End of studies internship offer – learning robust regression models

Titre/Title	Learning efficient Mondrian conformal regressors.
Encadrant(s) / Supervisor(s)	Sébastien Destercke, Sylvain Rousseau, Soundouss Messoudi
Laboratoire/Laboratory	Heudiasyc
Mots clés/Key words	Machine or deep learning, regression, conformal prediction
Descriptif du sujet/ Project description	Several machine learning models (especially neural networks) are able to perform very well for different tasks in terms of average precision. However, this remains insufficient in certain applications where an uncertainty measurement is necessary, especially when a bad prediction generates a great risk (for example medicine or finance). In addition, with average accuracy, these models generally fail to have consistent performance across the entire input space. In the case of regression, it is possible to make a prediction in the form of an interval to include an uncertainty measure instead of making a point prediction, (the smaller the interval, the more confident the model is of its prediction). It is also possible to add a statistical guarantee according to the level of error chosen by the user. One way to do this is conformal prediction, a generic method that can be incorporated into any machine or deep learning model. The objective of this internship is, first, to be interested in density estimation methods to identify regions of data density (sparsely populated, moderately populated, and heavily populated). Then, Mondrian conformal prediction [1] is considered to obtain valid and efficient models generating interval predictions according to the density region (sparse, moderately dense, and very dense). Finally, it is planned to train a deep model to learn the regressor and the Mondrian conformity measure based on the density estimates at the same time [2]. The tasks to be performed during this internship are as follows: - Exploring existing methods of density estimation. - Studying Mondrian conformal prediction in regression. - Using conformal prediction and a regressor according to the density estimation method(s) chosen. - Learning a regressor and a Mondrian conformity measure at the same time. To begin with, the intern will be able to study, understand and implement the article "Mondrian conformal regressors" [1]. Brief bibliography:

[1] Boström, H., & Johansson, U. (2020, August). Mondrian conformal regressors. In Conformal and Probabilistic Prediction and Applications (pp. 114-133). PMLR.

[2] Bellotti, A. (2020, August). Constructing normalized nonconformity measures based on maximizing predictive efficiency. In Conformal and Probabilistic Prediction and Applications (pp. 41-54). PMLR.

[3] Vovk, V. (2012, November). Conditional validity of inductive conformal predictors. In Asian conference on machine learning (pp. 475-490).

Possibilité de poursuite en thèse/ Possibility of continuing in PhD	Not considered for the moment.
Profil recherché/Sought profile	The applicant should have a strong background in computer science and/or mathematics, with ideally a specialization in machine learning and/or uncertainty modelling. The applicant should send the following items to soundouss.messoudi@hds.utc.fr, sylvain.rousseau@hds.utc.fr and sebastien.destercke@hds.utc.fr : • A complete CV • Motivation letter • Reference letters or mail of reference persons • Other items the applicant may find relevant (papers, reports, …)