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09h30

LISN Site Plaine - Digitéo

M-E, THÈSES ET HDR

Conformal Predictions and Risk Control in Machine Learning Models to Improve Performance and Human Decision-Making

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Keywords

Computer vision, uncertainty quantification, conformal prediction, risk control, deep learning

Abstract

Machine Learning (ML) and Deep Learning (DL) models are increasingly deployed in critical applications where errors may lead to severe consequences. Despite their strong predictive performance, their inability to reliably express uncertainty limits trust, safety, and compliance. Uncertainty Quantification (UQ) addresses this challenge by estimating confidence levels in predictions, enabling safer decision-making and improved performance. In this thesis, I introduce post-hoc, model-agnostic, and black-box UQ methods applicable to both classical tasks (regression, classification) and structured outputs such as segmentation and object detection. The contributions include: (1) new conformal prediction techniques integrated into the MAPIE library, including extensions to Gaussian processes, and (2) risk-control approaches based on accuracy for biomedical detection, as well as adaptive risk control for segmentation. Experiments on various real-world datasets demonstrate that these methods enhance the reliability and effectiveness of machine learning systems.

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