

# Tianjun Ke

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## Education

### Renmin University of China

BS in Statistics

Sept 2020 - June 2024\*

(Expected)

- **Overall GPA:** 3.95/4.0
- **Ranking:** 1/61

## Publications

### Revisiting Logistic-softmax Likelihood in Bayesian Meta-Learning for Few-Shot Classification

Tianjun Ke\*, Haoqun Cao\*, Zenan Ling, Feng Zhou

NeurIPS 2023 poster

### CLIP as Multi-Task Multi-Kernel Learning

Yucong Lin\*, Tianjun Ke\*, Xingpeng Xia, Jiaheng Yin, Jiaying Xu, Tianxi Cai, Junwei Lu

Submitted to ICLR 2024

### MIN: Multi-channel Interaction Network for Drug-Target Interaction with Protein Distillation

Shuqi Li, Shufang Xie, Hongda Sun, Yuhua Chen, Rui Yan, Tao Qin, Tianjun Ke

Submitted to Artificial Intelligence

\* denotes equal contribution

## Research Interest

My research interest lies in the intersection of statistics and computer science, focusing on giving statistical analyses of modern learning methods. My research topics include machine learning theory, Bayesian statistics, reinforcement learning, and AI4Science.

## Research Experience

### Research on In-context Learning (ICL) with Hawkes Process

July 2023 - Current

Core group member, supervised by Prof. Junwei Lu, Harvard University

- Objective: Investigate the dynamics of ICL in transformers with a single linear self-attention layer trained by gradient flow in a Hawkes process setting.
- Generalize the continuous-time multivariate Hawkes process to discrete-time to improve the modeling of natural language.
- Prove preliminary results about the gradient flow of the self-attention layer.
- Explore how to control the higher moments of the Hawkes process.

### Research on Statistical Inference after Adaptive Sampling in Linear Markov Decision Process (MDP)

May 2023 - Current

Core group member, supervised by Prof. Junwei Lu, Harvard University

- Objective: Provide a theoretical foundation for statistical inference in linear MDP and design novel algorithms that exploit the derived normality.
- Prove a series of Law of Large Numbers and Central Limit Theorem for generalized weighted martingale triangular array applicable to linear MDP.
- Derive theoretical analysis for linear MDP in a hypothetical “forward” algorithm.
- Explore how to apply the sub-sampling technique to tackle the dependency of states brought by “backward” Upper Confidence Bound algorithms that use Policy/Value Iteration.

### Revisiting Logistic-Softmax Likelihood in Bayesian Meta-Learning for Few-Shot Classification

Feb 2023 - May 2023

Core group member, supervised by Prof. Feng Zhou, Renmin University of China

- Objective: Uncover the theoretical properties of the logistic-softmax likelihood besides conditional conjugacy in Gaussian process models.
- Introduced logistic-softmax with temperature and proved its unique limiting behavior.
- Theoretically and empirically showed that softmax can be viewed as a particular case of logistic-softmax and logistic-softmax induces a larger family of data distributions than softmax.
- Derived an analytical mean-field approximation for posterior inference through data augmentation.
- Implemented the model in PyTorch, conducted extensive few-shot classification experiments on several benchmark datasets, and established sota results for classification accuracy and uncertainty calibration.
- Paper accepted by NeurIPS 23, co-first author.

## CLIP as Multi-Task Multi-Kernel Learning

July 2022 - May 2023

Core group member, supervised by Prof. Junwei Lu, Harvard University

- Objective: Provide a theoretical interpretation of CLIP utilizing the Reproducing Kernel Hilbert Space (RKHS) framework.
- Reformulated the notion of CLIP by a solid RKHS framework, reducing the problem of estimating the optimal CLIP mapping  $\phi$  to selecting an optimal RKHS by multiple kernel learning.
- Proved optimal convergence rate of the proposed multi-task multi-kernel estimator.
- Implemented the model in PyTorch and accelerated optimization by block coordinate gradient descent with closed-form updates.
- Conducted extensive simulation experiments for empirical investigation and verification of theoretical properties.
- Paper submitted to ICLR 24, co-first author.

## Research on Drug-Target Interaction and Cell Classification

Sep 2022 - Feb 2023

Group member, supervised by Prof. Rui Yan, Renmin University of China

- Objective: Utilize conservation score for automatic residue selection and noise reduction in drug-target interaction.
- Empirically verified that residues in the binding pocket are more conservative than that in the non-pocket area through experiments on the PDBbind v2020 dataset and coauthored a paper submitted to Artificial Intelligence.
- Investigated prospective deep learning methods for cell classification in scRNA-sequencing data, consisting of contrastive learning, hyperbolic learning, and graph neural networks.

## Research on Automatic Literature Screening for Clinical Practice Guidelines

June 2022 - July 2022

Group member, supervised by Prof. Yucong Lin, Beijing Institute of Technology

- Objective: Build a general framework for automatic medical literature screening, including data collection, feature extraction, model building, and performance evaluation.
- Curated a condensed citation dataset related to neck pain from PubMed, a large-scale database of over 35 million citations.

## Work Experience

### China Resources Trust

Jun 2022 - Jul 2022

Intern at Department of Intelligence and Digitalization

Shenzhen, China

- Independently handled the setup of testing environments and the development of application scenarios.
- Developed statistical analysis functionalities and implemented approval workflows on the workflow engine platform.
- Grasped the process management of enterprise-level software development.

## Skills

<b>Computer Skills</b>	C/C++, R, Python (DL Framework: Pytorch, Keras; Parallel Computing Framework: Pyspark)
<b>Math Skills</b>	Probability, Statistics, Mathematics Analysis, Linear Algebra, Measure Theory, Real analysis, Point Process, Functional Analysis, Financial Mathematics
<b>Language Skills</b>	Chinese ( <b>Native</b> ), Cantonese ( <b>Native</b> ), English ( <b>GRE 331+4, TOEFL 111</b> ), Japanese ( <b>N2</b> )

## Awards

- 2023 **Bronze Prize in Programming Contest of RUC**, Renmin University of China
- 2022 **National Scholarship (Awarded to 3 out of 179 candidates)**, China
- 2022 **National Third Prize in the 12th Market Research and Analysis Competition**, Commerce Statistical Society of China
- 2021 **Academic Excellence Award (Top 3% GPA)**, Renmin University of China

## Service

### Lab Mentor

Sep 2022 - Current

MedAI Lab (directed by Prof. Yucong Lin, Beijing Institute of Technology)

Renmin University of China

- Instruct new lab members with basic coding skills in PyTorch and elementary AI and statistical knowledge.
- Design and deliver a series of statistical lectures on machine learning, covering topics such as simulation experiments and learning theory.

## Interests

- Gender issues** Enthusiast for gender and LGBTQ+ issues; member of RUC Sex & Gender Study Community.
- Cinema** Big cinephile; favorite film of all time is *The Lighthouse*; member of RUC Film Association.