Mahyar JafariNodeh

Email : mahyarjn@mit.edu
Mobile : +1 617 852 7401

Education

- **Sharif University of Technology** — Tehran, Iran
  Bachelors in Electrical Engineering; GPA: 19.4 / 20 — *Sep 2019 - Jun 2023*
- **Massachusetts Institute of Technology** — Cambridge, MA
  Institute for Data, Systems and Society (IDSS) — *Sep 2023 -*
  Laboratory for Information and Decision Systems (LIDS)
  Ph.D. Program in Social Engineering Systems

Research Interests

- Networks and System Sciences
- Language Modeling
- Causal Inference
- Theory of Optimization and Learning

Publications

** Indicates equal contribution.*

- **M. JafariNodeh**, A. Ajorlou, A. Jadbabaie, "Belief Samples Are All You Need For Social Learning.", Submitted to IEEE Conference on Decision and Control (CDC), 2024. Paper
- G. Aminian, A. Bagheri*, **M. JafariNodeh***, R. Karimian*, MH. Yassaee, "Semi-supervised Learning under Self-training via f-Divergence.", The Second Tiny Papers Track at ICLR, 2024. Paper

Experience

- **MIT** — Cambridge, MA
  Research Assistant — *Sep 2023 -*
  - **Alignment of Language Models**:
    M. JafariNodeh, A. Beirami, "Language Model Alignment Through The Lens of Genralized Divergences", Manuscript Under Preparation.
    - What We Do: We are extending language model alignment techniques by using more general divergence functions, such as -Rényi divergence, as the penalizing function over the alignment dataset.
    - What Is The Result: By employing -Rényi divergence instead of KL divergence, we aim to mitigate the impact of large log-likelihood ratios that can occur with small probabilities (heavy-tailed distributions).
    - Why It Is Important: This approach could make language model alignment more reliable by addressing the limitations of KL divergence in handling heavy-tailed distributions. Improving alignment reliability is crucial for developing safe and trustworthy language models.
  - **Non-Asymptotic Continuous Average Treatment Effect Estimation**:
    M. JafariNodeh, M. Ghadiri, A. Jadbabaie, "Finite Population Continuous Average Treatment Effect Estimation via Regression Adjustment.", Manuscript Under Preparation.
    - What We Do: We explored regression adjustment for experiments with multiple and continuous treatments, offering unbiased estimators with variance tied to linear fit quality, and extended our analysis to include a finite set of dosages using non-parametric estimators.
    - What Is the Result: Provided non-asymptotic bias and variance bounds for both types of treatments, revealing a dependency on the continuous treatment effect curve's smoothness and analyzing the balance between dosage diversity and unit allocation.
    - Why It Is Important: Our work broadens the understanding of experimental design beyond traditional treatment/control setups, with implications for scientific, medical, and industrial research, especially in optimizing the inclusion and analysis of varied treatment intensities.
  - **Convergence of ADAM Under Heterogeneous Curvatures**:
    M. JafariNodeh, A. Reisizadeh, A. Jadbabaie, "Convergence of ADAM Under Heterogeneous Curvatures.", Manuscript Under Preparation.
    - What We Do: We aim to analyze the convergence of the Adam optimization algorithm under the assumptions of bounded noise and a Hessian matrix with heterogeneous curvatures.

    - What Is The Result: We plan to formalize the convergence rate of Adam, expressing it in terms of problem-dependent constants and the condition number of the diagonal Hessian matrix.
    - Why It Is Important: Understanding the convergence behavior of Adam under heterogeneous curvatures will provide insights into its performance compared to SGD in such settings, since ADAM has fueled the modern networks and variants of it are used to train the giant chatbots.

- **Marco Mondelli's Lab** ISTA, Austria
  Scientific Intern - Prof. Marco Mondelli *July 2022 - Sep 2022*
  - **Analyzing Behvaior of SAM Optimization Techniques**:
    - What We Do: Investigated SAM's impact on shallow neural networks, modifying it to probe generalization in over-parameterized scenarios, simplifying analysis to derive a closed-form solution for weights.
    - What Is the Result: Our adapted SAM algorithm matched or outperformed the original, demonstrating a monotonic decrease in test loss with increased model complexity, indicative of mitigating double descent.
    - Why It Is Important: This study enhances understanding of optimization and model generalization, suggesting SAM's potential in self-tuning regularization and reducing computational costs in neural network training.

  The poster is available in here

- **Statistical Signal Processing lab** Sharif University, Tehran
  Research Assistant *Oct 2021 - Jun 2023*
  - **A Framework for Recommender Systems**:
    - What We Do: Developed a method combining latent feature extraction from time series and user-item interactions with graph-based techniques to predict and prevent user churn, advancing to a personalized recommender system using graph signal processing.
    - What Is the Result: Achieved a sparse, high-performance network that outperforms current models in accuracy, utilizing frequency domain analysis for a fair and customizable recommender system.
    - Why It Is Important: Enhances subscription-based company strategies by preventing churn and personalizing recommendations, introducing a novel application of graph signal processing for improved service delivery.

Skills Summary

- **Languages**: Java, C++, Python, C, SQL, R, Unix scripting
- **Tools**: Kubernetes, Docker, Hadoop, GIT, XCode, Keras, Pytorch, Tensorflow, Jax

Service

Reviewer for ISIT 2024

Honors and Awards

- Ranked 5th among 180: EE Department, Sharif University of Technology

  Overall Ranking among all the EE students across all the fields.

- Academic Achievement Award, EE Department, Sharif University of Technology, 2022

  Awarded to top 3 highest GPA in the corresponding academic year.

- Academic Achievement Award, EE Department, Sharif University of Technology, 2021

  Awarded to top 3 highest GPA in the corresponding academic year.

- Ranked 68th (top 0.1%) among 250,000 students taking part in Iran National University Entrance Exam (Konkur) in Mathematics/Physics Branch, 2019

Selected Advanced Courses

Course	**Topic**
Probability Theory	Mathematics
High Dimensional Probability	Mathematics
Random Processes	Mathematics
Real-Complex-Functional Analysis	Mathematics
Convex Optimization	Mathematics
Advanced Optimization	Mathematics
Foundations of Statistics	Mathematics
Foundations of Deep Learning	Learning
Theory of Machine Learning	Learning
Information Theoretical Statistical Learning	Learning
Design and Analysis of Algorithms	CS

Academic Projects

- **Implement a multi-modal sentiment analysis and caption generator**: Develop from scratch a high-performance multi-modal model based on state-of-art RNN-based NLP tools and leveraging methods from Signal processing to perceive the voices and CNNs to process the video and maintain it's performance on Filimo movie subscription service. (Apr '22)
- **Sentiment Analysis Network using modified BERT**: developing and maintaining a new NLP framework to analyze and recognize sentiments of comments in the review sections of the company using tools like Python, Java, and Libraries such as Pytorch, Keras from structured and unstructured data-types and state-of-art algorithms to modify BERT (a highly used NLP-based tool) to increase the accuracy of the model and keeping the framework online to analyze user feedbacks at any time. (Dec '21)
- **Picture denoising Using RNN's**: Implemented an RNN-based system that denoises the noisy pictures by getting help from tools from signal processing such as wavelet transform and using RNNs on the output to output a more clear picture. (Feb '22)
- **A fair movie website**: Design a recommender system for a created social net that preserves fairness, in the sense that it can be personalized and each user may set his degree of personalization (By using graph signal processing tools in the users' graph). (Work is done in the second paper and implemented here) (Oct '22)

TA Experience

- **Information theory**
  Held tutorial classes — *Sep 2022 - Feb 2023*
- **Advanced Linear Algebra**
  Held tutorial classes and designed HWs — *Feb 2022 - Jul 2022*
- **Probability theory**
  Designed HW/Quiz questions — *Sep 2021 - Feb 2022*

Professional References

1. Prof. Ali Jadbabaie
   Massachusetts Institute of Technology
   Email: jadbabai@mit.edu

2. Prof. Marco Mondelli
   Institute of Science and Technology Austria (ISTA)
   Email: marco.mondelli@ist.ac.at

3. Ahmad Beirami
   Senior Research Scientist
   Google Research
   Email: ahmad.beirami@gmail.com