Tzu-Heng (Brian) Huang

Email: **thuang273@wisc.edu**

Phone Number: 608-960-6927

Personal Webpage: **zihengh1.github.io/**

Education

- **University of Wisconsin-Madison** — Madison, Wisconsin
  Third-year Ph.D. student in Computer Science. Minor in Economics. — *Aug. 2021 – Present*
- **National Chengchi University (NCCU)** — Taipei, Taiwan
  B.S. in Computer Science. (Major GPA: 3.96/4.30) — *Sep. 2016 – Jul. 2020*

Research Interests

I am passionate about advancing machine learning by creating effective techniques that empower models to **acquire more knowledge with reduced supervision**. For example, I have developed a knowledge transfer/trading framework involved with multi-agents to buy and sell parameter sets to improve diverse downstream performance so that the burden for extensive training cost reduces [1]. Additionally, I have delved into the realm of data-centric machine learning, specializing in the design of efficient techniques like data curation [3], prompting [4], and auto-labeling [5]. These strategies utilize weak supervision frameworks to build foundational models, reducing the reliance on extensive human annotations.

Research Experience

- **Department of Computer Science, UW-Madison** — Madison, Wisconsin
  Graduate Research Student, advised by Prof. Frederic Sala — *Feb. 2022 - Present*
  - **Train 'n Trade: Foundations of Parameter Markets [1]**:
    - Designed a valid knowledge transfer marketplace for multiple agents to buy/sell parameters and cost down training expenses.
  - **Geometry-Aware Adaptation for Pretrained Models [2]**:
    - Proposed a new adaption technique by leveraging limited relational information in label spaces to improve pretrained models.
  - **Multimodal Data Curation via Object Detection and Filter Ensembles [3]**:
    - Developed a novel data curation technique via filter ensembles for multimodal datasets and improved vision-language model.
    - Rank #1 on the small-scale filtering track of ICCV'23 Datacomp competition leaderboard.
  - **ScriptoriumWS: A Code Generation Assistant for Weak Supervision [4]**:
    - Proposed a low-cost data labeling framework with weak supervision by leveraging Code LLMs to synthesize labeling sources.
  - **AutoWS-Bench-101: Benchmarking Automated Weak Supervision with 100 Labels [5]**:
    - Developed a new benchmark to evaluate automated weak supervision techniques in diverse application domains.

- **Awan.AI** — San Jose, California
  CEO and Co-founder, collaborated with TechTCM — *May. 2023 - Present*
  - **Large Language Model for Traditional Chinese Medicine**:
    - Customized low-cost generative AI (with LLaMa family) to build the first language model for traditional Chinese medicine.
  - **Vision Language Model for Tongue Diagnosis in Traditional Chinese Medicine**:
    - Research on CLIP model with crowdsourcing tongue images and medical diagnosis to detect extreme multi-label syndromes.

- **Argonne National Laboratory** — Lemont, Illinois
  Research Intern, advised by Dr. Charles Catlett — *Jun. 2019 - Sep. 2019*
  - **Radiative Error Reduction for Low-cost Temperature Sensors**:
    - Researched pattern identification on time series and ensemble learning to improve calibration model performance.

- **Department of Computer Science, NCCU** — Taipei, Taiwan
  Research Assistant at Data Mining Lab, advised by Prof. Man-Kwan Shan — *Sep. 2018 - Aug. 2021*
  - **Efficient and Effective Quality Audit Frameworks for Large Scale Sensor Networks [6]**:
    - Proposed a novel quality audit framework to inspect sensor performance via approx. algorithms and time-series correlations.
  - **Early Prediction of Affected Sensors by Local Events Detected over Social Media**:
    - Leveraged spatial-temporal GNN models to detect anomalies in multivariate time series and label affected timestamps.
    - Developed an early prediction framework with BiGRU/BiLSTM models for affected region prediction with F1-score of **80%**.
  - **Missing Value Estimation of Large Scale Air Monitoring Sensor Network**:
    - Developed spatial-temporal correlation models for missing value imputation with error rate less than **10%.**
    - Improved correlation models through sequential-based time series segmentation by **17%**.

- **Institute of Information Science, Academia Sinica** — Taipei, Taiwan
  Research Intern at Network Research Lab, advised by Dr. Ling-Jyh Chen — *Feb. 2018 - Jul. 2020*
  - **Calibrating Low-cost PM2.5 Sensors in Large Scale IoT Environmental Monitoring Systems**:
    - Proposed an adaptive calibration framework with regression-based models to ensure data quality of low-cost sensors.
    - Project was awarded a Student Research Scholarship granted by the Ministry of Science and Technology, Taiwan.

- **PiM25 – Environmental Sensing Hub**:
  - Designed a maker-based sensor hub with over-the-air updates to detect various environmental conditions.
  - Deployed on-device pretrained audio models to recognize environmental sounds with F1-score of **75%**.
  - PiM25 was accepted by **HKoscon'19** and **COSCUP'19** to demonstrate and was the first TW's project reported by Magpi.

Publications

[1] Tzu-Heng Huang, Harit Vishwakarma, Frederic Sala, "Train 'N Trade: Foundations Of Parameter Markets", *in Neural Information Processing Systems (NeurIPS), 2023.*
[2] Nicholas Roberts, Xintong Li, Dyah Adila, Sonia Cromp, **Tzu-Heng Huang**, Jitian Zhao, Frederic Sala, "Geometry-Aware Adaptation For Pretrained Models", *in Neural Information Processing Systems (NeurIPS), 2023.*
[3] Tzu-Heng Huang*, Changho Shin*, Sui Jiet Tay, Dyah Adila, Frederic Sala, "Multimodal Data Curation Via Object Detection And Filter Ensembles", *in ICCV Workshop: Towards the Next Generation of Computer Vision Datasets, 2023.*
[4] Tzu-Heng Huang, Catherine Cao, Spencer Schoenberg, Harit Vishwakarma, Nicholas Roberts, Frederic Sala, "ScriptoriumWS: A Code Generation Assistant For Weak Supervision", *in ICLR Workshop: Deep Learning For Code, 2023* and *in Midwest Machine Learning Symposium, 2023.*
[5] Nicholas Roberts, Xintong Li, **Tzu-Heng Huang**, Dyah Adila, Spencer Schoenberg, Cheng-Yu Liu, Lauren Pick, Haotian Ma, Aws Albarghouthi, Frederic Sala, "AutoWS-Bench-101: Benchmarking Automated Weak Supervision with 100 Labels", *in Neural Information Processing Systems (NeurIPS), 2022.*
[6] Tzu-Heng Huang, Cheng-Hsien Tsai, Man-Kwan Shan, "Key Sensor Discovery for Quality Audit of Air Sensor Networks", *in ACM International Conference on Mobile Systems, Applications, and Services (MobiSys), 2020.*

Awards

- **Conference Scholar Award**: granted by NeurIPS'23.
- **Datacomp Competition**: rank #1 on the small-scale filtering track of ICCV'23 Datacomp competition leaderboard.
- **First-year Departmental Scholarship**: granted by Department of Computer Science, UW-Madison.
- **International Research Intern Scholarship**: granted by National Chengchi University (NCCU).
- **Undergraduate Research Scholarship**: granted by the Ministry of Science and Technology (MOST), Taiwan.

Invited Talks

- **IoT Instantiation: Air Sensor Deployment**: invited by Nangang High School (Taipei), Dec. 2019.
- **Internship Abroad Scholarship Sharing**: invited by National Chengchi Univerisity, Sep. 2019.
- **LASS Conference International Session**: invited by Institute of Information Science, Academia Sinica, Jul. 2019.
- **Techbang Magazine Sharing: PiM25 Project**: invited by Techbang Magazine, Mar. 2019.
- **Raspberry Pi Jam: PiM25 Project**: invited by Raspberry Pi Foundation (Taiwan), Mar. 2019.
- **The 24th of Raspberry Pi Meetup: PiM25 Project**: invited by Raspberry Pi Foundation (Taiwan), Jan. 2019.

Academic Services

- **Co-organizer**: AutoML Cup in AutoML'23.
- **Paper Reviewer**: GLOBECOM'20, NeurIPS'23, ICLR'24.
- **Student Association of Taiwna (SAT), UW-Madison**: President, Jun. 2022 - May. 2023.
- **Student Association of Taiwan (SAT), UW-Madison**: Vice President, Jun. 2021 - May. 2022.

Programming Skills

- **Programming Languages**: Python, R, C++, SQL, LaTeX, and Shell Programming.
- **Technologies**: PyTorch, Tensorflow, Keras, ShinyApp, PostgreSQL, Linux, Flask, Dash, Git, and Vim.