MAML is a Noisy Contrastive Learner in Classification

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Contribution

Prove that MAML is a noisy contrastive learning algorithm and propose a zeroing trick to mitigate the noise.

Take Home Message

Q1 Why is MAML effective in learning representations?
A1 Because MAML implicitly exploits contrastive learning.

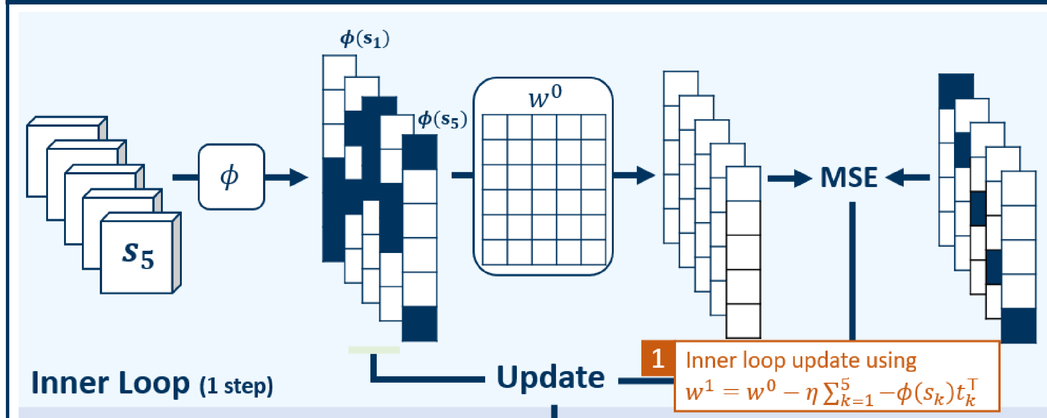
Q2 What is the role of inner loop in MAML?
A2 In inner loop, classifier memorizes support features.

Q3 What is the role of support data in MAML?
A3 The support features act as the prototypes.

MAML + Our Zeroing Trick

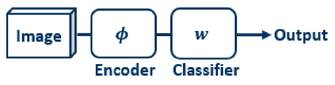
Require inner-/outer-loop learning rate: η/ρ
Require encoder/classifier parameters: θ $\mathbf{w}$
Set $\mathbf{w} \leftarrow 0$ (the zeroing trick)
while not done **do**
  Sample tasks $\{T_1, \dots T_{N_{batch}}\}$
  for $n = 1, 2, \dots, N_{batch}$ **do**
    $\{S_n, Q_n\} \leftarrow$ sample from T_n
    $\theta_n = \theta$
    for $i = 1, 2, \dots, N_{step}$ **do**
      $\theta_n \leftarrow \theta_n - \eta \nabla_{\theta_n} L_{\theta_n, S_n}$
    end for
  end for
  Update $\theta \leftarrow \theta - \rho \sum_{n=1}^{N_{batch}} \nabla_\theta L_{\theta_n, Q_n}$
  Set $\mathbf{w} \leftarrow 0$ (the zeroing trick)
end while

A Motivating Example



Setting:
5-way 1-shot using MAML with **one** inner-loop iteration under **MSE loss**.

Model:

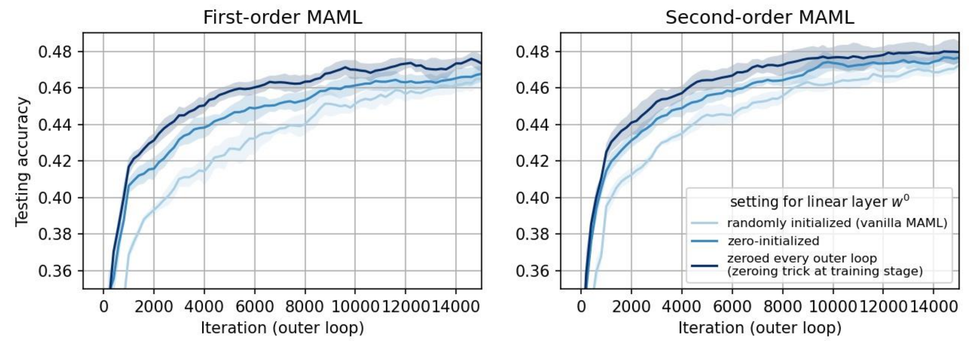


Value:

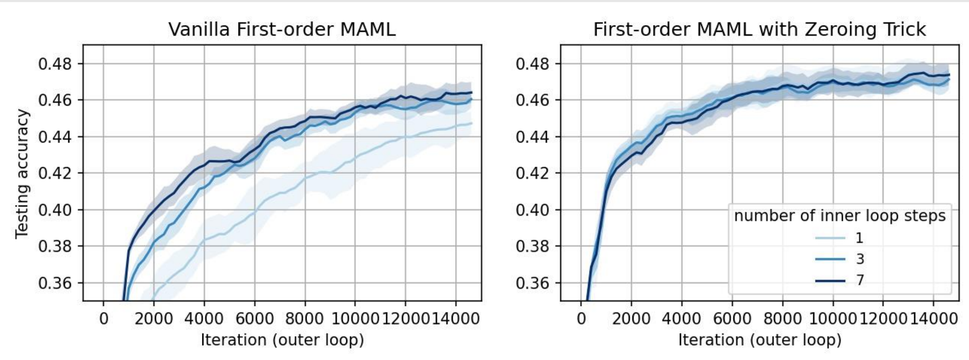
3 Loss from negative sample
q_1 and s_1 have different labels. The loss happens to ask their inner product of features to be zero.

4 Loss from positive sample
q_1 and s_3 have same labels. The loss happens to ask their inner product of features to be one.

1 Using Zeroing Trick Mitigates Inherent Noise in MAML



2 Without Inherent Noise, a Larger Number of Inner Loop Update Steps Is Not Necessary



3 We Identify the Difference Between FOMAML and SOMAML From a Contrastive Learning Perspective.