libconform v0.1.0: a Python library for conformal prediction

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1. Introduction

This paper introduces the Python library `libconform`, implementing concepts defined in Vovk et al. (2005), namely the conformal prediction framework and Venn prediction for reliable machine learning. These algorithms address a weakness of more traditional machine learning algorithms which produce only bare predictions, without their confidence in them/the probability of the prediction, therefore providing no measure of likelihood, desirable and even necessary in many real-world application domains.

The conformal prediction framework is composed of variations of the conformal prediction algorithm (CP), first described in Vovk et al. (1999); Saunders et al. (1999). A conformal predictor provides a measurement of confidence in its predictions. A Venn predictor, on the other hand, provides a multi-probabilistic measurement, making it a probabilistic predictor. Below in the text, Venn predictors are included if only "conformal prediction framework" is written, except stated otherwise.

The conformal prediction framework is applied successfully in many real-world domains, for example face recognition, medical diagnostic and prognostic and network traffic classification (see Balasubramanian et al., 2014, part 3).

It is build on traditional machine learning algorithms, the so called underlying algorithms (see Papadopoulos et al., 2007), which makes Python the first choice for implementation, since its machine learning libraries are top of the class, still evolving and improving due to the commitment of a great community of developers and researchers.

`libconform`'s aim is to provide an easy to use, but very extensible API for the conformal prediction framework, so developers can use their preferred implementations for the underlying algorithm and can leverage the library, even in this early stage. `libconform v0.1.0` is **not** yet stable; there are still features missing and the API is very likely to change and improve. The library is licensed under the MIT-license and its source code can be downloaded from `https://github.com/jofas/conform`.

This paper combines `libconform`'s documentation with a short introduction to the implemented algorithms. Paragraphs marked with **i** contain general information about the library and descriptions of the internal workings, while paragraphs marked with **!** describe changes in future versions.

Appendix A provides an overview over `libconform`'s API and Appendix B contains examples on how to use the library.

References

Vineeth Balasubramanian, Shen-Shyang Ho, and Vladimir Vovk. *Conformal Prediction for Reliable Machine Learning: Theory, Adaptations and Applications*. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 1st edition, 2014. ISBN 0123985374, 9780123985378.

Harris Papadopoulos, Vladimir Vovk, and Alex Gammerman. Conformal prediction with neural networks. volume 2, pages 388 – 395, 11 2007. ISBN 978-0-7695-3015-4. doi: 10.1109/ICTAI.2007.47.

Craig Saunders, Alex Gammerman, and Vladimir Vovk. Transduction with confidence and credibility. 1999.

Vladimir Vovk, Alex Gammerman, and Craig Saunders. Machine-learning applications of algorithmic randomness. 1999.

Vladimir Vovk, Alex Gammerman, and Glenn Shafer. *Algorithmic Learning in a Random World*. Springer, 2005. Springer, New York.