Youheng Zhu

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EDUCATION

Huazhong University of Science and Technology, <div style="text-align:right">Wuhan, China</div>
Major: Computer Science and Technology <div style="text-align:right">Cumulative GPA: 4.56/5.00 , 91.4/100</div>
Additionally enrolled in or audited several senior courses of mathematics major.

PUBLICATIONS

- **Information-theoretic Analysis of the Gibbs Algorithm: An Individual Sample Approach**
  Y.Zhu, Y.Bu ; to appear in, *IEEE Information Theory Workshop (ITW)*, Shenzhen, China, Nov. 2024.
  long version for *IEEE Transaction on Information Theory (TIT)* in preparation.
  PDF available at: `https://arxiv.org/abs/2410.12623`

RESEARCH EXPERIENCE

Min-max Hardness for Function Estimation in Banach Spaces <div style="text-align:right">Illinois, US</div>
Research Intern, Northwestern University IEMS, supervised by Yiping Lu <div style="text-align:right">October 2024 — Now</div>

- Studying dualization and min-max hardness of function estimation and functional estimation.

Offline Reinforcement Learning Theory for Partially Observable Systems <div style="text-align:right">Illinois, US</div>
Research Intern, University of Illinois at Urbana-Champaign, supervised by Nan Jiang <div style="text-align:right">July 2024 — Nov. 2024</div>

- Used binning method to study the theory and guarantee of bellman error minimization algorithms for POMDP under belief space smoothness conditions. Relaxed the condition of belief space bisimulation to Lipchitz value functions for controlling abstraction error. Completed a note about belief space binning analysis.
- Studied the theory and guarantees of Future Dependent Value Function (FDVF). Trying to resolve the curse of memory by assuming belief space smoothness condition (Proceeding).

Information-Theoretic Analysis for Gibbs Algorithm in the Asymptotic Regime <div style="text-align:right">Wuhan, China</div>
Research Intern (Remote), University of Florida, supervised by Yuheng Bu <div style="text-align:right">Dec. 2023 — May 2024</div>

- Explored conditionally tight information-theoretic generalization error bound for Gibbs algorithm.
- Studied the asymptotic behavior of information for Gibbs algorithm, proposed and proved an important result that the gap between the sum of information regarding single samples and the information regrading the whole dataset can be order-wise small.

Exploring Generalization Error of the Gibbs Algorithm via Information Neural Estimator <div style="text-align:right">Wuhan, China</div>
Research Project Leader (Remote), University of Florida, Research group of Yuheng Bu <div style="text-align:right">July 2023 — Dec. 2023</div>

- Used MALA (a type of MCMC) to sample from Gibbs algorithm on random feature model.
- Developed a Symmetrized-KL divergence neural estimator to explore the information measure generalization error bound of the learning problem. Code available at: `https://github.com/ZhuYouheng/MINE-f-divergence`

Simulating Blood Stream Using Lattice Boltzmann Method <div style="text-align:right">Wuhan, China</div>
Team Member, Huazhong University of Science and Technology, Research group of Baocang Shi <div style="text-align:right">Jan. 2023 — Oct. 2023</div>

- Designed simple models to characterize bloodstream in a vessel, models include both 2D and 3D versions.
- Implemented LBM using C++ and Taichi language, numerically solve the Navier-Stokes equation that characterizes the bloodstream in our model. Taichi code available at: `https://github.com/ZhuYouheng/simple-LBM-based-on-taichi`

Real-time Ray-Tracing and Many Lights Problem <div style="text-align:right">Wuhan, China</div>
Research Intern, Huazhong University of Science and Technology <div style="text-align:right">Mar. 2022 — Dec. 2022</div>

- Explored the use of stochastic lightcut and spatial-temporal reuse of light-tree nodes to accelerate real-time ray-tracing.
- Helped use Falcor, a real-time rendering framework provided by NVIDIA, to implement the experiments.
- Explored the method of spatial-temporal reuse in real-time bidirectional ray-tracing.

SELECTED PROJECTS

- **Differential Geometry: An Equilibrium Proof to Minimum Surface Equation**
  A course project for Differential Geometry. In physics, the minimization of energy or action represents equilibrium states and real motion, from which the idea was used to derived the minimal surface equation in this passage.

- **Sudoku Generator and Solver Based on Solving SAT Problem**
  Implementation of a solver for arbitrary SAT problem with formatted input using C++. Transfer a Sudoku problem into an SAT problem, and use the solver to generate a Sudoku with single solution or simply solve a given Sudoku problem.
- **Ada-boost Model Based on Decision Stump and Logistic Regression**
  Used Decision Stump and Logistic Regression as base classifier to implement an Ada-boost classifier. Implemented from scratch using python.
- **Five-stage Pipeline RISC-V CPU Design**
  Used Logisim to design a Five-stage pipeline RISC-V CPU which supports multi-level interrupt. Based on the complete CPU that was designed, a simple I/O mechanism was realized using interrupt and a playable mini game was accomplished.
- **Cyber-Punk HD-2D Rendering Style Rhythm Game**
  A game made as a team with unity, with shader design and particle system to achieve a HD-2D effect.

SELECTED AWARDS

Scholarship of Weichai Power, Weichai Power Corporation. 2023

Scholarship for Academic Excellence, Huazhong University of Science and Technology. 2023
    Awarded to top 2 in class.

Scholarship for Rising Stars in Optic Valley, Committee of Wuhan East Lake High-tech Development Zone. 2022
    2 students selected in the entire CS Department, 10,000 CNY.

Merit Student, Huazhong University of Science and Technology. 2022
    Awarded to top 5%.

Bronze Medal at Chinese Physics Olympiad (CPhO), Final. Rank 5 in Guangdong Province at semi-final 2020

SKILLS AND MATHS

- **Programming:** C/C++, C#, Python, Assembly, Taichi, OpenMP, MPI, OpenGL, DirectX12, MySQL
- **Software:** Unity, Logisim
- **Maths:** Real Analysis, Abstract Algebra, Topology, Measure-theoretic Probability Theory, Stochastic Process (With Martingale), Basic Measure Theory, Information Theory, Functional Analysis, Harmonic Analysis, Differential Geometry, Intro-level Set Theory and Model Theory, Sobolev Spaces and Generalized Function (still learning).