Tzu-Heng (Brian) Huang

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Education

- **University of Wisconsin, Madison (UW-Madison)** — Madison, Wisconsin
  Ph.D. in Computer Science. — *Aug. 2021 – Present*
  - [**Research**]: Machine Learning, Weak Supervision, and Game Theory.
  - [**Teaching**]: TA of Data Science Programming, Intro. to AI, and Machine Learning.
- **National Chengchi University (NCCU)** — Taipei, Taiwan
  B.S. in Computer Science. — *Sep. 2016 – Jul. 2020*
  - [**Research**]: Machine Learning, Data Mining, and Sensor Networks.
  - [**Teaching**]: TA of Data Mining, Database Management System, Algorithms, and Social Computing.

Research Interests

My research currently focuses on building efficient and effective machine learning mechanism for multiple agents to transfer/trade knowledge cooperatively and competitively. Especially, I like to perform research to pursue Pareto frontier, Nash equilibrium, and discover provable performance guarantees. I also research on developing automatic frameworks in weak supervision with foundation models. My past research interests lay in optimizing data quality in large-scale low-cost sensor networks and building machine learning models with spatio-temporal data to forecast, detect anomalies, and model sensor correlation.

Research Experience

- **Department of Computer Science, UW-Madison** — Madison, Wisconsin
  Graduate Research Student at Sala Lab — *Feb. 2022 - Present*
  - **Modeling Models in the Model Marketplace**:
    - Designed trading mechanisms for multiple agents to transfer knowledge and optimize agents' utilities.
    - Developed effective trading policies to evaluate the value of transferred knowledge in **bayesian game theory**.
  - **AutoWS-Bench-101: Benchmarking Automated Weak Supervision with 100 Labels [3]**:
    - Contributed a new benchmark to evaluate automated WS techniques with diverse application domains.
  - **ScriptoriumWS: A Code Generation Assistant for Weak Supervision [4]**:
    - Developed prompting strategies with **code generation model** to synthesized labeling functions in WS.
  - Advised by Prof. Frederic Sala.
- **Argonne National Laboratory** — Lemont, Illinois
  Research Intern at Mathematics and Computer Science Division — *Jun. 2019 - Sep. 2019*
  - **Pattern Identification Based Calibration Model on Time Series for Radiative Error Reduction**:
    - Developed ensemble learning with **DNN** to calibrate temperature sensor for radiative error reduction.
    - Proposed **pattern identification** on time series to improve the performance of calibration model by **25%.**
    - Established RESTful API to transfer sensor data between two large scale air monitoring network platforms.
  - Advised by Dr. Charles Catlett and Dr. Rajesh Sankaran.
- **Department of Computer Science, NCCU** — Taipei, Taiwan
  Research Assistant at Data Mining and Multimedia Lab — *Sep. 2018 - Aug. 2021*
  - **Early Prediction of Affected Sensors by Local Events Detected over Social Media**:
    - Developed **spatial-temporal GNN** models to detect anomalies in time series for affected sensor labeling.
    - Built attention-based **BiGRU/BiLSTM/TCN** models to **early predict** affected sensors with F-score of **80%.**
  - **Efficient and Effective Quality Audit Frameworks for Large Scale Sensor Networks [1, 2]**:
    - Proposed a novel **quality audit framework** to inspect sensor performance with sensor data correlation modeling.
    - Developed effective approximation algorithms with **CPLEX MIP solver** to optimize facility location problem.

- **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 time series segmentation with **sequential clustering algorithm** by **17%**.
- Advised by Prof. Man-Kwan Shan.

- **Institute of Information Science, Academia Sinica** Taipei, Taiwan
  Research Intern at Network Research Lab *Feb. 2018 - Jul. 2020*
  - **Real-time Air Quality Forecasting with Seq2seq Model for Edge Computing**:
    - Developed accurate **Seq2seq** models to forecast multivariate time series in large scale low-cost sensor networks.
  - **Calibrating Low-cost PM2.5 Sensors in Large Scale IoT Environmental Monitoring Systems**:
    - Proposed adaptive calibration framework with regression-based models to ensure data quality of low-cost sensors.
    - Project was awarded Student Research Scholarship granted by the Ministry of Science and Technology in Taiwan.
  - **Environmental Sensing Hub (PiM25)**:
    - Designed a maker-based sensor hub with **over-the-air** updates to detect various environmental conditions.
    - Deployed an **on-device pretrained audio model** to recognize environmental sounds with F-score of **75%**.
    - This open-source project is released online and was accepted by **HKoscon'19** and **COSCUP'19** to present.
    - PiM25 is cooperated with Raspberry Pi Org. in Taiwan and was the **first** Taiwan's project reported by Magpi.
  - Advised by Prof. Ling-Jyh Chen.

- **College of Commerce, NCCU** Taipei, Taiwan
  Research Assistant at Human Resource Lab *Jul. 2017 - Jul. 2020*
  - **Conditional Indirect Effects in Multi-level Models with Monte Carlo Simulations**:
    - Developed an interactive online tool to estimate effects for multilevel models with **Monte Carlo** simulation.
  - **Predicting Employee Attrition with Machine Learning Models**:
    - Discovered useful knowledge rules and potential factors for Pegatron manufacturing plants to retain employees.
    - Developed ML models **(SVM/XGBoost/LightGBM)** to predict employee turnover with accuracy over **90%**.
  - **Automative Assessment Tool of Employee Personality**:
    - Developed an automative data visualization platform to analyze and generate employee personality assessments.
  - Advised by Prof. Changya Hu.

Teaching Experience

- **Spring 2023 at UW-Madison CS**: TA of Machine Learning (CS 760).
- **Fall 2022 at UW-Madison CS**: TA of Introduction to Artificial Intelligence (CS 540).
- **Spring 2022 at UW-Madison CS**: TA of Data Science Programming (CS 220).
- **Fall 2021 at UW-Madison CS**: TA of Data Science Programming (CS 220).
- **Spring 2021 at NCCU CS**: TA of Algorithms (Undergraduate Course).
- **Fall 2020 at NCCU CS**: TA of Data Mining (Graduate Course).
- **Fall 2020 at NCCU CS**: TA of Social Computing (Graduate Course).
- **Spring 2020 at NCCU CS**: TA of Database Management System (Graduate Course).
- **Spring 2020 at NCCU CS**: TA of Data Mining (Graduate Course).

Publications

[1] Tzu-Heng Huang, Cheng-Hsien Tsai, Man-Kwan Shan, "Key Sensor Discovery for Quality Audit of Air Sensor Networks", MobiSys'20.
[2] Tzu-Heng Huang and Man-Kwan Shan, "An Effective and Efficient Quality Audit Framework for Large Scale Sensor Networks".
[3] 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", NeurIPS'22.
[4] Tzu-Heng Huang, Harit Vishwakarma, Nicholas Roberts, Catherine Cao, Spencer Schoenberg, Frederic Sala, "ScriptoriumWS: A Code Generation Assistant for Weak Supervision", under review.

Invited Talks

- **IoT Tutorial for High School Students**: Lecturer, invited by Nangang High School, Dec. 2019.
- **International Internship Sharing - Research Project**: Speaker, invited by NCCU, Sep. 2019.
- **LASS Conference International Session - Research Project**: Speaker, invited by Academia Sinica, Jul. 2019.
- **Techbang Magazine Sharing - PiM25 Project**: Speaker, invited by Techbang Magazine, Mar. 2019.
- **Raspberry Pi Jam - PiM25 Project**: Speaker, invited by Raspberry Pi Org. (TW), Mar. 2019.
- **The 24th of Raspberry Pi Meetup - PiM25 Project**: Speaker, invited by Raspberry Pi Org. (TW), Jan. 2019.

Academic Services

- **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.
- **IEEE Global Communications Conference (IEEE GLOBECOM'20)**: Paper Reviewer, Jul. 2020.

Honors and Awards

- **First-year CS Departmental Scholarship**: granted by Department of Computer Science, UW-Madison.
- **International Research Intern Scholarship**: granted by National Chengchi University (NCCU), Taiwan.
- **Undergraduate Research Scholarship**: granted by the Ministry of Science and Technology (MOST), Taiwan.

Programming Skills

- **Programming Languages**: Python, R, C++, C, SQL, LaTeX, Shell Programming, GAMS, and VBA.
- **Technologies**: **Pytorch, Tensorflow, Keras**, ShinyApp, Linux, Flask, Dash, Git, and Vim.
- **Database Management Systems**: PostgreSQL, MySQL, and SQLite.