Muhang Tian

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Education

Courant Institute, New York University Jan. 2025 – Expected Dec. 2029
PhD in Computer Science

Duke University Aug. 2020 – May 2024
BS in Computer Science, double minor in Mathematics and Economics (GPA: 3.9/4.0)
Graduation with Highest Distinction

Honors and Awards

Alex Vasilos Memorial Award: the highest award conferred by Duke Computer Science. 2024
Henry M. MacCracken Award: multi-year funding for New York University PhD students. 2024
CS+ Summer Research Fellowship: Duke summer research funding ($10,000). 2022 – 2023

Publications

*Equal contribution

[1] Peng, N.*, Tian, M.*, & Fain, B. (2025). **Multi-objective Reinforcement Learning with Nonlinear Preferences: Provable Approximation for Maximizing Expected Scalarized Return.** *Proceedings of the International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS)*. [Paper]

[2] Tian, M., Chen, B.*, Guo, A.*, Jiang, S., & Zhang, A. R. (2024). **Reliable Generation of Privacy-preserving Synthetic Electronic Health Record Time Series via Diffusion Models.** *Journal of the American Medical Informatics Association (JAMIA)*. [Paper]

[3] Zhu, C. Q.*, Tian, M.*, Semenova, L., Liu, J., Xu, J., Scarpa, J., & Rudin, C. (2024). **Fast and Interpretable Mortality Risk Scores for Critical Care Patients.** *Journal of the American Medical Informatics Association (JAMIA)*. [Paper]

[4] Fan, Z.*, Peng, N.*, Tian, M.*, & Fain, B. (2023). **Welfare and Fairness in Multi-objective Reinforcement Learning.** *Proceedings of the International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS)*. [Paper]

Research Experience

Diffusion Model for Synthetic Data Generation May 2023 – Dec. 2023

- Explored generating mixed-type time series data with multinomial and Gaussian diffusions using bidirectional recurrent neural network as the backbone.
- Conducted experimentation on healthcare, financial, and electricity datasets. Experimentally demonstrated the proposed approach produces synthetic samples with high data utility and outperforms all state-of-the-art time series generative adversarial networks by a big margin.
- Experimentally showed the synthetic samples can improve downstream model performance by using them for data augmentation. [Paper]

Nonlinear Multi-objective Reinforcement Learning May 2022 – May 2024

- Explored optimizing expectation over a nonlinear objective on the cumulative reward (we call this nonlinear objective for short), proven to be APX-hard due to the expectation over the nonlinearity.
- Proposed an approximate algorithm that optimizes this objective by considering past accumulated discounted rewards, experimentally verified the algorithm converges, then theoretically argued the convergence using Banach fixed-point theorem. [Paper]

- Followed up another work that uses dynamic programming to produce a policy with approximate theoretical guarantee for optimizing the nonlinear objective. Conducted extensive experiments to prove the algorithm outperforms all baselines and its predecessor. [Paper]
- Motivated the application of nonlinear objective optimization in the context of fairness and equity in reinforcement learning, where the nonlinear function encodes some desiderata of the overall utility of the users' combined individual rewards.

Interpretable Machine Learning for Risk Prediction Jan. 2023 – Oct. 2023

- Explored finding an interpretable model for classification task through approximately optimizing a L0 regularized logistic regression model with integer, sparsity, and box constraints.
- Motivated by the healthcare setting, proposed to add group sparsity constraint on top of all existing constraints. Group sparsity partitions the variables into groups, and the solution needs to satisfy users' predetermined group sparsity level, enabling more control on the model.
- Conducted extensive experiment on both in-distribution and out-of-distribution setting by applying the proposed approach on MIMIC III/IV and eICU datasets. Demonstrated the algorithm performs similarly as commonly-used ML algorithms like XGBoost while being sparse and interpretable. [Paper]

Bandit and Reinforcement Learning Algorithms Oct. 2022 – Mar. 2023

- Researched Sample Average Uncertainty approach towards multi-arm bandit problems by utilizing approximate sample mean variance as an exploration bonus. Investigated foundations of RL and bandit algorithms. [Report]
- Investigated the effects of heavily skewed reward distributions on LMC-TS algorithm by benchmarking its performance with bandit algorithms such as LinTS, LinUCB, Epsilon-Greedy along with their neural network versions.
- Implemented Deep Q-Learning, Proximal Policy Optimization (PPO), and Advantage Actor-Critic algorithms from scratch and compared their performances in Atari environments. [W&B Report][Code]

INTERNSHIPS

Machine Learning Engineer | *Big Ideas Lab* Nov. 2022 – Mar. 2023
Implemented EfficientDet for object detection tasks on COVID-19 saliva test results. Collected data from public sources and applied data augmentation techniques to improve average precision by 35%. [Code]

Software Engineer | *Afloat* May 2022 – Aug. 2022
Maintained company server, performed software testing, and weekly reported directly to co-founders.

Data Engineer | *Big Ideas Lab* May 2022 – Oct. 2022
Used data from wearable devices such as Garmin and Apple Watch to estimate health outcomes with ML. Implemented ML algorithms to perform healthcare data analysis for the open-source repository.

ACADEMIC SERVICES

Reviewer: NeurIPS (2023), ICLR (2024), AAAI (2025), IEEE ICHI (2023).
Teaching Assistant: Design and Analysis of Algorithms, Microeconomics, Econometrics.

TECHNICAL SKILLS

Languages: Python, Java, JavaScript, C/C++, R, SQL, MATLAB, CSS/HTML.
Softwares: PyTorch, TensorFlow, Keras, scikit-learn, NumPy, Pandas, Linux, Slurm, Docker, Git, Linux.