**Xuhao Chen** *Curriculum vitae*

CONTACT INFORMATION
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RESEARCH INTEREST
Software and hardware AI systems for data mining and machine learning on graphs, including parallel programming system and hardware architecture for emerging graph algorithms.

ACADEMIC POSITIONS

**Postdoctoral Research Associate** **Sep. 2020 - Present**
Computer Science & Artificial Intelligence Laboratory (CSAIL),
Massachusetts Institute of Technology (MIT)
*Supervisor*: Professor Arvind
*Research Area*: Parallel Computer Architecture

**Research Fellow** **Jan. 2019 - Aug. 2020**
Institute for Computational Engineering and Sciences,
University of Texas at Austin
*Supervisor*: Professor Keshav Pingali
*Research Area*: Parallel Computing

**Assistant Research Scientist** **Jan. 2015 - May. 2018**
Department of Computer Science,
National University of Defense Technology (NUDT), China
*Research Area*: Computer Architecture

**Visiting Student** **Oct. 2012 - Oct. 2014**
Department of Electrical and Computer Engineering,
University of Illinois at Urbana-Champaign (UIUC)
*Advisor*: Professor Wen-Mei Hwu
*Research Area*: Computer Architecture

EDUCATION

**Ph.D. in Computer Science** **Sep. 2009 - Dec. 2014**
National University of Defense Technology (NUDT), China
*Advisor*: Professor Zhiying Wang
*Thesis*: Cache Management for Manycore Accelerators

**B.S. in Computer Science** **Sep. 2005 - Jun. 2009**
National University of Defense Technology (NUDT), China
*Rank*: 1/144

PEER-REVIEWED PUBLICATIONS

[1] Loc Hoang, Xuhao Chen, Hochan Lee, Roshan Dathathri, Gurbinder Gill, Keshav Pingali, "Efficient Distribution for Deep Learning on Large Graphs", Workshop on Graph Neural Networks and Systems (**GNNSys**), 2021

[2] Xuhao Chen*, Tianhao Huang*, Shuotao Xu, Thomas Bourgeat, Chanwoo Chung, Arvind, "FlexMiner: A Pattern-Aware Accelerator for Graph Pattern Mining", International Symposium on Computer Architecture (**ISCA**), 2021

[3] Xuhao Chen, Roshan Dathathri, Gurbinder Gill, Loc Hoang, Keshav Pingali, "Sandslash: A Two-Level Framework for Efficient Graph Pattern Mining", International Conference on Supercomputing (**ICS**), 2021

[4] Xuhao Chen, Roshan Dathathri, Gurbinder Gill, Keshav Pingali, "Pangolin: An Efficient and Flexible Graph Pattern Mining System on CPU and GPU", International Conference on Very Large Databases (**VLDB**), 13(8): 1190-1205, 2020

[5] Xuhao Chen, Li-Wen Chang, Christopher I. Rodrigues, Jie Lv, Zhiying Wang, Wen-Mei W. Hwu. "Adaptive Cache Management for Energy-efficient GPU Computing", In the 47th International Symposium on Microarchitecture (**MICRO**), 2014

[6] Xuhao Chen, Cheng Chen, Jie Shen, Jianbin Fang, Tao Tang, Canqun Yang, Zhiying Wang, "Orchestrating Parallel Detection of Strongly Connected Components on GPUs", Parallel Computing (**ParCo**), Volume 78, Pages 101-114, 2018

[7] Xuhao Chen, Pingfan Li, Jianbin Fang, Tao Tang, Zhiying Wang, Canqun Yang, "Efficient and High-quality Sparse Graph Coloring on the GPU", Concurrency and Computation: Practice and Experience (**CPE**), Volume 29, Issue 10, 2017

[8] Xuhao Chen, Shengzhao Wu, Li-Wen Chang, Wei-Sheng Huang, Carl Pearson, Zhiying Wang, Wen-Mei W. Hwu. "Adaptive Cache Bypass and Insertion for Many-core Accelerators", In Proceeding of the MES Workshop in conjunction with ISCA-41, 2014

[9] Loc Hoang*, Vishwesh Jatala*, Xuhao Chen, Udit Agarwal, Roshan Dathathri, Grubinder Gill, Keshav Pingali, "DistTC: High Performance Distributed Triangle Counting", IEEE High Performance Extreme Computing Conference (**HPEC**), 2019

[10] Hang Zhang, Xuhao Chen, Nong Xiao, Fang Liu, "Optimizing STT-RAM Based Register File Energy Consumption on GPGPU with Delta Compression", In Proceeding of the 53rd Design Automation Conference (**DAC**), 2016

[11] Zhen Xu, Xuhao Chen, Jie Shen, Yang Zhang, Cheng Chen, Canqun Yang, "GARDENIA: A Domain-specific Benchmark Suite for Next-generation Accelerators", ACM Journal on Emerging Technologies in Computing Systems (**JETC**), 15(1): 9, 2019

[12] Hang Zhang, Xuhao Chen, Nong Xiao, Fang Liu, "Red-Shield: Shielding Read Disturbance for STT-RAM Based Register files on GPUs", In Proceeding of the 26th Great Lakes Symposium on VLSI (**GLSVLSI**), 2016

[13] Pingfan Li, Xuhao Chen, Jie Shen, Jianbin Fang, Tao Tang, Canqun Yang, "High Performance Detection of Strongly Connected Components in Sparse Graphs on GPUs", In the Proceedings of the PMAM Workshop in conjunction with PPoPP-22, 2017

[14] Hang Zhang, Xuhao Chen, Nong Xiao, Lei Wang, Fang Liu, Wei Chen, Zhiguang Chen, "Shielding STT-RAM Based Register files on GPUs Against Read Disturbance", ACM Journal on Emerging Technologies in Computing Systems (**JETC**), 13(2): 27, 2016

[15] Pingfan Li, Xuhao Chen, Zhe Quan, Jianbin Fang, Huayou Su, Tao Tang, Canqun Yang, "High Performance Parallel Graph Coloring on GPGPUs", IPDPS Workshop, 2016

[16] Jing Chen, Jianbin Fang, Weifeng Liu, Tao Tang, Xuhao Chen, Canqun Yang, "Efficient and Portable ALS Matrix Factorization for Recommender Systems", IPDPS Workshop, 2017

[17] Jianbin Fang, Peng Zhang, Zhaokui Li, Tao Tang, Xuhao Chen, Cheng Chen, Canqun Yang, "Evaluating Multiple Streams on Heterogeneous Platforms", Parallel Processing Letters, Volume 26, Issue 4, 2016

[18] Canqun Yang, Cheng Chen, Tao Tang, Xuhao Chen, Jianbin Fang, Jingling Xue, "An Energy-Efficient Implementation of LU Factorization on Heterogeneous Systems". ICPADS, 2016

[19] Zhaokui Li, Jianbin Fang, Tao Tang, Xuhao Chen, Cheng Chen, Canqun Yang, "Evaluating the Performance Impact of Multiple Streams on the MIC-Based Heterogeneous Platform". IPDPS Workshop, 2016

## Research Experience

**Hardware Accelerator for Graph Pattern Mining** **Sep. 2020 - Present**
*With Arvind*
Design and implemented a pattern-aware hardware accelerator, FlexMiner [2], for graph pattern mining (GPM). FlexMiner offers an order of magnitude speedup over state-of-the-art software GPM solutions.

**Programming Framework for Graph Pattern Mining** **Jan. 2019 - Aug. 2020**
*With Keshav Pingali*
Design and implemented two graph pattern mining (GPM) frameworks, Pangolin [4] and Sandslash [3]. Pangolin targets both CPU and GPU. It is the first GPM system that supports GPU mining, and it is orders-of-magnitude faster than previous GPM systems. Sandslash targets CPU only. It provides a novel two-level programming interface and supports adavanced GPM optimizations, which offers 8x speedup over Pangolin on CPU.

**Parallel Graph Algorithms on GPU** **Jan. 2015 - Dec. 2018**
*With Zhiying Wang*
Design and implemented various parallel graph algorithms [6,7,9,11] on GPU, including vertex coloring, strongly connected components and sparse neural networks.

**Cache Architecture for Irregular Algorithms on GPU** **Sep. 2009 - Dec. 2014**
*With Wen-Mei Hwu* and *Zhiying Wang*
Designed and implemented efficient cache architectures [5,8,10,12,14] for GPU. In particular, irregular algorithms (e.g., graph algorithms), cause memory divergence which leads to cache contention on GPU. I proposed *adaptive cache management* [5] for GPU, which effectively combines warp throttling and cache bypassing, and achieves significant speedups.

## Selected Honors and Awards

- Graph Challenge 2019 Student Innovation Awards 2019
- China Computer Federation (CCF) Distinguished PhD Dissertation Nominee 2015
- Ci Yun-Gui Scholarship for Graduate, NUDT (top 1%) 2010
- Meritorious Winner, Mathematical Contest In Modeling (MCM), COMAP 2009
- Distinguished Graduate, NUDT (top 1%), 2009
- First rank, Scholarship of Excellent Achievements, NUDT (top 3%) 2009
- Ci Yun-Gui Scholarship for Undergraduate, NUDT (top 1%) 2008
- First-rank Prize, China Undergraduate Mathematical Contest in Modeling 2007
- First rank, Scholarship of Excellent Achievements, NUDT (top 3%) 2007

## Teaching Experience

**Computer Architecture** (undergraduate course) **Fall 2008 NUDT**
- With Professor Zhiying Wang
- Teaching Assistant to redesign the labs and the final project for a 5-stage pipelined in-order processor, and mentor students on course projects

**Design and Analysis of Algorithms** (undergraduate course) **Fall 2010 NUDT**
- With Professor Jianping Yin
- Teaching Assistant to mentor students on labs and final projects and help with scoring

**CS 380C: Advanced Topics in Compilers** (graduate course) **Fall 2019, UT Austin**
- With Professor Keshav Pingali
- Teaching Assistant to setup a course project and mentor students on the project

**6.886: Algorithm Engineering** (graduate course) **Spring 2021, MIT**
- With Professor Julian Shun
- Guest lecture on Pangolin [Slides]

## Mentoring Experience

1. Tianhao Huang (second year PhD with Prof. Arvind).
   Closely collaborate on project: Hardware Accelerator for Graph Pattern Mining
2. Loc Hoang (second year PhD with Prof. Keshav Pingali).
   Closely collaborate on project: Distributed Framework for Graph Neural Networks
3. Siyu Zhang (first year PhD with Prof. Keshav Pingali).
   Mentoring course project: Parallel and Distributed $k$-clique Listing on Large Graphs
4. Pingfan Li (master student with Prof. Zhiying Wang).
   Mentoring thesis project: Parallel Graph Coloring and SCC Detection on GPU
5. Jie Lv (master student with Prof. Wen-Mei Hwu).
   Closely collaborate on project: Adaptive cache management for GPU
6. Zhihao Xie (undergraduate student with Prof. Wen-Mei Hwu).
   Mentoring course project: Characterization of irregular algorithms on GPU

## Grants

- NSF of China Grant No.61502514 (2015), PI: Xuhao Chen
  "Memory Hierarchy for Energy-efficient Heterogeneous Processors"
  Wrote successful grant proposal, led and completed the project
- NSF of China Grant No.61272144 (2012), PI: Zhiying Wang
  "Energy-efficient Asynchronous Manycore Processor"
  Co-wrote successful grant proposal and presented proposed research at kickoff meeting

## Talks

1. Software and Hardware Systems for Emerging Graph Algorithms [Video]
   MIT Fast Code Seminar, April 28, 2021
2. Pangolin: An Efficient and Flexible Graph Mining System on CPU and GPU [Video]
   International Conference on Very Large Databases (VLDB), Tokyo, Japan, Sep. 2020
3. High Performance Detection of SCCs in Sparse Graphs on GPUs
   PMAM Workshop in conjunction with PPoPP-22, Austin, TX, Feb. 2017
4. Adaptive Cache Management for Energy-efficient GPU Computing
   International Symposium on Microarchitecture (MICRO), Cambridge, UK, Dec. 2014
5. Adaptive Cache Bypass and Insertion for Many-core Accelerators
   MES Workshop in conjunction with ISCA-41, Minneapolis, MN, June 2014

## Academic Service

- Invited reviewer for ACM Transactions on Architecture and Code Optimization
- Invited reviewer for ACM Transactions on Modeling and Performance Evaluation of Computing Systems
- Invited reviewer for Microprocessors and Microsystems: Embedded Hardware Design
- Invited reviewer for Journal of Supercomputing

## References


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