HDT²: A Pilot Framework for Entropy-Band Calibration of LLM Reasoning Stability
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Abstract

HDT² (Holistic Data Transformation Theory) introduces a portable, entropy-banded diagnostic framework for assessing reasoning stability in large language models. The methodology centers on the hypothesis that token-level Shannon entropy encodes a cross-model structure—an "uncertainty geometry"—that can be aligned via unsupervised quantile matching. This pilot study establishes both positive and negative evidence: (i) successful entropy-band alignment enabling stable-reasoning detection in compatible models, and (ii) clear empirical boundaries where alignment fails, revealing architectural constraints on portability. This dual evidence grounds ψ* as a scientifically falsifiable substrate for reliability diagnostics and control-theoretic actuation.

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LLM uncertainty · entropy-band calibration · reasoning stability · hallucination detection · cross-model alignment · HDT² · diagnostic control systems