Yao-Hung Hubert Tsai

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Research Summary

My primary research interests lie in the general areas of Machine Learning, in particular Deep Learning and Statistics. I focus on providing principled and systematic understandings of cutting edge machine learning methodologies. On this basis, I develop algorithms and computational models to improve the performance, generalization, and interpretability of data representations. Applications of my research span Core Machine Learning (**CoreML**), Computer Vision (**CV**), Natural Language Processing (**NLP**), and Speech Processing (**SP**).

Education

Carnegie Mellon University, Pittsburgh, PA, USA *Aug 2016 - Aug 2021 (Expected)*

- Ph.D. in Machine Learning Department within School of Computer Science (GPA: 4.08/4.3)

National Taiwan University, Taipei, Taiwan *Aug 2010 - Jun 2014*

- B.S. in Electrical Engineering (graduated with Department Honors) (GPA: 4.17/4.3)
- Presidential Awards in 2011/2012/2014, Undergraduate Ceremony Representative (top 10 students out of 230)

Research Experiences

Graduate Research Assistant, Carnegie Mellon University *Aug 2016 - Present*

CoreML Providing an information-theoretical explanation for the effectiveness of the self-supervised learned representations [ICLR'21A]. The explanation inspires new loss function designs [ICLR'21A, ICLR'21B].

CoreML Tractable and scalable mutual information estimation [ICLR'21B, NeurIPS'20].

CV/NLP/SP Analyzing human language from spoken text, facial attributes, and tones of voice [EMNLP'20, ACL'19, ICLR'19].

CV/NLP Learning modality-invariant feature space across vision and text [ICCV'17, N-LLD'17].

CoreML Deep neural networks regularization [NeurIPS'19] and Transformer architecture explanation [EMNLP'19].

- Advisor: Dr. Ruslan Salakhutdinov & Dr. Louis-Philippe Morency

Graduate Research Intern, Facebook AI Research *Summer 2020*

SP Improving and providing a better understanding of self-supervised speech representation learning. Works include 1) incorporating temporal structures within representations, 2) unifying different loss function designs, and 3) introducing weak supervision from fast and cheap clustering [ICASSP'21].

- Host: Dr. Abdelrahman Mohamed

Graduate Research Intern, Apple Inc. *Summer 2019*

CV 3D object recognition from multi-sensory data, spanning LiDAR, Radar, and RGB sensors.

CV Improving the scalability and stability of routing mechanism in Capsule networks [ICLR'20].

- Host: Dr. Nitish Srivastava & Dr. Ruslan Salakhutdinov

Graduate Research Intern, Allen Institute for Artificial Intelligence *Summer 2018*

CV/NLP Video spatiotemporal relationships modeling for common sense retrieval [CVPR'19].

- Host: Dr. Santosh Kumar Divvala & Dr. Ali Farhadi

Graduate Research Intern, Microsoft Research *Summer 2017*

CoreML Temporal order discovery in unordered dataset [N-TSW'17].

- Host: Dr. Nebojsa Jojic

Visiting Scholar, RIKEN AIP/ Kyoto University *Winter 2017, Winter 2018, Winter 2019*

CoreML Optimal transportation, high-dimensional feature selection, semi-supervised mutual information estimation, and linear-time distribution divergence measurement [see `https://yaohungt.github.io/research.html`].

- Host: Dr. Makoto Yamada & Dr. Masashi Sugiyama

Research Assistant, CITI, Academia Sinica *Aug 2015 - Aug 2016*

CV Domain Adaptation for Visual Object Recognition [CVPR'16, AAAI'16].

- Host: Dr. Yu-Chiang Frank Wang

Selected Publications (complete list at https://yaohungt.github.io/research.html)

ICLR'21A **Y.-H. H. Tsai**, Y. Wu, R. Salakhutdinov, L.-P. Morency. "Self-supervised Learning from a Multi-view Perspective", *International Conference on Learning Representations, 2021.*

ICLR'21B **Y.-H. H. Tsai***, M. Q. Ma*, M. Yang, H. Zhao, L.-P. Morency, R. Salakhutdinov. "Self-supervised Representation Learning with Relative Predictive Coding", *International Conference on Learning Representations, 2021.*

ICASSP'21 W.-N. Hsu, **Y.-H. H. Tsai**, B. Bolte, R. Salakhutdinov, A. Mohamed. "HUBERT: How much can a bad teacher benefit ASR pre-training?", *NeurIPS Self-Supervised Learning for Speech and Audio Processing Workshop, 2020.*

NeurIPS'20 **Y.-H. H. Tsai**, H. Zhao, M. Yamada, L.-P. Morency, R. Salakhutdinov. "Neural Methods for Point-wise Dependency Estimation", *Neural Information Processing Systems, 2020.* (Spotlight Presentation)

EMNLP'20 **Y.-H. H. Tsai***, M. Q. Ma*, M. Yang*, R. Salakhutdinov, L.-P. Morency. "Multimodal Routing: Improving Local and Global Interpretability of Multimodal Language Analysis", *Empirical Methods in Natural Language Processing, 2020.*

ICLR'20 **Y.-H. H. Tsai**, N. Srivastava, H. Goh, R. Salakhutdinov. "Capsules with Inverted Dot-Product Attention Routing", *International Conference on Learning Representations, 2020.*

NeurIPS'19 H. Zhao*, **Y.-H. H. Tsai***, R. Salakhutdinov, G. Gordon. "Learning Neural Networks with Adaptive Regularization", *Neural Information Processing Systems, 2019.*

EMNLP'19 **Y.-H. H. Tsai**, S. Bai, M. Yamada, L.-P. Morency, R. Salakhutdinov. "Transformer Dissection: A Unified Understanding of Transformer's Attention via the Lens of Kernel", *Empirical Methods in Natural Language Processing, 2019.*

ACL'19 **Y.-H. H. Tsai***, S. Bai*, P. P. Liang, J. Z. Kolter, L.-P. Morency, R. Salakhutdinov. "Multimodal Transformer for Unaligned Multimodal Language Sequences", *Association for Computational Linguistics, 2019.*

ICLR'19 **Y.-H. H. Tsai***, P. P. Liang*, A. Zadeh, L.-P. Morency, R. Salakhutdinov. "Learning Factorized Multimodal Representations", *International Conference on Learning Representations, 2019.*

CVPR'19 **Y.-H. H. Tsai**, S. K. Divvala, L.-P. Morency, R. Salakhutdinov, A. Farhadi. "Video Relationship Reasoning using Gated Spatio-Temporal Energy Graph", *Conference on Computer Vision and Pattern Recognition, 2019.*

N-TSW'17 **Y.-H. H. Tsai**, H. Zhao, R. Salakhutdinov, N. Jojic. "Learning Markov Chain in Unordered Dataset", *NeurIPS Time Series Workshop, 2017.* (Oral Presentation)

ICCV'17 **Y.-H. H. Tsai**, L.-K. Huang, R. Salakhutdinov. "Learning Robust Visual-Semantic Embeddings", *International Conference on Computer Vision, 2017.*

N-LLD'17 **Y.-H. H. Tsai**, R. Salakhutdinov. "Improving One-Shot Learning through Fusing Side Information", *NeurIPS Learning with Limited Labeled Data: Weak Supervision and Beyond, 2017.*

CVPR'16 **Y.-H. H. Tsai**, Y.-R. Yeh, Y.-C. F. Wang. "Learning Cross-Domain Landmarks for Heterogeneous Domain Adaptation", *Computer Vision and Pattern Recognition, 2016.*

AAAI'16 **Y.-H. H. Tsai**, C.-A. Hou, W.-Y. Chen, Y.-R. Yeh, Y.-C. F. Wang. "Domain-Constraint Transfer Coding for Imbalanced Unsupervised Domain Adaptation", *Association for the Advancement of Artificial Intelligence, 2016.*

Selected Honors & Awards

Facebook Fellowship, Facebook *2020*

AI2 Fellowship, Allen Institute for Artificial Intelligence *2018*

Government Scholarship to Study Abroad (GSSA), Taiwan Ministry of Education *2016*

National Representative Honorable Mention, International Physics Olympiad Selection Camp *2009/2010*

1st Runner-Up/Third Prize, Regional/National Physics Olympiad for Senior High School *2009*

Honorable Mention, International Junior Science Olympiad Selection Camp *2008*

Teaching Experiences & Professional Services

Teaching Assistant, Carnegie Mellon University *Fall 2017* and *Spring 2019*

- 10-707 Topics in Deep Learning (Instructor: Dr. Ruslan Salakhutdinov)
- 10-716 Advanced Machine Learning / New Statistical Machine Learning (Instructor: Dr. Pradeep Ravikumar)

CMU Machine Learning Department: PhD Admission, Master Admission, Speaking Skills.

Conference and Journal Reviewer: ICML, NeurIPS, ICLR, ICCV, CVPR, AISTATS, ACL, EMNLP, TPAMI, TIP.
Student Advising: Denny Wu (BSc, CMU, 2018 → PhD, Toronto), Muqiao Yang (MSc, CMU, 2020 → PhD, CMU), Martin Q. Ma (MSc, CMU, 2020 → PhD, CMU), Yue Wu (BSc, CMU, 2020 → PhD, CMU)