# Ali Lotfi Rezaabad

*2501 Speedway, Austin, TX 78712*

☎ (240) 302-0810 | ✉ alotfi@utexas.edu | 🏠 Homepage | ⌨ Github | 🔗 LinkedIn | 🎓 Google Scholar

## Education

**The University of Texas at Austin, ECE Department**                                *Texas, USA*

PH.D. CANDIDATE IN ELECTRICAL & COMPUTER ENGINEERING WITH FOCUS ON MACHINE LEARNING                *Aug. 2017 - Nov. 2022*

- Contrastive Representation Learning, Domain Adaptation, Generative Models, Adversarial Training

**Sharif University of Technology, EE Department**                                *Tehran, Iran*

M.SC. IN ELECTRICAL ENGINEERIN WITH FOCUS ON COMMUNICATION SYSTEMS                *Aug. 2014 - June 2016*

- Optimization, Millimeter Wave Cellular Networks, Wireless Communication Systems

**University of Kerman, EE Department**                                *Kerman, Iran*

B.SC. IN ELECTRICAL ENGINEERING WITH FOCUS ON COMMUNICATION SYSTEMS                *Aug. 2010 - June 2014*

- MIMO wireless communication, Space-Time Block Codes (STBC)

## Skills

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| **Areas of Expertise** | **D**omain adaptation, **C**ontrastive representation learning, **A**dversarial training, **V**ariational Inference, **K**nowledge Distillation, **S**core-based models |
| **High-level languages** | **P**ython(Expert), **M**atLab(Expert), **C**++(Fluent) |
| **Frameworks** | **P**yTorch, **T**ensorflow, **S**ciPy, **S**cikit-learning |
| **Cloud Platforms** | **A**WS |

## Graduate Coursework

**N**atural language processing, **D**eep probabilistic modeling, **L**arge-scale optimization, **I**nformation theory **C**ombinatorics & **G**raph theory, **S**tatistical models for big data, **P**robability & stochastic process, **S**tochastic process, **A**daptive filters, **A**dvanced communication systems

## Selected Projects

***Domain Adaptation***                                                                *PyTorch*

- **Knowledge Distillation**; designed and developed a knowledge distillation framework for self-supervised contrastive learning, where the useful information from the source model drifts to the target (goal) model.
- **Few-Shot Training**; the proposed knowledge distillation framework was modified and enhanced to transfer the source model's knowledge to the target model with very few acquired target samples, so named *Few-Max*.
- **Verification of Efficiency**; the proposed *Few-Max* knowledge distillation scheme was scrutinized based on different source and target dataset scenarios, including from natural images (ImagNet as the source) to MRI model (as the target).
- Deliveries: Paper, Code

***Robust Adversarial Training***                                                                *PyTorch*

- **Robust Neural Networks**; proposed a method for jointly training a provably robust classifier and detector, specifically by introducing an additional "abstain/detection" into a classifier.
- **Verifiable Robust Networks**; innovated a pioneer scheme to extend certification techniques by considering detection to provide provable verification.
- Deliveries: Patent, Paper, Code

***Hyperbolic Variational Inference***                                                                *PyTorch*

- **Hyperbolic Graph Embedding**; demonestrated and proved that the inclusion of variational inference objective in conjunction with a hyperbolic embedding in latent space is able to capture tree-like hierarchical representation and improve quantitative metrics on downstream tasks. (link)
- **Semi-Implicit Variational Inference**; provably showed that the semi-implicit variational inference provably reduces the mutual information between the input and latent representation.
- **Enhanced Semi-Implicit Variational Inference**; represented a method to enforce the objective function with an additional mutual information term and providing a computationally tractable approach for estimating it.
- **Hyperbolic Adversarially Learned Inference**; ongoing project on applying hyperbolic geometry to generative adversarial networks.
- Deliveries: Paper, Code

### *Natural Language Processing* *PyTorch, Gensim, NumPy, SciPy*

- **Neural Networks for Sentiment Analysis**; implementation of feedforward (deep averaging) NNs, LSTM, and bi-directional LSTM networks by using various dimensional GloVe vectors for sentiment analysis task.
- **Sequential CRF for Named Entity Recognition**; implementation of a CRF sequence tagger based on Viterbi algorithm for NER task.
- **Classification for Person Name Detection**; explored and reinforced different feature extraction methods for person name detection
- – Deliveries: Code

### *Generative Models* *Tensorflow, PyTorch, NumPy*

- **InfoMax-Pixel RNN**; design and developed a new family of variation autoencoder, *InfoMax-VAE*, with Pixel RNNs and Pixel CNNs for image generation.
- **Variational Auto-encoders (VAEs)**; the study and implementation of well-known VAE frameworks, *e.g.*, $\beta$-VAE, Info-VAE, Adversarial-VAE, Factor-VAE, MMD-VAE, Wasserstein-VAE, Pixel-CNN VAE.
- **Generative Adversarial Networks (GANs)**; surveyed different dual representation for GANs, Info-GAN, f-GAN and Wasserstein-GAN.
- **Text Generation**; innovated an energy-efficient spiking LSTM networks for generating new texts, word-level and character-level.
- – Deliveries: Paper-1, Code-1, Paper-2, Code-2

### *Entropy and Mutual Information Estimation with Deep Networks* *Tensorflow*

- **Mutual Information Neural Estimation (MINE)**; the study and implementation of MINE algorithm.
- **Variational Info-Bottleneck**; the study and implementation of variational info-bottleneck.
- **Info-Regularizer**; mitigation of the overfitting phenomenon of deep neural networks using information-theoretic regularizer.
- – Deliveries: Code

### *Inference* *Tensorflow, PyTorch*

- **Stein Inference**; studied the theory and implementation of Stein variational gradient descent.
- **Semi-Implicit Variational Inference**; studied the theory of semi-implicit variational inference; with input as implicit random variable and a parametric variational posterior distribution.

## Experiences

### Robert Bosch LLC (Bosch Center for AI) *Pennsylvania, USA*
MACHINE LEARNING RESEARCH INTERNSHIP *June. 2021 - Aug. 2021*

- Developed a recurrent latent variable model for sensory data acquired from an electric car engine.
- Proposed a domain adaptation method to robustly model recurrent latent variables for the real-world scenario (under heavy noise from the environment).

### Robert Bosch LLC (Bosch Center for AI) *Pennsylvania, USA*
MACHINE LEARNING RESEARCH INTERNSHIP *June. 2020 - Aug. 2020*

- Proposed a robust adversarial training with an abstain option to improve adversarial training performance on clean images. The work has been patented. US Patent(17/035,203)
- Proposed verifiable adversarially trained network based on interval bound propagation. The resulting paper has been accepted at ICLR, 2021.

### UT Dell Medical School *Texas, USA*
MACHINE LEARNING SCIENTIST *Jan. 2020 - June 2020*

- Proposed a machine learning-based approach for phenotyping pediatric patients with Asthma. The results are published at machine learning conference for healthcare, MLHC, 2020.

### The University of Texas at Austin *Texas, USA*
RESEARCH ASSISTANT *Aug. 2017 - PRESENT*

- Ongoing project on few-shot domain adaptation for unsupervised contrastive representation learning. (link)
- Completed project on extracting hierarchical representations from high-dimensional datasets. (link)
- Completed project on the intersection of information theory and generative models to boost the quality of new generated samples. (link)

### Sharif University of Technology *Tehran, Iran*
RESEARCH ASSISTANT *Aug. 2014 - June 2017*

- Reinforcement learning applications to 5G wireless communications
- Proposed a framework for 5G wireless network infrastructure planning (the results are published on IEEE transaction of vehicular technology)

### The University of Texas at Austin *Texas, USA*
TEACHING ASSISTANT *Aug. 2017- June 2018*

- Probability & stochastic process/ Linear systems design & analysis

# Patents

F. Sheikholeslami, Z. Kolter, **A. Lotfi Rezaabad** "Method and System for Probably Robust Classification With Detection of Adversarial Examples", *US Patent App. 17/035,203, 2022.* (link)

# Publications

**A. Lotfi Rezaabad**, S. Kumar, S. Vishwanath, and J. Tamir, "Few-Max: Few-Shot Domain Adaptation for Unsupervised Contrastive Representation Learning", *Preprint. Under review.* (link)

**A. Lotfi Rezaabad**, R. Kalantari, S. Vishwanath, M. Zhou, and J. Tamir, "Hyperbolic Graph Embedding with Enhanced Semi-Implicit Variational Inference", *Proceedings of The 24th International Conference on Artificial Intelligence and Statistics,* AISTATS 2021. (link)

F. Sheikholeslami, **A. Lotfi Rezaabad**, and Z. Kolter, "Provably robust classification of adversarial examples with detection", *The Ninth International Conference on Learning Representations*, ICLR 2021. (link)

**A. Lotfi Rezaabad**, R. Peters, M. Sitter, A. Shende, and S. Vishwanath "Phenotyping Patients with Asthma: Preprocessing, and Clustering Algorithms" *2020 Proceedings of the 4th Machine Learning for Healthcare Conference*, August 7-8, Michigan, USA. (link)

**A. Lotfi Rezaabad** and Sriram Vishwanath, "Long Short-Term Memory Spiking Networks and Their Applications", *International Conference on Neuromorphic Systems 2020 (ICONS 2020). Association for Computing Machinery*, New York, NY, USA, Article 3, 1–9. (link)

**Ali Lotfi Rezaabad**, and Sriram Vishwanath, "InfoMax-VAE: Learning Representation by Maximizing Mutual Information in Variational Autoencoder ", *IEEE International Symposium on Information Theory (ISIT)*, CA, USA, 2020, pp. 2729-2734. (link)

**A. Lotfi Rezaabad**, H. Beyranvand, J. A. Salehi, and M. Maier, "Ultra-Dense 5G Small Cell Deployment for Fiber and Wireless Backhaul-Aware Infrastructures", *in IEEE Transactions on Vehicular Technology*, vol. 67, no. 12, pp. 12231-12243, Dec. 2018. (link)

**A. Lotfi Rezaabad**, S. Talebi and A. Chizari, "Two quasi orthogonal space-time block codes with better performance and low complexity decoder," *10th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP)*, Prague, 2016, pp. 1-5. (link)

V. AmiriKooshki, M. A. SadatHosseini, **A. Lotfi Rezaabad** and S. Talebi, "Performance enhancement of the Golden code by utilizing the ORIOL antenna," *8th International Symposium on Telecommunications (IST)*, Tehran, 2016, pp. 288-292. (link)