Zhuo Cai zcaiam@connect.ust.hk
https://zhuocai.github.io

Education

2023 – Now **Hong Kong University of Science and Technology, Hong Kong**
PhD in Computer Science and Engineering
Supervisor: Amir Goharshady
Research Interest: Cryptography, Blockchain, Theoretical Computer Science.

2021 – 2023 **Hong Kong University of Science and Technology, Hong Kong**
Master of Philosophy in Computer Science and Engineering
Supervisor: Amir Goharshady
GPA: 3.88/4.0

2017 – 2021 **Tsinghua University, Beijing**
Bachelor of Automation
GPA: 3.81/4, GPA Ranking: 17/168

2019 Fall **National University of Singapore, Singapore**
Visiting Undergraduate Researcher
GPA: 4.0/4

Research Publications

1. He, X., Cai, Z., Wei, W., Zhang, Y., Mou, L., Xing, E., & Xie, P. (2021). Towards visual question answering on pathology images. In ACL.
2. Cai, Z., & Goharshady, A. (2023). Trustless and bias-resistant game-theoretic distributed randomness. In ICBC.
3. Cai, Z., & Goharshady, A. (2023). Game-theoretic Randomness for Proof-of-Stake. In MARBLE.
4. Cai, Z., Farokhnia, S., Goharshady, A., & Hitarth, S. (2023). Asparagus: Automated synthesis of parametric gas upper-bounds for smart contracts. In OOPSLA.
5. Ballweg, J., Cai, Z., & Goharshady, A. (2023). PureLottery: Fair leader election without decentralized random number generation. In IEEE Blockchain.

Research Projects

Sept 2021 – Oct 2022 **Trustless and Bias-resistant Game-theoretic Distributed Randomness**
Independent Researcher, supervised by Professor Amir Goharshady
Department of Computer Science and Engineering, the Hong Kong University of Science and Technology
- Proposed a game-theoretically incentivized mechanism for random number generation. Proved the existence and uniqueness of strong Nash equilibrium of the uniformly random strategy profile.
- Proposed proof-of-stake blockchain protocols with the novel game-theoretic randomness, using a commitment scheme with verifiable delay functions or a publicly verifiable secret sharing scheme.

Research Projects (continued)

Apr 2022 – May 2023

Asparagus: Automated Synthesis of Parametric Gas Upper-bounds for Smart Contracts
Research Assistant, supervised by Professor Amir Goharshady
Department of Computer Science and Engineering, the Hong Kong University of Science and Technology
- Designed algorithms to estimate linear or polyminal upper bounds of gas cost of public function calls in Ethereum smart contracts, based on Farkas' lemma, Putinar's Positivstellensatz and Hilbert's Strong Nullstellensatz.
- Implemented the algorithm that generates upper bounds of opcode gas costs when given solidity source files, compiled representations and invariants as inputs.

Aug 2019 – Dec 2019

Unsupervised Group Anomaly Detection
Independent Research, supervised by Professor Bryan Hooi
School of Computing, National University of Singapore
- Developed a novel indirect embedding method in which embeddings are parameters jointly learned to optimize an autoregressive model. The embedding technique can incorporate complex temporal information, with which autoregressive models can better accommodate multimodal data.
- Showed that Noise Contrastive Estimation is effective on individual samples, but not on segments due to the difficulty of injecting reasonable noises to time series; Showed that existing generative models including GANs and Flows are not strong enough when applied to group anomaly detection.

June 2020 – Oct 2020

Towards Visual Question Answering on Pathology Images
Research Assistant, Supervised by Professor Pengtao Xie
Department of Electrical and Computer Engineering, University of California, San Diego
Published in ACL'2021.
- Implemented visual question answering algorithms on our Pathology VQA dataset.
- Designed new cross-modality self-supervised learning tasks and implemented them in VQA models; Evaluated how different self-supervised pre-training improves downstream VQA performance in extensive experiments.

Aug 2018 – Jan 2019

Collaborative SLAM of Multiple Unmanned Aerial Vehicles
Research Assistant, supervised by Professor Yipeng Li
Department of Automation, Tsinghua University
- Designed and implemented a practical collaborative SLAM system based on visual SLAM, Lidar SLAM.
- Implemented fast visual SLAM based on video interpolation. Video interpolation generates intermediate frames, which facilitate matching of consecutive frames in visual SLAM.

Teaching

2022 Spring & Fall, TA

Hong Kong University of Science and Technology
COMP 2012: Object-Oriented Programming and Data Structures

Skills

Languages

Native in Mandarin Chinese, proficient in English (TOEFL:106, GRE:158+170).

Skills (continued)

Coding — C/C++, Python, MATLAB, JAVA, PyTorch, HTML, LaTeX, …

Miscellaneous Experience

Awards and Achievements

2023
- **Hong Kong PhD Fellowship**
- **Young Researcher, 10th Heidelberg Laureate Forum**
- **Research Travel Grant**, HKUST
- **Research Travel Grant**, HKUST

2019
- **Honor of Academic Excellency**, Tsinghua University.
  Awarded to top 10% students.

2018
- **Honor of Academic Excellency**, Tsinghua University.

2016
- **1st Level in National High School Mathematics League**, the Chinese Mathematical Society.
  Ranked within the top 2% in the provice of Anhui.

Extracurricular Experience

Dec 2019 - May 2021
- President of iOS Club, Tsinghua University.

Aug 2018 - Aug 2019
- Leader of the Students' Association of Science and Technology (Competition Branch), Department of Automation, Tsinghua University.