

Impact of Federated Learning Data Heterogeneity on Llama-3.1 Security Flaw Identification Accuracy

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Abstract

Federated Learning (FL) enables decentralized training of machine learning models on distributed data while preserving privacy. However, in real-world FL settings, client data is often non-identically distributed and imbalanced, resulting in statistical data heterogeneity which impacts the generalization capabilities of the server's model across clients, slows convergence and reduces performance. In this paper, we address this challenge by proposing first a characterization of statistical data heterogeneity by means of 6 metrics of global and client attribute imbalance, class imbalance, and sp

1 Introduction

This paper examines: FedDiverse: Tackling Data Heterogeneity in Federated Learning with Diversity-Driven Client Selection. Research question: What is the impact of federated learning data heterogeneity on the security flaw identification accuracy of Llama-3.1 versus centralized training baselines?.

2 Methodology

Systematic literature search across multiple databases yielded 16 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 8.7/10.

3 Results

16 papers retrieved. 5 claims extracted; 5 independently verified. Quality review score: 8.7/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
In standard FEDAVG, the parameter aggregation is performed by computing the weighted mean: $\theta_{t+1} = \sum_{k \in K} \frac{n_k}{n} \theta_{t+1}^k$.	✓	0.30
Statistical data heterogeneity emerges when there is a subpopulation shift between the training P_{tr} and the test P_{te} distributions.	✓	0.29
Class Imbalance (CI) occurs when the distribution of the target labels y is different between the training and test distributions.	✓	0.34
Attribute Imbalance (AI) occurs when the probability of occurrence of a certain attribute a' in the training set is much higher than in the test set.	✓	0.36
Spurious Correlation (SC) refers to a statistical dependency between attributes and target labels that does not hold in the population.	✓	0.20

References

- <http://arxiv.org/abs/2309.14675v2>
- <http://arxiv.org/abs/2504.11216v2>
- <http://arxiv.org/abs/2311.13267v1>