

How (and why) to interrogate a model

We introduce a new way to detect unreliable machine predictions

How do we evaluate if someone is telling the truth or giving us an intelligent answer to a question? Picture a sharp trial lawyer, like one on TV, grilling a witness on the stand. The lawyer asks probing questions, digs for details, entertains hypotheticals, and tests the consistency of the witness's story. By stress testing their logic, the lawyer can uncover whether the witness is unreliable, just by interrogating. This is precisely what we set out to do with machine learning models.

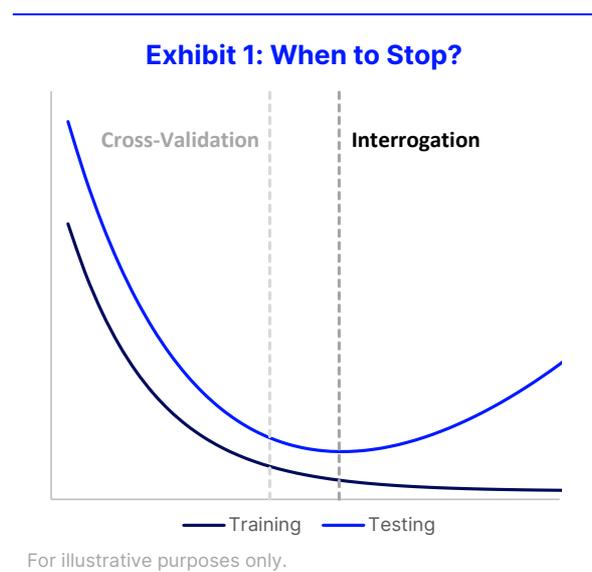
Traditionally, data scientists rely on a convoluted process of segmenting data and retraining model variants to judge the reliability of a prediction model – this is called cross-validation. It is useful, but it can't

evaluate the model trained on all available data, it reduces statistical power, it is prone to data leakage in time series settings, and it is computationally expensive. Cross-validation can be cumbersome.

We propose an alternative: interrogation. Like the trial lawyer grilling a witness, we interrogate prediction functions by asking a lot of questions and synthesizing the results. We break down their logic into linear, nonlinear, pairwise, and high-order interaction components using our Model Fingerprint method. Then, we test these components to see if they can be clearly identified amidst the noise.

We put our interrogation technique to the test by attacking a common problem: when should we stop training a powerful neural network? If we stop too early, the model *underfits* the data and won't work well in the future. If we stop too late, it *overfits* the data and makes different mistakes. The result was striking: interrogation identified near-optimal stopping times in advance, without ever using a validation sample. Interrogation is model-agnostic, so we can even use it to evaluate black-box prediction models.

If you're talking to someone and it becomes clear that they lack a basic understanding of a subject (underfitting) or they view even the simplest matters as complex chains of coincidences and conspiracies (overfitting), you are wise to think twice before acting on their hunch. Now, we can hold prediction models to the same standard.



For more on this topic, see our 2025 working paper: **"Replacing Cross-Validation with Interrogation: A Universal Test for Underfitting and Overfitting"** by Megan Czasonis, Yin Li, Huili Song, and David Turkington.

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