Jiayu Zheng

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Education

Brown University — Providence, RI
Sc.M. in Data Science — Sept. 2022 – Present

- GPA 4.0
- Relevant Courses:
  Data Science, Data Engineering, Statistical Learning, Machine Learning, Deep Learning, Operating Systems, Artificial Intelligence (TA), Computer Vision(TA), Parallel Computing(Audit)

Zhejiang University — Zhejiang, China
Sc.B. in Chemistry with Honors — Sept. 2018 – June 2022

- Certificate in **AI+X**
- Graduated from the Cho Kochen Honors College
- Major GPA: 3.92/4.0, Cumulative GPA: 3.8/4.0, Rank: 2%
- Relevant Courses:
  C, Java, Object-Oriented Programming, Mathematical Modeling, Digital Logic Design, Linux Application Technology, Advanced Data Structure and Algorithm Analysis

Publications And Manuscripts

Relation-CLIP: Towards Relation-Aware Embeddings With Weakly Contrastive Learning (in progress) — 2023

- **Jiayu Zheng**, Shekhar Pradhan

A Molecular Stereostructure Descriptor Based On Spherical Projection — 2020

- Licheng Xu, Xin Li, Miaojiong Tang, Luotian Yuan, **Jiayu Zheng**, Shuoqing Zhang, Xin Hong

Research Experience

Graduate Research Assistant — Providence, RI
Conversational AI Lab, *Brown University* — June 2023 – Present

- Co-advised by Prof. Shekhar Pradhan and Prof. Ritambhara Singh
- Conducted research on relation-aware CLIP with specialized training objectives and hard negative mining
- Collected a hard-negative dataset for MSCOCO Captions by prompting large language models (LLM)
- Designed a relation-aware image-text contrastive (ITC) training objective to explicitly encourage models to discriminate between highly similar images and captions
- Designed a weakly supervised, LLM-in-the-loop, labeling function to determine whether alternative captions retain original semantics

Graduate Research Assistant — Providence, RI
BATS Lab, *Brown University* — Apr. 2023 – Present

- Advised by Prof. Stephen Bach
- Designed data-efficient, transferable soft prompts, called *reasoning function tokens*, trained in a bootstrapping manner to improve the out-of-domain (OOD) generalizability of LLMs and VLMs
- Measured the performance of Mistral-7b-instruct LLM on text classification datasets, like Ledgar legal documents classification and SMS Spam
- Collected "text relation entity" corpora by prompting Mistral-7b-instruct and bootstrap-finetuned itself on the corpora

Undergraduate Research Assistant — Zhejiang, China
Zhejiang University — Apr. 2020 – July 2022

- Conducted research on representation learning of molecules, contributing to one published study and one thesis
- Designed a numeric descriptor to transform the van der Waals force field of molecules to a sequence of 2D matrices, collected a dataset using the descriptor, trained a CNN to predict the stereo-selectivity of reactions
- Designed a distance-aware message-passing mechanism inspired by the locality of atomic interaction, which greatly reduces the MSE of energy prediction using GNNs

Projects

JNeedle | *Python, C, CUDA* Dec. 2023 – Feb. 2024

- Implemented a PyTorch-like reverse-mode AutoDiff Deep Learning Library with a Numpy-like C/CUDA accelerated array operation backend
- Built trainable deep neural nets like ResNet, CNN, and Transformer using only the package

TiltShiftFilter | *C++, OpenMP, CUDA* Sept. 2023 – Dec. 2023

- Implemented a tilt-shift filter to convert real-life photos to miniature scenes by applying Gaussian blur that increases with the distance from the focal plane
- Achieved 10x speed-up (*c.f.* Python) by creating filters using OpenMP and implementing convolution using CUDA; 560x speed-up in total with further quantized blur scales

GourmAIt | *Python, PyTorch* July 2023 – Sept. 2023

- Performed image classification on a noisy dataset, Food101, with self-supervised learning (SSL)
- Implemented Google Research's Noisy Student Training, where pseudo labels generated by a teacher model are used to train a larger-or-equal-size student model, which is then used as the teacher in the next iteration
- Implemented ResNet with stochastic depth, step-wise unfreezing scheduling, and learning rate scheduling to maximize the performance gain in the fine-tuning phase

TransformerHub | *Python, PyTorch* Sept. 2022 – Aug. 2023

- Implemented various encoder-only, decoder-only, and encoder-decoder Transformer models including Transformer, BERT, GPT, ViT, and CLIP
- Implemented advanced features like sliding window attention, rotary position embedding, mixed precision training, and gradient accumulation

WeenixOS | *C, Unix kernel, X86_64 arch* Feb. 2023 – May 2023

- Developed a well-functioning, kernel-based, Unix operating system, the WeenixOS, as the semester-long project of the course Operating Systems, instructed by Prof. Thomas Doeppner
- Implemented a thread pool, device drivers, a virtual file system (VFS), an S5FS, and a virtual memory system
- Implemented various system calls, like do_waitpid, do_read, do_write, do_brk, do_fork, etc.

CyberBarista | *Python, TensorFlow, Scikit-learn* Sept. 2022 – Dec. 2022

- Implemented an ensemble of nine models, including an ElasticNet, a multi-layer perceptron (MLP), etc., to predict the quality score of coffee beans
- Interpreted the model output using feature-based methods: random perturbation, weight magnitude, and SHAP

Teaching and Mentorship

Teaching Assistant | *Computer Vision*, Brown University Feb. 2024 – June 2024

- Developed course assignments; mentored groups of students; held debugging and conceptual sessions

Teaching Assistant | *Artificial Intelligence*, Brown University Sept. 2023 – Dec. 2023

- Mentored groups of students for the final project; held debugging sessions; graded assignments

Mentor | *Data Science bootcamp*, Brown University Apr. 2023

- Introduced fundamental concepts of data science to a group of underrepresented high school students

Mentor | *Women in Data Science (WiDS)*, Brown University Feb. 2023

- Provided hands-on guidance of Python, numpy, pandas; Mentored attendees to do time series weather forecasting

Head Teaching Assistant | *Structural Chemistry and Spectroscopy*, Zhejiang University Feb. 2020 – Dec. 2021

- Developed course materials, designed assignments, and hosted group presentations

Honors and Awards

Outstanding Graduates of Zhejiang University	2022
Cho Kochen Honors College Scholarship for Innovation (publications or international contest awards)	2021
Second-Class Scholarship for Elite Students in Basic Sciences (top 20%)	2021
Outstanding Students of Zhejiang University	2019, 2021
Zhejiang University Scholarship, Third Prize (top 15%)	2020
Zhejiang University Scholarship, First Prize (top 3%)	2019, 2021

Technical Skills

Programming Language: Python, C/C++, Java, CUDA, SQL (SQLite), Latex, R
Deep Learning Packages: Tensorflow, PyTorch, Huggingface Transformers, LangChain, OpenAI Gym, Scikit-learn
Development Tools: Venv, Conda, Docker, Git, ssh, Jupyter, CMake, SLURM, gdb, wandb
LLMs/VLMs: GPT2-4, OPT, T0++, Llama1/2, T5, Flan-T5, Falcon, Mistral; CLIP, BLIP, ALBEF, GPT-4v