

# Rui Pan

<https://ruipan.xyz/> | [rpan33@wisc.edu](mailto:rpan33@wisc.edu) | (+1) 608-960-0303

## EDUCATION

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### University of Wisconsin-Madison

*B.S. in Computer Science and Applied Mathematics*

- GPA: 3.96/4.00

Madison, WI, USA

*Sep 2018 – Dec 2021*

## RESEARCH INTERESTS

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I am broadly interested in big data systems (Machine Learning Systems, Cloud/Distributed Systems, Networks). For now, I am doing research on **Machine Learning Systems**, with a focus on optimizing systems for Deep Neural Network training. I am applying to Ph.D. programs that start in Fall 2022!

## PUBLICATIONS

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[1] [Paper] Shockwave: Efficient and Fair Resource Allocation for Dynamic Adaption. Pengfei Zheng, **Rui Pan**, Tarannum Khan, Shivaram Venkataraman, Aditya Akella. 2021. *In submission*.

[2] [Poster] AgDH: A System for Gathering and Distributing Dairy Data. **Rui Pan**, Steven R. Wangen, Michael C. Ferris. 2020. *Presented at the 3rd Annual WID Symposium*.

## RESEARCH EXPERIENCE

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### Undergraduate Research Assistant w/ Prof. Shivaram Venkataraman

Madison, WI, USA

*Project 1: Fair and Efficient Resource Allocation for DNN Training Workloads in GPU Clusters* Mar 2021 – Present

- In this work, we develop a policy, Shockwave, for fair and efficient scheduling/resource allocation of dynamic deep learning training workloads in large-scale multi-tenant GPU clusters.
- I contributed to the implementation and integration of our novel allocation policy into Gavel (OSDI '20), an existing scheduling framework. I also implemented in Gavel the mechanism to approve dynamic adaption (e.g., batch size scaling) of training workloads.
- I contributed to the implementation of dynamic optimizations, Accordion (MLSys '21) & Gradient Noise Scale (arXiv '18), for common DNN training workloads to increase the system throughput without loss of accuracy.
- In both simulation and large-scale physical experiments, we outperform state-of-the-art scheduling policies (Themis, Least Attained Service, Allox) in efficiency by 35%, avg jct by 10%, fairness by 50% on average.

*Project 2: How Structured Backpropagation Pruning Improves Deep Learning Clusters*

Jun 2020 – Feb 2021

- In this work, we systematically control the amount of backpropagation at individual workers in distributed DNN training. This technique, Structured Backpropagation Pruning, simultaneously reduces network bandwidth, compute utilization, and memory use while preserving model quality.
- I developed an iteration-level cluster scheduler based on existing frameworks (PyTorch Elastic, BytePS from OSDI '20) to support fine-grained scheduling, frequent checkpointing, different communication protocols (all\_reduce/parameter server), and constant worker migration with a low overhead in order to capitalize on the resources saved by Structured Backpropagation Pruning.

### Undergraduate Research Assistant

Jan 2020 – Mar 2021

*Advisors: Dr. Steven Wangen and Prof. Michael Ferris*

Madison, WI, USA

- In this work, we propose Dairy Brain, an analytics platform for evaluating and predicting the performance of dairy cows by aggregating large quantities of dairy data.
- I developed, deployed and maintained the Agricultural Data Hub (AgDH), a warehouse-scale computing infrastructure for the collection, storage, homogenization, and distribution of dairy farm's feeding, milking, and management data in a series of PostgreSQL data marts.
- I hosted poster sessions at the 3rd WID Research Symposium and presented in outreach meetings for the local dairy industry.

### Incoming Research Intern @ MPI-INF

Jan 2022 – Jun 2022 (Expected)

*Advisor: Prof. Yiting Xia (Network-accelerated distributed machine learning)*

Saarbrücken, Germany

## PROFESSIONAL EXPERIENCE

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### Tutor in Computer Science and Math

Sep 2019 – May 2020

*Undergraduate Learning Center @ College of Engineering, UW-Madison*

*Madison, WI, USA*

- Held weekly drop-in and by-appointment tutoring sessions to help students with understanding concepts and debugging programming assignments.
- Tutored students in 8 core introductory computer sciences and 5 math courses, and offered information and personal advice on course enrollment and career choices.
- Helped a total of ~100 students.

### Subtitle Translator

May 2019 – May 2020

*Coursera*

*Online*

- Volunteered in translating English subtitles to Simplified Chinese subtitles in multiple courses (An Introduction to Programming, Building Web Applications in PHP, Neural Networks and Deep Learning).

### Student Instructor

Sep 2017 – Aug 2018

*Research and Development Center @ High School Affiliated to Shanghai Jiao Tong University*

*Shanghai, China*

- Designed two introductory computer science courses (Intro to AP CS & Data Analysis with Python).
- Adapted course material from CS61A & CS61B @ Berkeley and CS50 @ Harvard.
- Gave lectures to 10+ students.

## RELEVANT COURSES

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**Graduate-level:** Advanced Operating Systems, Big Data Systems (audit I/P), High Performance Computing

**Undergraduate CS:** Algorithms, Artificial Intelligence, Bioinformatics, Computer Architecture, Computer Vision, Database Systems, Data Analysis, Networking, Operating Systems, Theory of Computing

**Undergraduate Math:** Calculus, Combinatorics, Discrete Math, Mathematical Data Science (I/P), Numerical Linear Algebra, Probability

**Coursera:** Cloud Computing (I/P), Deep Learning, Software Engineering, Front-end Web Design, Back-end Web Applications, Cryptography

## TECHNICAL SKILLS

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**Languages:** Python, Java/C#, C/C++, SQL, JavaScript, HTML/CSS, R

**Frameworks and Tools:** PyTorch, Git, Docker, PostgreSQL, CUDA, OpenMP, MPI, Apache Spark