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Interpretrability, at the crossroads of global and local sensitivity analysis

This internship is part of a collaborative research project conducted jointly with IIT Bombay (India), in partnership with Professor S. Akshay. The project will begin with an indepth study of a recent paper by Akshay et al., which introduces a concrete and innovative algorithm designed to stabilize and improve unstable discrete configurations within classification trees. Understanding this contribution will provide the student with a solid foundation in modern algorithmic techniques for enhancing decision-tree–based models.

In parallel, the intern will undertake a comprehensive review of the state of the art concerning the statistical estimation of Sobol' indices. These global sensitivity measures play a central role in quantifying the influence of input variables on model outputs, and mastering their theoretical properties as well as their numerical estimation will be essential for the next stage of the project.

The overarching goal of the internship will be to integrate these two complementary perspectives on sensitivity analysis. By combining the local stabilization insights derived from Akshay et al.'s algorithm with the global interpretability offered by Sobol' indices, the project aims to develop a unified sensitivity analysis framework capable of capturing both fine-grained and large-scale behaviors of complex algorithms. This merged approach is expected to open new pathways for improving the robustness, interpretability, and reliability of machine-learning models.

Bibliography

Ahmad, A., Tayal, T. V., Gupta, A., & Akshay, S. Sensitivity Verification for Additive Decision Tree Ensembles. *The Thirteenth International Conference on Learning Representations.*

Gamboa, F., Gremaud, P., Klein, T., & Lagnoux, A. (2022). Global sensitivity analysis : A novel generation of mighty estimators based on rank statistics. Bernoulli, 28(4), 2345-2374.