Shahab Asoodeh

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Research and Teaching Interests

- Information theory and its applications to interpretable and responsible machine learning
- Privacy-preserving mechanism design and algorithmic fairness
- Theoretical machine learning and artificial intelligence
- Information theory for Social Good

Professional Employment

- **Harvard University** — **Cambridge, MA**
  Postdoctoral Fellow, School of Engineering and Applied Science — *2019–present*
  Faculty Mentor: **Flavio Calmon**
- **The University of Chicago** — **Chicago, IL**
  Postdoctoral Scholar, Computation Inst. and Inst. of Genetics and System Biology — *2017–2019*
  Faculty Mentors: **James Evans** (CI) and **Ishanu Chattopadhyay** (IGSB)

Education

- **Queen's University** — **Kingston, ON**
  Ph.D. in Applied Mathematics — *2017*
  Advisors: **Tamás Linder** and **Fady Alajaji**
  Thesis: Information and estimation theoretic approaches to data privacy
- **Queen's University** — **Kingston, ON**
  M.Sc. in Applied Mathematics — *2012*
  Advisors: **Tamás Linder** and **Fady Alajaji**
- **ETH Zürich and TU Delft** — **Switzerland and The Netherlands**
  M.Sc. in Electrical Engineering — *2011*
  Advisors: **Amos Lapidoth** (ETH), **Jos Weber** (TUD)
- **Shahid Beheshti University (Iran's National University)** — **Tehran, Iran**
  B.Sc. in Electrical Engineering — *2008*

Publication

Pre-prints

- **S. Asoodeh**, M. Aliakbarpour, and F. Calmon, "Strong data processing inequalities for statistical estimation under local differential privacy", *Submitted to Symposium on Foundations of Responsible Computing (FORC)*, 2021. [**pdf**]
- **S. Asoodeh**, M. Aliakbarpour, and F. Calmon, "Local differential privacy is equivalent to contraction of E_γ-divergence", *Submitted to IEEE Int. Symp. on Inf. Theory (ISIT)*, 2021. [**arXiv**]
- **S. Asoodeh**, W. Chen, F. Calmon, and A. Özgür, "Differentially private federated learning: An information-theoretic perspective", *Submitted to IEEE Int. Symp. on Inf. Theory (ISIT)*, 2021. [**pdf**]
- **S. Asoodeh**, M. Diaz, and F. Calmon, "Privacy analysis of online learning algorithms via contraction coefficient", *Submitted to IEEE Transactions on Information Theory*, 2020. [**arXiv**]

- W. Alghamdi, **S. Asoodeh**, H. Wang, F. Calmon, D. Wei and K. N. Ramamurthy, "Fair machine learning via model projection", 2020. [**short version**]
- P. Sadeghi, **S. Asoodeh**, and F. Calmon, "Differentially private mechanisms for count queries", 2020.[**arXiv**]
- M. Diaz, **S. Asoodeh**, F. Alajaji, T. Linder, J. Mingo and S. Belinschi, "On the noise-information separation of a private principal component analysis scheme", 2020. [**arXiv**]

Book Chapter

- **S. Asoodeh**, F. Alajaji and T. Linder, Almost perfect privacy for additive Gaussian privacy filters, *Springer-Verlag Lecture Notes in Computer Science: Information-Theoretic Security*, p. 259-278, 2016.

Workshop Papers

- **S. Asoodeh**, J. Liao, F. Calmon, O. Kosut, L. Sankar, "A better bound gives a hundred rounds: Differential privacy through the lens of f-divergences", *Theory and Practice of Differential Privacy, ACM Conf. Computer and Communication Security (CCS)*, 2020.
- **S. Asoodeh** and F. Calmon, "Differentially-private federated learning: Information-theoretic view", *ICML Workshop on Federated Learning for User Privacy*, 2020. [**pdf**]
- H. Hsu, **S. Asoodeh**, and F. Calmon, "Discovering information-leaking samples and features", in *NeurIPS Workshop on Privacy and Machine Learning*, 2019.

Journals

- **S. Asoodeh**, J. Liao, F. Calmon, O. Kosut, L. Sankar, "Three variants of differential privacy: lossless conversion and applications", *IEEE Journal on Selected Areas in Information Theory*, vol. 2(1), pp. 208-222, 2021. [**IEEE**][**arXiv**]
- **S. Asoodeh**, and F. Calmon, "Bottleneck problems: Information and estimation-theoretic view", *Entropy Special Issue on Information-Theoretic Methods for Deep Learning*, 2020. **[Invited Paper]** [**publisher's version**]
- **S. Asoodeh**, M. Diaz, F. Alajaji and T. Linder, "Estimation efficiency under privacy constraints", *IEEE Transaction on Information Theory,* vol. 65 (3), pp. 1512-1534, March 2019.
- **S. Asoodeh**, M. Diaz, F. Alajaji and T. Linder, "Information extraction under privacy constraint", *Information*, 2016.

Peer-Reviewed Conference Proceedings

- N. Yadati, T. Gao, **S. Asoodeh**, P. Talukdar, and A. Louis, "Graph neural networks for soft semi-supervised learning on hypergraphs", *Accepted in Pacific-Asia Conf. Knowledge Discovery and Data Mining (PA-KDD),* 2021. [pdf] [supplementary]
- H. Hsu, **S. Asoodeh**, and F. Calmon, "Information obfuscation via information density estimation", in *Int. Conf. on Artificial Intelligence and Statistics (AISTATS),* 2020.
- W. Alghamdi, **S. Asoodeh**, H. Wang, F. Calmon, D. Wei and K. N. Ramamurthy, "Model projection: theory and applications to fair machine learning", in *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2020.
- **S. Asoodeh**, J. Liao, F. Calmon, O. Kosut, and L. Sankar, "A Better bound gives a hundred rounds: Enhanced privacy guarantees via f-divergences", in *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2020.
- **S. Asoodeh**, Mario Diaz, and F. Calmon, "Privacy amplification of iterative algorithms via contraction coefficient", in *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2020.
- T. Gao, **S. Asoodeh**, Y. Huang, and J. Evans, "Wasserstein soft label propagation on hypergraphs: algorithm and generalization error bounds", in *Proc. 33rd AAAI Conf. on Artificial Intelligence (AAAI)*, 2019.
- H. Hsu, **S. Asoodeh**, and F. Calmon, "Information-theoretic privacy watchdogs", in *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2019.

- H. Hsu, **S. Asoodeh**, S. Salamatian and F. Calmon, "Generalizing bottleneck problems", *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2018.
- **S. Asoodeh**, Y. Huang and I. Chattopadhyay, "Tamper-free communication over deletion channels", in *Proc. IEEE Conference on Decision and Control (CDC)*, 2018.
- **S. Asoodeh**, T. Gao, and J. A. Evans, "Curvature of hypergraphs via multi-marginal optimal transport", in *Proc. IEEE Conference on Decision and Control (CDC)*, 2018.
- **S. Asoodeh**, M. Diaz, F. Alajaji and T. Linder, "Privacy-aware guessing efficiency", in *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2017.
- **S. Asoodeh**, F. Alajaji and T. Linder, "Almost perfect privacy over additive Gaussian channel", in *Proc. Int. Conference on Information Theoretic Security*, 2016.
- **S. Asoodeh**, F. Alajaji and T. Linder, "Privacy-aware MMSE estimation", in *Proc. IEEE Int. Symp. on Inf. Theory (ISIT)*, 2016.
- **S. Asoodeh**, F. Alajaji and T. Linder, "Lossless secure source coding: Yamamoto's setting", in *Proc. 53rd Annual Allerton Conference on Communication, Control, and Computing*, 2015.
- **S. Asoodeh**, F. Alajaji and T. Linder, "On maximal correlation, mutual information and a data privacy problem", *Canadian Workshop on Information Theory*, 2015.
- **S. Asoodeh**, F. Alajaji and T. Linder, Notes on information theoretic privacy, in *Proc. 52nd Annual Allerton Conference on Communication, Control, and Computing*, 2014.
- **S. Asoodeh**, F. Alajaji and T. Linder, "An achievability proof for the lossy coding of Markov sources with feed-forward", *Proc. Canadian Workshop on Information Theory*, 2013.
- **S. Asoodeh**, "On the energy of a single-bit communication in the Poisson channel with feedback", *Queen's Biennial Symposium on Communications*, 2012.
- **S. Asoodeh**, A. Lapidoth and L. Wang,"It takes half the energy of a photon to send one bit reliably on the Poisson channel with feedback", *Joint Workshop on Coding and Communications*, 2010.
- **S. Asoodeh**, "A new stopping criterion for turbo decoder in the presence of SNR mismatch", in *Proc. IEEE Int. Congress on Ultra Modern Telecomm. and Control Systems (ICUMT)*, 2010.
- **S. Asoodeh**, H. Ramezani and H. Samimi, "Gaussian approximation for LDPC codes", in *Proc. IEEE Int. Conf. on Wireless Communications (WICOM)*, 2007.
- **S. Asoodeh** and H. Maddahi, "On PN code acquisition in direct sequence CDMA", in *Proc. IEEE Int. Conf. on Wireless Communications (WICOM)*, 2007.
- **S. Asoodeh** and A. R. Rezazade, "A novel algorithm for CFO estimation in OFDM-based systems", in *Proc. Int. Conf. on Communications and Inf. Tech. (CIIT)*, 2007.
- **S. Asoodeh** and A. R. Rezazade, "Design of optimal period interleaver in turbo codes", in *Proc. Canadian Workshop on Information Theory*, 2007.
- E. Afjei, **S. Asoodeh** and A. Dargahi, "Error analysis in finite difference solution of linear and non-linear cylindrical magnetostatic problems", in *Proc. IEEE ACEMP*, 2007.

Research Funding

- **2020, Oracle Labs:** Private Federated Learning: From Theory to Practice. PI: Flavio Calmon. (80k USD)

Code Implementation

- Our **framework** on deep learning with differential privacy guarantees will soon be integrated into the analysis directory of Google's TensorFlow Privacy.

Talks and Workshops

- Information theory for responsible machine learning, 2021: **[Invited]**
  - Department of Computer Science and Engineering, NYU Tandon School of Engineering
  - Faculty of Information (iSchool), University of Toronto
  - Department of Computing and Software, McMaster University
  - Department of Computer Science, University of Vermont
  - School of Mathematical and Statistical Sciences, Clemson University
  - Mathematical Institute, Leiden University
- Privacy analysis of iterative algorithms via f-divergences, Google Research Seattle, 2021. **[Invited]**
- On the equivalence between local differential privacy and contraction of E_γ-divergence, Privacy Tools Meeting, Harvard University, 2021. **[Invited]**
- Three variants of differential privacy: Lossless conversion and applications, Theory and Practice of Differential Privacy (TPDP), 2020.
- Differentially private federated learning: An information-theoretic perspective, ICML Workshop on Federated Learning for User Privacy and Data Confidentiality (FL-ICML), 2020.
- Contraction coefficients of Markov kernels with applications in privacy amplification, Information Theory and Application (ITA), 2020. **[Invited]**
- Discovering information-leaking samples and feature, NeurIPS workshop on Privacy in Machine Learning, 2019.
- A better bound gives a hundred rounds: Enhanced privacy guarantees via f-divergences, Privacy Tools Meeting, Harvard University, 2019. **[Invited]**

Teaching and Mentoring Experience

- **Main Instructor**, Queen's University
  Responsibilities included developing the syllabus, choosing the material, preparing and delivering all lectures, leading class discussion, grading all assignment and advising students.
  - Probability I (2015): MTHE/STAT 351, 35 students
  - Engineering Data Analysis (2015): MTHE 367, 160 students
- **Co-instructor**, Capstone ML Project APCOMP 297R, Harvard University
  Mentoring graduate students in Computational Science and Engineering Capstone Project in partnerships with Google and Inari
  - Inari's project: published in Towards Data Science **[featured as "editor's pick"]**
  - Google's project: published in Towards Data Science
- **Pedagogical Training**, Harvard University
  Foundations of Teaching in STEM, **Bok Center of Teaching and Learning**, 2020
- **Teaching Assistant**, Queen's University
  - Information Theory (2014)
  - Combinatorial Graph Theory (2014)

Professional Services

- **Committee Work**: Member of program committee AAAI 2021
- **Reviewer**: Trans. on Information Theory, Trans. on Automatic Control, Trans. on Information Forensics and Security, Journal on Selected Area in Information Theory, ISIT 2016-2021, ICML 2020, AISTAT 2020, NeurIPS 2020 (**top 10% of high-scoring reviewers**)

Citizenship

- Iranian
- Permanent Resident of Canada (as of March 2021)