

Afshin Abdi

PH.D. CANDIDATE · GEORGIA TECH

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Dynamic and motivated researcher and professional with extensive experience in managing and working on projects from concept to completion. Skills include analytical thinking, creative problem solving, and computer programming. Have expertise and research/work experience in the areas of

Machine Learning · Optimization · Distributed Training · Signal & Image Processing · Data Science

Education

Georgia Institute of Technology

📍 Atlanta, GA

PH.D. IN ELECTRICAL AND COMPUTER ENGINEERING (EXPECTED JUNE, 2020)

GPA 4.0/4.0

Thesis: *Distributed Learning and Inference in Deep Models*

Sharif University of Technology

📍 Iran

M.SC. IN ELECTRICAL ENGINEERING, COMMUNICATION

GPA 18.07/20

B.SC. IN ELECTRICAL ENGINEERING, COMMUNICATION

GPA 18.60/20

Research Experience

Georgia Institute of Technology

📍 Atlanta, GA

GRADUATE RESEARCH ASSISTANT

2014–present

- Distributed Training and Inference of Deep Neural Networks (2017–present)
- Federated Learning over Wireless Edge Networks (2019–present)
- Deep Learning for Coding and Communication (2018–present)
- Deep Model Compression (2017–present)
- Compressed Sensing and Signal Processing in Biology (2016–present)
- (Universal) Data Compression (2014–2016)

University of Tehran

📍 Iran

RESEARCHER

2011–2013

- Distributed Source Coding
- Functional Compression in Sensor Networks

Work Experience

ProcessMiner

📍 Atlanta, GA

DATA SCIENCE INTERN

May–July, 2018

I developed and evaluated various algorithms for processing and cleaning data, causality analysis and finding the most significant parameters in controlling the quality of the final product in paper mill industry. The algorithms were implemented in [Python](#), and tested and successfully evaluated on real data by the industry experts. The outcomes of the algorithm were used to simplify and improve the quality control of the products in the manufacturing process.

Kavosh co.

📍 Iran

CO-FOUNDER AND PRODUCT DEVELOPER

2012–2013

We designed and developed numerous products for automatic traffic monitoring and road inspection, and delivered various services based on the computer vision and signal processing, such as

- 3D imaging and inspection of road surface in real-time (using [CUDA](#) and [C++](#)),
- Automatic traffic monitoring, including license plate recognition and OCR, and instantaneous and average speed measurement of each car (using [C++](#) and [C#](#)).

Beena

📍 Iran

R&D MANAGER FOR ALGORITHM DEVELOPMENT AND COMPUTER VISION

2009–2011

Lead a successful team of researchers and engineers, and worked on various projects from concept to production for automatic real-time inspection of trains and railways. Developed algorithms based on joint laser-camera imaging, computer vision, and 3D reconstruction for parameter measurement and anomaly detection, using [MATLAB](#), [C++](#), [Embedded C++](#), and [LabView](#). Examples of the developed products include *WheelView*, *LazerView*, and *BrakeView*.

Teaching Experience

Course Development

UNIVERSITY OF TEHRAN

2011

Participated in Developing *Real-Time Digital Signal Processing Laboratory Using TI Processors*.

Instructor

UNIVERSITY OF TEHRAN

2012–2013

Instructor of "A Short Course on Real-Time Digital Signal Processing Using TI DSP Processors".

Teaching Assistant

GEORGIA TECH

Teaching Assistant for the course *Introduction to Signal Processing*.

SHARIF UNIVERSITY OF TECHNOLOGY

Teaching Assistant for the courses *Adaptive Filters*, *DSP Processors*, *Digital Signal Processing Lab*, *Differential Equations*, and *Communication systems I*.

Honors and Awards

Student Travel Award, AAAI conference on Artificial Intelligence, 2020

📍 New York, NY

CSIP Outstanding Research Award, Georgia Tech, 2019

📍 Atlanta, GA

Colonel Oscar P. Cleaver Award, Top Score in Ph.D. Preliminary Exam, Georgia Tech, 2013

📍 Atlanta, GA

Gold medal, 13th Iran's National Mathematics Olympiad

📍 Iran

Silver medal, 12th Iran's National Mathematics Olympiad

📍 Iran

Selected (top 50), 6th Iran's National Informatics Olympiad

📍 Iran

Rank #6, Iran's National Universities Entrance Exam for M.Sc. in Mathematics

📍 Iran

Rank #2, Iran's National Universities Entrance Exam for M.Sc. in Computer Science

📍 Iran

Rank #8, Iran's National Universities Entrance Exam for M.Sc. in Communications

📍 Iran

Rank #3, Top B.Sc. Students in Electrical Engineering at Sharif University of Technology

📍 Iran

Selected Projects

> Machine Learning: Algorithms and Applications

Distributed and Parallel Training of Deep Neural Networks

Georgia Tech

PH.D. RESEARCH

2017–present

Developed and analyzed novel algorithms to mitigate communication bottleneck in distributed training from three different perspectives: *Information Theory and CEO*, *Matrix Factorization*, and *Compressive Sampling*. Implemented and evaluated using [Python](#) and [Tensorflow](#).

Federated Learning in Wireless Edge Networks

Georgia Tech

PH.D. RESEARCH

2019–present

Proposed a novel communication and distributed learning algorithm that satisfies the edge network's constraints, such as unreliable transmissions and limited power, while preserving data privacy and benefiting from wireless over-the-air computations.

Distributed Model Inference

Georgia Tech

PH.D. RESEARCH

2019–present

Developed and analyzed novel techniques for efficient training and inference of distributed multimodal/multi-input deep models over a (wireless) sensor network, using [Python](#) and [Tensorflow](#).

Deep Model Compression

Georgia Tech

PH.D. RESEARCH

2017–present

We proposed *Net-Trim*, a fast layer-wise convex optimization framework, to prune trained deep neural networks. We analyzed the sample complexity of the method, and mathematically proved the consistency between the original and the pruned deep models. [[Github](#)]

Applications of Deep Learning in Coding and Communication

Georgia Tech

PH.D. RESEARCH

2018–present

Exploiting the manifold nature of the joint source-channel coding problems, we have developed novel neural network architectures and devised information theoretic/VAE-based cost functions for training using [Python](#) and [Tensorflow](#).

› Signal Processing and Compressed Sensing

Compressed Sensing with Side-Information in Biology

Georgia Tech

GRADUATE RESEARCH

2016–present

Proposed and evaluated novel algorithms to estimate the micro-RNAs' concentrations or discover their abnormal behavior through measurements from a small group of cheap biosensors, where we have utilized the side-information about the micro-RNAs' behavior, such as sparsity, bounded variations (expressed through ℓ_2 or ℓ_∞ norms), and causality, to improve the estimation accuracy.

Optimum Sensor Selection

Georgia Tech

GRADUATE RESEARCH

2017

Developed and evaluated a novel optimization technique to select the optimum set of sensors from a library of sensors in the presence of noise and interference, using [MATLAB](#) and [cvx](#).

Computation, Quantization, and Rate-Distortion in Biology

Georgia Tech

GRADUATE RESEARCH

2016–2017

Analyzed stochastic computations in biological agents, developed algorithms for the optimal quantization and investigated its distortion in sensing and estimation of the concentration of molecular signals in the synthetic biological agents equipped with ligand receptors.

Causality Analysis in Time-Series Signals

ProcessMiner

INTERNSHIP

2018

Developed and evaluated various algorithms for cleaning, processing and causality analysis of time-series signals in [Python](#). The results were used to simplify and improve the quality control of the products in the paper mill industry.

› Information Theory, Compression and Communication

In-Field Seismic Signal Compression

Georgia Tech

GRADUATE RESEARCH

2014

Developed and analyzed various techniques for efficient compression of seismic signals based on minimum-entropy and sparse dictionary learning, one-bit re-sampling, and exploiting memory from previous transmissions.

Universal Data Compression

Georgia Tech

GRADUATE RESEARCH

2014

We analyzed how using information from past compressed data can significantly improve the compression gain, especially for short blocks of data, such as network packets. We developed efficient methods to exploit that knowledge using [C++](#) and [MATLAB](#).

Publications

› Machine Learning: Algorithms and Applications

1. A. Abdi and F. Fekri, "Indirect stochastic gradient quantization and its application in distributed deep learning," in *AAAI conference on Artificial Intelligence*, 2020, **20% acceptance rate**
2. A. Abdi and F. Fekri, "Quantized compressive sampling of stochastic gradients for efficient communication in distributed deep learning," in *AAAI conference on Artificial Intelligence*, 2020, **20% acceptance rate**
3. A. Aghasi, A. Abdi, and J. Romberg, "Fast convex pruning of deep neural networks," *SIAM Journal on the Mathematics of Data Science*, 2020
4. A. Abdi and F. Fekri, "Reducing communication overhead via ceo in distributed training," in *IEEE International Workshop on Signal Processing Advances in Wireless Communications*, 2019

5. Y. M. Saidutta, A. Abdi, and F. Fekri, "Joint source-channel coding for gaussian sources over AWGN channels using variational autoencoders," in *IEEE International Symposium on Information Theory*, July 2019
6. Y. M. Saidutta, A. Abdi, and F. Fekri, "M to 1 joint source-channel coding of gaussian sources via dichotomy of the input space based on deep learning," in *Data Compression Conference (DCC)*, 2019
7. Y. M. Saidutta, A. Abdi, and F. Fekri, "Joint source-channel coding of gaussian sources over AWGN channels via manifold variational autoencoders," in *Annual Allerton Conference on Communication, Control, and Computing*, 2019
8. A. Abdi and F. Fekri, "Nested dithered quantization for communication reduction in distributed training," *arXiv preprint arXiv:1904.01197*, 2019
9. A. Aghasi, A. Abdi, N. Nguyen, and J. Romberg, "Net-trim: Convex pruning of deep neural networks with performance guarantee," in *Advances in Neural Information Processing Systems*, 2017, **presented as Spotlight, 3% acceptance rate**
10. A. Abdi, and F. Fekri, "RePurpose: Restructuring and Pruning of Deep Models for Parallel Distributed Inference," *submitted to International Conference on Machine Learning (ICML)*, 2020
11. A. Abdi, Y. M. Saidutta, and F. Fekri, "Analog Compression and Communication for Federated Learning over Wireless MAC," *submitted to IEEE International Workshop on Signal Processing Advances in Wireless Communications*, 2020
12. Y. M. Saidutta, A. Abdi, and F. Fekri, "VAE for Joint Source-Channel Coding of Distributed Gaussian Sources over AWGN MAC," *submitted to IEEE International Workshop on Signal Processing Advances in Wireless Communications*, 2020
13. A. Abdi, and F. Fekri, "A Convex Optimization Framework for Model Compression with Performance Guarantee," *in Process*

➤ Signal Processing, Compressed Sensing, and Applications in Biology

1. H. Zhang, A. Abdi, and F. Fekri, "Recovering noisy-pseudo-sparse signals from linear measurements via ℓ_∞ ," in *Annual Allerton Conference on Communication, Control, and Computing*, 2019
2. H. Zhang, A. Abdi, and F. Fekri, "Compressive sensing with a multiple convex sets domain," in *IEEE International Symposium on Information Theory*, July 2019
3. H. Zhang, A. Abdi, and F. Fekri, "Analysis of sparse-integer measurement matrices in compressive sensing," in *IEEE International Conference on Acoustics, Speech and Signal Processing*, 2019
4. H. Zhang, A. Abdi, and F. Fekri, "Sparse recovery of sign vectors under uncertain sensing matrices," in *IEEE Information Theory Workshop*, 2018
5. H. Zhang, A. Abdi, and F. Fekri, "Compressive sensing with energy constraint," in *IEEE Information Theory Workshop*, 2017
6. H. Zhang, A. Abdi, and F. Fekri, "Recovery of sign vectors in quadratic compressed sensing," in *IEEE Information Theory Workshop*, 2017
7. A. Abdi and F. Fekri, "Optimal sensor selection in the presence of noise and interference," in *IEEE International Symposium on Information Theory*, 2017
8. H. Zhang, A. Abdi, F. Fekri, and H. Esmailzadeh, "Error correction for approximate computing," in *Annual Allerton Conference on Communication, Control, and Computing*, 2016
9. A. Abdi, A. Einolghozati, and F. Fekri, "Quantization in molecular signal sensing via biological agents," *IEEE Transactions on Molecular, Biological and Multi-Scale Communications*, vol. 3, no. 2, 2017
10. A. Abdi, A. Einolghozati, and F. Fekri, "Computing framework in biological cells via stochastic methods," in *IEEE Information Theory Workshop*, 2017
11. A. Einolghozati, J. Zou, A. Abdi, and F. Fekri, "Micro-RNA profile detection via factor graphs," in *IEEE International Workshop on Signal Processing Advances in Wireless Communications*, 2016
12. H. Zhang, A. Abdi, and F. Fekri, "Structure Learning for Graphical Models from Indirect Observations," *submitted to ECML-PKDD*, 2020

➤ Data Compression

1. A. Payani, A. Abdi, X. Tian, F. Fekri, and M. Mohandes, "Advances in seismic data compression via learning from data: Compression for seismic data acquisition," *IEEE Signal Processing Magazine*, vol. 35, no. 2, March 2018
2. X. Tian, A. Abdi, E. Liu, and F. Fekri, "Seismic signal compression through delay compensated and entropy constrained dictionary learning," in *IEEE International Workshop on Signal Processing Advances in Wireless Communications*, 2018
3. X. Tian, A. Abdi, E. Liu, and F. Fekri, "Memory-assisted seismic signal compression based on dictionary learning and sparse coding," in *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, 2017
4. A. Payani, A. Abdi, and F. Fekri, "Memory-assisted compression of seismic data: Tackling a large alphabet-size problem by statistical methods," in *SEG's International Exposition*, 2017
5. A. Abdi and F. Fekri, "Mixture source identification in non-stationary data streams with applications in compression," in *IEEE International Conference on Acoustics, Speech and Signal Processing*, 2017

6. A. Abdi, A. Payani, and F. Fekri, "Learning dictionary for efficient signal compression," in *IEEE International Conference on Acoustics, Speech and Signal Processing*, 2017
7. A. Payani, A. Abdi, and F. Fekri, "Near optimal representative subset selection from short sequences generated by a stationary source," in *IEEE International Workshop on Signal Processing Advances in Wireless Communications*, 2016
8. A. Abdi and F. Fekri, "Source identification and compression of mixture data from finite observations," in *IEEE Information Theory Workshop*, 2015
9. F. Fekri, M. Sardari, A. Beirami, L. Huang, A. Abdi, "Packet-level clustering for memory-assisted compression of network traffic," US **Patent**, App. 15/191,280

Extracurricular Activity

Reviewer - Conferences

IEEE International Symposium on Information Theory, IEEE Information Theory Workshop, IEEE Wireless Communications and Networking Conference, International Conference on Machine Learning (ICML), Neural Information Processing Systems (NeurIPS), AAAI Conference on Artificial Intelligence, IEEE workshop on Signal Processing Advances in Wireless Communications (SPAWC)

Reviewer - Journals

IEEE Trans. on NanoBioScienc, IEEE Trans. on Signal Processing, IEEE Communications Letters