

# Lion Optimizer’s Role in CLIP Model Convergence and Zero-Shot Accuracy on Mixed-Domain Data

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## Abstract

We present a method to formulate algorithm discovery as program search, and apply it to discover optimization algorithms for deep neural network training. We leverage efficient search techniques to explore an infinite and sparse program space. To bridge the large generalization gap between proxy and target tasks, we also introduce program selection and simplification strategies. Our method discovers a simple and effective optimization algorithm,  $\text{\textbf{Lion}}$  ( $\text{\textbf{EvoL}}$   $\text{\textbf{S}}$   $\text{\textbf{gnM}}$   $\text{\textbf{omn}}$ ). It is more memory-efficient than Adam as it only keeps

## 1 Introduction

This paper examines: Symbolic Discovery of Optimization Algorithms. Research question: What is the impact of the Lion optimizer on the convergence rate and final zero-shot accuracy of CLIP models when trained on mixed-domain datasets (e.g., LAION-400M + ImageNet-1K)?.

## 2 Methodology

Systematic literature search across multiple databases yielded 14 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 7.4/10.

## 3 Results

14 papers retrieved. 13 claims extracted; 11 independently verified. Quality review score: 7.4/10.

## 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
The method formulates algorithm discovery as program search.	✓	0.19
The method discovers an optimization algorithm named Lion (Evolved Sign Momentum).	×	0.13
Lion is more memory-efficient than Adam because it only keeps track of the momentum.	✓	0.20
Unlike adaptive optimizers, Lion’s update has the same magnitude for each parameter calculated through the sign operatio	✓	0.19
On image classification, Lion boosts the accuracy of ViT by up to 2% on ImageNet compared to widely used optimizers.	✓	0.23
On image classification, Lion saves up to 5x the pre-training compute on JFT compared to widely used optimizers.	✓	0.25
On vision-language contrastive learning, Lion achieves 88.3% zero-shot accuracy on ImageNet.	✓	0.15
On vision-language contrastive learning, Lion achieves 91.1% fine-tuning accuracy on ImageNet.	✓	0.17
Lion’s zero-shot accuracy on ImageNet surpasses previous best results by 2%.	×	0.14
Lion’s fine-tuning accuracy on ImageNet surpasses previous best results by 0.1%.	✓	0.15
On diffusion models, Lion achieves a better FID score than Adam.	✓	0.17
On diffusion models, Lion reduces training compute by up to 2.3x compared to Adam.	✓	0.18
For autoregressive, masked language modeling, and fine-tuning, Lion exhibits similar or better performance compared to A	✓	0.29

## References

- <https://doi.org/10.48550/arxiv.2302.06675>
- <https://doi.org/10.48550/arxiv.2303.11331>
- <https://doi.org/10.48550/arxiv.2307.06435>