Reading Group: Information-Theoretic & PAC-Bayes Generalization

1 General Information

Time: *Tuesdays , 10:00 to 11:30* **Location:** *EE 403*
Contact: *tinati@usc.edu*

Short Description. Goal: study generalization bounds for learning algorithms using information-theoretic and PAC-Bayesian tools. We will read and reconstruct proofs for mutual/conditional mutual information bounds, change-of-measure techniques, and PAC-Bayes bounds, starting from the references below and extending as needed.

2 References (starting points)

- **Main Reference.** F. Hellström, G. Durisi, B. Guedj, M. Raginsky, *Generalization Bounds: Perspectives from Information Theory and PAC-Bayes*. arXiv:2309.04381.
- **Mutual information bounds.** A. Xu, M. Raginsky, *Information-theoretic analysis of generalization capability of learning algorithms*. arXiv:1705.07809.
- **PAC-Bayes primer.** P. Alquier, *User-friendly introduction to PAC-Bayes bounds*. arXiv:2110.11216.

3 Format

We will mostly use the board: write down proofs step by step, unpack the key inequalities, and discuss the intuition behind each move. The emphasis is on understanding why the arguments work and how to modify them for different loss models, data assumptions, or algorithms.

4 Schedule

Week 1: Kickoff & MI view of generalization

Date: *11/04 (Tuesday)* **Presenter:** *Mohammad*

- Generalization gap; decoupling lemma; expected bound via $I(S;W)$.
- Reading: Xu–Raginsky (arXiv:1705.07809) §1, §3.1–3.2 (core lemmas & main theorem).