DAOUDA **SOW**

3896 Summit Pointe, Columbus, OHIO, 43230 · +1 614 440 9921
Sow.53@osu.edu

My research interests are mainly about **optimization methods for modern Machine Learning (ML), robust and safe ML**. On the theoretical side, I am interested in building new frameworks, especially through the lens of bilevel optimization, that capture modern ML applications such as Meta Learning, Adversarial Training, Hyperparameter Optimization, etc. On the practical side, I aim to design new algorithms with provable guarantees to tackle these problems as well as develop their practical and efficient implementations.

SKILLS

- Large-scale Optimization Algorithms and Theory for training ML models
- Implementation of Deep Learning methods and Optimization algorithms
- Deep Learning for Computer Vision
- Classical Computer Vision and Image Processing
- Classical Machine Learning
- Programming languages I use regularly: Python, MATLAB, C++.
- Deep Learning frameworks: Pytorch, TensorFlow, Keras, Scikit Learn
- Languages: English, French, Pulaar, and Wolof

EDUCATION

- **The Ohio State University**, Columbus, OHIO, USA
  Ph.D. student in Department of Electrical and Computer Engineering – since 2019
- **Beijing University Of Aeronautics And Astronautics**, Beijing, CHINA
  M.Sc. in Pattern Recognition and Intelligent Systems – 2019
- **Ecole Polytechnic de Thies**, Thies, SENEGAL
  Undergraduate studies in Electromechanical Engineering – 2017

SELECTED RESEARCH PROJECTS

- **Robust Learning:**
  - Currently developing methods for online adversarial training that are robust to distributional shifts and/or imbalanced datasets. We formulate the problem into a novel compositional bilevel optimization problem and propose a principled way of optimizing the so-called instance weights associated with individual data losses. Our formulation yields **+10% on average accuracy** compared to the original framework by Madry et al.

In particular, our framework mitigates the issue of non-uniform per-class performances in adversarial training.
    - We are **targeting NeurIPS 2023** for this project and will make our code public soon.

- **Online Meta Learning Under Distribution Shifts:**
    - Propose a novel online meta-learning algorithm in non-stationary environments without knowing the task boundaries.
    - Built 3 dynamic online few-shot benchmarks from a mixture of several vision datasets (MNIST, FashionMNIST, Omniglot, Tiered-ImageNet, Symbols) to simulate the realistic dynamic setting. Extensive experiments demonstrate the advantage of our method over existing baselines in all benchmarks.
    - Provide a regret analysis of the proposed algorithm. Our analysis captures a trade-off between the impact of task similarity on the performance of standard online meta-learning with known task boundaries and the performance under task boundary detection uncertainty.
    - Paper is **submitted for publication** and all codes will be publicly available soon.

- **Hessian-free Algorithms for Efficient Bilevel Optimization:**
    - Propose a simple but effective Hessian-free method which uses a zeroth-order-like approach to approximate the response Jacobian in bilevel optimization based on the difference between two gradient-based optimization paths. On the Few-shot Meta-learning problem over a ResNet-12 network, our approach outperforms the state-of-the-art optimization-based meta learners. Experiments on Hyperparamter optimization further demonstrate the competitiveness of our approach. Paper is **accepted by NeurIPS 2022.**
    - Propose a simple and easy-to-implement primal-dual bilevel optimization algorithm in the practical setting where the inner problem admits multiple minimizers. Paper is submitted for publication.
    - Provide the convergence rate analysis of all proposed algorithms.

PUBLICATIONS

- **Daouda Sow**, Sen Lin, Zhangyang Wang, Yingbin Liang. "Doubly Robust Instance-Reweighted Adversarial Training", submitted for publication, 2023. Arxiv

- **Daouda Sow**, Kaiyi Ji, Yingbin Liang. "On the convergence theory for Hessian-free bilevel algorithms", Advances in Neural Information Processing Systems (NeurIPS), 2022. Arxiv

- **Daouda Sow**, Sen Lin, Yingbin Liang, Junshan Zhang. "Algorithm Design for Online Meta-Learning with Task Boundary Detection", submitted for publication, 2023. Arxiv

- Sen Lin, **Daouda Sow**, Yingbin Liang, Ness Shroff. "Online Bilevel Optimization: A Single-Loop Method with Window Averaging", submitted for publication, 2023.

- **Daouda Sow**, Kaiyi Ji, Ziwei Guan, Yingbin Liang. "A primal-dual approach to bilevel optimization with multiple inner minima", submitted for publication, 2022. Arxiv

- **Daouda Sow**, Zengchang Qin, Mouhamed Niasse, Tao Wan. “A Sequential Guiding Network With Attention for Image Captioning”, IEEE ICASSP 2019. Arxiv