# Wencong Xiao

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5th year Ph.D. candicate in joint Ph.D. program of MSRA and BUAA

## Education

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

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

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

## Publications

### 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$^2$: 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 Workloads** submitted to **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** submitted to **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

**Distributed Graph Computation Meets Large-scale Machine Learning** submitted to **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** submitted to **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)

**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$^2$ is built to leverage the elegance of graph engines in easy programming, structure-aware optimization, and great scalability, while maintain the ML features. Tux$^2$ achieves up to 10x performance speedup comparing with PowerLyra/PowerGraph and Petuum/ParameterServer. Tux$^2$ 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

2018 Ph.D. National scholarship award.
OSDI'18 scholarship award.
SoCC'18 scholarship award.
2017 Microsoft research fellowship nomination award.
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, LaTeX. |
| System analysis | Performance tuning, outlier diagnostics, bottleneck investigation. |
| Open-source System | YARN, Kubernetes, Tensorflow, PyTorch, Spark, PowerGraph. |