Mher Safaryan | CV

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IST Austria, Am Campus 1, 3400 Klosterneuburg, Austria

Current Position

- **Marie Skłodowska-Curie Fellow (MSCA COFUND IST-BRIDGE)** — **ISTA, Austria**
  Institute of Science and Technology Austria (ISTA) — *Nov 2022–present*
  Optimization Theory and Algorithms for Machine Learning, advisor: Prof. Dan Alistarh
  ▹ **Industrial Secondment** — **Neural Magic Inc., USA**
  New Optimization Methods for LLM Compression, advisor: Dr. Alexandre Marques — *Sep 2024–Feb 2025*

Research Interests

◊ optimization (theory and algorithms), machine learning, federated learning
◊ large-scale, convex/non-convex, stochastic/deterministic optimization, variance reduction
◊ communication/computation/memory efficient and scalable optimization algorithms
◊ collaborative learning (asynchronous, adversarial, local training, heterogeneity, etc.)
◊ model compression (knowledge distillation, pruning, sparse optimization, quantization)
◊ information theory (compression, encoding schemes, vector quantization)

Education

- **Ph.D. in Mathematics** — **Yerevan State University, Armenia**
  Department of Mathematics, Chair of Theory of Functions — *Sep 2015–Jun 2018*
  Thesis: On estimates for maximal operators associated with tangential regions

- **M.Sc. in Mathematics (GPA 20/20)** — **Yerevan State University, Armenia**
  Department of Mathematics, Chair of Theory of Functions — *Sep 2013–Jun 2015*
  Thesis: Some generalizations of theorems of Fatou and Littlewood

- **B.Sc. in Mathematics (GPA 19.64/20)** — **Yerevan State University, Armenia**
  Department of Mathematics and Mechanics — *Sep 2009–Jun 2013*
  Thesis: Some properties of convergent and divergent convolution type operators

Experience

- **Postdoctoral Research Fellow** — **KAUST, Saudi Arabia**
  King Abdullah University of Science & Technology (KAUST) — *Oct 2019–Oct 2022*
  Department of Applied Mathematics and Computational Sciences
  Optimization for Machine Learning, advisor: Prof. Peter Richtárik

Teaching Assistance

Special Topics in Federated Learning (Spring 2020): Prof. Peter Richtárik
Stochastic Gradient Descent Methods (Fall 2020): Prof. Peter Richtárik

Research Technician — **KAUST, Saudi Arabia**
King Abdullah University of Science & Technology (KAUST)
Computer, Electrical and Mathematical Sciences & Engineering (CEMSE) Division
KAUST SRI, Center for Uncertainty Quantification in Computational Science and Engineering

▷ *Computer Algebra for Differential Equations* — *Nov 2016–Oct 2019*
Automation of symbolic PDE analysis with Wolfram Mathematica, advisor: Prof. Diogo Gomes
- *Finding conservation and dissipation laws for a system of time-dependent evolution equations*
- *Symbolic methods for overdetermined systems of linear PDEs with free parameters*

▷ *[collaboration] Big Data Optimization in Machine Learning* — *Jan 2019–Oct 2019*
Stochastic optimization methods, advisor: Prof. Peter Richtárik

Junior Researcher — **Yerevan, Armenia**
Institute of Mathematics of National Academy of Sciences — *Aug 2014–June 2019*
Real Analysis Department, advisor: Prof. Grigori Karagulyan
Harmonic Analysis: Real-variable Methods, Orthogonality, and Oscillatory Integrals

Search Engine Developer — **Yerevan, Armenia**
Teamable Software — *Apr 2014–Nov 2016*
Working extensively on data quality and all aspects of search engine in the product.
Building intelligent, advanced and scalable search engine with Python and Apache Solr.

Assistant Teacher of Olympiad Mathematics — **Yerevan, Armenia**
Quantum School — *2011–2012*

Internships and Visits

Participant — **Okinawa, Japan**
Okinawa Institute of Science and Technology (OIST) — *2024, Mar 4-16*
Machine Learning Summer School (MLSS)
Poster presentation on "Knowledge Distillation Performs Partial Variance Reduction"

Internship Student — **KAUST, Saudi Arabia**
King Abdullah University of Science & Technology (KAUST) — *2016, April–June*
Computer, Electrical and Mathematical Science and Engineering (CEMSE) Division
Automation of basic operations in analysis of PDEs using Wolfram Mathematica: variational derivative of a functional, integration by parts, generating polynomials with respect to certain symmetry groups and simplifying integral identities.

Visiting Student — **Bonn, Germany**
Hausdorff Research Institute for Mathematics (HIM) — *2016, Jan 11–15*
Winter School on *Advances in Mathematics of Signal Processing*

Programming Intern — **Yerevan, Armenia**
Instigate Training Center, Instigate Mobile CJSC — *Oct 2012–Jul 2013*

Publications

Conference papers

Thomas Robert, Mher Safaryan, Ionut-Vlad Modoranu, Dan Alistarh
LDAdam: Adaptive Optimization from Low-Dimensional Gradient Statistics,
International Conference on Learning Representations (ICLR) 2025
(acceptance rate: 32.08%, total submissions: 11,565)

- Diyuan Wu, Ionut-Vlad Modoranu, Mher Safaryan, Denis Kuznedelev, Dan Alistarh
  The Iterative Optimal Brain Surgeon: Faster Sparse Recovery by Leveraging Second-Order Information
  Conference on Neural Information Processing Systems (NeurIPS) 2024
  (acceptance rate: 25.8%, total submissions: 15,671)

- Ionut-Vlad Modoranu, Mher Safaryan, Grigory Malinovsky, Eldar Kurtic, Thomas Robert, Peter Richtárik, Dan Alistarh
  MicroAdam: Accurate Adaptive Optimization with Low Space Overhead and Provable Convergence
  Conference on Neural Information Processing Systems (NeurIPS) 2024
  (acceptance rate: 25.8%, total submissions: 15,671)

- Rustem Islamov, Mher Safaryan, Dan Alistarh
  AsGrad: A Sharp Unified Analysis of Asynchronous-SGD Algorithms
  International Conference on Artificial Intelligence and Statistics (AISTATS) 2024
  (acceptance rate: 27.5%, total submissions: 1980)

- Mher Safaryan, Alexandra Peste, Dan Alistarh
  Knowledge Distillation Performs Partial Variance Reduction
  Conference on Neural Information Processing Systems (NeurIPS) 2023
  (acceptance rate: 26.1%, total submissions: 13,330)

- Bokun Wang, Mher Safaryan, Peter Richtárik
  Theoretically Better and Numerically Faster Distributed Optimization with Smoothness-Aware Quantization Techniques
  Conference on Neural Information Processing Systems (NeurIPS) 2022
  (acceptance rate: 25.6%, total submissions: 10,411)

- Mher Safaryan, Rustem Islamov, Xun Qian, Peter Richtárik
  FedNL: Making Newton-Type Methods Applicable to Federated Learning
  International Conference of Machine Learning (ICML) 2022
  (acceptance rate: 21.9%, total submissions: 5630)

- Xun Qian, Rustem Islamov, Mher Safaryan, Peter Richtárik
  Basis Matters: Better Communication-Efficient Second Order Methods for Federated Learning
  International Conference on Artificial Intelligence and Statistics (AISTATS) 2022
  (acceptance rate 29%, total submissions: 1685)

- Mher Safaryan, Filip Hanzely, Peter Richtárik
  Smoothness Matrices Beat Smoothness Constants: Better Communication Compression Techniques for Distributed Optimization
  Conference on Neural Information Processing Systems (NeurIPS) 2021
  (acceptance rate: 26%, total submissions: 9122)

- Mher Safaryan, Peter Richtárik
  Stochastic Sign Descent Methods: New Algorithms and Better Theory
  International Conference of Machine Learning (ICML) 2021
  (acceptance rate: 21.5%, total submissions: 5513)

Journal papers

- Rustem Islamov, Xun Qian, Slavomír Hanzely, Mher Safaryan, Peter Richtárik
  Distributed Newton-Type Methods with Communication Compression and Bernoulli Aggregation
  Transactions on Machine Learning Research (TMLR), 2023
- Aleksandr Beznosikov, Samuel Horváth, Peter Richtárik, Mher Safaryan
  On Biased Compression for Distributed Learning
  Journal of Machine Learning Research (JMLR), 2023
- Mher Safaryan, Egor Shulgin, Peter Richtárik
  Uncertainty Principle for Communication Compression in Distributed and Federated Learning and the Search for an Optimal Compressor
  Information and Inference: A Journal of the IMA, 2021
- Mher Safaryan
  On Generalizations of Fatou's Theorem in L^p for Convolution Integrals with General Kernels
  The Journal of Geometric Analysis, Volume 31, pp. 3280–3299, 2021
- Mher Safaryan
  On an equivalency of rare differentiation bases of rectangles
  Journal of Contemporary Mathematical Analysis, Volume 53(1), pp. 57-61, 2018
- Grigori Karagulyan, Mher Safaryan
  On a theorem of Littlewood
  Hokkaido Mathematical Journal, Volume 46(1), pp. 87-106, 2017
- Grigori Karagulyan, Davit Karagulyan, Mher Safaryan
  On an equivalency of differentiation basis of dyadic rectangles
  Colloquium Mathematicum, Volume 146, pp. 295-307, 2017
- Grigori Karagulyan, Mher Safaryan
  On generalizations of Fatou's theorem for the integrals with general kernels
  The Journal of Geometric Analysis, Volume 25(3), pp. 1459-1475, 2014
- Yuri Movsisyan, Sergey Davidov, Mher Safaryan
  Construction of free g-dimonoids
  Algebra and Discrete Mathematics, Volume 18(1), pp. 138–148, 2014

Preprints

- Arto Maranjyan, Mher Safaryan, Peter Richtárik
  GradSkip: Communication-Accelerated Local Gradient Methods with Better Computational Complexity, arXiv:2210.16402, *(under submission, TMLR)*, 2022
- Alyazeed Albasyoni, Mher Safaryan, Laurent Condat, Peter Richtárik
  Optimal Gradient Compression for Distributed and Federated Learning, arXiv:2010.03246, 2020
- Diogo A. Gomes, Mher Safaryan, Ricardo de Lima Ribeiro, Mohammed Sayyari
  A Surprisingly Effective Algorithm for the Simplification of Integrals and Sums Arising in the Partial Differential Equations and Numerical Methods, KAUST Repository, 2020

Awards

- **Top Reviewer Award at NeurIPS 2022**

- **Marie Skłodowska-Curie Fellowship** — **IST Austria**
  MSCA COFUND IST-BRIDGE — *Nov 2022 - Apr 2025*
- **Top Reviewer Award at AISTATS 2022**
- **Nominal Fellowship Djrbashian** — **Yerevan State University**
  Given to one student for excellence and research — *Spring 2015*
- **Nominal Fellowship Mergelyan** — **Yerevan State University**
  Given to one student for excellence and research — *Spring 2014*
- **YSU bronze medal** — **Yerevan State University**
  YSU best student competition, Department of Mathematics — *2013*
- **Third Prize (2011, 2013), Honorable mention (2012)** — **American University in Bulgaria**
  International Mathematics Competition (IMC) for University Students — *2011-2013*

Teaching

- **Set Theory** — **Yerevan State University**
  Lecturer (informal mini-course) — *2015*
- **Calculus** — **Yerevan State University**
  Teaching Assistant — *2016 Jan-Apr*
- **Stochastic Gradient Descent Methods** — **KAUST**
  Teaching Assistant — *Fall 2020*
- **Special Topics in Federated Learning** — **KAUST**
  Teaching Assistant — *Spring 2020*

Co-supervision of Master's Theses

Artavazd Maranjyan, Yerevan State University, Armenia, (Jan 2022 – Oct 2022).....

Arto Maranjyan, Mher Safaryan, Peter Richtárik
GradSkip: Communication-Accelerated Local Gradient Methods with Better Computational Complexity
arXiv:2210.16402, 2022
Currently: PhD student at KAUST, Saudi Arabia (August 2023 - present)

Rustem Islamov, Institut Polytechnique de Paris, France (Apr 2023 – Sep 2023).....

Rustem Islamov, Mher Safaryan, Dan Alistarh
AsGrad: A Sharp Unified Analysis of Asynchronous-SGD Algorithms
International Conference on Artificial Intelligence and Statistics (AISTATS) 2024
Currently: PhD student at The University of Basel, Switzerland (October 2023 - present)

Reviewing

- ELLIS PhD Programm (Evaluator): 2023, 2024.
- International Conference on Learning Representations (ICLR): 2020, 2021, 2022
- International Conference on Machine Learning (ICML): 2020, 2021, 2023

- Conference on Neural Information Processing Systems (NeurIPS): 2020, 2021, 2022, 2023
- International Conference on Artificial Intelligence and Statistics (AISTATS): 2022, 2024
- ICML 2021 Workshop on Federated Learning for User Privacy and Data Confidentiality (FL-ICML'21)
- NeurIPS OPT Workshop on Optimization for Machine Learning: 2023, 2024
- International Symposium on Distributed Computing (DISC): 2024
- Journal of Machine Learning Research (JMLR)
- IEEE Transactions on Information Theory (TIT)
- IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)

Selected Talks

- International Conference on Machine Learning, July 17-23, 2022, Baltimore, Maryland USA **(spotlight)**
- Mohamed bin Zayed University of AI (MBZUAI), guest lecture, April 26, 2022 (virtual) **(invited)**
- Toyota Technological Institute at Chicago (TTIC) reserach seminar, April 6, 2022 (virtual) **(invited)**
- Rising Stars in AI Symposium 2022, March 13-15, KAUST **(invited)**
- Conference on Neural Information Processing Systems, December 6-14, 2021 (virtual)
- Federated Learning One World (FLOW) Seminar, August 4, 2021 (virtual)
- International Conference on Machine Learning, July 18-24, 2021 (virtual)
- ICLR Distributed and Private Machine Learning (DPML) Workshop, 2021 (virtual)
- NeurIPS International Workshop on Scalability, Privacy, and Security in Federated Learning (SpicyFL) 2020 (virtual)
- Federated Learning One World (FLOW) Seminar, November 25, 2020 (virtual)
- YerevaNN Machine Learning Research Seminar, April 25, 2020 (virtual)