Youheng Zhu

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EDUCATION

Huazhong University of Science and Technology, Wuhan, China
Major: Computer Science and Technology Cumulative GPA: 4.56/5.00 , 91.4/100 ; rank 9%

RESEARCH EXPERIENCE

Real-time Ray-Tracing and Many Lights Problem Wuhan, China
Research Intern, Huazhong University of Science and Technology Mar. 2022 — Dec. 2022

- Explored the use of stochastic lightcut and spatial-temporal reuse of light-tree nodes to accelerate real-time global illumination.
- 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.

Simulating Blood Stream Using Lattice Boltzmann Method Wuhan, China
Team Member, Huazhong University of Science and Technology, Research group of Baocang Shi Jan. 2023 — Oct. 2023

- Designed simple models to characterize bloodstream in a vessel, models include both 2D and 3D versions.
- Implemented the LBM using C++ and Taichi language, numerically solve the Navier-Stokes equation that characterizes the bloodstream in our model.

Exploring Generalization Error of the Gibbs Algorithm via Information Neural Estimator Wuhan, China
Research Project Leader (Remote), University of Florida, Research group of Yuheng Bu July 2023 — Dec. 2023

- 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.

Information-Theoretic Analysis for Gibbs Algorithm in the Asymptotic Regime Wuhan, China
Research Intern (Remote), University of Florida, supervised by Yuheng Bu Dec. 2023 — May 2024

- Explored conditionally tight information-theoretic generalization error bound for Gibbs algorithm.
- Studied the asymptotic behaviour of information for Gibbs algorithm, 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.

Offline Reinforcement Learning Theory Champaign, US
Research Intern, University of Illinois at Urbana-Champaign, supervised by Nan Jiang July 2024 — Now

- Exploring theory of Partially Observable Models in the Reinforcement Learning context (proceeding).

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.
  We established the asymptotic equivalence between the sum of symmetrized KL information between the output hypothesis and individual samples and that between the hypothesis and the entire dataset. We characterized the asymptotic behavior of various information measures in the context of the Gibbs algorithm, leading to tighter generalization error bounds.
  long version for *IEEE Transaction on Information Theory (TIT)* in preparation.

SELECTED PROJECTS

- **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.

AWARDS

Bronze Medal at Chinese Physics Olympiad (CPhO), Final. Rank 5 in Guangdong Province at semi-final 2020
Merit Student, Huazhong University of Science and Technology. Top 5% 2022
Scholarship for Academic Excellence, Huazhong University of Science and Technology. 2023

SKILLS

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