# Sahel Torkamani

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## Research Interests

**Theoretical Machine Learning, Differential Privacy, Zero-Knowledge Proof**.

## Education

2024– Ongoing **University of Edinburgh**,
*PhD in computer science, Supervised by Professor Rik Sarkar.* .

2019–2023 **Sharif University of Technology**,
*Bachelor of Applied Mathematics*.

2013–2019 **Farzanegan 1 High-School**,
*Diploma in Physics and Mathematics Discipline*,
National Organization for the Development of Exceptional Talent.

## Publications and Preprints

In submission **Secure data scoring and selection for machine learning models with zero-knowledge proofs**,
*Thomas Wong,* ***Sahel Torkamani****, Michele Ciampi, Rik Sarkar*.

FORC 2025 **Count on your elders: Laplace vs Gaussian noise (arxiv)**,
*Joel Daniel Andersson, Rasmus Pagh, Teresa Anna Steiner,* ***Sahel Torkamani***.

TPDP 2024 **Improved Counting under Continual Observation with Pure Differential Privacy (arxiv)**,
*Joel Daniel Andersson, Rasmus Pagh,* ***Sahel Torkamani***.

JSAIT 2023 **Optimal Differential Privacy via Graphs (arxiv)**,
***Sahel Torkamani****, Javad B. Ebrahimi, Parastoo Sadeghi, Rafael G. L. D'Oliveira, Muriel Médard*.

ISIT 2022 **Heterogeneous Differential Privacy via Graphs (arxiv)**,
***Sahel Torkamani****, Javad B. Ebrahimi, Parastoo Sadeghi, Rafael G. L. D'Oliveira, Muriel Médard*.

## Honor and Awards

2024 **Awarded scholarship from the Informatics Graduate School, University of Edinburgh**.

2024 **Awarded for the best speaker in undergraduate research seminars on graph theory and computer science**, *Sharif University of Technology*.

2019 **Awarded scholarship from the National Elites Foundation**.

2018 **National Silver Medal**, *Iranian Mathematics Olympiad*.

2017 **National and International Gold Ruler**, *Iranian Geometry Olympiad*, Advance Level.

2017 **National Silver Medal**, *Iranian Mathematics Olympiad*.

2016 **National Silver Ruler**, *Iranian Geometry Olympiad*, Medium Level.

2015 **National Gold and International Bronze Ruler**, *Iranian Geometry Olympiad*, Elementary Level.

## Internships and Summer Schools

2022 **Research Internship on Coding Theory and Machine Learning**,
*Supervised by Professor Marco Mondelli, Institute of Science and Technology Austria*.

2017 **Iran's National Olympiad of Mathematics Summer Camp**,
*For elite students winning a 3 round national competition*.

2016 **Iran's National Olympiad of Mathematics Summer Camp**,
*For elite students winning a 3 round national competition*.

## Talks and Presentations

Summer 2022 **Heterogeneous differential privacy via graphs**,
IEEE International Symposium on Information Theory (ISIT).

Summer 2022 **Optimal Binary Differential Privacy via Graphs**,
Institute of Science and Technology Austria (ISTA).

Summer 2022 **Sparse Multi-Decoder Recursive Projection Aggregation for Reed-Muller Codes with Neural Network Implementation**,
Institute of Science and Technology Austria (ISTA).

Autumn 2021 **Introduction to Coding Theory**, *Mini-Course (video)*,
Department of Mathematical Sciences, Sharif University of Technology.

## Teaching Experience

Spring 2025 **Machine Learning Theory**, *Teaching Assistant and Tutorial Lecturer*,
The School of Informatics, University of Edinburgh.

Autumn 2024 **Discrete Mathematics and Probability**, *Exam Marker*,
The School of Informatics, University of Edinburgh.

Autumn 2023 **Information Theory** , *Teaching Assistant (Unofficial)*,
Department of Mathematical Sciences, Sharif University of Technology.

Autumn 2021 **Statistics and Applications** , *Teaching Assistant (Unofficial)*,
Department of Mathematical Sciences, Sharif University of Technology.

Spring 2021 **Introduction to Algorithms and Python**, *Lecturer*,
Yasan Academy.

Spring 2020 **Algebra and Number Theory in Mathematics Olympiad**, *Lecturer*,
National Organization for Development of Exceptional Talents, Farzanegan 1.

## Research Projects

March 2022–September 2022 **Sparse MultiDecoder Recursive Projection Aggregation for Reed-Muller Codes**,
Marco Mondelli, Dorsa Fathollahi,
Reed-Muller codes are one of the oldest families of codes. Following Dorsa Fathollahi and Professor Marco Mondelli's paper, a sparse recursive projection aggregation (SRPA) decoder has been proposed, which achieves a performance that is close to the maximum likelihood decoder for short-length RM codes. In this project, we simulated an algorithm based on a neural network to lower the computational budget while keeping a performance close to that of the SRPA and RPA decoder by performing a better selection of projections in each sparsified decoder.

March 2021–October 2023 **Algorithms and Differential Privacy via Graphs** ,
Javad Ebrahimi, Parastoo Sadeghi, Rafael G. L. D'Oliveira, Muriel Médard,
In this project, we have generalized the previous framework for designing utility-optimal differentially private (DP) mechanisms via graphs in two main directions. First, we studied heterogeneous mechanisms where the partial mechanism can have different probability distributions at the boundary. Secondly, we studied a general heterogeneous privacy setting on neighboring datasets which provides different levels of privacy for each. Then, we extended a partial mechanism, which is only defined at the selected vertices set, to other datasets in the graph via the concept of the strongest induced DP condition in a computationally efficient and utility-optimal manner. .

## Selected Course Projects

2022 **Trade-Offs in Information-Theoretic Multi-Party One-Way Key Agreement**.
Final project for the *Cryptography I* course, surveying trade-offs in multi-party one-way key agreement protocols.

2021 **From Error-Correcting Codes to Sphere Packings and Simple Groups**.
Final project for the *Algebra I* course, surveying the algebraic technical details of error-correcting codes.

2020 **Developing a Multi-Player Hearthstone Game over a Local Network Using Java**.
Final project for the *Advanced Programming* course, implementing multi-threading and networking techniques.

## Relevant Courses

Postgraduate Machine Learning Theory, Seminar on Differential Privacy, Cryptography, Information Theory, Coding Theory

Undergraduate Advanced Numerical Analysis, Stochastic Processes, Probability and Applications, Statistics and Applications, Linear Algebra

## Skills

- **Programming:** Java, R, Matlab, Python
- **Frameworks:** PyTorch, NumPy, CUDA, Jupyter
- **Languages:** Persian (Native), English (IELTS Band Score 7, Toefl Overall Score 101), Italian (A2)

## References


**Professor Rik Sarkar**,
*Reader*,
University of Edinburgh,
rsarkar[at]inf.ed.ac.uk.

**Professor Muriel Médard**,
*Cecil H. Green Professor*,
Massachusetts Institute of Technology,
medard[at]mit.edu.

**Professor Marco Mondelli**,
*Assistant Professor*,
Institute of Science and Technology Austria,
marco.mondelli[at]ist.ac.at.

**Professor Parastoo Sadeghi**,
*Professor*,
University of New South Wales,
p.sadeghi[at]unsw.edu.au.

**Professor Rafael G. L. D'Oliveira**,
*Assistant Professor*,
Clemson University,
rdolive[at]clemson.edu.

**Professor Javad Ebrahimi**,
*Assistant Professor*,
Sharif University of Technology,
javad.ebrahimi[at]sharif.edu.