Xu Liu

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Department of Computer Science   Email: xliu13@wm.edu
College of William and Mary   Website: www.cs.wm.edu/~xl10

RESEARCH INTERESTS

Developing tools for performance analysis of highly parallel software systems

WORK EXPERIENCE

College of William and Mary
Assistant Professor in Computer Science   August 2014 -- Now

EDUCATION

Rice University
Doctor of Philosophy in Computer Science   August 2009 -- December 2014
Advisor: John Mellor-Crummey

Institute of Computing Technology, Chinese Academy of Science (CAS)
Master of Engineering in Computer Science   September 2006 -- June 2009

Beihang University
Bachelor of Engineering in Computer Science   September 2002 -- June 2006

AWARDS AND HONORS

- W&M Phi Beta Kappa John D Rockefeller Jr. Faculty Award for the Advancement of Scholarship, 2020
- IEEE TCHPC Early Career Researchers Award for Excellence in High Performance Computing, 2019
- ACM SIGPLAN Research Highlights, 2019
- Distinguished Paper Award of ICSE'19, 2019
- Best Paper Award of PPoPP'19, 2019
- Google Faculty Research Award, 2017-2018
- Nomination to ACM SIGs for CACM Research Highlight of ASPLOS'18, 2018
- Best Paper Finalist of IISWC'18, 2018
- Best Paper Award of PPoPP'18, 2018
- Best Paper Finalist of ASPLOS'17, 2017
- HiPEAC Paper Award of ASPLOS'17, 2017
- Best Paper Award of SC15, 2015
- NVIDIA teaching center, 2014
- Award of Excellence, Samsung Corporation, 2013

- The Numerical Algorithms Group (NAG) Fellowship, Rice University, 2013-2014
- BP Fellowship, Rice University, 2012-2013
- Schlumberger Fellowship, Rice University, 2011-2012
- Rice Graduate Fellowship, Rice University, 2009-2010
- Outstanding Student Award, Chinese Academy of Sciences, 2008
- Institute Chief Award for Best RA Students (Top 1%), Institute of Computing Technology, Chinese Academy of Sciences, 2007
- Graduate Student Scholarship, Chinese Academy of Sciences, 2006-2009
- Scholarship for Academic Excellence (Top 5%), Beihang University, 2004

PUBLICATIONS (students with underline)

Journal Publications

[TOPC'20] "Efficient Abortable-locking Protocol for Multi-level NUMA Systems: Design and Correctness", Milind Chabbi, Abdelhalim Amer, Xu Liu, ACM Transactions on Parallel Computing, 2020.

[TPDS'19] "Evaluating Modern GPU Interconnect: PCIe, NVLink, NV-SLI, NVSwitch and GPUDirect", Ang Li, Shuaiwen Leon Song, Jieyang Chen, Jiajia Li, **Xu Liu**, Nathan Tallent, and Kevin Barker, IEEE Transactions on Parallel and Distributed Systems.

[TPDS'18] "LWPTool: A Lightweight Profiler to Guide Data Layout Optimization", Chao Yu, Probir Roy, Yuebin Bai, Hailong Yang, **Xu Liu**, IEEE Transactions on Parallel and Distributed Systems, 2018. (Chao and Probir are both co-first authors.)

[TACO'18] "NUMA-Caffe: NUMA-Aware Deep Learning Neural Networks", Probir Roy, Shuaiwen Leon Song, Sriram Krishnamoorthy, Abhinav Vishnu, Dipanjan Sengupta, **Xu Liu**, ACM Transactions on Architecture and Code Optimization, 2018.

Conference Publications

[ICS'20] "What Every Scientific Programmer Should Know About Compiler Optimizations?", Jialiang Tan, Shuyin Jiao, Milind Chabbi, **Xu Liu**, The 34rd ACM International Conference on Supercomputing, Jun 29 - Jul 2, 2020, Barcelona, Spain Acceptance ratio: 30% (40/132).

[CGO'20] "ATMem: Adaptive Data Placement in Graph Applications on Heterogeneous Memories", Yu Chen, Ivy B. Peng, Zhen Peng, **Xu Liu**, Bin Ren, The 2020 International Symposium on Code Generation and Optimization, Feb 22-26, 2020, San Diego, CA, USA.

[SC'19] "Pinpointing Performance Inefficiencies via Lightweight Variance Profiling", Pengfei Su, Shuyin Jiao, Milind Chabbi, **Xu Liu**, The International Conference for High Performance Computing, Networking, Storage and Analysis, Nov 17-22, 2019, Denver, CO, USA. Acceptance ratio: 25.3% (87/344).

[ESEC/FSE'19] "Pinpointing Performance Inefficiencies in Java", <u>Pengfei Su</u>, <u>Qingsen Wang</u>, Milind Chabbi, **Xu Liu**, The 27th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering , Aug 26 - 30, 2019, Tallinn, Estonia Acceptance ratio: 24% (74/303).

[ICS'19] "Can We Trust Profiling Results?", <u>Hao Xu</u>, <u>Qingsen Wang</u>, Shuang Song, Lizy John, **Xu Liu**, The 33rd ACM International Conference on Supercomputing, Jun 26 - Jun 28, 2019, Phoenix, AZ Acceptance ratio: 23% (45/193).

[ICSE'19] "Redundant Loads: A Software Inefficiency Indicator", <u>Pengfei Su</u>, <u>Shasha Wen</u>, Hailong Yang, Milind Chabbi, **Xu Liu**, The 2019 International Conference on Software Engineering, May 25 - Jun 1, 2019, Montreal, Canada Acceptance ratio: 21% (109/529). Distinguished Paper Award

[PPoPP'19] "Lightweight Hardware Transactional Memory Profiling", <u>Qingsen Wang</u>, <u>Pengfei Su</u>, Milind Chabbi, **Xu Liu**, The 24th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, Feb 16-20, 2019, Washington, D.C.. Acceptance ratio: 19%. Best Paper Award

[HPCA'19] "Featherlight Reuse-distance Measurement", <u>Qingsen Wang</u>, Milind Chabbi, **Xu Liu**, The 25th IEEE International Symposium on High-Performance Computer Architecture, Feb 16-20, 2019, Washington, D.C.. Acceptance ratio: 19.7%.

[CGO'19] "Transforming Query Sequences for High-Throughput B+ Tree Processing on Many-core Processors", Ruiqin Tian, Junqiao Qiu, Zhijiao Zhao, **Xu Liu**, Bin Ren, The 2019 International Symposium on Code Generation and Optimization.

[VLDB'19] "Start Late or Finish Early: A Distributed Graph Processing System with Redundancy Reduction", Shuang Song, **Xu Liu**, Qinzhe Wu, Andreas Gerstlauer, Tao Li, Lizy John, The Forty-fifth International Conference on Very Large Data Bases, Aug 26-30, 2019, Los Angeles, CA, USA.

[IISWC'18] "Tartan: Evaluating Modern GPU Interconnect via a Multi-GPU Benchmark Suite", Ang Li, Shuaiwen Leon Song, Jieyang Chen, **Xu Liu**, Nathan Tallent, Kevin Barker, 2018 IEEE International Symposium on Workload Characterization, Sep 30-Oct 2, 2018, Raleigh, NC, USA. **Nominated as Best Paper Award.**

[ICS'18] "ProfDP: A Lightweight Profiler to Guide Data Placement in Heterogeneous Memory Systems", <u>Shasha Wen</u>, Lucy Cherkasova, Felix Xiaozhu Lin, **Xu Liu**, The 32nd ACM International Conference on Supercomputing, Jun 12-15, 2018, Beijing China. Acceptance ratio: 18.7% (36/193).

[ICS'18] "Towards Efficient SpMV on Sunway Many-core Architectures", Changxi Liu, Biwei Xie, Xin Liu, Wei Xue, Hailong Yang, **Xu Liu**, The 32nd ACM International Conference on Supercomputing, Jun 12-15, 2018, Beijing China. Acceptance ratio: 18.7% (36/193).

[ASPLOS'18] "Watching for Software Inefficiencies with Witch", <u>Shasha Wen</u>, **Xu Liu**, John Byrne and Milind Chabbi, The 23rd International Conference on Architectural Support for Programming Languages and Operating Systems, Mar

24-28, 2018, Williamsburg, VA. Acceptance ratio: 17.5%. **ACM SIGPLAN Research Highlights**

[PPoPP'18] "Featherlight On-the-Fly False-sharing Detection", Milind Chabbi, Shasha Wen and **Xu Liu**, The 23rd ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, Feb 24-28, 2018, Vienna, Austria. Acceptance ratio: 20%. **Best Paper Award.**

[PMAM'18] "An Evaluation of Vectorization and Cache Reuse Tradeoffs on Modern CPUs", Du Shen, Milind Chabbi and **Xu Liu**, The 2018 International Workshop on Programming Models and Applications for Multicores and Manycores, co-located with PPoPP'18, Feb 24-28, 2018, Vienna, Austria.

[CGO'18] "Lightweight Detection of Cache Conflicts", Probir Roy, Shuaiwen Leon Song, Sriram Krishnamoorthy and **Xu Liu**, The 2018 International Symposium on Code Generation and Optimization, Feb 24-28, 2018, Vienna, Austria. Acceptance ratio: 28%.

[CGO'18] "CUDAAdvisor: LLVM-based Runtime Profiling for Modern GPUs", Du Shen, Shuaiwen Leon Song, Ang Li and **Xu Liu**, The 2018 International Symposium on Code Generation and Optimization, Feb 24-28, 2018, Vienna, Austria. Acceptance ratio: 28%.

[CGO'18] "CVR: Efficient SpMV Vectorization on X86 Processors", Biwei Xie, Jianfeng Zhan, **Xu Liu**, Wanling Gao, Zhen Jia, Xinwen He, Lixin Zhang, The 2018 International Symposium on Code Generation and Optimization, Feb 24-28, 2018, Vienna, Austria. Acceptance ratio: 28%.

[IPDPS'17] "Dr-BW: Identifying Bandwidth Contention in NUMA Architectures with Supervised Learning", Hao Xu, Shasha Wen, Alfredo Gimenez, Todd Gamblin and **Xu Liu**, The 31st IEEE International Parallel and Distributed Processing Symposium, May 29-Jun 2, 2017, Orlando, Florida, USA. Acceptance ratio: 23%.

[ASPLOS'17] "RedSpy: Exploring Value Locality in Software", Shasha Wen, Milind Chabbi and **Xu Liu**, The 22nd International Conference on Architectural Support for Programming Languages and Operating Systems, Apr 8-12, 2017, Xi'an, China. Acceptance ratio: 17.4% (56/321). **Best Paper Finalist (6 out of 56).**

[ASPLOS'17] "FLEP: Enabling Flexible and Efficient Preemption on GPUs", Bo Wu, **Xu Liu**, Xiaobo Zhou and Changjun Jiang, The 22nd International Conference on Architectural Support for Programming Languages and Operating Systems, Apr 8-12, 2017, Xi'an, China. Acceptance ratio: 17.4% (56/321).

[ASPLOS'17] "Locality-Aware CTA Clustering For Modern GPUs", Ang Li, Shuaiwen Leon Song, Weifeng Liu, **Xu Liu**, Akash Kumar and Henk Corporaal, The 22nd International Conference on Architectural Support for Programming Languages and Operating Systems, Apr 8-12, 2017, Xi'an, China. Acceptance ratio: 17.4% (56/321). **HiPEAC Paper Award.**

[PPoPP'17] "An Efficient Abortable-locking Protocol for Multi-level NUMA Systems", Milind Chabbi, Halim Amer, Shasha Wen and **Xu Liu**, The 22nd ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, Feb 4-8, 2017, Austin, Texas, USA. Acceptance ratio: 22% (29/132).

[ISMM'16] "Characterizing Emerging Heterogeneous Memory", <u>Du Shen</u>, **Xu Liu** and Felix Xiaozhu Lin, The 2016 ACM SIGPLAN International Symposium on Memory Management, Jun 14, 2016, Santa Barbara, California, USA.

[HPDC'16] "SMT-Aware Instantaneous Footprint Optimization", <u>Probir Roy</u>, **Xu Liu** and Shuaiwen Leon Song, The 25th ACM international Symposium on High-Performance and Distributed Computing, May 31-Jun 4, 2016, Kyoto, Japan. Acceptance ratio: 15.5% (20/129).

[ASPLOS'16] "memif: Towards Programming Heterogeneous Memory Asynchronously", Felix Xiaozhu Lin and **Xu Liu**, The 21st International Conference on Architectural Support for Programming Languages and Operating Systems, Apr 2-6, 2016, Altanta, Georgia, USA. Acceptance ratio: 22% (53/240).

[CGO'16] "StructSlim: A Lightweight Profiler to Guide Structure Splitting", <u>Probir Roy</u> and **Xu Liu**, The 2016 International Symposium on Code Generation and Optimization, Mar 12-18, 2016, Barcelona, Spain. Acceptance ratio: 23% (25/108).

[CGO'16] "Cheetah: Detecting False Sharing Efficiently and Effectively", Tongping Liu and **Xu Liu**, The 2016 International Symposium on Code Generation and Optimization, Mar 12-18, 2016, Barcelona, Spain. (Tongping and Xu are both co-first authors.) Acceptance ratio: 23% (25/108).

[SC'15] "ScaAnalyzer: A Tool to Identify Memory Scalability Bottlenecks in Parallel Programs", **Xu Liu** and Bo Wu, The International Conference for High Performance Computing, Networking, Storage and Analysis, Nov 15-20, 2015, Austin, Texas, USA. Acceptance ratio: 22% (79/358). **Best Paper Award.**

[PACT'15] "Runtime Value Numbering: A Profiling Technique to Pinpoint Redundant Computations", <u>Shasha Wen</u>, **Xu Liu** and Milind Chabbi, The 24th International Conference on Parallel Architectures and Compilation Techniques, Oct 18-21, 2015, San Francisco, California, USA. Acceptance ratio: 21% (38/179).

[HotCloud'15] "Towards Hybrid Programming in Big Data", Peng Wang, Hong Jiang, **Xu Liu**, and Jizhong Han, The 7th USENIX Workshop on Hot Topics in Cloud Computing, July 6-7, 2015, Santa Clara, California, USA.

[PACT'14] "ArrayTool: A Lightweight Profiler to Guide Array Regrouping", **Xu Liu**, Kamal Sharma and John Mellor-Crummey, The 23rd International Conference on Parallel Architectures and Compilation Techniques, Aug 24-27, 2014, Edmonton, Alberta, Canada.

[PPoPP'14] "A Tool to Analyze the Performance of Multithreaded Programs on NUMA Architectures", **Xu Liu** and John Mellor-Crummey, The 19th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, Feb 15-19, 2014, Orlando, Florida, USA.

[CGO'14] "Call Paths for Pin Tools", Milind Chabbi, **Xu Liu** and John Mellor-Crummey, The 2014 International Symposium on Code Generation and Optimization, Feb 15-19, 2014, Orlando, Florida, USA.

[SC'13] "A Data-centric Profiler for Parallel Programs", **Xu Liu** and John Mellor-Crummey, The International Conference for High Performance Computing, Networking, Storage and Analysis, November 17-22, 2013, Denver, Colorado, USA.

[ICS'13] "A New Approach for Performance Analysis of OpenMP Programs", **Xu Liu**, John Mellor-Crummey and Mike Fagan, 27th International Conference on Supercomputing, June 10-14, 2013, Eugene, Oregon, USA.

[ISPASS'13] "Pinpointing Data Locality Bottlenecks with Low Overhead", **Xu Liu** and John Mellor-Crummey, 2013 IEEE International Symposium on Performance Analysis of Systems and Software, April 21-23, 2013, Austin, Texas, USA.

[CGO'11] "Pinpointing Data Locality Problems Using Data-Centric Analysis", **Xu Liu** and John Mellor-Crummey, 2011 International Symposium on Code Generation and Optimization, April 2-6, 2011, Chamonix, France.

FUNDING

- 2015-2018, NSF CISE Research Initiation Initiative (CRII): PI, $174,973
- 2015, summer research grant at W&M: PI, $4,000
- 2016, summer research grant at W&M: PI, $5,000
- 2016-2019, NSF CISE CNS Core Small: PI, $249,548
- 2017-2018, Google Faculty Research Award: PI, $65,400
- 2017-2022, DoE SciDAC 4: Senior Personnel, $85,500
- 2019-2020, Jeffress Trust Award: PI, $120,000
- 2019-2020, Google gift, $75,000

INVITED TALKS

- Oak Ridge National Laboratory, 2020
- Brown University, 2019
- NC State University, 2019
- Pacific Northwest National Laboratory, 2019
- Virginia Tech, 2019
- The University of Texas, Austin, Nov 2018
- Intel Brown Bags, Oct 2018
- Petascale Tools Workshop, Solitude, UT, Aug 2018
- The University of California, Irvine, Feb 2018
- Google, Feb 2018
- IBM T.J.Watson Research Lab, Yorktown Heights, NY, Nov 2016
- HP Lab, Palo Alto, CA, Oct 2015
- Lawrence Livermore National Laboratory, Livermore, CA, Jul 2015
- Department of Computer Science and Engineering, Michigan State University, East Lansing, MI, March 2014
- 7th Petascale Tools Workshop, Madison, WI, July 2013
- IBM CASCON, Toronto, Canada, November 2012
- CScADS Workshop, Salt Lake City, UT, June 2012
- Parallel Processing for Scientific Computing, Savannah, GA, February 2012
- CScADS Workshop, Lake Tahoe, CA, August 2011

- CScADS Workshop, Salt Lake City, UT, August 2010
- 2012, 2013 and 2014 Rice Oil & Gas HPC Workshop

COLLEGE SERVICE

- Award and Prize Committee, 2017-2018, 2019–2020
- Faculty Search Committee, 2018-2019
- Colloquium Committee, 2016-2018
- Freshmen advisor, 2016-2019
- Graduate Admission Committee, 2014-2016, 2018-2020
- Graduate Curriculum Committee, 2014-2016
- Session chair for 2015 Graduate Research Symposium

ACADEMIC SERVICE

- DOE grant panelist, 2014
- NSF panelist, 2015, 2016
- Program co-chair: HIPS'16 collocated with IPDPS'16
- Technical program committee member for IPDPS'15, LCPC'15 (poster), PPoPP'16 (ERC), ICPP'16, CCGrid'17, ICPP'17, ICPP'18, ASPLOS'18, CGO'18, PPoPP'19, CGO'19, SC'19, ISMM'19, CC'20, CGO'20, PPoPP'20, HPCA'20, IPDPS'20, LCTES'20, ICPP'20
- Journal reviewer: TACO, JPDC, TPDS, TC, TODAES

COURSE TEACHING

- CSCI 780 Multi-core Computing [Fall 2018][Fall 2016]
- CSCI 652 Advanced Compiler Construction [Fall 2019][Spring 2018][Spring 2016][Fall 2014]
- CSCI 312 Principles of Programming Languages [Spring 2020][Spring 2019][Fall 2017][Spring 2017][Fall 2015][Spring 2015]

STUDENTS

Graduated Ph.D. students
Probir Roy (Assistant Professor at University of Michigan at Dearborn)
Qingsen Wang (Google)
Shasha Wen (Amazon)

Graduated Master students
Wenting Tan (Edelman Financial Engines)

Graduated undergraduate students
Xiaonan Hu (currently Ph.D. candidate at Duke)

Current Ph.D. students
Du Shen, Pengfei Su, Hao Xu, Bolun Li, Jialiang Tan, Yueming Hao