

Zhengfeng (Jeff) Lai

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EDUCATION

University of California, Davis

Ph.D. student in Electrical and Computer Engineering

Davis, CA

Sept. 2019 – June 2023

Zhejiang University

B.Eng. in Information Engineering

Hangzhou, China

Sept. 2015 – June 2019

RESEARCH INTERESTS

Semi-supervised learning and its robustness & applicability study on gigapixel pathology images, machine learning in healthcare, active learning, few-shot learning.

PREPRINTS

- **Z. Lai**, C. Wang, L. Cerny Oliveira, B. Dugger, S-C. Cheung, C-N. Chuah, “SemA-Path: Semi-supervised Active Learning with Hierarchical Selection for Pathology Image Classification and Segmentation”, under review by **IEEE Transactions on Medical Imaging**.

PUBLISHED/ACCEPTED PAPERS

- **Z. Lai**, C. Wang, H. Gunawan, S-C. Cheung, and C-N. Chuah, “Smoothed Adaptive Weighting for Imbalanced Semi-Supervised Learning: Improve Reliability Against Unknown Distribution Data”, The 39th International Conference on Machine Learning (**ICML**) 2022.
- **Z. Lai**, C. Wang, S-C. Cheung, and C-N. Chuah, “SaR: Self-adaptive Refinement on Pseudo Labels for Multiclass-Imbalanced Semi-supervised Learning”, 2022 **CVPR** Workshop on Learning with Limited Labelled Data for Image and Video Understanding.
- **Z. Lai**, L. Cerny Oliveira, R. Guo, W. Xu, Z. Hu, K. Mifflin, C. DeCarlie, S-C. Cheung, C-N. Chuah, and B. N. Dugger, “BrainSec: Automated Brain Tissue Segmentation Pipeline for Scalable Neuropathological Analysis”, **IEEE Access**, 2022.
- **Z. Lai***, C. Wang*, L. Cerny Oliveira, B. Dugger, S-C. Cheung, C-N. Chuah, “Joint Semi-supervised and Active Learning for Segmentation of Gigapixel Pathology Images with Cost-Effective Labeling”, in **Proceedings of the IEEE/CVF International Conference on Computer Vision** (pp. 591-600).
- **Z. Lai**, C. Wang, Z. Hu, B. Dugger, S-C. Cheung, C-N. Chuah, “A Semi-supervised Learning for Segmentation of Gigapixel Histopathology Images from Brain Tissues,” 43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Oct 31-Nov 4, 2021.
- **Z. Lai**, P. Vadlaputi, D. J. Tancredi, M. Garg, R. I. Koppel, M. Goodman, W. Hogan, N. Cresalia, S. Juergensen, E. Manalo, S. Lashminrusimha, C-N. Chuah, and H. Siefkes, “Enhanced Critical Congenital Cardiac Disease Screening by Combining Interpretable Machine Learning Algorithms,” 43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Oct 31-Nov 4, 2021.
- **Z. Lai**, K. Guo, W. Xu, Z. Hu, B. Dugger, S. Cheung, and C-N. Chuah, “Automated Grey and White Matter Segmentation in Digitized Ab Human Brain Tissue Slide Images, IEEE ICME 2020 Workshop on Multimedia Services and Technologies for Smart Health (MUST-SH), July 2020.
- L. Cerny Oliveira, **Z. Lai**, W. Geng, H. Siefkes, C-N. Chuah, ”A Machine Learning Driven Pipeline for Automated Photoplethysmogram Signal Artifact Detection”, 1st Workshop on Artificial Intelligence and Internet of Things for Digital Health (AIIOT4DH) at IEEE CHASE, Dec 16-17, 2021.
- K. Doshi, G. Rehm, P. Vadlaputi, **Z. Lai**, S. Lakshminrusimha, C-N. Chuah, and H. M Siefkes, “A Novel System to Collect Dual Pulse Oximetry Data for Critical Congenital Heart Disease Screening Research,” Journal of Clinical and Translational Science, pp. 1-25, October 2020.
- C. Linhu, C. Wang, C. Nuo, J. Wu, **Z. Lai**, J. Song, “Rapidly tunable and highly reversible bio-inspired dry adhesion for transfer printing in air and a vacuum,” Soft Matter 15, no. 1 (2019): 30-37.

RESEARCH EXPERIENCE

Major advisors: Prof. Chen-Nee Chuah, *Fellow, IEEE*, and Prof. Sen-Ching Cheung, *Fellow, IEEE*.

SemA-Path: Semi-supervised Active Learning Pathology Image Analysis Sept. 2021 – March 2022
Graduate Student Researcher Davis, CA

- Proposed a semi-supervised active learning framework (SemA-Path) with Hierarchical Selection for pathology image analysis.
- SemA-Path can reduce both labeling efforts and computational complexity in AL cycles.
- This is the first work that deeply fuses SSL and AL for pathology images.

Class-imbalanced Semi-supervised Learning (SSL) in Real-world Scenarios Oct. 2020 – May 2021
Graduate Student Researcher Davis, CA

- Proposed Smoothed Adaptive Weighting (SAW) scheme to update per-example weight for each unlabeled data.
- SAW improves the state-of-the-art SSL algorithms significantly and outperforms other class-imbalanced methods.
- This is the first work that does not make any assumption on the unlabeled set.

Joint Active and Semi-supervised Learning: Minimize Labeling Costs Oct. 2020 – May 2021
Graduate Student Researcher Davis, CA

- Proposed a joint active and semi-supervised learning framework towards minimizing labeling costs.
- Designed a region-based selection criterion to effectively expand the diversity of the labeled set with less labeling efforts. This criterion quantifies the whole region's uncertainty to guarantee the robustness.
- Evaluated the proposed framework on a pathology dataset, and achieved competitive results compared to supervised learning when only 0.1% regions are labeled.

ML-driven System for Critical Congenital Heart Defect Screening Feb. 2020 – June 2021
Co-advised by Dr. Heather Siefkes at UC Davis Children's Hospital Sacramento, CA

- Created an automated real-time data collection system to collect additional pulse oximetry data in newborns.
- Developed an end-to-end pipeline from data cleaning, feature extraction, to machine learning diagnosis for detecting Critical Congenital Heart Defect (CCHD).
- Proposed system enhanced the current standard screening system installed at children's hospital.

Automated Segmentation Pipeline for Gigapixel Pathology Images Sept. 2019 – June 2020
Co-advised by Dr. Brittany Dugger at UC Davis Alzheimer's Disease Center Sacramento, CA

- Proposed an automated pipeline combining CNN-based module and Image Processing module for segmentation of grey/white Matter in brain tissue slide of ultra-high resolution (gigapixel level).
- Incorporated ResNet-18 with a Neural Conditional Random Field layer for modeling spatial relationship, outperforms U-Net and FCN with 1% and 10% improvements of IoU.
- Explored the applicability of self-attention module (CBAM) on neuropathology images.
- Provided interpretable explanation in neuropathology for the proposed CNN models by Grad-CAM.

INDUSTRIAL EXPERIENCE

PhD Data Science Intern at Electronic Arts June 2021 – Sept. 2021
Advisor: Jason Park Redwood city, CA

- Designed a few-shot toxic object detection pipeline with transfer learning.
- Explored zero-shot learning for unseen classes in the dataset.

National Science Foundation's Innovation Corps Program (I-Corps) Jan. 2021 – Mar. 2021
Team with Dr. Heather Siefkes, Dr. Jim Swick, Pranjali Vadlaputi Washington, D.C.

- Successfully completed the requirements of I-Corps by finishing more than 100 interviews in pediatric field.
- Named as one of the inventors on a patent application **"Systems and Methods for Classifying Critical Heart Defects."**

Artificial Intelligence Engineer Intern June 2018 – Aug. 2018
DeepThink (Top 10 AI Startup Company in Hangzhou) Hangzhou, China

- Implemented an ICO Scan Identification System based on RNN with real-world white books.
- Designed a LSTM model to predict Ethereum trends using blockchain activity data with 65% of accuracy.
- Maintained the Linux Server for 20 members in the group.

TEACHING & MENTORING EXPERIENCE

Lead Teaching Assistant for EEC 193AB

Sept. 2019 – Mar. 2021

University of California, Davis

Davis, CA

- Helped develop and teach EEC 193 AB (AI Systems Senior Design) for two years.
- Independently hosted lab sessions and mentored four teams over 2 academic quarters.
- Designed three lab assignments involving classical ML algorithms (Logistic Regression, SVM), CNN and basic Python in the application of ML on health.

Summer Undergraduate Research Mentor

June 2021 – Sept. 2021

University of California, Davis

Davis, CA

- Mentored one undergraduate on website design for visualizing waveform from photoplethysmogram signals.
- Mentored one undergraduate on waveform artifact detection by using machine learning algorithms.
- Designed three lab assignments involving classical ML algorithms (Logistic Regression, SVM), CNN and basic Python in the application of ML on health.

PROFESSIONAL SERVICES

Reviewer:

- NeurIPS 2021 & 2022
- ICML 2022
- IEEE Transaction on Image Processing
- CVPR Workshop 2022
- BIBE 2021

TECHNICAL SKILLS

Programming: Python, C/C++, Matlab

Developer Tools: Git, Docker, Google Cloud Platform, VS Code, Visual Studio, PyCharm

Frameworks: PyTorch, Tensorflow, Caffe, OpenCV, Scikit-Learn

AWARDS

- 2018 Interdisciplinary Contest In Modeling: Meritorious Winner
- Outstanding Senior Design Project Award of UC Davis, 2019
- The Best Senior Design of ISEE, ZJU in 2019: Multiple Objects Detection
- 2019 ZJU Overseas Senior Design Scholarship