

Model Fingerprint

A general and efficient framework for AI/ML interpretability

As AI and machine learning become deeply integrated into decision making processes, the need to interpret complex “black box” models has become increasingly critical. In this paper, we outline our novel “Model Fingerprint” approach to model explanation and show how it shifts the focus from assigning feature importance to truly understanding the logical structure of a model.

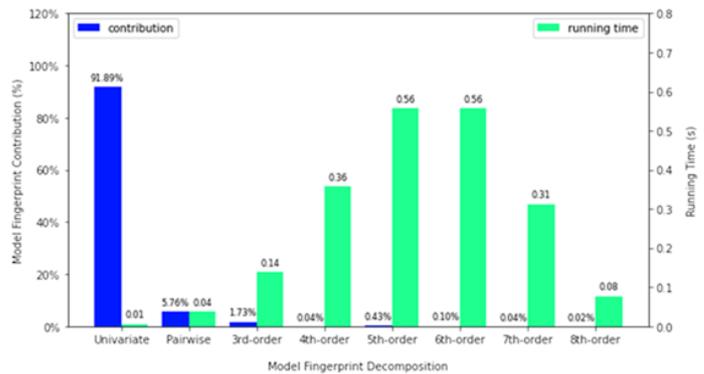
Many explanation methods, including widely used attribution techniques, ask how important each feature is to a model’s prediction. This is useful, but importance alone offers only a partial view of how a model reasons. Understanding a model is like understanding a movie. You cannot grasp the story by only listing how important each character is, even if the list is accurate. Movies are not driven by characters in isolation but by interactions – by scenes in which characters meet, by sequences of events, and by pivotal moments that make the ending inevitable. Knowing that a character mattered does not explain how or why the plot unfolded.

SHAP-style methods faithfully attribute feature importance for a model, and Model Fingerprint is fully consistent with them. In the limit, the cumulative contributions identified by Model Fingerprint converge to SHAP attributions. The distinction lies in how explanation is constructed. Rather than starting with a top-down score, Model Fingerprint builds explanations from the bottom up, identifying the smallest sets of interacting components that already reveal coherent model logics. This naturally yields low-order approximations (LOA): compact descriptions that capture what truly drives decisions, while remaining extensible rather than reductive.

Model Fingerprint reframes what it means to understand a machine learning model. It connects attribution to logic, approximation to insight, and convergence to rigor. In doing so, it advances the science of interpretability from measuring importance toward explaining reasoning – an essential step for models we must not just use, but understand.

For more on this topic, see our 2026 working paper: **“Model Fingerprint: General and Efficient Interpretability from Fundamental Prediction Logic”** by Yimou Li, Yin Li, and David Turkington.

Exhibit 1: Explanatory Contribution versus Computation Cost



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