

# Qinyi Luo

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## Education

### Ph.D. in Computer Science

University of Southern California, Los Angeles, CA, USA

Aug. 2017 – present

Advisor: Prof. [Xuehai Qian](#)

### B.Eng. in Electronic Engineering

Tsinghua University, Beijing, China

June 2017

GPA: 92/100 Rank: 5/240

Aug. 2013 – Jun. 2017

## Publications

- [1] Youwei Zhuo, Jingji Chen, Gengyu Rao, **Qinyi Luo**, Yanzhi Wang, Hailong Yang, Depei Qian, and Xuehai Qian. 2021. Distributed Graph Processing System and Processing-in-memory Architecture with Precise Loop-carried Dependency Guarantee. *ACM Trans. Comput. Syst.* 37, 1–4, Article 5 (June 2021). [PDF](#).
- [2] Youwei Zhuo, Jingji Chen, **Qinyi Luo**, Yanzhi Wang, Hailong Yang, Depei Qian, and Xuehai Qian. SympleGraph: Distributed graph processing with precise loop-carried dependency guarantee. *PLDI 2020*. [PDF](#).
- [3] **Qinyi Luo**, Jiaao He, Youwei Zhuo, and Xuehai Qian. Prague: High-performance heterogeneity-aware asynchronous decentralized training. *ASPLOS 2020*. [PDF](#).
- [4] **Qinyi Luo**, Jinkun Lin, Youwei Zhuo, and Xuehai Qian. HOP: Heterogeneity-aware decentralized training. *ASPLOS 2019*. [PDF](#).
- [5] Youwei Zhuo, Jinglei Cheng, **Qinyi Luo**, Jidong Zhai, Yanzhi Wang, Zhongzhi Luan, and Xuehai Qian. CSE: Parallel Finite State Machines with convergence set enumeration. *MICRO 2018*. [PDF](#).
- [6] Yirong Lv, Bin Sun, **Qinyi Luo**, Zhibin Yu, and Xuehai Qian. CounterMiner: Mining big performance data from hardware counters. *MICRO 2018*. [PDF](#).
- [7] **Qinyi Luo**, Rahul Gupta, and Shrikanth S. Narayanan. Transfer learning between concepts for human behavior modeling: An application to sincerity and deception prediction. *Interspeech 2017*. [PDF](#).

## Work Experience

### Research Intern, NVIDIA Corporation

May 2020 – Aug. 2020

Mentors: Eiman Ebrahimi, Isaac Gelado. Manager: David Nellans.

## Awards and Honors

2021-2022 MHI Ph.D. Scholar (6 students in ECE dept., USC)	2021
Facebook Fellowship Program Finalist (top 3.5%)	2021
WiSE Qualcomm Top-Off Fellowship	2020
8th Heidelberg Laureate Forum attendee (224 young researchers worldwide)	2020
Microsoft Research PhD Fellowship nominee (3 students in CS dept., USC)	2019
Microsoft Ada Lovelace Fellowship nominee (3 students in CS dept., USC)	2018
Outstanding Graduate of Beijing	2017
Friend of Tsinghua – AVIC Scholarship (~0.4% at EE dept., Tsinghua University)	2016
Beijing Merit Student Award (~0.5% at Tsinghua University)	2016

WeTech Qualcomm Global Scholars Award ( <i>18 winners in China</i> )	2016
National Scholarship of China ( <i>~2% at Tsinghua University</i> )	2015

## Research Projects

### Automatic generation of hybrid strategies for distributed training of machine learning models

Advisor: Prof. [Xuehai Qian](#), USC Jan. 2020 – present

- Devised a unified representation of data parallelism, model parallelism, pipeline parallelism and their hybrids
- Applied a multi-level search algorithm to select parallelization strategies with superior performance

### Distributed graph processing with precise loop-carried dependency guarantee

Advisor: Prof. [Xuehai Qian](#), USC Nov. 2018 – Mar. 2021

\* Collaborative project with senior Ph.D. students

- Removed redundant computation in existing frameworks by enforcing loop-carried dependency
- Proposed circulant scheduling and double buffering to boost performance
- Outperformed Gemini / D-Galois by 1.42x/3.30x on average and up to 2.30x/7.76x

### Straggler Mitigation in Decentralized Training via System-algorithm Co-design

Advisor: Prof. [Xuehai Qian](#), USC Sept. 2018 – Dec. 2019

- Proposed Partial All-Reduce that enables fast and randomized group-based synchronization
- Designed smart group generation strategies to avoid synchronization conflict
- Achieved 4.4x/1.2x speedup over Ring All-Reduce when stragglers are present / absent

### A Heterogeneity-aware Decentralized Machine Learning Training System

Advisor: Prof. [Xuehai Qian](#), USC Aug. 2017 – Aug. 2018

- Identified a unique property of decentralized training, iteration gap, and analyzed its upper-bound
- Introduced queue-based synchronization to enable fast execution with controlled iteration gap
- Developed decentralized protocols for backup workers and bounded staleness to deal with transient stragglers; proposed skipping iterations to mitigate persistent stragglers
- Implemented the system upon TensorFlow; experiments showed 1.4-2.8x speedup using the proposed straggler-mitigation methods

### Parallel Finite State Machines (FSM) with Convergence Set Enumeration

Advisor: Prof. [Xuehai Qian](#), USC Aug. 2017 – Jun. 2018

\* Collaborative project with senior Ph.D. students

- Proposed state set  $\rightarrow$  state set mapping to enable efficient enumerative FSM
- Developed a convergence set prediction algorithm and re-execution mechanisms to deal with inaccurate predictions
- Obtained on average 2.0x/2.4x speedup and maximum 8.6x/2.7x speedup across 13 benchmarks over Lookback Enumeration / Parallel Automate Processor

### Mining Big Performance Data from Hardware Counters

Advisor: Prof. [Xuehai Qian](#), USC Aug. 2017 – Jun. 2018

\* Collaborative project with senior Ph.D. students

- Proposed rigorous data mining methodology to make full use of performance data using data cleaning, event ranking, pruning and interaction analysis
- Performed experiments using CloudSuite, Spark version of HiBench and a real-world Spark application
- Showed significant error reduction and capability of identifying important configuration parameters

### Data Mining for Indoor Air Quality Monitoring

Advisor: Prof. [Pingyi Fan](#), Tsinghua University Nov. 2016 – Jun. 2017

- Applied FEM-based clustering to indoor air quality data analysis
- Found several clusters with interpretable physical meanings
- Improved the spatial and temporal performance with dynamic programming

### **Transfer Learning between Sincerity and Deception Prediction**

Advisor: Prof. [Shrikanth Narayanan](#), USC

Jun. 2016 – Aug. 2016

- Applied transfer learning to human behavioral trait modeling
- Proposed a stacked generalization framework for predicting sincerity and deception, using GFK transformation to ameliorate differences between in-domain and out-of-domain data characteristics
- Achieved significantly better results than baseline models trained using in-domain data only

## **Teaching & Mentoring**

TA for <i>Parallel and Distributed Computation</i> (EE-451) at USC	Spring 2019, Spring 2020 & Spring 2021
Mentor for a new Ph.D. student in the <a href="#">USC WiSE</a> Mentorship Program	Fall 2020
TA for <i>Discrete Methods in Computer Science</i> (CSCI-170) at USC	Fall 2020
TA for <i>Introduction to Computer Systems</i> (CSCI-356) at USC	Fall 2018
Volunteer teaching at Qinghua Primary School, Dali, Yunnan, China	Summer 2015