Rui Zhu

Affiliation

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Research Interests

My primary field of research interest is reinforcement learning. In particular, I am interested in scalable and distributed deep reinforcement learning that solves a large collection of tasks. I am also interested in distributed optimization for large scale deep learning and recommender systems, especially in distributed asynchronous optimization algorithms that enable data and model parallelism to achieve higher training throughput.

Education

University of Alberta, Edmonton, AB, Canada
Department of Electrical and Computer Engineering

- **Ph.D.**, Electrical and Computer Engineering, Sept. 2014 - Present
  - *Thesis:* Nonconvex Optimization Algorithm for Large-Scale Statistical Machine Learning
  - *Advisor:* Dr. Di Niu
  - *Selected Courses:* Reinforcement Learning (A-,), Machine Learning (A), Probability and Measure (A)

Xidian University, Xi'an, Shaanxi, China
School of Telecommunications Engineering

- **M.Sc.**, Cryptography, Sept. 2011 - Mar. 2014
  - *Thesis:* Research on Security issues of Network Coding based Distributed Storage Systems
  - *Advisor:* Dr. Ning Cai
  - *Selected Courses:* Information Theory (A), Cryptography (A-)
- **B.Eng.**, Electrical Engineering, Sept. 2007 - June. 2011
  - *Thesis:* On Algebraic Construction of Low-Density Parity Check Codes

Research Projects

Wedge Networks Inc., Calgary, AB, Canada:
Research Intern

- **Graph Convolutional Network for Cybersecurity.** (Relevant preprints: [A2, A1]):
  - Propose an Android malware detection approach based on GCN and static analysis. Android applications are described by graphs with sparse node features.
  - Extend vanilla GCN to classify these graphs and propose batch training scheme.
  - Experiments from real-world sample collections show significant improvements over conventional machine-learning-based approaches as well as most popular commercial anti-virus engines.

University of Alberta, Edmonton, AB, Canada:
Research Assistant

- **Distributed Optimization Methods for Large-Scale Machine Learning** (Relevant preprints: [A5, A4]):
  - Propose an asynchronous blockwise ADMM for training in shared memory systems with decentralized data.

- ▷ Propose an asynchronous stochastic proximal gradient (Asyn-ProxSGD) method for large-scale nonconvex nonsmooth optimization problems. Asynchrony in shared memory systems is also studied.
- ▷ Established convergence guarantees of ADMM and Asyn-ProxSGD for nonconvex nonsmooth optimization with asynchronous updates.

◊ **Matrix and Tensor Approximation** (Relevant paper: [C3, C2, J1]):

- ▷ Propose *Expectile Matrix Factorization* (EMF) and *Quantile Matrix Factorization* (QMF) by introducing asymmetric least squares (least absolute error) into the matrix factorization framework.
- ▷ Proved that for EMF, the alternating minimization algorithm converges to a global optimum and exactly recovers the true low-rank matrices in the noiseless case.
- ▷ Propose a novel web service recommendation and network latency prediction method using QMF.

◊ **Networking Optimization** (Relevant paper: [C1, C5]):

- ▷ Studied the problem of logical multicast in virtualized datacenter networks with software switches. Proposed novel optimal solutions for this problem.
- ▷ Designed the model and algorithms to efficiently select servers in content delivery networks. Proposed a constant PTAS for this NP-hard problem.

Honors and Awards

- ◊ Alberta Innovates Graduate Student Scholarship (Former AITF), 2017.
- ◊ INFOCOM 2017 Student Travel Award, 2017.
- ◊ Graduate Scholarship, 2011 - 2013.
- ◊ Student Award of Merit (top 5%), 2010 - 2011.
- ◊ Excellent Academic Performance Award (top 10%), 2008 - 2009, 2009 - 2010.
- ◊ 1st Place Xidian University Programming Contest, 2009.

Research and Technical Skills

- ◊ **Programming Language**: Python (proficient), C/C++ (proficient), Java (proficient), Bash Shell (familiar).
- ◊ **Deep Learning Frameworks**: TensorFlow (proficient), PyTorch (familiar), MXNet (familiar).
- ◊ **Big Data and Database**: Spark (familiar), SQL (working knowledge), MongoDB (working knowledge).

Professional Services

Journal reviewer:

- ◊ IEEE/ACM Transactions on Networking
- ◊ IEEE Transactions on Mobile Computing
- ◊ IEEE Transactions on Information Forensics and Security
- ◊ Springer Multimedia System

Conference reviewer:

- ◊ NIPS 2016
- ◊ IEEE ISIT 2016 & 2018
- ◊ IEEE ITW 2015

Teaching Experience

Teaching assistant at the University of Alberta for the following courses:

- ECE 240: Continuous Time Signals and Systems
- ECE 315: Computer Interfacing
- ECE 340: Discrete Time Signals and Systems
- ECE 440: Digital Computer Processing of Images

Publications

Journal Publications

[J1] **Rui Zhu**, Bang Liu, Di Niu, Zongpeng Li, and Hong Vicky Zhao. Network latency estimation for personal devices: a matrix completion approach. *IEEE/ACM Transactions on Networking (ToN)*, 2016.

Conference Publications

[C1] **Rui Zhu**, Di Niu, Baochun Li, and Zongpeng Li. Optimal multicast in virtualized datacenter networks with software switches. In *Proc. IEEE INFOCOM*, Atlanta, GA, USA, May 2017.

[C2] **Rui Zhu**, Di Niu, and Zongpeng Li. Robust web service recommendation via quantile matrix factorization. In *Proc. IEEE INFOCOM*, Atlanta, GA, USA, May 2017.

[C3] **Rui Zhu**, Di Niu, Linglong Kong, and Zongpeng Li. Expectile matrix factorization for skewed data analysis. In *Proc. AAAI*, San Francisco, GA, USA, 2017.

[C4] **Rui Zhu**, Di Niu, and Zongpeng Li. Online code rate adaptation in cloud storage systems with multiple erasure codes. In *28th Biennial Symposium on Communications (BSC 2016)*, Kelowna, BC, Canada, June 2016.

[C5] **Rui Zhu**, Di Niu, and Baochun Li. Min-cost live webcast under joint pricing of data, congestion and virtualized servers. In *Proc. NETGCOOP*, Trento, Italy, 2014.

[C6] **Rui Zhu** and Wangmei Guo. On the secure conditions for distributed storage systems. In *2013 International Symposium on Network Coding (NetCod 2013)*, Calgary, AB, Canada, 2013.

ArXiv Preprints

[A1] Chenglin Li, **Rui Zhu**, Di Niu, Keith Mills, Hongwen Zhang, and Husam Kinawi. Android malware detection based on factorization machine. 2018. arXiv:1805.11843.

[A2] **Rui Zhu**, Chenglin Li, Di Niu, Hongwen Zhang, and Husam Kinawi. Android malware detection using large-scale network representation learning. 2018. arXiv:1806.04847.

[A3] **Rui Zhu** and Di Niu. A model parallel proximal stochastic gradient algorithm for partially asynchronous systems. *arXiv preprint arXiv:1810.09270*, 2018.

[A4] **Rui Zhu**, Di Niu, and Zongpeng Li. Asynchronous stochastic proximal methods for nonconvex nonsmooth optimization. 2018. arXiv:1802.08880.

[A5] **Rui Zhu**, Di Niu, and Zongpeng Li. A block-wise, asynchronous and distributed admm algorithm for general form consensus optimization. 2018. arXiv:1802.08882.