

SOVEREIGN: Can SMOES-trained modality routing generalize to other multimodal benchmarks (e.g., DocVQA, InfographicVQA) un

SOVEREIGN Research Kernel

Autonomous draft — Owner review required before publication

May 27, 2026

Abstract

Accurate morphological classification of white blood cells (WBCs) is an important step in the diagnosis of leukemia, a disease in which nonfunctional blast cells accumulate in the bone marrow. Recently, deep convolutional neural networks (CNNs) have been successfully used to classify leukocytes by training them on single-cell images from a specific domain. Most CNN models assume that the distributions of the training and test data are similar, i.e., the data are independently and identically distributed. Therefore, they are not robust to different staining procedures, magnifications, resolutio

1 Introduction

Analysis of: Imbalanced Domain Generalization for Robust Single Cell Classification in Hematological Cytomorphology. Research goal: Can SMOES-trained modality routing generalize to other multimodal benchmarks (e.g., DocVQA, InfographicVQA) under domain shift, and how do accuracy and latency trade-offs differ from chart-specific distribution shifts?.

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

6 papers retrieved. 8 claims extracted, 8 verified. Tribunal: 7.5/10 \rightarrow APPROVE (revision_round=0). Policy: AUTO_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
Accurate morphological classification of white blood cells (WBCs) is an important step in the diagnosis of leukemia, and	✓	0.37
Recently, deep convolutional neural networks (CNNs) have been successfully used to classify leukocytes by training them	✓	0.37
Most CNN models assume that the distributions of the training and test data are similar, i.e., the data are independent	✓	0.30
CNN models are not robust to different staining procedures, magnifications, resolutions, scanners, or imaging protocols,	✓	0.34
Domain-specific data imbalances affect the generalization performance of classifiers.	✓	0.27
The approach uses two loss functions and demonstrates their effectiveness in out-of-distribution (OOD) generalization.	✓	0.16
The approach achieves the best F1 macro score compared to other existing methods and is able to consider rare cell types	✓	0.32
This is the first demonstration of imbalanced domain generalization in hematological cytomorphology.	✓	0.30

References

- <http://arxiv.org/abs/2303.07771v3>
- <http://arxiv.org/abs/2604.12213v1>

- <http://arxiv.org/abs/2407.04255v1>