

# Wencong Xiao

✉ xiaowencong@gmail.com

☎ +86 18611201750

📍 T2 #12328, No.5 Danling Street, Haidian, Beijing, China, 100080

🎓 5th Ph.D. candidate in joint Ph.D. program of MSRA and BUAA

## Education

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- 2014 – 2019     **Ph.D., Beihang University, in Distributed System**  
Joint Ph.D. program with Microsoft Research Asia  
Supervisors: Lidong Zhou (MSRA), Wei Li (Beihang University)
- 2010 – 2014     **B.S., Computer Science, Beihang University**  
Thesis title: *Job Performance Study on Big Data Platform.*

## Internship Experience

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- 2014.7 - present     Microsoft Research Asia.  
System Research Group, Mentor: Ming Wu, Lidong Zhou
- 2016.7 - 2016.10     Microsoft Research Redmond.  
System Research Group, Mentor: Lidong Zhou

## Research Interests

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Distributed System: Machine Learning System, Resource Management, Graph Computing  
Recent focus: building efficient and scalable systems for deep learning

## Publications

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### Conference paper

- Gandiva: Introspective Cluster Scheduling for Deep Learning** OSDI'18  
Wencong Xiao, Romil Bhardwaj, Ramachandran Ramjee, Muthian Sivathanu, Nipun Kwatra, Zhenhua Han, Pratyush Patel, Xuan Peng, Hanyu Zhao, Quanlu Zhang, Fan Yang and Lidong Zhou
- Tux<sup>2</sup>: Distributed Graph Computation for Machine Learning** NSDI'17  
Wencong Xiao, Jilong Xue, Youshan Miao, Zhen Li, Cheng Chen, Ming Wu, Wei Li and Lidong Zhou
- Scheduling CPU for GPU-based Deep Learning Jobs** SoCC'18 Poster  
Wencong Xiao, Zhenhua Han, Hanyu Zhao, Xuan Peng, Quanlu Zhang, Fan Yang and Lidong Zhou
- Optimization Mapping for Deep Learning** SOSP'17 AISys  
Wencong Xiao, Cheng Chen, Youshan Miao, Jilong Xue and Ming Wu
- All You Need to Know about Scheduling Deep Learning Jobs** SOSP'17 SRC  
Wencong Xiao, Fan Yang and Lidong Zhou
- Analysis of Large-Scale Multi-Tenant GPU Clusters for DNN Training Workloads** for EuroSys'19  
Myeongjae Jeon, Shivaram Venkataraman, Amar Phanishayee, Junjie Qian, Wencong Xiao and Fan Yang (extended version of MSR-TR-2018-13)
- Balanced Sparsity for Efficient DNN Inference on GPU** for AAAI'19  
Zhuliang Yao, Shijie Cao, Wencong Xiao, Lanshun Nie and Chen Zhang
- KV-Direct: High-Performance In-Memory Key-Value Store with Programmable NIC** SOSP'17  
Bojie Li, Zhenyuan Ruan, Wencong Xiao, Yuanwei Lu, Yongqiang Xiong, Andrew Putnam, Enhong Chen and Lintao Zhang
- Memory Efficient Loss Recovery for Hardware-based Transport in Datacenter** APNet'17  
Yuanwei Lu, Guo Chen, Zhenyuan Ruan, Wencong Xiao, Bojie Li, Jiansong Zhang, Yongqiang Xiong, Peng Cheng and Enhong Chen
- GraM: Scaling Graph Computation to the Trillions** SoCC'15  
Ming Wu, Fan Yang, Jilong Xue, Wencong Xiao, Youshan Miao, Lan Wei, Haoxiang Lin, Yafei Dai and Lidong Zhou

### Journal paper

- Tux<sup>2</sup>: Distributed Graph Computation for Large-scale Machine Learning** for TPDS  
Wencong Xiao, Jilong Xue, Youshan Miao, Zhen Li, Cheng Chen, Ming Wu, Wei Li and Lidong Zhou
- SAD: Scheduling Appropriate Resources for Deep Learning Jobs** for TPDS  
Wencong Xiao, Zhenhua Han, Hanyu Zhao, Xuan Peng, Quanlu Zhang, Fan Yang and Lidong Zhou
- BeamRaster: A Practical Fast Massive MU-MIMO System with Pre-computed Precoders** TMC  
Meng Meng, Wencong Xiao, Tong He, Yuechen Tao, Kun Tan, Jiansong Zhang and Wenjie Wang

## Research Experiences (selected)

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**GPU Cluster Resource Management for Deep Learning.** 2017.1 – 2018.5

*Supervised by Fan Yang and Lidong Zhou (published in OSDI'18)*

Deep learning (DL) training is feedback-driven exploration with wide heterogeneity in terms of GPU usage. Gandiva is built to address such challenges in cluster management by leveraging the intra-job predictability feature with introspective scheduling. Achievement:

- Identifies three unique features in DL jobs: feedback-driven exploration in progress, performance heterogeneity in resource affinity, intra-job predictability in periodicity
- Co-designs scheduler and frameworks (e.g., Tensorflow) for introspective scheduling
- Proposes low-level primitives for DL scheduling: time-slicing, packing, migration, etc.
- Accelerates AutoML hyper-parameter exploration up to 13.6x and improves GPU cluster utilization by 26%

**Distributed Graph Computation for Machine Learning.** 2015.11 – 2016.7

*Supervised by Ming Wu and Lidong Zhou (published in NSDI'17)*

Machine learning (ML) algorithms (e.g., Logistic Regression) exhibit graph traversal patterns that naturally fit in graph engine. Tux<sup>2</sup> is built to leverage the elegance of graph engines in easy programming, structure-aware optimization, and great scalability, while maintain the ML features. Tux<sup>2</sup> achieves up to 10x performance speedup comparing with PowerLyra/PowerGraph and Petuum/ParameterServer. Tux<sup>2</sup> extends graph engine with innovations in three dimensions:

- Scheduling: stale synchronous parallel model for trade-off between convergence and efficiency
- Data representation: heterogeneous data model for flexible and efficient optimization
- Programming: a novel MEGA graph model to easily implement ML algorithms

**High Performance Graph Computing over RDMA.** 2014.9 – 2015.10

*Supervised by Ming Wu (published in SoCC'15)*

Developed GraM, an efficient and scalable graph engine for graph algorithms (e.g., PageRank). It scales up to multi-core while scales out in a cluster, significantly beating state-of-art graph engines often over an order of magnitude on typical graph algorithms. Besides, GraM is capable to process PageRank on a trillion-edge graph with 64 servers in 140 seconds, setting a new milestone for graph computing. GraM exploits the multi-core CPU architecture and RDMA-based NIC with key designs:

- Uses a unified message-passing model for both scale up and out
- Benefits from a special designed multi-core aware RDMA-based communication stack with computation and communication overlapping
- Adopts auto-adaptive configuration trade-off in scale cost and parallelism benefit

## Awards

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| 2018 | Ph.D. National scholarship award.<br>OSDI'18 scholarship award.<br>SoCC'18 scholarship award. |
| 2017 | Microsoft research fellowship nomination award.<br>NSDI'17 scholarship award.                 |
| 2016 | Microsoft research rising star award.   |
| 2014 | Outstanding undergraduate student award of Beijing China.                                     |

## Skills

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| Programming        | C + +, Python, Java, C#, Bash, $\text{\LaTeX}$ .                   |
| System analysis    | Performance tuning, outlier diagnostics, bottleneck investigation. |
| Open-source System | YARN, Kubernetes, Tensorflow, PyTorch, Spark, PowerGraph.          |