

Seminario CMM- Maths&AI

Speaker: Jorge Silva, Departamento de Ingeniería Eléctrica, Universidad de Chile

Title: Understanding encoder–decoder structures in machine learning using information measures.

Abstract: We present a theory of representation learning to model and understand the role of encoder–decoder design in machine learning (ML) from an information-theoretic angle. We use two main information concepts, information sufficiency (IS) and mutual information loss to represent predictive structures in machine learning. Our first main result provides a functional expression that characterizes the class of probabilistic models consistent with an IS encoder–decoder latent predictive structure. This result formally justifies the encoder–decoder forward stages many modern ML architectures adopt to learn latent (compressed) representations for classification. To illustrate IS as a realistic and relevant model assumption, we revisit some known ML concepts and present some interesting new examples: invariant, robust, sparse, and digital models. Furthermore, our IS characterization allows us to tackle the fundamental question of how much performance could be lost, using the cross entropy risk, when a given encoder–decoder architecture is adopted in a learning setting. Here, our second main result shows that a mutual information loss quantifies the lack of expressiveness attributed to the choice of a (biased) encoder–decoder ML design. Finally, we address the problem of universal cross-entropy learning with an encoder–decoder design where necessary and sufficiency conditions are established to meet this requirement. In all these results, Shannon’s information measures offer new interpretations and explanations for representation learning.

Miércoles 14de Mayo 2025 a las 15:00 hrs.

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