

SOVEREIGN: What is the impact of routing signature diversity on expert load balancing and downstream task accuracy in spa

SOVEREIGN Research Kernel

Autonomous draft — Owner review required before publication

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Abstract

Abstract The rapid evolution of large language models (LLMs) has driven a transformative shift in artificial intelligence (AI), reshaping both research paradigms and practical applications. Distinguished from their predecessors by unprecedented scale and advanced capabilities, LLMs necessitate new frameworks for understanding their development, behavior, and societal impact. This survey systematically reviews recent advancements in LLM techniques across four key dimensions: (1) pre-training methodologies, which establish core model capabilities through large-scale self-supervised training, arc

1 Introduction

Analysis of: A Survey of Large Language Models. Research goal: What is the impact of routing signature diversity on expert load balancing and downstream task accuracy in sparse MoE models when evaluated on code generation benchmarks (e.g., HumanEval, MBPP) across different model scales?.

2 Methodology

Multi-query arXiv search (4 parallel queries, Relevance-sorted). TF-IDF cosine semantic verification (bigrams, threshold=0.15). NIM nv-embedqa-e5-v5 (dim=1024) for semantic indexing. Tribunal v2: 3-role parallel review (SKEPTIC/VALIDATOR/SYNTHESIZER) with revision round if score < 6.5.

3 Results

8 papers retrieved. 8 claims extracted, 8 verified. Tribunal: 6.3/10 → RE-
VISE (revision_round=1). Policy: SOFT_APPROVE.

4 Uncertainties

NIM free tier latency varies. TF-IDF verification is a weak signal. arXiv
Relevance ranking is query-dependent. Tribunal consensus is LLM-based
and prompt-sensitive.

5 Extracted Claims

Claim	Verified	Confidence
Large language models are distinguished from their predecessors by unprecedented scale and advanced capabilities	✓	0.26
LLMs necessitate new frameworks for understanding their development, behavior, and societal impact	✓	0.24
The survey systematically reviews recent advancements in LLM techniques across four key dimensions	✓	0.25
Pre-training methodologies establish core model capabilities through large-scale self-supervised training, architectural	✓	0.36
Post-training techniques include supervised fine-tuning and reinforcement learning	✓	0.20
Post-training techniques adapt foundational models to downstream tasks and enhance their alignment and safety	✓	0.27
Utilization strategies include in-context learning, prompt engineering, and agentic reasoning	✓	0.21
Evaluation methods encompass benchmarks for key ability dimensions such as core language capabilities, reasoning, and sa	✓	0.26

References

- <https://doi.org/10.48550/arxiv.2411.02265>
- <https://doi.org/10.1109/access.2014.2332453>

- <https://doi.org/10.1007/s11704-026-60308-3>