HUANGJIE ZHENG

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RESEARCH INTERESTS

General Interests: Bayesian Learning and Statistical Inference methods for probabilistic modeling with application to several domains, such as Deep Learning, Representation Learning, etc.

- Deep generative model, *e.g.* Generative Adversarial Network, Variational Autoencoder, *etc.*
- Representation Learning from high-dimensional data.
- Corresponding problems in relevant fields like computer vision, *etc.*

EDUCATION

University of Texas at Austin (UT) August 2019 - Present
PhD student in Statistics and Data Science.
GPA: 4.0/4.0

Shanghai Jiao Tong University (SJTU) March 2017 - March 2019
M.S. in Information Engineering (Sino-French Cooperative Education Program).
GPA: 3.87/4.0

Telecom ParisTech ENST September 2016 - March 2017
Grande Ecole Engineer Cycle in Data Science and Computer Networking.
Average Course Grade: A

Shanghai Jiao Tong University (SJTU) September 2012 - August 2016
B.S. in Information Engineering (Sino-French Cooperative Education Program).
GPA: 3.66/4.3

PUBLICATIONS

[1] **H. Zheng**, X. Chen, J. Yao, H. Yang, C. Li, Y. Zhang H. Zhang, I. W. Tsang, J. Zhou and M. Zhou. CCT: Contrastive Conditional Transport for Representation Learning. Preprint, 2021. (Submitted to ICML 2021)

[2] **H. Zheng** and M. Zhou. ACT: Asymptotic Conditional Transport. Preprint, 2020. (Submitted to ICML 2021) [PDF]

[3] H. Zhang, Z. Wang, J. Xu, H. Zhang, **H. Zheng**, M. Zhou, J. Bian and F. Wang. Semantic Transport for Unsupervised Domain Adaptation (Submitted to SIGKDD 2021)

[4] X. Chen, S. Chen, J. Yao, **H. Zheng**, Y. Zhang, and I. W. Tsang. Learning on Attribute-Missing Graphs. IEEE transactions on pattern analysis and machine intelligence, 2020. [PDF]

[5] Q. Zhang, **H. Zheng**, M. Zhou. MCMC-Interactive Variational Inference. Preprint, 2020. [PDF]

[6] T. Ni, L. Xie, **H. Zheng**, E. K. Fishman, A. L. Yuille. Elastic Boundary Projection for 3D Medical Imaging Segmentation. CVPR 2019 [PDF]

[7] **H. Zheng**, L. Xie, T. Ni, Y. Zhang, Y. Wang, Q. Tian, E. K. Fishman, A. L. Yuille. Incorporating Multi-Phase Information for Medical Imaging Segmentation. Preprint, 2019. [PDF]

[8] **H. Zheng**, J. Yao, Y. Zhang, I. W. Tsang and J. Wang. Understanding VAEs in Fisher-Shannon Plane. AAAI Proceedings of the Thirty-Third AAAI Conference on Artificial Intelligence, 2019. [PDF]

[9] **H. Zheng**, J. Yao, Y. Zhang and I. W. Tsang. Degeneration in VAE: in the Light of Fisher Information Loss. Preprint, 2018. [PDF]

[10] **H. Zheng**, Y. Wang, C. Han, F. Le, R. He and J. Lu. Learning and Utilizing Ontology with Machine Learning in Attack Detection. 17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/ 12th IEEE International Conference On Big Data Science And Engineering (TrustCom/BigDataSE) 2018. (Oral Presentation) [Link]

[11] **H. Zheng**, J. Yao, and Y. Zhang. Describing Geographical Characteristics with Social Images. MultiMedia Modeling. Springer International Publishing, 2017. (Oral Presentation) [Link]

RECENT PROJECT

Contrastive Conditional Transport for Representation Learning October 2020 - Present
University of Texas at Austin, advised by Prof. Mingyuan Zhou

- We propose to investigate the contrastive learning in a view of the conditional transport. An intuition is the feature extractor is encouraged to minimize the transport cost of the positive samples and maximize the transport cost of the negative samples.
- We propose a new objective function which learns two conditional distributions to determine the importance of positive and negative pairs for the cost computation. These two learnable conditional distributions encourage the learner to capture local connectivity of positive and negative samples
- Better interpretability and robustness are very nice properties of our method. Our method shows better performance than SOTA methods on various datasets. Moreover, our method is compatible with most of the existing methods. For example, on the ImageNet dataset, our model can be adapted on Moco/Moco v2 framework and improve the performance by around 2%.
- Our method shows the robustness in learning representations on some imbalanced datasets. For example, we decrease the number of samples in some classes of the datasets for training and keep the same testing set for testing. On this class-imbalanced datasets, most of existing contrastive learning methods underperform than in the normal case to large extent, while our method preserves the effectiveness of learning and shows better performance.

Asymptotic Conditional Transport May 2020 - Present
University of Texas at Austin, advised by Prof. Mingyuan Zhou

- We propose asymptotic conditional transport (ACT) as a new divergence to measure the difference between two probability distributions. ACT consists of the expected cost of a forward transport from a data point of one distribution to the other distribution, and that of a backward CT which reverses the transport direction.
- Equipped with two navigators that amortize the computation of conditional transport plans, the ACT divergence comes with unbiased sample gradients that are straightforward to compute, making it amenable to mini-batch stochastic gradient descent based optimization.
- On a wide variety of benchmark datasets for generative modeling, substituting the default statistical distance of an existing GAN with the ACT divergence is shown to consistently improve the performance.
- Apart from generative models, we have already started working on applying ACTs conditional transport plans to a wide variety of tasks, including contrastive representation learning, image-to-image translation, and imitation learning (inverse reinforcement learning) tasks, etc. and get good preliminary results on these tasks.

MCMC interacted Variational Inference August 2019 - Present
University of Texas at Austin, advised by Prof. Mingyuan Zhou

- To improve MCMC strategies and Variational Inference, we propose MCMC-interactive variational inference (MIVI) to not only estimate the posterior in a time constrained manner, but also facilitate the design of MCMC transitions.
- We propose to utilize stochastic gradient Langevin dynamics (SGLD) and Gibbs sampling for more flexible posterior modeling and optimization.
- To prevent "over-pruning" and "posterior collapsing" in VAE models, we propose various encoding strategies and gradient estimators to make VAEs more robust and obtain tighter lower bound, as well as better latent code.
- We also propose to generalize the lower bound, and the novel encoding strategy can be applied to the generator in generative adverserial net (GAN), which provides a new way to combine VAEs and GANs.

PREVIOUS PROJECT

Learning on Attribute-Missing Graphs July 2018 - July 2019
Shanghai Jiao Tong University, advised by Prof. Ya Zhang

· We study the graph whose nodes partially provide attribute information and existing graph learning methods including the popular GNN cannot provide satisfied learning performance since they are not specified for attribute-missing graphs. By making a shared-latent space assumption, we develop a novel distribution matching based GNN for structure-attribute transform and get promising results, which can benefit numerous real-world applications such as link prediction and node attribute completion tasks.

Unsupervised Image Anomaly Detection in the Light of Information Theory July 2018 - July 2019
Shanghai Jiao Tong University, advised by Prof. Ya Zhang

· We study Variational AutoEncoders (VAEs) and anomaly detection problems in the perspective of information theory. We propose insight of using an information theoretic lower bound for optimization in anomaly detection. With this bound, we can achieve better results than SOTA methods with only normal data.

Improving Variational Autoencoders with Fisher Information July 2015 - July 2018
Shanghai Jiao Tong University, advised by Prof. Ya Zhang

· We explore why the trade-off between representation learning quality and likelihood maximization exists in VAEs, and how to balance the trade-off effectively, through Modeling with Fisher information and Shannon entropy, and with the *Uncertainty Principle*.
· We study on two-stage combination of generative model and deep learning and find out how to learn hierarchical representation using topic model and low-level features extracted with deep learning based method.
· We propose an application in mining descriptive characteristics of a region from social images, using the learned representation.

Aligning Arterial and Venous Phases for CT images segmentation May 2018 - Dec 2018
Johns Hopkins University, advised by Prof. Alan L. Yuille

· We investigate the problem of organ segmentation on multi-phase medical images. In this specific work, we study the abdominal CT scans that often have arterial phase and venous phase, which provide complementary information for the task.
· From the perspective of generative models, we explore the intrinsic gap between the ideal setting and the real world scenario, which often makes it difficult to use multi-phase knowledge.
· We propose a framework that combines knowledge transfer and segmentation to incorporate the useful information from both phases. Our model improves the segmentation result on two-phase and mono-phase data.

SELECTED HONORS AND AWARDS

Outstanding Graduates of Shanghai (Top 5% in Shanghai)	2019
National Scholarship for Graduate Students	2017
Excellent Teaching Assistant	2017
Outstanding Graduates of Shanghai (Top 5% in Shanghai)	2016
Excellent Undergraduate Thesis in SJTU (Top 1% in University)	2016
Meritorious Winner in Mathematical Contest in Modeling (MCM)	2015
Undergraduate-Entrance Bursary (Top 1% in Chinese University Entrance Exam)	2012