Tong Yang

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Personal Site: https://pptmiao.github.io
Research Interests:
Optimization, Machine Learning Theory

Education

Carnegie Mellon University Aug 2023–Present
Ph.D. in Electrical and Computer Engineering

Peking University Sep 2022–June 2023
M.S. in Data Science

University of California, Berkeley Jan 2022–May 2022
Exchange Program, GPA: 4.0/4.0

Xi'an Jiaotong University Sep 2018–July 2022
B.S. in Mathematics (Honors Program), GPA: 4.01/4.3, Major rank:1/50

Research & Project Experience

Research Topic: Algorithm Design for Solving Variational Inequalities
Jan 2022–Present, University of California, Berkeley
Collaborators: Michael I. Jordan, Tatjana Chavdarova, Matteo Pagliardini

- Worked on the project *solving variational inequalities via a first-order interior point-based method* with Tatjana Chavdarova and Michael I. Jordan. This paper has been accepted by *NeurIPS 2022* Workshop *OPT*. The full version has been accepted by *ICLR 2023* as *spotlight* paper. (https://arxiv.org/abs/2206.10575)
  1. Designed a new algorithm whose convergence rate could match the theoretical lower bound of this algorithm under mild conditions.
  2. Verified the theoretical results on several experiments (e.g. GANs).
- Improved the previous work with Michael I. Jordan, Tatjana Chavdarova, and Matteo Pagliardini. We have submitted this work to *ICLR 2024*. (https://arxiv.org/abs/2210.15659)
  1. Derived a way to relax the assumptions in the previous work while maintaining the same convergence rate.
  2. Gave the *first* analytically derived last-iterate convergence rate for general monotone variational inequalities.
  3. Managed to finish the book-long proofs (about 40 pages) within a week.

Research Topic: Cascade Optimization for Inverse Problems with Entropy-Preserving Hyperparameter Tuning
July 2022–Present, New York University
Collaborators: Qi Lei, Quan Zhang, Tianci Liu

- Proposed an automated and principled framework to solve inverse problems with deep generative models. This work has been accepted by *ICML 2023*. (https://arxiv.org/abs/2210.13983)

1. Designed a cascade optimization algorithm that has a global convergence guarantee to efficiently reconstruct images in inverse problems.
2. Developed a method to solve a bilevel optimization problem for automated hyperparameter tuning.

Research Topic: Designing Natural Policy Gradient Methods with Entropy Regularization for Federated Multi-task Reinforcement Learning
July 2023–Present, Carnegie Mellon University
Collaborators: Yuejie Chi, Shicong Cen, Yuting Wei, Yuxin Chen

- Developed federated vanilla and entropy-regularized natural policy gradient (NPG) methods under softmax parameterization, where gradient tracking is applied to the global Q-function to mitigate the impact of imperfect information sharing. We have submitted this work to *ICLR 2024*.

  1. Established non-asymptotic global convergence guarantees under exact policy evaluation, which is nearly independent of the size of the state-action space, and illuminates the impacts of network size and connectivity. To the best of our knowledge, this is the first time that global convergence is established for federated multitask RL using policy optimization.
  2. Proved the convergence of the developed algorithms are robust with respect to the inexactness of policy evaluation.

Research Topic: Algorithm Design for the Transformer
April 2023–Present, Peking University
Advisor: Zhouchen Lin

- Proposed a novel parameter update rule for the Transformer that has a convergence guarantee and could update the layer-wise weights and activations in parallel.

  1. Reformulate the transformer's feed-forward expression to make it block multi-convex, and update its parameters by a variant of block coordinate descent method which has a global convergence guarantee.
  2. Applied the new algorithm on ViT and conducted experiments on the ImageNet dataset. Our results are comparable to the baseline.

Research Topic: Designing a New Frank-Wolfe Type Method for Variational Inequalities
May 2023–Present, Peking University
Advisor: Tatjana Chavdarova

- Modified the original Frank-Wolfe method and developed a new projection-free algorithm for general monotone variational inequality problems.

  1. Proposed the first Frank-Wolfe type method that has a convergence guarantee for general monotone variational inequality problems.
  2. Provided new veriants of our algorithm that achieve faster convergence rate for VIs with polytope constraint set.

Research Topic: Design of Efficient Algorithms for Finding Points on High-dimensional Convex Polyhedra
Sep 2021–Jan 2022, Peking University
Advisor: Zhouchen Lin

- My first project on optimization and machine learning theory.

1. Studied convex analysis with a focus on interior point methods and common first-order methods.
2. Designed a new interior-point point algorithm to find a point on a high-dimensional convex polyhedron efficiently.

Research Topic: Multi-task Self-supervised Object Detection and Other Tasks in Machine Learning
June 2020–Jan 2022, Xi'an Jiaotong University
Adviser: Junmin Liu

- This is my first deep learning project.
  1. Reproduced classical backbones in Computer Vision, such as ResNet, the Transformer, and Vision Transformer (ViT) using Pytorch.
  2. Reproduced two-stage object detection networks using Pytorch, including R-CNN, Fast R-CNN, and Faster R-CNN, etc.
  3. Studied different self-supervised object detection models.
  4. Designed new auxiliary tasks for two-stage multi-task self-supervised object detection models.

Competition Experience

- The first prize of China Undergraduate Mathematical Contest in Modeling in Shaanxi division, 2019.
- The first prize of China Undergraduate Mathematical Contest in Modeling in Shaanxi division, 2020.
- Honorable Mention of Mathematical Contest In Modeling, 2020.
- The second prize of The Chinese Mathematics Competitions (Mathematics Group), 2019.
- The first prize of Campus Mathematical Contest in Modeling, 2019.
- The second prize of Campus Collegiate Programming Contest, 2021.

Scholarships & Awards

- Outstanding Student of Xi'an Jiaotong University (2%), 2018-2019, 2019-2020, 2020-2021.
- National Encouragement Scholarship (3%), 2018-2019.
- HIWIN Scholarship (1%), 2019-2020.
- ZhuFeng Scholarship (1%), 2018-2019,2019-2020.
- National Scholarship (1%), 2020-2021.

Technical Skills

- **Languages:** Python, C, C++, C#, MATLAB, LaTeX
- **ML Frameworks:** PyTorch, TensorFlow, Keras