36-782: Homework 2
Due on 10/19/2023

Instructions. Select a paper from the list below, or choose another paper related to the course topics, and prepare a short report (**5 ± 3 pages**) providing an overview of the main results of the paper. Here are possible topics to cover while preparing the report.

- Clearly describe the problem, and discuss its significance and any practical applications.

- Explain the main technical result of the paper. Discuss the different assumptions made, how do they compare to prior works, and what happens if we relax one or more of the assumptions/hypotheses?

- Present an overview of the proof of the main technical result(s). Focus on explaining the ideas, and not repeating the steps of the proof.

- Discuss possible extensions or generalizations of the results. Highlight the main technical challenges in obtaining the generalizations.

Note. You can work on this either individually, or in groups of two.

Papers

Limit Theorems in probability.

- Barron (1985): Entropy and the central limit theorem, *The Annals of Probability*.

- Algoet and Cover (1988): A Sandwich Proof of the Shannon-McMillan-Breiman Theorem, *The Annals of Probability*.

- Johnson (2000): Entropy inequalities and the Central Limit Theorem, *Stochastic Processes and their Applications*.

- Gavalakis and Kontoyiannis (2021): An information-theoretic proof of a finite de Finetti theorem, *Electronic Communications in Probability*.

Applications in Machine learning.

- Steinke and Zakynthinou (2020): Reasoning about generalization via conditional mutual information, *Conference on Learning Theory*.

- Goldfeld and Polyanskiy (2020): The information bottleneck problem and its applications in machine learning. *IEEE Journal on Selected Areas in Information Theory*

Sequential Decision Making.

- Russo and van Roy (2016): An information-theoretic analysis of Thompson sampling, *Journal of Machine Learning Research*.

- Raginsky and Rakhlin (2011): Information-based complexity, feedback and dynamics in convex programming, *IEEE Transactions on Information Theory*.

Sequential Prediction.

- Wu et al. (2023): Regret Bounds for Log-Loss via Bayesian Algorithms, *IEEE Transactions on Information Theory.*

- Feder and Polyanskiy (2021): Sequential prediction under log-loss and misspecification, *Conference on Learning Theory.*

Hypothesis Testing.

- Nitinawarat et al. (2013): Controlled Sensing for Multihypothesis Testing, *IEEE Transactions on Automatic Control.*

- Harremoes, Lardy, and Grunwald (2023): Universal Reverse Information Projections and Optimal E-statistics, *IEEE International Symposium on Information Theory.*