JIZHOU HUANG

CONTACT INFORMATION

1 Brookings Dr, St. Louis, MO 63130
Phone: (314) 546-9213
Email: huang.jizhou@wustl.edu

RESEARCH OVERVIEW

My research focuses on theoretical computer science/algorithms and complexity; the primary goal of my job is to develop theoretically efficient algorithms for modeling the properties of subgroups of a given population.

EDUCATION

Sept. 2019 – present **PhD in Computer Science**
Washington University in St. Louis, St. Louis, MO, USA

Sept. 2016 – Dec. 2018 **MS in Electrical Engineering & Computer Science**
Washington University in St. Louis, St. Louis, MO, USA

Sept. 2011 – May 2015 **BE in Automation**
Beijing Jiaotong University, Beijing, CHINA

RESEARCH EXPERIENCE

Oct. 2016 – present **Washington University in St. Louis**, St. Louis, MO, USA
Research Assistant, Advisor: Brendan Juba

Conditional Classification

- Studied the Conditional Classification Problem for halfspace selectors/conditions where the target is to model properties of subsets of the data defined by halfspaces.
- Proposed the first polynomial-time approximation algorithm for conditional classification with homogeneous halfspaces selectors/conditions under Gaussian distribution. Our algorithm achieved the best approximation factor until then.
- Discovered that Conditional/Selective Classification with halfspace selectors is at least as hard as the problem of Agnostic Linear Classification.
- Showed that approximating conditional classification within a smaller additive error is computationally hard under the hardness assumption of Shortest Vector Problem.

Fairness Auditing

- Studied the problem of Fairness Auditing for statistical subgroups define on halfspaces, where the goal is to efficiently verify the existence of any subgroup that is discriminated against by a given decision-making process.
- Showed the first distribution-specific hardness result for auditing subgroups defined by Linear Threshold Functions (halfspaces). Specifically, given the Shortest Vector Problem (a famous problem about lattices) cannot be solved, we proved that no non-trivial polynomial-time approximation algorithm exists for auditing halfspace subgroups even under Gaussian distribution.
- Developed the first Polynomial-Time Approximation Scheme (PTAS) for auditing subgroups on homogeneous halfspaces under Gaussian distribution with provable guarantees.
- Studied the problem of Fairness Auditing for conjunctive subgroups, and proposed an "improper" polynomial-time algorithm that guarantees to return a subgroup defined by some polynomials if there exists an conjunctive subgroup being discriminated against by the rule.

Low-Energy Neural Networks

- Studied the family of low-energy threshold neural networks by investigating its expressive power and circuit complexity lower bound.
- Constructed a mathematical model for low-energy threshold neural networks, which has fitted into the hierarchies of several powerful clustering methods.
- Studied the relationship between the Unique Games Conjecture on expander graph and our formulation of low-energy neural networks.
- Proposed a Support Vector Machine like program to capture different active patterns of the networks. Discovered that the number of variables involved in each constraint of the program is upper bounded by the constant energy complexity, and proved that the program could be refuted efficiently by Sum Of Squares proof system (joint work with Zihao Deng).
- Discovered that the set of possible weights of each feasible solution forms a convex cone over hinge loss, which indicates the meaningful way to differentiate weights of different loss is by angles. Formulated our problem as a spherical optimization that can fit into geodesical optimization framework and enable us to add strong convexity to our loss function (joint work with Zihao Deng).

Dec. 2014 – Mar. 2016 **Beijing Jiaotong University**, Beijing, CHINA
Research Student, Advisor: Shikui Wei

Boosting Massive Image-Search System using FPGA

- Built an Image-searching system with C# on PC, applied *k-Nearest Neighbor* (kNN) algorithm as the processing algorithm of the system.
- Implemented a kNN image-searching algorithm in C++ on FPGA with the same time complexity as the one implemented in C# to allow meaningful comparison.
- Applied optimization instructions to the C++ code using Vivado High-Level Synthesis Software, which significantly improved the throughput of the algorithm on FPGA.
- Integrated the optimized program into a Zedboard embedded system using Vivado Software and set up multiple properties of the system using C on Xilinx SDK.
- Configured AXI Direct Memory Access via Xilinx SDK to achieve high-speed data exchanging between an on-board SD card and Xilinx Artix-7 FPGA, which solved the problems caused by memory deficiency and slow data transfer.

TEACHING

Spring 2024 **Washington University in St. Louis**, St. Louis, MO, USA
Teaching Assistant
CSE 513T Theory of Artificial Intelligence and Machine Learning

- Filled in for lectures.

Fall 2021 **Washington University in St. Louis**, St. Louis, MO, USA
Teaching Assistant
CSE 513T Theory of Artificial Intelligence and Machine Learning

- Filled in for lectures.
- Graded students' homework and held weekly TA sessions to answer students' questions.

PUBLICATIONS

- D. Hsu, **J. Huang**, and B. Juba. Distribution-Specific Auditing For Subgroup Fairness. The 5th annual Symposium on Foundations of Responsible Computing, Cambridge, MA, USA, 2024.
- **J. Huang**, B. Juba. Distribution-Specific Agnostic Conditional Classification With Halfspaces. The 13th International Conference on Learning Representations. (under review)

WORKSHOPS

- Daniel Hsu, **Jizhou Huang**, and Brendan Juba. Auditing Subgroup Fairness on Nice Distributions. In *NSF Fairness in AI PI Meeting*, Arlington, VA, USA, 2023.

WORK EXPERIENCE

May 2023 – Aug. 2023 **Meta**, Menlo Park, CA, USA
Software Engineer Intern, Mentor: Na Zhang

Path-Based Trigger Network

- Created a trigger net retrieval model to enhance Facebook Reels recommendations, modeling user engagement with items through their previously engaged items.
- Established a corresponding serving module for the trigger net, enabling the generation of user-specific recommendations. Additionally, developed an offline testing system to validate the model's accuracy and effectiveness.
- Proposed and implemented a novel variant of the trigger net using Gram-Schmidt decomposition, resulting in reduced training loss compared to the baseline model.
- Orchestrated Quality Enhancement (QE) experiments for both models and refined them based on real-world user feedback.

May 2022 – Aug. 2022 **Meta**, Menlo Park, CA, USA
Software Engineer Intern, Mentor: Wei Chang

Multi-interest Retrieval

- Worked on building neural network models to capture different human interests at retrieval stage for Facebook reels recommendation.
- Built and trained a two-tower network model consist of multiple sparse neural networks using PyTorch.
- Wrote a Presto script to analyze the pair-wise correlations between individual neural networks.
- Built and evaluated other state-of-art models using multiple neural networks, such as attention networks.

HONORS

- FORC 2024 Best Student Paper