Sizhuang He

 Ann Arbor, MI | 734-450-2764 | sizhuang@umich.edu | https://sizhuanghe.github.io | *Updated in Jan 2024*

EDUCATION

Yale University   **New Haven, CT**
Ph.D. in Computer Science   *Aug 2024 – 2029 (Expected)*
Advised by Dr. David van Dijk

University of Michigan   **Ann Arbor, MI**
Bachelor of Science in Honors Mathematics, minor in Computer Science, GPA: 4.00/4.00   *Aug 2021 – Apr 2023*
*Graduated with **Highest Distinction***

Shanghai Jiao Tong University   **Shanghai, China**
Bachelor of Science in Electrical and Computer Engineering, GPA: 3.52/4.00   *Aug 2019 – Jul 2021*

RESEARCH INTERESTS

I am dedicated to the development of **deep learning methodologies with biomedical applications**. My current research is centered around **modeling continuous spatiotemporal dynamics** using neural networks, grounded in theories of integral equations and iterative methods. Additionally, I have a keen interest in Geometric Deep Learning and Language Models and their applications in computational biology.

PUBLICATIONS & PREPRINTS

1. E. Zappala, D. Levine, **S. He**, S. Rizvi, S. Lévy and D. van Dijk, *Operator Learning Meets Numerical Analysis: Improving Neural Networks through Iterative Methods*, arXiv:2310.01618

RESEARCH EXPERIENCE

van Dijk Lab at Yale University   **New Haven, CT & Remote**
Research Intern, advised by Dr. David van Dijk   *Apr 2023 – Present*

- Currently focusing on modeling continuous spatiotemporal dynamics using neural networks, based on Integral Equation theory and iterative methods.
- Developed the **P**icard **I**teration **G**raph neural **N**etwork (PIGN), an innovative Graph Neural Network architecture founded on fixed-point iterations. This design has empirically demonstrated enhanced proficiency in capturing long-range interactions within graphs. [Refer to Publication 1]

Research Experience for Undergraduate (REU)   **Ann Arbor, MI**
Federated Learning on Medical Applications   *Jun 2022 – Aug 2022*

- Engineered an adaptive Federated Averaging (FedAvg) algorithm, innovatively assigning dynamic weights to client nodes based on their trustworthiness. This approach effectively filters out adversarial inputs during training, safeguarding the integrity and reliability of the global model against contamination.
- The enhanced model demonstrated superior performance in simulated environments featuring adversarial clients, consistently outperforming the standard Federated Averaging (FedAvg) approach in terms of accuracy and robustness.

PROJECTS

Enhancing Reasoning in Small Language Models with Iterative Method | *Natural Language Processing, Deep Learning*

- Developed an innovative language model architecture, derived from BERT, that iteratively extracts and integrates context information from training data, improving the model's reasoning capabilities without substantially increasing its size.
- Extensively trained and fine-tuned the model across a variety of NLP datasets and tasks, such as Question Answering, Context Entailment, Next Word Generation, and Masked Prediction, demonstrating its versatility and effectiveness in diverse applications.
- Project currently in progress, with ongoing refinements and evaluations to optimize performance and applicability in real-world NLP challenges.

MetaDIMM | *Single Cell RNA Sequencing Analysis, Computational Biology, Unsupervised Machine Learning*

- Developed an innovative unsupervised clustering algorithm for categorizing cell types using scRNAseq data.
- Designed a unique gene grouping mechanism, employing Principal Component Analysis (PCA) to aggregate genes into 'meta genes' based on their expression correlations, thereby enhancing the model's ability to accurately and efficiently classify genomic data.
- Applied a Dirichlet Multinomial Mixture Model for interpretable clustering.

TEACHING EXPERIENCE

MATH285: Honors Multivariable and Vector Calculus **Ann Arbor, MI**
Course Assistant *Jan 2023 – Apr 2023*
- Collaborated with the professor in the development of weekly assignments and examination materials, ensuring a comprehensive assessment of student understanding.
- Conducted weekly office hours, providing personalized assistance and clarification on complex topics to enhance student learning and performance.

MATH571: Numerical Linear Algebra **Ann Arbor, MI**
Grader *Jan 2023 – Apr 2023*
- Graded assignment problems and offered feedbacks to students, ensuring a fair and productful study environment.

EECS475: Intro. to Cryptography **Ann Arbor, MI**
Grader *Jan 2023 – Apr 2023*
- Graded assignments projects and exams, providing detailed feedback and maintaining an equitable and productive learning atmosphere..

MATH498: Mathematical Foundations on Machine Learning **Ann Arbor, MI**
Grader *Sep 2022 – Dec 2022*
- Graded assignments and projects, offering feedback to foster a fair and conducive educational environment.

COURSEWORK

Pure Mathematics: Linear Algebra (A+), Honors Analysis I & II (A & A), Honors Algebra I & II (A+ & A), Intro. to Real Analysis (PhD-level, A+)

Applied Mathematics: Nonlinear Dynamics and Chaos (A+), Stochastic Processes (A), Numerical Linear Algebra (A), Applied Functional Analysis (PhD-level, A+), Mathematical Foundations on Machine Learning (A+)

Statistics: Probability and Distribution Theory (A+), Intro. to Statistical Theory (in progress), Regression and Data Analysis (in progress), Modeling and Analysis of Time Series Data (in progress)

Computer Science: Data Structures and Algorithms (A), Computer Organization (A), Foundations for Computer Science (A), Intro. to Algorithms (A), Natural Language Processing (A), Machine Learning for Computational Biology (A)

HONORS

Outstanding Achievement in Mathematics Award **University of Michigan**
Recognized at the annual award ceremony of the Mathematics Department *Apr 2023*

James B. Angell Scholar (Five time) **University of Michigan**
Recognized at the 100-th annual Honors Convocation of the University of Michigan *Mar 2023*

University Honors (Five time) **University of Michigan**
Recognized at the 100-th annual Honors Convocation of the University of Michigan *Mar 2023*

SKILLS

Programming Languages: C/C++, Python, Javascript, HTML/CSS, R

Machine Learning: PyTorch, PyTorch-Geometric, MATLAB