Institute of Technology, USA. 2017-2018

Undergraduates Yuchen Ma, Hangzhou Dianzi University, China. 2016-Now
Nicholas Liu, Georgia Institute of Technology, USA. 2017

## TEACHING EXPERIENCE

Spring 2017 As a Teach Assistant of "Intro to High-Performance Computing (OMSCS) (CSE 6220)"

Fall 2014 As a Teach Assistant of "High-Performance Computing: Tools and Applications (CSE 6230)"

May 2012 As a Teach Assistant of "Parallel Computer Architecture" class of Dragonstar Project

Jun 2012 As a Teacher for Training of "Parallel Computing on GPU using CUDA" in Sun Yat-sen University

## PROFESSIONAL MEMBERSHIPS

Member of the Association of Computing Machinery (ACM)

Member of the Association of Computing Machinery (ACM-Women)

Member of the Institute of Electrical and Electronics Engineers (IEEE)

Member of the Society for Industrial and Applied Mathematics (SIAM)

## REFERENCES

Dr. Richard W. Vuduc, Associate Professor
School of Computational Science and Engineering,
Georgia Institute of Technology, Atlanta, GA, USA.
Email: richie@cc.gatech.edu

Dr. Jimeng Sun, Associate Professor
School of Computational Science and Engineering,
Georgia Institute of Technology, Atlanta, GA, USA.
Email: jsun@cc.gatech.edu

Dr. Tamara G. Kolda, Distinguished Member of Technical Staff
Sandia National Laboratories, Livermore, CA, USA.
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Dr. Xu Liu, Assistant Professor
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