Yu-Hsuan (Dennis) Wu

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Education

Northwestern University, Evanston, IL — Enrolled: Sep 2022 — Expected: Jun 2024
Master of Science in Computer Science — Overall GPA: 3.81
Master Thesis: Improved Memory Capacity Bound with Learnable Hopfield Energy.

National Central University, Taouyuan, Taiwan — Enrolled: Sep 2017 — Expected: Jun 2021
Bachelor of Science in Computer Science — Overall GPA: 3.56 — Major GPA 3.89

Research Interests

Foundations of Machine Learning

- Memorization capability of neural networks
- Representation learning
- Energy based and associative memory models

Publications

Published

[1] *"Associated Learning: an Alternative to End-to-End Backpropagation that Works on CNN, RNN, and Transformer,"* International Conference on Learning Representations (ICLR) (2021), Dennis Wu, Dinan Lin, Vincent Chen, Hung-Hsuan Chen. openreview.

[2] *"AI-based College Course Selection Recommendation System: Performance Prediction and Curriculum Suggestion,"* Dennis Wu, Eric Hsiaokuang Wu. IEEE IS3C, IEEE Xplore.

[3] *"Detecting Inaccurate Sensors on a Large-Scale Sensor Network Using Centralized and Localized Graph Neural Networks,"* Dennis Wu, Tsu-Heng Lin, Xin-Ru Zhang, Chia-Pan Chen, Jia-Hui Chen, Hung-Hsuan Chen, IEEE Sensors (2023) **Featured Article**, Vol 23, no.15, 16446 IEEE Xplore.

[4] *"HonestBait: Forward References for Attractive but Faithful Headline Generation,"* Chih-Yao Chen*, Dennis Wu*[1], Lun-Wei Ku, Findings of the Association for Computational Linguistics: (ACL) 2023 arXiv:2306.14828.

[5] *"On Sparse Modern Hopfield Models,"* Jerry Yao-Chieh Hu, Donglin Yang, Dennis Wu, Chenwei Xu, Bo-Yu Chen, Han Liu, Thirty-seventh Conference on Neural Information Processing Systems (2023) arXiv:2309.12673.

Under Review

[6] *"Memory Enhanced Multivariate Time Series Prediction with Generalized Sparse Hopfield Models,"* Under review, Dennis Wu, Jerry Hu, Weijian Li, Han Liu.

[7] *"Non-parameteric Sparse Hopfield Models,"* Jerry Hu, Matt Chen, Dennis Wu, Han Liu. Under review.

Research Experience & Selected Projects

Magics Lab, Northwestern University — Evanston, IL
Advisor: Prof. Han Liu — Sep 2022 – present (graduate research)
Learnable Hopfield Energy for Improved Memory Capacity Bound

- Proposed a learnable kernel function for improved modern Hopfield memory capacity bound
- Derived the update rule for the improved memory capacity bound
- Proved by the loss minimizer of the uniformity loss is also the separation value minimizer in the memory space
- Proposed an objective function to bring larger memory capacity to multi-head attention

Adversarial AutoAugment for Private Machine Learning

- Proposed an augmentation sensitive generalization bound for Adversarial AutoAugment
- Improved state-of-the-art membership inference defense methods by including augmentations during training
- Proposed a theoretical framework to describe the tradeoff between utility and privacy and identify its sweetspot

Memory Enhanced Multivariate Time Series Prediction [6]

- Proposed an adjustable sparse Hopfield model for different noise levels of data
- Proposed two memory plugin modules for time series prediction that considers external stimulus
- Obtained state-of-the-art on multiple time series prediction datasets
- Proposed a novel time series prediction based on generalized sparse Hopfield and its memory retrieval mechanism

[1] Alphabetical order

Data Analysis Research Team, National Central University Taoyuan, Taiwan
Advisor: Prof. Hung-Hsuan Chen Sep 2019 – Jan 2022 (undergraduate research)
Efficient Rare Word Embedding with Dynamic Regularization

- Designed a training algorithm with dynamic L2 regularization weight for rare words embeddings to alleviate potential harmful biases on rare words
- Utilized Cython to speed-up the training process

Associated Learning: an Alternative to End-to-End Backpropagation that Works on CNN, RNN, and Transformer [1]

- Proposed a general framework to decompose end-to-end backpropagation that works on several popular model architectures
- Reduced the time complexity from quadratic to linear with respect to dataset size and model depth
- Outperformed LSTM, CNN, Transformer on classification accuracies on several benchmarks; requires less epochs to converge
- Achieved better generalization ability on random label and noisy data tests

Natural Language Processing and Sentiment Analysis Lab, Academia Sinica Taipei, Taiwan
Advisor: Prof. Lun-Wei Ku Nov 2020 – Jan 2022 (Research Assistant)
Faithful Headline Generation via Forward Reference [4]

- Proposed a RL-based debiased faithfulness discriminator, making natural language inference robust from style shifts
- Proposed a psycho-linguistic inspired technique "forward reference" for attractive headline generation

Hyperbolic Label Embedding for Fine-Grained Text Classification

- Developed a hyperbolic tree embedding workflow for fine-grained emotion embedding
- Proposed a metric learning framework for fine-grained sentiment classification

Awards

- Best Paper Award (IEEE-IS3C)
- Featured Article (IEEE Sensors Aug-2023)
- NCU Undergraduate research Scholarship - National Central University (2017-2018)
- NCTU undergraduate research scholarship - Academia Sinica - (2020-2021)

Work Experiences

Media Tek Inc. Taipei, Taiwan
Teaching Assistant for Transformers and Deep Learning 2022 Summer

- Led the lab session on transformer implementation and vision tranformer training

Northwestern University Evanston, IL
Teaching Assistant, CS312, Data Privacy 2023 Winter, 2024 Fall

- Held office hours
- Assist students on assignments, including calculations on differential privacy, coding etc.
- Mentor students on course projects, including private machine learning, private communication etc.

Professional Service

Peer Reviewer for **ICML**, **Neurips**, **ICLR**