

## Abstract

Machine learning has become a pervasive and influential technology, shaping decisions that have a significant impact on individuals and societies. Beyond its technical implementations, machine learning embodies implicit or explicit epistemological assumptions, framing it as a knowledge-generating practice that formalizes, interprets, and mechanizes aspects of the world. This thesis investigates the relationship between machine learning and the philosophy of science, with a particular emphasis on the epistemological aspects of explanation and its related concepts.

This work analyzes how machine learning inherits and transforms the epistemic ideals of modern science. By drawing parallels with philosophical debates on empiricism, generalization, and the problem of induction, it develops the notion of “*relational empiricism*,” an interpretative framework that redefines empiricism through the structural relations that link data, models, and observations. Building on this foundation, the thesis addresses the philosophical notion of explanation by revisiting models of scientific explanation from a historical standpoint and comparing them with current debates in eXplainable Artificial Intelligence (XAI). This comparison highlights several conceptual tensions, which are tackled through a range of philosophical perspectives. Within this context, the Black Box problem emerges, revealing deeper epistemological tensions between opacity and its various dimensions. The thesis further examines the development of medical explanation and its intersections with artificial intelligence, illustrating how philosophical conceptions of causality, trust, and explanatory adequacy inform contemporary debates on interpretability and explanation in clinical settings. Through the integration of historical, philosophical, and computational perspectives, the work presents a comprehensive framework for understanding machine learning and XAI as both technological and epistemic endeavors, illuminating how computational systems not only extend but also transform the way knowledge is justified and explained.