Shahrzad Kianidehkordi

shkiani.github.io | shahrzad.kianidehkordi@mail.utoronto.ca | +1(416)230-2796 | Toronto, ON

Highlights of Qualification

- Gold medalist in National Mathematical Olympiad, with a keen interest in applying mathematics and theory to applied AI and engineering for novel innovations and efficient implementation.
- Certified at Int. HBC summer school, Japan, and interned at Huawei, refining programming skills.
- Researched trustworthy distributed computing. Contributed to enhancing system reliability.
- Applied coding theory and approximation to mitigate straggler effect in distributed computing.
- Integrated overlapped groups in differential private federated learning. Improved privacy-utility tradeoff.
- Interned at CISPA, Germany, modeled dynamic trust and incentives to enhance privacy-utility tradeoff.

Education

- Ph.D. in **Communications (Trustworthy Distributed Learning)**, GPA: 3.94/4 Sep 2019 - Present
  MASc. in **Communications (Distributed Coded Computing)**, GPA: 3.74/4 2017 - 2019
  University of Toronto (UofT), Department of Electrical and Computer Engineering (ECE)
- B.Sc. in **Electrical Engineering (Digital Systems)**, GPA: 17.4/20 2012 - 2017
  Sharif University of Technology (SUT), Department of Electrical Engineering
  Minor in **Economics**, GPA: 17.4/20
  SUT, Department of Management and Economics

- Certified at **North American School of Information Theory (NASIT)** June 2023
  University of Pennsylvania, Philadelphia, PA, USA
- Certified at **International High-Performance Computing Summer School (IHPCSS)** July 2019
  RIKEN Center for Computational Science(R-CCS) and Kobe University, Kobe, Japan

Research and Work Experiences

- **Graduate Research Assistant** 2017 - Present
  ECE department, UofT, Supervisor: Prof. Stark C. Draper
  - Closely collaborated with 3 professors, 2 postdocs, 2 PhD students, and 3 MASc students during my PhD and MASc studies, focusing on 4 projects which leads to published research.
  - **MASc thesis:** Researched coded distributed computing (CDC), mixing coding theory and distributed computing. Formulated unified geometric perspective for CDC. Designed "hierarchical" CDC inspired by coded modulation in digital communication. Developed order-statistics analysis. Run Monte Carlo simulations in MATLAB. Implemented on Amazon EC2/Compute Canada using MPI in Python/C++.
  - **1st Ph.D. project:** Integrated approximate computing into CDC to further mitigate stragglers effect. Designed "successive" approximate coding, a rate-distortion analogs for CDC. Enabled multiple recovery stages for faster lower-fidelity results, inspired by learning applications. Analyzed finite precision and approximation errors. Implemented in Python. Showcased improved accuracy-speed tradeoff.
  - **2nd Ph.D. project:** Researched federated learning (FL). Integrated overlapping group structure into FL, accommodating users belonging to multiple groups while preserving privacy within/across groups. Analyzed and controlled privacy leakage propagation via differential private mechanisms. Reduced unnecessary randomness between trusted peers, improving privacy-accuracy tradeoff.
  - **3rd Ph.D. project:** UofT-CISPA joint project, conducted during internship at CISPA. Awarded Mitacs Globalink for internship in Germany.

- **Visiting Scientist, Intern** Apr-Jul 2024
  SprintML Lab, CISPA Helmholtz Center for Information Security, Saarbrücken , Germany
  Supervisors: Prof. Franziska Boenisch and Prof. Adam Dziedzic
  - Collaborated on a 6-month project with 3 professors and a MASc student—3 months in-person, 3 months online. Mentored the MASc student and coordinated task delivery to supervisors.
  - Researched privacy-preserving federated learning and incentive mechanisms. Contributed theoretical and optimization guidelines to novel dynamic trust modeling and incentive mechanism designs.
  - Implemented in PyTorch on Google Cloud GPUs. Showcased improved utility-privacy tradeoff.

- **Machine Learning Researcher, Intern** Summer 2021
  Accelerated Neural Technology (Ant) Team, Noah's Ark Lab, Huawei Technologies Co., Montreal
  Supervisor: Prof. Vahid Partovi Nia
  - Collaborated with hardware team. Conducted theoretical problem-solving. Communicated design advises to hardware team. Presented theoretical findings to other teams. Authored comprehensive reports.
  - Researched acceleration techniques for training large neural networks (NN). Contributed and formulated novel theoretical bounds beneficial for floating-point arithmetic in NN model training.
  - Studied implementation details of PyTorch's layer-by-layer computations in NN. Focused on floating-point arithmetic and identified numerical instabilities in both forward and backward functions.

- **Undergraduate Research Intern** July 2015-Sep 2015
  Chinese University of Hong Kong (CUHK), Department of Inf. Eng., Supervisor: Prof. Chandra Nair
  - Studied fundamental open problems in network information theory. Focused on modeling achievable regions and bounds for particular communications channels. Developed simulations in MATLAB.

- **Undergraduate Research Assistant** 2015-2017
  Image and Multimedia Processing Lab, SUT, Supervisor: Prof. Farokh Marvasti
  - Attended Signal Processing Cup 2015 in a group of 3 math Olympiad winners and a Ph.D. student. Our team ranked 1st nationally and 8th internationally. Designed motion artifacts cancellation method for heart rate tracking problem. Used PPG/acceleration signals to estimate high-resolution PPG spectrum.

Publications

1 **S. Kiani**, F. Boenisch, and S. Draper, *"Controlled privacy leakage propagation throughout overlapping grouped learning," IEEE J. Selected Areas in Inf. Theory (***JSAIT***)*, 2024.
2 **S. Kiani**, F. Boenisch, and S. Draper, *"Controlled privacy leakage propagation throughout differential private overlapping grouped learning," IEEE Int. Symp. Inf. Theory (***ISIT***)*, Athens, Greece, 2024.
3 **S. Kiani** and S. Draper, *"Successive approximated coded matrix multiplication," IEEE J. Selected Areas in Inf. Theory (***JSAIT***)*, 2022.
4 **S. Kiani** and S. Draper, *"Successive approximated coded matrix multiplication," IEEE Int. Symp. Inf. Theory (***ISIT***)*, Espoo, Finland, Jun 2022.
5 **S. Kiani**, T. Adikari, and S. Draper, *"Hierarchical Coded Elastic Computing," IEEE Int. Conf. on Acoustics, Speech, and Signal Processing (***ICASSP***)*, Toronto, ON, Canada, May 2021.
6 **S. Kiani**, N. Ferdinand, and S. Draper, *"Hierarchical Coded Matrix Multiplication," IEEE Trans. Inf. Theory (***TIT***)*, 2020.
7 **S. Kiani**, N. Ferdinand, and S. Draper, *"Cuboid Partitioning for Hierarchical Coded Matrix Multiplication,"* workshop on Coded ML, *IEEE Int. Conf. Machine Learning (***ICML***)*, 2019.
8 **S. Kiani**, N. Ferdinand and S. Draper, *"Hierarchical Coded Matrix Multiplication," IEEE Canadian Workshop on Inf. Theory (***CWIT***)*, Hamilton, ON, Canada, Jun 2019.
9 S. Sadrizadeh, **S. Kiani**, M. Boloursaz, F. Marvasti, *"Iterative Method for Simultaneous Sparse Approximation,"* in *Scientia Iranica, Transaction D: Computer Science and Electrical Engineering*, 2019.
10 **S. Kiani**, N. Ferdinand and S. Draper, *"Exploitation of Stragglers in Coded Computation," IEEE Int. Symp. Inf. Theory (***ISIT***)*, Vail, Colorado, Jun 2018.
11 M. Boloursaz, M. Eskandari, E. Asadi, **S. Kiani**, F. Marvasti, *"Heart Rate Tracking Using Wrist-Type Photoplethysmographic (PPG) Signals during Physical Exercise with Simultaneous Accelerometery," IEEE Signal Processing Letters (***SPL***)*, 2016.

Technical Skills

- Experience with operating systems: **Microsoft Windows** and **Linux**, and with distributed version control systems: **GIT** and **Mercurial**. Skillful in documentation using **LaTeX** and **Microsoft Office**.
- Proficiency in scripting languages: **Python** and **MATLAB**, in programming language: **C++**. Familiarity with **C**, **Java**, and **Julia**, and with hardware description language: **Verilog**.
- Ability to use cloud and HBC systems: **Compute Canada**, **Amazon EC2**, and Google Cloud.
- Knowledge of **parallel/multi-thread** programming, and basic familiarity with **GPU** programming
- Familiar with deep learning frameworks: **PyTorch** during research, and **TensorFlow** during courses.

Awards and Honors

- **Gold** medal in National Mathematical Olympiad in Iran 2011
- **8th** place in IEEE Signal Processing Cup 2015 among 60 teams 2015
- Accepted into CUHK competitive internship, granted with full scholarships 2015
- Accepted into the IHPCSS in Japan, granted with full scholarship. July 2019
- Winner of **Ontario Graduate Scholarship (OGS)** for two consecutive years. 2019-2021
- Recipient of University of Toronto student and research fellowship. 2017-2023
- Winner of **DiDi graduate award** for four consecutive years. 2020-2024
- **NSERC Scholar**, Alexander Graham Bell Graduate Scholarship-Doctoral (CGS D3). 2021-2024
- **Mitacs Globalink** research award abroad. Apr-Jul 2024

Teaching and Mentoring Experiences

- Teaching assistant in *"Signal and Systems"* (ECE216) at UofT. Winter'19,'20,'22,'24
- Teaching assistant in *"Advanced Engineering Maths."* (MAT290) at UofT. Fall'19,'20,'21,'22,'23
- Teaching assistant in *"Algorithms and Data Structures"* (ECE1762) at UofT. Winter'23
- Teaching assistant in *"Algorithm Design, Analysis and Complexity"* (CSC373) at UofT. Fall'20
- *Mentoring* an undergraduate student who got involved in the Co-op program at NVIDIA. 2019
- Teaching assistant in *"Matrix Algebra and Optimization"* (ECE367) at UofT. Fall'18
- Teaching assistant in *"Principles of Electronics"* at SUT. Fall'16
- *Olympiad* Math Teacher in Tehran Farzanegan 1 and 3 High Schools (SAMPAD), Iran. 2012 - 2016

Talks and Presentations

- Presented Publications $1-2$ at *ISIT*'24, Greece.
- Presented Publications $3-4$ at *ISIT*'22, Finland, *Munich Workshop on Coding and Cryptography*'22.
- Presented Publication 5 at *ICASSP*'21, Canada.
- Presented Publications $6-8$ and 10 at *CWIT'19*, Canada, *Alumni Machine Intelligence Bootcamp*'18, *Computing Hardware for Emerging Intelligent Sensory Applications AGM*'19, and *IHPCSS*'19, Japan.

Selective Graduate Courses

- System Modeling and Analysis (A+)
- Statistical Methods for ML and Data Mining (A+)
- Learning to Search: Current ML Algorithms (A+)
- Introduction to Statistical Learning (A)
- Convex Optimization (A-)
- Algorithm and Data Structure (A-)
- Detection and Estimation (A)
- Random Processes (A+)
- Error Control Codes (A)

Professional Services and Activities

- **Reviewed** IEEE Journals/Conferences/workshops 2018 - Present
  - TIT/ JSAIT/ Trans. Commun/ Trans. Signal processing/ Inf. Theory Workshop/ ISIT.
- Attended North American Summer School in Inf. Theory**(NASIT' 23)** June 2023
  - Trained in *information and coding theory*, *federated learning and privacy*, and *statistical learning*.
- Attended summer school in High Performance Computing **(IHPCSS' 19)** July 2019
  - Attended fully-funded training in parallel and GPU programming, and data-intensive computing.
- *Question Designer, Corrector* and *Referee* in the high school student competition at SUT. 2014
- Assembling and commissioning an *automatic direction finder robot* in Sharif Cup at SUT. 2013

Selected Course Projects

- *"Image debluring"*, *"Optical character recognition"*, *"Audio echo cancellation"*. MATLAB. Signals Systems
- *"Segmentation"*, *"HR measurement"*, *"Digital image de-noising"*. MATLAB. Digital Signal Processing
- *"Feature extraction/classification of EEG signal using NN"*. MATLAB. AI and Biological Computation
- *"Snake video game"*. C++ using Pthread. Advanced Programming.
- *"Developed communication protocols to design SMS transfer system"*. JAVA. Data Networks.
- *"JPEG image compression"*. HDL and MATLAB. ASIC/FPGA Design.
- *"Seizure detection and prediction via ML"*. TensorFlow. Statistical Learning.
- *"Text generation with structural reader and adversarial Discriminator"*. Learning to Search.