Internal Causal Mechanisms Robustly Predict Language Model Out-of-Distribution Behaviors

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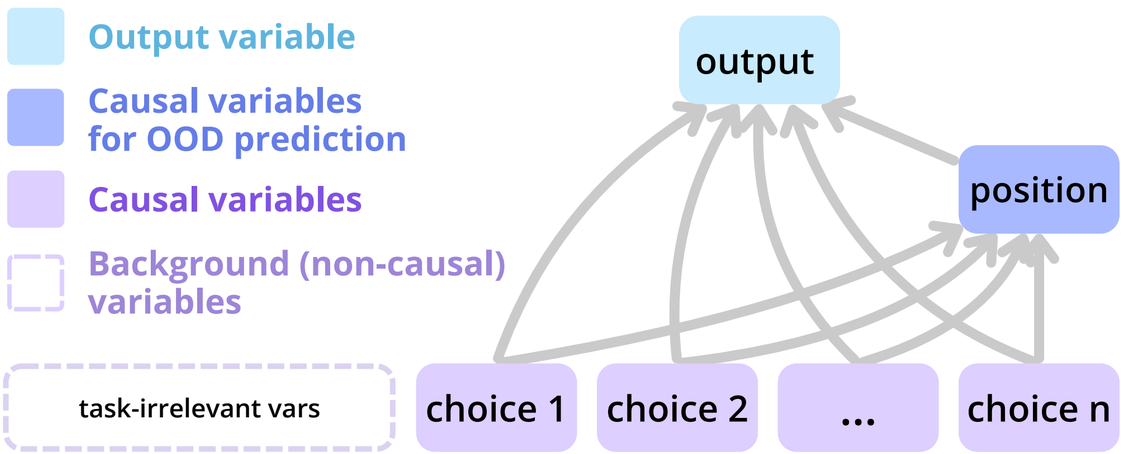
Interp Finding: Causal Mechanisms of MCQA



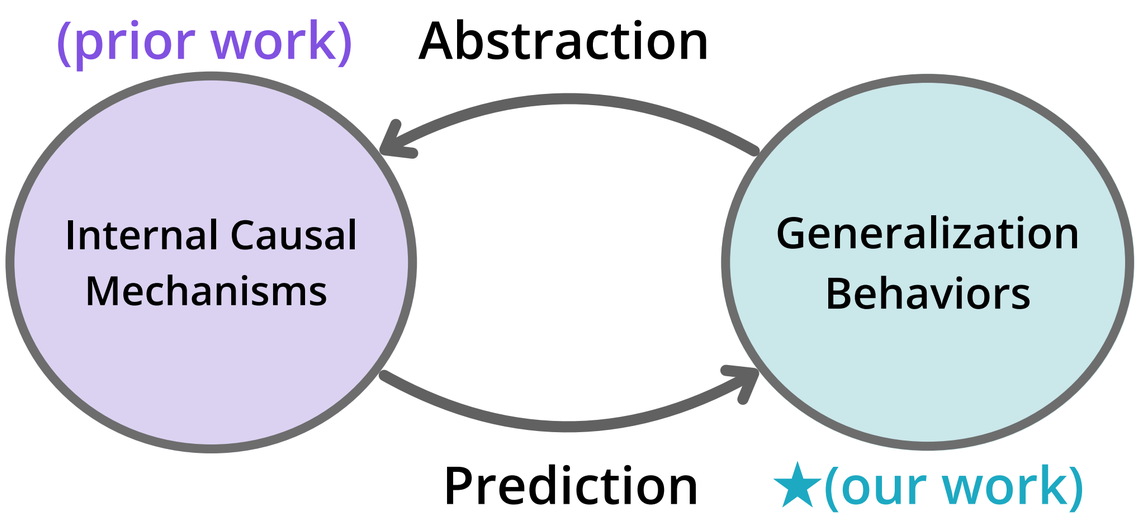
Task: Predict OOD Behaviors on MMLU

Find the degree for the given field extension Q(sqrt(2), sqrt(3), sqrt(18)) over Q.

ID Scenario	***OOD Scenario***
A. 0	Alpha. 0
B. 4	Bravo. 4
C. 2	Charlie. 2
D. 6	Delta. 6
Answer: B.	**Answer: *Delta.***

Methods: Abstraction → Prediction

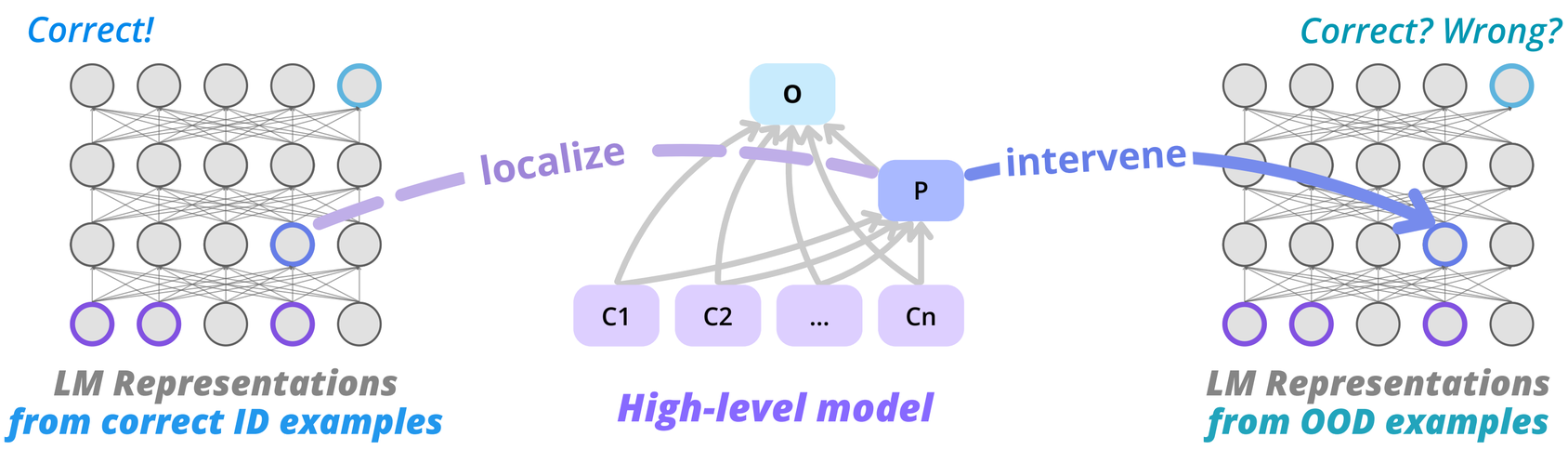
The model solves a task successfully → it likely implements a **systematic solution, i.e. a causal mechanism**



The model implements the same causal mechanism on an OOD example → it likely predicts the OOD example **correctly**

Abstract the high-level causal model from ID examples that model correctly solves

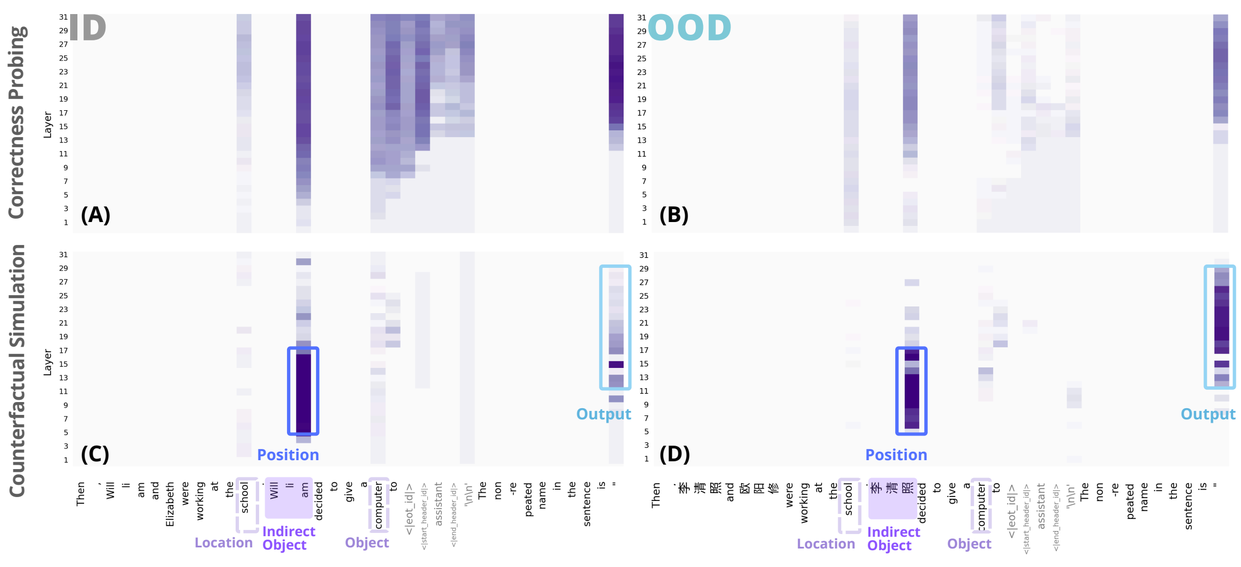
Predict the output correctness by checking the implementation of key causal variables



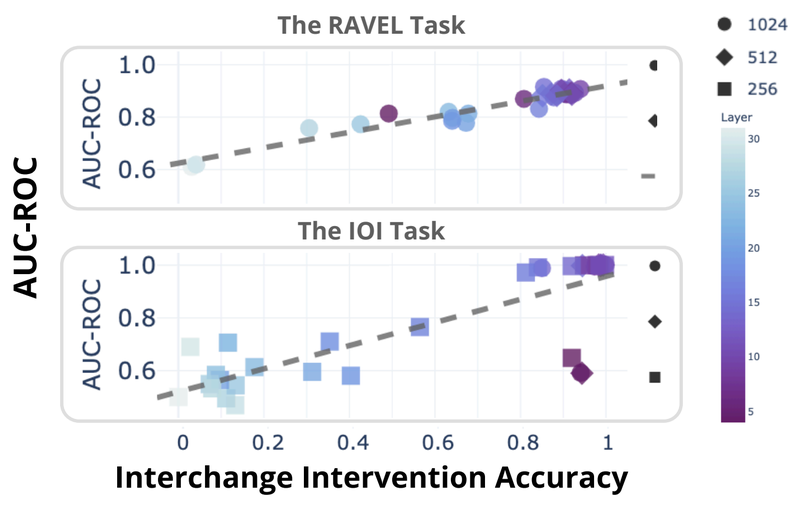
Measure the extent to which an abstraction exists via **interchange intervention accuracy**

Experiment Results

The **most robust features** for correctness prediction are those that play a **causal** role in the model's behavior.



ID and OOD Probing and Intervention Results



Interchange Intervention accuracy reliably predicts model output **correctness**.