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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 2021 Apr. – Present
Ph.D. Candidate in Computer Science (Cum GPA: 89.25 / 100) *Waterloo, ON, CA*
(Advisor: Prof. Jimmy Lin)

Rochester Institute of Technology 2017 Aug. – 2019 Jul. (Transferred Out)
Ph.D. Candidate in Computer Science (Cum GPA: 3.780 / 4.0) *Rochester, NY, USA*
(Advisor: Prof. Richard Zanibbi)

University of Delaware 2013 Aug. – 2015 Aug.
M.S. in Electrical and Computer Engineering (Cum GPA: 3.867 / 4.0) *Newark, DE, USA*
(Advisor: Prof. Hui Fang)

China Ji Liang University (CJLU) 2009 Aug. – 2013 Jun.
B.S. in Information and Computation Science *Hangzhou, P.R. China*

Selected Publications

2022 CLEF (Best Paper) **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.*

2020 ECIR Gavin Nishizawa, Jennifer Liu, Yancarlos Diaz, Abishai Dmello, **Wei Zhong** and Richard Zanibbi. *MathSeer: A Math-Aware Search Interface with Intuitive Formula Editing, Reuse, and Lookup.*

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 Apr. 2021 – Present
Research Assistant and Teaching Assistant *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 Apr. 2020 – Sep. 2020
NLP Researcher (internship) *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 Aug. 2017 – Aug. 2019
Research Assistant *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 transfered to the University of Waterloo due to U.S. visa issues caused by the COVID-19 pandemic.

Huawei Technologies Sep. 2016 – July. 2017
Software developer *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) Jun. 2015 – Aug. 2015
WEB backend (S.M.A.R.T.S program internship) *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.