

LIU LIU

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RESEARCH INTERESTS

My research interests reside at the intersection between Computer Architecture and Machine Learning, with a focus on boosting performance, energy-efficiency, and robustness with algorithm-architecture co-optimization. My research pioneers *elastic* processing and architectures for ML.

EDUCATION

- 2016-2022 **University of California, Santa Barbara**
Ph.D. in Computer Science
Committee Chairs: Dr. Yuan Xie and Dr. Yufei Ding
Committee Members: Dr. Timothy Sherwood and Dr. William Wang
- 2013-2015 **University of California, Santa Barbara**
M.S. in Computer Engineering
- 2009-2013 **University of Electronic Science and Technology of China**
B.Eng. in Information Display and Optoelectronic

PROFESSIONAL EXPERIENCES

- 2022-present **Assistant Professor**
Department of Electrical, Computer, and Systems Engineering
Rensselaer Polytechnic Institute, Troy, NY
- 2016-2022 **Graduate Student Researcher**
Department of Computer Science
UC Santa Barbara, CA
- 2018-2020 **Summer Research Intern** (Mentor: Dr. Zhenyu Gu)
Alibaba DAMO Academy, Sunnyvale, CA
- Summer 2016 **Research Intern** (Mentor: Dr. Shaoshan Liu)
PerceptIn Inc., Santa Clara, CA
- Spring 2016 **Research Associate**
Department of Electrical and Computer Engineering
UC Santa Barbara, CA

AWARDS AND HONORS

- 2021 Grand Finalist, Student Research Competition (SRC) at MICRO
- 2020 Peter J Frenkel Fellowship, the Institute for Energy Efficiency, UCSB
- 2019 Travel Grant, ICLR
- 2018 NSF Student Travel Grant, ISCA
- 2016 Computer Science Fellowship, UCSB
- 2016 Travel Grant, Non-Volatile Memories Workshop
- 2013 Outstanding Undergraduate Dissertation Award
- 2013 Scientific and Technological Innovation Fund for College Students
- 2010-2011 First-Class People's Scholarship

PUBLICATIONS

- [ISCA'22] Jilan Lin*, Ling Liang*, Zheng Qu, Ishtiyaque Ahmad, **Liu Liu**, Fengbin Tu, Trinabh Gupta, Yufei Ding, Yuan Xie. "INSPIRE: In-Storage Private Information Retrieval via Protocol and Architecture Co-Design." In *2022 49th International Symposium on Computer Architecture*. (*co-primary)
- [ASPLOS'22] Zheng Qu*, **Liu Liu***, Fengbin Tu, Zhaodong Chen, Yufei Ding, Yuan Xie. "DOTA: Detect and Omit Weak Attentions for Scalable Transformer Acceleration." In *2022 27th International Conference on Architectural Support for Programming Languages and Operating Systems*. (*co-primary)
- [ASPLOS'22] Bangyan Wang, Lei Deng, Fei Sun, Guohao Dai, **Liu Liu**, Yu Wang, Yuan Xie. "A One-for-All and $O(V \log(V))$ -cost Solution for Parallel Merge Style Operations on Sorted Key-Value Arrays." In *2022 27th International Conference on Architectural Support for Programming Languages and Operating Systems*.
- [ISSCC'22] Fengbin Tu, Zihan Wu, Yiqi Wang, Ling Liang, **Liu Liu**, Yufei Ding, Leibo Liu, Shaojun Wei, Yuan Xie, Shouyi Yin. "A 28nm 15.59 μ J/Token Full-Digital Bitline-Transpose CIM-based Sparse Transformer Accelerator with Pipeline/Parallel Reconfigurable Modes." In *2022 International Solid-State Circuits Conference*.
- [SC'21] Zhaodong Chen*, Zheng Qu*, **Liu Liu**, Yufei Ding, Yuan Xie. "Efficient Tensor Core-based GPU Kernels for Structured Sparsity under Reduced Precision." In *2021 International Conference for High Performance Computing, Networking, Storage, and Analysis*. (*co-primary)
- [MICRO'21] **Liu Liu***, Jilan Lin*, Zheng Qu, Yufei Ding, Yuan Xie. "ENMC: Extreme Near-Memory Classification via Approximate Screening." In *2021 54th IEEE/ACM International Symposium on Microarchitecture*. (*co-primary)

- [Computer'21] **Liu Liu**, Jie Tang, Shaoshan Liu, Bo Yu, Yuan Xie, Jean-Luc Gaudiot. "II-RT: A Runtime Framework to Enable Energy-Efficient Real-Time Robotic Vision Applications on Heterogeneous Architectures." *IEEE Computer* 54, no. 4 (2021): 14-25.
- [MICRO'20] **Liu Liu**, Zheng Qu, Lei Deng, Fengbin Tu, Shuangchen Li, Xing Hu, Zhenyu Gu, Yufei Ding, Yuan Xie. "DUET: Boosting Deep Neural Network Efficiency on Dual-Module Architecture." In *2020 53rd IEEE/ACM International Symposium on Microarchitecture*.
- [ICML'20] **Liu Liu**, Lei Deng, Zhaodong Chen, Yuke Wang, Shuangchen Li, Jingwei Zhang, Yihua Yang, Zhenyu Gu, Yufei Ding, Yuan Xie. "Boosting Deep Neural Network Efficiency with Dual-Module Inference." In *2020 International Conference on Machine Learning*.
- [DAC'20] Fei Sun, Minghai Qin, Tianyun Zhang, **Liu Liu**, Yen-Kuang Chen, Yuan Xie. "Computation on Sparse Neural Networks and its Implications for Future Hardware." In *2020 57th ACM/IEEE Design Automation Conference*.
- [ICLR'19] **Liu Liu**^{*}, Lei Deng^{*}, Xing Hu, Maohua Zhu, Guoqi Li, Yufei Ding, Yuan Xie. "Dynamic Sparse Graph for Efficient Deep Learning." In *2019 Seventh International Conference on Learning Representations*. (*co-primary)
- [TCAD'18] Lei Deng, Ling Liang, Guanrui Wang, Liang Chang, Xing Hu, Xin Ma, **Liu Liu**, Jing Pei, Guoqi Li, Yuan Xie. "Semimap: A Semi-Folded Convolution Mapping for Speed-Overhead Balance on Crossbars." *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems* 39, no. 1 (2018): 117-130.
- [Front. Neurosci.'18] Lei Deng, Zhe Zou, Xin Ma, Ling Liang, Guanrui Wang, Xing Hu, **Liu Liu**, Jing Pei, Guoqi Li, Yuan Xie. "Fast Object Tracking on a Many-Core Neural Network Chip." *Frontiers in neuroscience* 12 (2018): 841.
- [TNNLS'18] Shuang Wu, Guoqi Li, Lei Deng, **Liu Liu**, Dong Wu, Yuan Xie, Luping Shi. "L1-Norm Batch Normalization for Efficient Training of Deep Neural Networks." *IEEE transactions on neural networks and learning systems* 30, no. 7 (2018): 2043-2051.
- [ASP-DAC'17] **Liu Liu**, Ping Chi, Shuangchen Li, Yuanqing Cheng, Yuan Xie. "Building Energy-Efficient Multi-Level Cell STT-RAM Caches with Data Compression." In *2017 22nd Asia and South Pacific Design Automation Conference*.
- [ICCAD'16] Shuangchen Li, **Liu Liu**, Peng Gu, Cong Xu, Yuan Xie. "NVSIM-CAM: A Circuit-Level Simulator for Emerging Nonvolatile Memory based Content-Addressable Memory." In *2016 IEEE/ACM International Conference on Computer-Aided Design*.
- [GLSVLSI'16] Peng Gu, Shuangchen Li, Dylan Stow, Russell Barnes, **Liu Liu**, Eren Kursun, Yuan Xie. "Leveraging 3D Technologies for Hardware Security: Opportunities and Challenges." In *2016 International Great Lakes Symposium on VLSI*.

WORKSHOP & POSTER PAPERS

- [SRC'21] **Liu Liu**, Zheng Qu, Yufei Ding, Yuan Xie. "Transformer Acceleration with Dynamic Sparse Attention." *ACM Student Research Competition (SRC) at the 54th International Symposium on Microarchitecture (MICRO)*, Final Presentation, 2021.
- [DAC'18] **Liu Liu**. "Towards Efficient Deep Neural Networks: A Software-Hardware Co-Design Approach." *The 55th ACM/IEEE Design Automation Conference*, Ph.D. Forum, 2018.
- [DAC'17] **Liu Liu**, Shaoshan Liu, Zhe Zhang, Jie Tang, Yuan Xie. "HEMERA: Heterogeneous Architecture for Emerging Robotic Applications." *The 54th ACM/IEEE Design Automation Conference*, Poster, 2017.
- [HALO'16] Maohua Zhu, **Liu Liu**, Linuo Xue, Chao Wang, Yuan Xie. "CNNLab: a Novel Parallel Framework for Neural Networks using GPU and FPGA." *Workshop on Hardware and Algorithms for Learning On-a-chip*, co-located with ICCAD, 2016.

PROFESSIONAL SERVICE

- 2023 ASPLOS Web Chair
2022 ISCA (ERC), ICML, AICAS
2021 NeurIPS, CAL, JSA
2020 DAC (External Expert)
2019 DAC (External), MICPRO
2018 MICPRO

TEACHING EXPERIENCE

- Summer 2021 CS16 Problem Solving with Computers I, UCSB
Fall 2017 CS130A Data Structures and Algorithms I, UCSB