

## INTRODUCTION

BSc. in **Elite Undergraduate Training Program of Applied Mathematics**,  
Information and Computing Science Department, School of Mathematical Sciences,  
Peking University (PKU)

Sep. 2021 – Jul.2025 (Expected)

Beijing, China

Research interests: **Optimization and Computation Theory** with application to **Machine Learning**

A brief introduction:

With a deep passion for exploring mathematical structures and practical algorithms, I have a broad interest in optimization and the theory of computation. I am particularly focused on exploring continuous and discrete optimization techniques in operations research, machine learning, statistical estimation, and theoretical computer science.

From a methodological perspective, my current research involves:

- (1) Developing optimization models and computational methods for decision-making under uncertainty.
- (2) Variational analysis for stochastic nonsmooth and nonconvex optimization.
- (3) Using machine learning methods to solve combinatorial optimization problems.
- (4) Submodular optimization and continuous extensions for combinatorial optimization.

## RESEARCH

• **An Adaptive Sampling Algorithm for Nonsmooth Stochastic Optimization with DC Objectives** Mar. 2024 –Present  
Supervised by Prof. Ying Cui, Department of Industrial Engineering and Operations Research, University of California, Berkeley.

We propose an adaptive sampling algorithm for stochastic nonsmooth nonconvex optimization problems with difference-of-convex (DC) objectives. The sample size and step size of the algorithm are determined by the current estimates of stochastic quantities.

We investigate the Sample Average Approximation (SAA) error separately for the convex and the linearized concave parts in expectation. The latter is closely related to the convergence of the SAA for subdifferential mappings. To the best of our knowledge, we are the first to derive its convergence rate in expectation.

Due to the different convergence rates and DCA's special structure, we should use different sampling sizes to achieve the optimal error-sample size trade-off.

**The paper is on-work. As the primary contributor to the theoretical derivations and numerical experiments, I am the first author of the paper.**

• **Towards Unsupervised End-to-End Learning for Partial Maximum Satisfiability Problems** Feb. 2023 – May. 2024  
Supervised by Prof. Zaiwen Wen, Beijing International Center for Mathematical Research, Peking University.

We apply Monte Carlo Policy Gradient Method for CO problems, based on Erdős probabilistic graph model and penalty framework.

We propose U-SAT, a novel end-to-end learning framework that provides high-quality solutions for PMS problems, including:

- (1) Decoding with recursive rounding and unit propagation;
- (2) Refining the model with weight adaption.

**The paper was submitted. I developed the theoretical derivation, including the convergence analysis of SGD. I am the co-first author of the paper.**

• **Searching for Polarization in Signed Graphs via Equivalent Continuous Optimization** Jul. 2023 – Present  
Supervised by Prof. Sihong Shao, School of Mathematical Sciences, Peking University.

We develop a discrete penalty framework with convergence guarantee to find local signed Cheeger constant on graph, whose original form is fractional 0-1 integer programming. Both the numerator and denominator is submodular.

Via Lovász Extension, our method is equivalent to  $\ell_1$  exact penalty function methods for continuous optimization.

We design RatioDCA for the equivalent continuous problem with penalty terms, with appropriate subgradient selection.

**The paper is on-work. As the primary contributor to the theoretical derivations and numerical experiments, I am the first author of the paper.**

## SELECTED GRADUATE AND BASIC CORE COURSES

The courses marked with \* are graduate/ undergraduate combined courses.

Algorithms on Bigdata Analysis*	Prof. Zaiwen Wen	96
Optimization Methods*	Prof. Zaiwen Wen	91
Mathematical Modeling	Prof. Sihong Shao	98
Methods of Stochastic Simulations*	Prof. Tiejun Li	93
Fundamentals of Theoretical Computer Science*	Prof. Bican Xia	95
Randomized Algorithms	Prof. Yuqing Kong	92
High-dimensional Numerical Methods*	Prof. Sihong Shao	91
Numerical Methods: Principles, Algorithms and Applications	Prof. Tiao Lu	92
Advanced Algebra (II)	97.5	Data Structure and Algorithm 96
Ordinary Differential Equations	89	Mathematical Statistics 88

Courses in progress for the senior year:

Algorithms for Combinatorial Optimization\*, Functions of Real Variables, Functional Analysis, Applied Partial Differential Equations, Algorithmic game theory, High-Dimensional Probability\*, Statistical Models and Computing Methods\*

## SEMINAR

### • Optimization Theory and Algorithms

Feb. 2023 – Dec. 2024

Organized by Prof. Zaiwen Wen, the seminar lies in the broad field of large-scale computational optimization with applications in science and engineering.

I gave a presentation on Monte Carlo Policy Gradient Method for CO problems, based on Erdős probabilistic graph model.

### • Combinatorial Optimization

Jul. 2023 – Dec. 2023

Organized by Prof. Sihong Shao, including several topics on Combinatorial Optimization Algorithm.

I gave a presentation on SOS (sum of squares) methods with moment hierarchy in polynomial optimization, and its application to several problems.

### • Multiscale Analysis in Applied Mathematics

Mar. 2023 – Jun. 2023

Organized by Assistant Prof. Zhennan Zhou, mainly about the book Multiscale Methods - Averaging and Homogenization.

I gave a presentation on Homogenization for Parabolic PDEs.

## HONORS & AWARDS

- Admitted to **Elite Undergraduate Training Program of Applied Mathematics** (Top 5%) 2023
- First Prize in the Beijing Division of the National College Student Mathematics Contest 2022
- Academic Excellence Award in School of Mathematical Sciences (Top 10%) 2023
- National second prize in China Undergraduate Mathematical Contest in Modeling (CUMCM) (Top 1 in PKU) 2023