Shayan Talaei

Curriculum Vitae

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Education

Bachelor of Computer Engineering 2019 - Present

Sharif University of Technology, Tehran, Iran

Rank 2 out of 199 students in the computer engineering department.

Total GPA: 19.82/20

Publications and Preprints

H. Zakerinia, **S. Talaei**, G. Nadiradze, D. Alistarh, "QuAFL: Federated Averaging Can Be Both Asynchronous and Communication-Efficient." Submitted to ICLR 2023 Conference. (arxiv)

S. Talaei, G. Nadiradze, D. Alistarh, "Hybrid Decentralized Optimization: First- and Zeroth-Order Optimizers Can Be Jointly Leveraged for Faster Convergence." To be submitted to ICML 2023 Conference. (arxiv)

Research interests

- **Machine learning**
- **ML theory**
- **Optimization**
- **Statistical models**
- **Distributed computing**

Research Internships and Projects

Internship in Machine Learning Theory June 2022 - Present

Swiss Federal Institute of Technology in Lausanne (EPFL Switzerland)

Supervised by: Prof. Emmanuel Abbe, Theodor Misiakiewicz

- **Evolving Kernels**
  We developed an algorithm inspired by the merged-staircase property to combine kernels iteratively. We constructed a sequence of kernels, such that each kernel is derived from previous kernels and their corresponding models so that it outperformed all the previous models. Using this technique, kernel methods can be improved to compete with neural networks on real-world datasets, specifically in small-size sample regimes.
- **The Effect of Bottlenecks on Reasoning Neural Networks**
  We studied the effect of binary bottlenecks in neural network architectures. We observed that using a sufficiently large dataset and the correct-size bottleneck, the model will be forced to do reasoning instead of memorizing the inputs.

Internship in Distributed and Federated Optimization July 2021 - June 2022

Institute of Science and Technology Austria (IST Austria)

Supervised by: Prof. Dan Alistarh, Dr. Giorgi Nadiradze

- **Quantized Asynchronous Federated Learning** (arxiv)
  We presented a new variant of the classic federated averaging (FedAvg), which supports both asynchronous communication and communication compression. I implemented a time-based simulator using Pytorch to study the behavior of different federated learning algorithms.
- **Hybrid Decentralized Optimization** (arxiv)
  We initiated the study of "Hybrid Decentralised Optimization" where nodes with zeroth-order and first-order capabilities jointly attempt to solve a distributed optimization task. To prove a linear speedup in convergence rate, I proposed a new analysis technique that works even with noisy gradient estimators. Moreover, I implemented a distributed simulator to study the convergence behavior of our algorithm combined with different gradient estimators.

Awards

2019 **Gold medal** International Mathematical Olympiad (IMO), United Kingdom.
2019 **Gold medal** ELMO Mathematical Olympiad, USA MOP.
2018 **Gold medal (Perfect score)** European Mathematical Cup (EMC), Croatia.
2018 **Gold medal (Rank 1)** Iranian National Mathematical Olympiad, Iran.
2019 **Silver medal** Romanian Master of Mathematics (RMM), Romania.
2019 **First-degree Diploma** XVIII Silk Road Mathematical Competition (SRMC), Kazakhstan.
2018 **First-degree Diploma** XVII Silk Road Mathematical Competition (SRMC), Kazakhstan.
2017 **Gold medal (as national and international)** Iranian Geometry Olympiad (IGO), Iran.
2016 **Gold medal (as national and international)** Iranian Geometry Olympiad (IGO), Iran.
2017 **First Diploma** XIII Olympiad in Geometry in honor of I.F.Sharygin, Russia.
2016 **Second Diploma** XII Olympiad in Geometry in honor of I.F.Sharygin, Russia.

Selected presentations

Set agreement impossibility proof through Combinatorial Topology Dec. 2021
Modern distributed systems and algorithms course at IST Austria
Presentation on the proof of FLP impossibility from the perspective of Combinatorial Topology, as the course project. (slides)

Constraint satisfaction technique for Combinatorics problems Feb. 2021
The joint Iran-Ukraine mathematics olympiad camp
Lectured on a self-developed technique and thinking method for multi-conditional statement problems.
Explained and utilized the technique in the IMO and RMM most challenging problems.
Presentation in English for **the national gold medalists of Iran and Ukraine**.

Teaching experience

Teacher assistant Spring 2021
Sharif University of Technology (SUT Iran)
Teacher assistant for the course discrete mathematics and structures lectured by Prof. Mohammad Ali Abam.
Organized and taught problem-solving sessions for a third of the course syllabus.
Graded midterm exam of the course for 100 students.

Scientific committee member 2019-2021
Iranian Young Scholar Club(IYSC)
Proposing and selecting problems for the Iranian National Mathematical Olympiad: first, second rounds, summer camp exams, IMO team selection tests.
Instructor and consultant in mathematics competitions for the Iranian gold medalists and Iran's IMO team members.

Scientific committee member Sept. 2020
Iranian Geometry Olympiad (IGO)
Gauged and crafted solutions for more than 90 problems proposed from 12 countries.
Collaborated with other members in designing contests for three levels, held in 49 countries. (booklet)

Skills

Programming	Python | R | Java | C | C++ | SQL | Bash | LaTeX | Racket | Verilog
Frameworks	PyTorch | Tensorflow, Keras | JAX | NumPy | Pandas | Scikit-Learn | CUDA | Jupyter
Languages	Persian: Native | English: IELTS Band Score 7.5, TOEFL iBT Score 107

Related Coursework

Machine **L**earning | **D**eep **L**earning | **A**rtificial **I**ntelligence | **L**inear **A**lgebra | **Prob**ability and **Stat**istics
Modern **Dis**tributed **Sys**tems and **Opt**imization (at IST Austria) | **C**omputer **N**etworks | **O**perating **S**ystems
Numerical Methods for **Opt**imization | **A**lgorithm **D**esign | **A**dvanced **P**rogramming | **D**iscrete **S**tructures

References

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