

# Zhong, Wei

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## Summary

Specializing in the intersection of information retrieval and deep learning, I have developed state-of-the-art structure search engine and neural retriever for mathematical language. As a skilled engineer with a strong coding background, I have also developed and deployed a successful online math search engine research demo available at <https://approach0.xyz>. During my Ph.D. program, I won two Best Paper awards, showcasing my research and innovation skills as well.

Currently seeking internship or full-time job opportunities, I am expected to graduate in Fall 2023.

## Education

### University of Waterloo

Ph.D. Candidate in Computer Science (Cum GPA: 89.25 / 100)  
(Advisor: Prof. [Jimmy Lin](#))

2021 May. – Present  
Waterloo, ON, CA

### Rochester Institute of Technology

Ph.D. Candidate in Computer Science (Cum GPA: 3.780 / 4.0)  
(Advisor: Prof. [Richard Zanibbi](#))

2017 Aug. – 2019 Jul. (Transferred Out)  
Rochester, NY, USA

### University of Delaware

M.S. in Electrical and Computer Engineering (Cum GPA: 3.867 / 4.0)  
(Advisor: Prof. [Hui Fang](#))

2013 Aug. – 2015 Aug.  
Newark, DE, USA

### China Ji Liang University (CJLU)

B.S. in Information and Computation Science

2009 Aug. – 2013 Jun.  
Hangzhou, P.R. China

## Selected Publications

**2023 SIGIR** **Wei Zhong**, Sheng-Chieh Lin, Jheng-Hong Yang, Jimmy Lin *One Blade for One Purpose: Advancing Math Information Retrieval using Hybrid Search*.

**2022 CLEF (Best Paper and SOTA results)** **Wei Zhong**, Yuqing Xie, Jimmy Lin *Applying Structural and Dense Semantic Matching for the ARQMath Lab 2022, CLEF*.

**2022 EMNLP Findings (1st Math NLP workshop)** **Wei Zhong**, Jheng-Hong Yang, Yuqing Xie and Jimmy Lin *Evaluating token-level and passage-level dense retrieval models for math information retrieval*.

**2021 CLEF (#1 Formula Search System)** **Wei Zhong**, Xinyu Zhang, Ji Xin, Richard Zanibbi, Jimmy Lin *Approach zero and anserini at the CLEF-2021 arqmath track: Applying substructure search and BM25 on operator tree path tokens*.

**2021 SIGIR** **Wei Zhong**, Jimmy Lin *PyAo: A Python Toolkit for Accessible Math-Aware Search*.

**2020 ECIR** **Wei Zhong**, Shaurya Rohatgi, Jian Wu, C. Lee Giles and Richard Zanibbi. *Accelerating Substructure Similarity Search for Formula Retrieval*.

**2019 ECIR (Best Application Paper)** **Wei Zhong** and Richard Zanibbi. *Structural Similarity Search for Formulas using Leaf-Root Paths in Operator Subtrees*.

## Experience

### University of Waterloo

Research Assistant and Teaching Assistant

Apr. 2021 – Present

Waterloo, ON, Canada

- Created a state-of-the-art neural math-aware search engine, which currently holds top performance in two recent Math Information Retrieval datasets (CLEF ARQMath-2 and ARQMath-3). My work earned me a Best Paper award at CLEF, a major IR evaluation forum.
- Successfully trained and integrated various popular domain-adapted models, such as DPR, ColBERT, CoCondenser, and MAE, for Math Information Retrieval.
- Experienced in building million-scale pretraining and fine-tuning datasets, and deploying neural retrievers for system search in Math Information Retrieval from the ground up.

### DMAI

NLP Researcher (internship)

Apr. 2020 – Sep. 2020

Guangzhou, P.R. China

- Developed a math expression simplifier that requires fewer simplifying steps compared to the company's online version. The project utilizes lock-free MCTS, RNN with attention, and CRF.
- Worked on tag prediction using BERT, LDA, Mutual Information, and SVM.
- Experienced in fine-tuning agent decision strategies using GBDT+LR and Reinforcement Learning techniques.

### Rochester Institute of Technology

Research Assistant

Aug. 2017 – Aug. 2019

Rochester, NY, USA

- Created a state-of-the-art structure search engine for math, achieving top results on the NTCIR dataset, and received a best application paper award at ECIR (a top IR conference in Europe).
- Improved the efficiency of the structure search engine by a factor of 3, making real-world effective math structure search feasible for the first time.
- Discontinued and transferred to the University of Waterloo due to U.S. visa issues caused by the COVID-19 pandemic.

### Huawei Technologies

Software developer

Sep. 2016 – July. 2017

Shenzhen, P.R. China

- STB (TV Box) Hardware Abstraction Layer code maintenance.
- Participated Peach Fuzzing testing for Android-based system interface.

### SevOne (2015 Glassdoor best places to work)

WEB backend (S.M.A.R.T.S program internship)

Jun. 2015 – Aug. 2015

Wilmington DE, US

- PHP, C/C++, MySQL code maintenance.
- Search engine back-end rewriting using CLucene.

## Selected Projects

### Approach Zero Math-aware search engine

2015 – Present

- Ranked as the top Community Promotion Ad of Math StackExchange in both 2020 and 2021 (higher than the rank of OverLeaf), one of the largest math Q&A communities.
- Obtained the state-of-the-art scores in the NTCIR-12, CLEF-2021 and CLEF-2022 Tasks.
- An online version of the search engine is made available, capable of searching millions of posts in real-time. The search is performed using five low-end Linode instances.

**PyAo** Evaluation toolkit for math IR systems and neural retrievers 2021 – Present

- › Created effective training data for math IR from scratch.
- › Implemented DPR, ColBERT, CoCondenser, MAE models in one code framework.
- › Developed easy-to-use pipelines to pipelines to facilitate pretraining, domain adaptation, fine-tuning, inference, and evaluation of math IR models, using a BERT backbone.

**TinyNN and MNN** Educational deep learning frameworks Sep. – Oct. 2019

- › My contributions include denoising autoencoder, Restricted Boltzmann Machine (w/ CD-k training) and activation maximization (AM) visualization.
- › Refactored its CNN convolutional layer (the *im2col* function).
- › Hand-written gradient/Jacobian matrix derivation and utilized GPU acceleration with CuPy.

**Mathsteps-v2** A step-by-step math solver June. 2020

- › Designed a declarative macro language for representing mathematical transformations, which significantly reduces the need for engineering changes when a new math transformation is introduced.
- › Efficient lock-free MCTS math solver in C language, search space is reduced by a policy network.

**Search engine UI** A modern Web UI that supports mobile device June. 2020

- › Modern, responsive, and single-page UI application written in Vue 3.
- › Provided good user experience while serving half a million real user queries with a gzipped JavaScript bundle size of only 860 bytes.

**Gateway** An API gateway service Nov. 2020

- › Solid and minimal API gateway router based on Nginx, Lua and OpenResty.
- › Technologies: Docker Swarm service discovery, JWT login, rate limit for unique IP, Prometheus statistics and metrics, and TLS automatic renewal.

**Calabash** An orchestration layer for Docker Swarm that can be operated through a Shell or Web UI Jan. 2021

- › Experience in bootstrapping a modern web app with a simple and maintainable DevOps approach.
- › Deployed highly available search services that utilize sharding, load balancing, and service discovery techniques to ensure fault-tolerance and scalability.
- › Technologies: Shell script, Node-js, Docker Swarm, VPS/Cloud APIs. .

## Tech. Skill

**Software** Linux/Shell, Git, Web technologies, C/C++, Python, PyTorch, Docker.

**Hardware** Embedded system design, VHDL (See my [8bits TTL CPU in Multisim](#) and [Flappy Bird game in VHDL!](#))

## Communication Skills

**Teaching Skill** Instructed an algorithm colloquium on Dantzig's simplex algorithm and attended a credited Teaching Skills Workshop in Rochester Institute of Technology. Hosted TA office hours in CS 136 of University of Waterloo, with very positive feedback from students.

**Presentation Skill** Presented 7+ research papers as the first author, including 2 best paper award winners, and maintained effective communication with two native speaker Ph.D. advisors for over 4 years.