Hongpei Li

ishongpeili@gmail.com | Github | Homepage | Google Scholar

Education

Shanghai University of Finance and Economics (SUFE) 2021/09 - 2025/07
Honor Bachelor of Engineering in Data Science and Big Data Technology
Pilot Class of Research Institute for Interdisciplinary Science Shanghai, China
GPA 3.77/4.0 Average Score 89.44/100 Major GPA 3.87 Major Average Score 91.48/100
Main Courses:

- Mathematics: Discrete Mathematics, Linear Algebra, Mathematical Analysis, Probability, Mathematical Statistics, Stochastic Process, Numerical Computation Method, Game Theory, Dynamic Programming, High-Dimensional Data Analysis, Data-Driven Decision Making, Operations Management, Linear & Nonlinear Programming, Advanced Operations Research
- Computer Science: Python, C++, Data Structure, Data Mining, Machine Learning, Deep Learning, Advanced Program Design and Experiment, Algorithmic Design & Analysis
- Economics: Microeconomics, Macroeconomics, Economic Management of Computer Application, Econometrics, Money and Banking

Research Interests

My research interests include Optimization, Artificial Intelligence and the Interdisciplinary of Operations Research and Machine Learning. For example, I am interested in the following topics:

- **Optimization**: Design and implement efficient algorithms for large-scale realistic optimization problems.
- **Artificial Intelligence**: Utilize Artificial Intelligence techniques to improve scientific fields and engineering problems.
- **Computing**: Improve the efficiency of training and inference of LLMs and large-scale optimization problems.

Publications

- ***Restarted Primal-Dual Hybrid Conjugate Gradient Method for Large-Scale Quadratic Programming*** (Major Revision in **INFORMS Journal on Computing**)
  Y. Huang, W. Zhang, **H. Li**, D. Ge, H. Liu, and Y. Ye. (2024). *arXiv preprint* ([Paper])([Datasets])([Python])([Julia])
- ***Solving Integrated Process Planning and Scheduling Problem via Graph Neural Network Based Deep Reinforcement Learning*** (to be submitted soon)
  H. Li, H. Zhang, Z. He, Y. Jia, B. Jiang, X. Huang, and D. Ge. (2024). *arXiv preprint* ([Paper])([Code])
- ***BenLOC: A Benchmark for Learning to Configure MIP Optimizers***
  H. Li, Z. He, Y. Wang, S. Pu, Q. Deng, W. Tu, and D. Ge. (2025). *arXiv preprint* ([Paper])([Code])
- ***PDHCG: A Scalable First-Order Method for Large-Scale Competitive Market Equilibrium Computation***
  H. Liu, Y. Huang, **H. Li**, D. Ge and Y. Ye (2025). *arXiv preprint* ([Paper])
- ***FMIP: Multimodal Flow Matching for Mixed Integer Linear Programming***
  H. Li, H. Yuan, H. Zhang, D. Ge, M. Wang and Y. Ye (2025). *arXiv preprint*

Research Experience

Generative Models for Linear Programming&Mixed Integer Programming Sep.2024 - Present
Adviser: Prof. Mengdi Wang, Prof. Yinyu Ye Princeton University, Stanford University

- A framework for generating high qulified solution of LPs and MILPs using generative models.
- Significantly decrease (**more than 70%**) the number of iterations required to solve linear programs over a variety of datasets.

Warm-Starting PDHCG using Learning-based Methods Aug. 2024 - Nov.2024
Adviser: Prof. Huikang Liu Shanghai Jiao Tong University, Cardinal Optimizer

- A framework for warm-starting PDHCG using learning-based methods, which is well-implemented to support efficient batch processing inference and sampling.
- A novel neural network inspired by the role of iteration in PDHCG algorithm.
- Competitive performance on a variety of standard datasets.

Deep Reinforcement Learning (DRL) for Scheduling Problems Mar.2024 - Aug.2024
Adviser: Prof. Dongdong Ge Prof. Bo Jiang Shanghai Jiao Tong University, SUFE, Cardinal Optimizer

- Use DRL to solve the integrated process planning and scheduling problem, a kind of realistic and difficult scheduling problem.
- Well-implemented simulation environment of the integrated process planning and scheduling problem, supporting GPU-accelerated and batch processing training and inference. This environment allows for utilizing various algorithms efficiently.
- A novel **graph representation** of the problem based on MDP formulation and well-designed **dense reward function**. Also, some strategies are proposed to **reduce meaningless exploration**.
- The proposed method can make decisions within a few seconds and outperform traditional dispatching methods, as well as obtain an improvement of **11.35%** compared with OR-Tools SAT-CP Solver and the Gurobi MILP Solver with a 7200-second time limit on large instances. compared with optimizers. Offering a new perspective for solving the integrated process planning and scheduling problem.

Primal-Dual Hybrid Conjugate Gradient Method (PDHCG) Apr.2024 - Oct.2024
Adviser: Prof. Yinyu Ye Prof. Dongdong Ge Prof. Huikang Liu Stanford University, Shanghai Jiao Tong University

- An efficient and GPU-accelerated first order method for large-scale quadratic programming problems.
- Solid theoretical analysis, showing that the convergence of PDHCG has **much greater resilience to ill-conditionin** than previous First-Order Methods (e.g., rAPDHG, SCS).
- 5 times faster than the restarted accelerated primal-dual hybrid gradient (rAPDHG) method in large-scale problems and about 100 times faster than other existing methods (e.g., SCS, COPT).
- Implement GPU version and low-rank acceleration independently, obtaining more than 10 times faster than the CPU version and GPU full-matrix version respectively.

Machine Learning for MIP Optimizer Configuration Dec.2023 - Oct.2024
Prof. Dongdong Ge, Prof. Qi Deng, Prof. Wentin Tu, Dr. Qi Huangfu Shanghai Jiao Tong University, SUFE, Cardinal Optimizer

- Extract comprehensive handcrafted features from the detailed internal logs of Cardinal Optimizer (COPT), which are proprietary and not publicly disclosed, to equip users with sufficient data for model training.
- Provide several standard machine learning models, including Random Forest and Graph Neural Networks, standard evaluation metrics and various labeled benchmark datasets for optimizer configuration.

Personal Projects Lhongpei

- **DRL for Campus Auto-Delivery Vehicle** Developed an innovative framework integrating Deep Reinforcement Learning (DRL) and Mixed-Integer Programming (MIP) for campus auto-delivery vehicles, aimed at optimizing resource allocation and route efficiency.
  - **Part 1**: Formulated the allocation problem as a MIP model, leveraging the COPT optimizer to achieve optimal resource distribution.
  - **Part 2**: Employed DRL models to determine the shortest delivery paths, accounting for environmental disturbances on campus. developed a DRL agent, trained in a simulated environment with a similar disturbance distribution, enables real-time dynamic path adjustments, offering adaptive and efficient routing solutions to users.

  Awarded the Shanghai Municipal Bronze Award in the Internet+ University Student Innovation and Entrepreneurship Competition**(43/34000)**

- **Learning To Optimize: Recurrent Neural Network-Based Quasi-Newton Method**
  - Use Recurrent Neural Networks (RNNs), such as LSTM and GRU, to learn a preconditioner inspired by the Quasi-Newton method.
  - Show faster convergence compared with the traditional Quasi-Newton method and gradient descent method after training on datasets with similar distributions.

- ✓ **Restaurant Recommendation**
  - Use a variety of recommendation algorithms, including collaborative filtering (item-based, user-based), matrix competition to recommend restaurants to users based on their preferences and historical data.

Employment Held

LLMs Technical Intern (Inference Optimization) Feb.2025 - Present
Cardinal Optimizer Shanghai, China
`Responsibility`: GPU operator optimization and inference acceleration for large-scale models. Currently, I'm exploring to use techniques in Operations Research to design better parallel methods in distributed training and accelerate inference in LLMs.

TA of Advanced Operations Research Feb.2024 - Jun.2024
`Professor`: Bo Jiang, Jianjun Gao Research Institute for Interdisciplinary Science@SUFE
`Responsibility`: online tutorial, weekly tutorial, assisting students with related questions and grading of the homework and exams.
`Syllabus`: This course mainly focuses on the fields of Operations Research, including Optimization Theory, Integer Programming, Revenue Management, Constrained & Unconstrained Optimization, Robust Optimization.

TA of OOAD (Object-Oriented Analysis and Design) Sep.2023 - Jan.2024
`Professor`: Bundit Laekhanukit Institute for Theoretical Computer Science (ITCS) @SUFE
`Responsibility`: online tutorial, weely tutorial, assisting students with related questions and guiding the students to complete projects using Kotlin.
`Syllabus`: This course mainly focuses on understanding the principles of object-oriented programming and design.

Volunteer

Peer Tutor in Programming Design Foundations Sep.2022 - Dec.2022
I volunteered as a peer tutor to assist students struggling with the computer programming course. This course focuses on the basic concepts of programming, including foundations of C/C++ and basic algorithm problems selected from Luogu, a Chinese online judge and algorithm competition platform similar to Codeforces.

University Students' Union Sep.2021 - Sep.2022
My main responsibility in the Students' Union is to advertising clubs and activities to students using posters and social media. I leveraged my skills in painting and using Photoshop and Illustrator to design posters and banners. I also response to connect clubs.

Technical Skills and Hobbies

- **Programming Languages:** Python, C/C++, Julia, MATLAB, R, Kotlin
- **Frameworks and Tools:**
  - ***Machine Learning:*** JAX, PyTorch, PyTorch Geometric (PyG), PyTorch Lightning, Scikit-learn, Gym, Isaac Gym
  - ***Operations Research:*** COPT, Gurobi, SCIP, HIGHS, OR-Tools, JuMP, CVX
  - ***Document Formatting:*** LaTeX, Markdown, Typst
  - ***Others:*** NumPy, Pandas, CUDA, CPython, JuliaCall, PythonCall, Shell, SSH, Git, YAML, JSON, Office, Phothoshop.
- **Hobbies:** Drawing, Biking, Skiing, Photography, Puzzle, Assembled Model, Coffee