Structured Prediction with Localization

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Standard ML techniques learn real valued functions. However, nowadays many machine learning problems require to learn functions with structured output, e.g., automatic text translation (string \rightarrow string), image captioning (image \rightarrow string), speech recognition, prediction on graphs, learning on manifolds, learning to rank documents, protein folding, etc. In this context, current research [1] focuses on developing ad-hoc algorithms for each structured problem, often without theoretical guarantees.

Recently, [2,3] proposed a unifying theoretical framework to address general structured prediction problems by introducing a novel learning strategy with strong statistical guarantees. In particular, the derived methods are expressed in terms of an optimization problem in the output space. However, the topology and the inner structure of the data is crucial to devise proper learning strategies. Relevant data come from physical process or, more generally, processes with a recursive structure. A first step to leverage the internal structure of the process generating the data for proper structured prediction has been done in [4], where data constituted by a collection of loosely interacting parts has been considered.

The goal of this mémoire is to explore, study and summarize the state of the art on structured prediction in [3,4] from a theoretical and an algorithmic viewpoint.

References

[1] H.B. Gükhan, T. Hofmann, B. Schölkopf, A. J. Smola, B. Taskar, and S. V. N. Vishwanathan. Predicting Structured Data (Neural Information Processing). The MIT Press, 2007.

[2] C. Ciliberto, A. Rudi and L. Rosasco. A Consistent Regularization Approach for Structured Prediction. In Advances in Neural Information Processing Systems 2016. (pp. 4412-4420).

[3] C. Ciliberto, L. Rosasco, A. Rudi. General Framework for Consistent Structured Prediction with Implicit Loss Embeddings. Journal of Machine Learning Research, 21(98):167, 2020.

[4] C. Ciliberto, F. Bach, and A. Rudi. Localized structured prediction. Advances in Neural Information Processing Systems. 2019