

EDUCATION

Carnegie Mellon University Ph.D. in Electrical and Computer Engineering	Aug 2023–Present
Peking University M.S. in Data Science	Sep 2022–June 2023
University of California, Berkeley Exchange Program, GPA: 4.0/4.0	Jan 2022–May 2022
Xi'an Jiaotong University B.S. in Mathematics (Honors Program), GPA: 4.01/4.3, Major rank:1/50	Sep 2018–July 2022

WORK EXPERIENCE

- Machine learning student researcher in Google May 2025–Current

SELECTED PUBLICATIONS

Multi-head Transformers Provably Learn Symbolic Multi-step Reasoning via Gradient Descent
NeurIPS 2025

Authors: **Tong Yang, Yu Huang, Yingbin Liang, Yuejie Chi**

arXiv: <https://arxiv.org/abs/2508.08222>

We aim to provide mechanistic understandings of how transformers acquire on the chain-of-thought multi-step reasoning of the Transformer by theoretically analyzing the Transformer's training dynamics and generalization on symbolic reasoning tasks on trees.

Exploration from a Primal-Dual Lens: Value-Incentivized Actor-Critic Methods for Sample-Efficient Online RL

NeurIPS 2025

Authors: **Tong Yang, Bo Dai, Lin Xiao, Yuejie Chi**

arXiv: <https://arxiv.org/abs/2506.22401>

Motivated by recent online reinforcement learning developments in exploration via optimistic regularization, we propose a provable efficient and practical actor-critic method to balance the fundamental trade-off between exploration and exploitation.

Incentivize without Bonus: Provably Efficient Model-based Online Multi-agent RL for Markov Games

ICML, 2025

Authors: **Tong Yang, Bo Dai, Lin Xiao, Yuejie Chi**

arXiv: <https://arxiv.org/abs/2502.09780>

In this paper, we propose a novel model-based algorithm, called VMG, that incentivizes exploration via biasing the empirical estimate of the model parameters towards those with a higher collective best-response values of all the players when fixing the other players' policies, thus encouraging the policy to deviate from its current equilibrium for more exploration.

Faster WIND: Accelerating Iterative Best-of-N Distillation for LLM Alignment

AISTATS 2025

Authors: **Tong Yang, Jincheng Mei, Hanjun Dai, Zixin Wen, Shicong Cen, Dale Schuurmans, Yuejie Chi, Bo Dai**

arXiv: <https://arxiv.org/abs/2410.20727>

Recent advances in aligning large language models with human preferences have corroborated the growing importance of best-of-N distillation (BOND). We establish a novel framework, WIN rate Dominance (WIND), with a series of efficient algorithms for regularized win rate dominance optimization that approximates iterative BOND.

In-Context Learning with Representations: Contextual Generalization of Trained Transformers

Conference: *NeurIPS 2024*

Authors: **Tong Yang, Yu Huang, Yingbin Liang, Yuejie Chi**

arXiv: <https://arxiv.org/abs/2408.10147>

This work aims to provide theoretical understandings on in-context learning ability of transformers by investigating the training dynamics of transformers through the lens of non-linear regression tasks.

Federated Natural Policy Gradient and Actor Critic Methods for Multi-task Reinforcement Learning

Conference: *NeurIPS 2024*

Authors: **Tong Yang, Yuejie Chi, Shicong Cen, Yuting Wei, Yuxin Chen**

arXiv: <https://arxiv.org/abs/2311.00201>

Federated reinforcement learning enables collaborative decision making of multiple distributed agents without sharing local data trajectories. In this work, we consider a multi-task setting where the agents target at learning a globally optimal policy that maximizes the sum of the discounted total rewards of all the agents in a decentralized manner, where each agent only communicates with its neighbors over some prescribed graph topology.

A Primal-Dual Approach to Solving Variational Inequalities with General Constraints

Conference: *ICLR 2024*

Authors: **Tatjana Chavdarova*, Tong Yang*, Matteo Pagliardini, Michael I. Jordan** (* alphabetical)

arXiv: <https://arxiv.org/abs/2210.15659>

In this work, we improve **ACVI**—a first-order gradient methods to solve general variational inequalities (VIs)—by circumventing its limiting assumption that analytic solutions of specific subproblems are available.

Solving Constrained Variational Inequalities via a First-order Interior Point-based Method

Conference: *ICLR 2023 (spotlight)*

Authors: **Tong Yang*, Michael I. Jordan*, Tatjana Chavdarova***

arXiv: <https://arxiv.org/abs/2206.10575>

Inspired by the efficacy of the alternating direction method of multipliers (ADMM) method in the single-objective context, we generalize ADMM to derive a first-order interior-type method for constrained variational inequality problems.

Optimization for Amortized Inverse Problems

Conference: *ICML 2023*

Authors: **Tianci Liu*, Tong Yang* Quan Zhang, Qi Lei**

arXiv: <https://arxiv.org/abs/2210.13983>

In this paper, we propose an efficient amortized optimization scheme for inverse problems with a deep generative prior. Specifically, the optimization task with high degrees of difficulty is decomposed into optimizing a sequence of much easier ones.

Value-Incentivized Preference Optimization: A Unified Approach to Online and Offline RLHF

ICLR 2025

Authors: **Shicong Cen, Jincheng Mei, Katayoon Goshvadi, Hanjun Dai, Tong Yang, Sherry Yang, Dale Schuurmans, Yuejie Chi, Bo Dai**

arXiv: <https://arxiv.org/abs/2405.19320>

Reinforcement learning from human feedback (RLHF) has demonstrated great promise in aligning large language models (LLMs) with human preference. In this paper, we introduce a unified approach to online and offline RLHF – value-incentivized preference optimization (VPO).

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

- Wei Shen and Xuehong Zhang Presidential Fellowship, 2025
- 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.