

# Yilin Gu

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## EDUCATION

**The Chinese University of Hong Kong, Shenzhen**, Shenzhen, China

M.S., Information Management and Business Analytics (IM track)

Sept. 2021 - Nov. 2023

- GPA: 3.60/4.0, graduated with Distinction

Visiting Student, Data Science (Applied Mathematics track)

Nov. 2021 - Nov. 2023

- GPA: 4.0/4.0, enrolled in PhD-level courses

- Core Courses: Measure Theoretic Probability, Optimization Theory, Analysis of Algorithms

**Macau University of Science and Technology**, Macau, China

B.S., Business Analytics

Sept. 2017 - June 2021

Visiting Student, Applied Mathematics and Data Science

Sept. 2019 - June 2021

- GPA: 3.53/4.0, graduated with First Class Honor

## RESEARCH INTERESTS

### Methodology:

- Optimization Theory: Distributionally robust optimization, Contextual optimization, Nonconvex-nonconcave minmax optimization, Finite-dimensional variational inequalities problem.
- Machine Learning Theory: Model-based data mining, Supervised representation learning, Adversarial learning, Numerical analysis, Information theory, Interpretability for machine learning.
- Manufacturing and Operation Research: Supply chain management, Supply chain coordination, Inventory management, Game theory, Supply chain finance, Data-driven decision making.

**Application:** Analyzing and designing optimization algorithms and applying them to applications arising in supply chain management, machine learning, system engineering, etc.

**Research Statement:** [\[research statement\]](#)

## WORKING PAPER

### A. Variational Inequality and Minimax Problem

- **Yilin Gu**, Junwen Qiu (2023). Normal Map-Based Proximal Optimistic Gradient Descent Ascent Methods for Nonsmooth Nonconvex-Nonconcave Minmax Problem.
  - My three-hour presentation at EPFL: [\[video\]](#) [\[slides\]](#) [\[notebooks\]](#) [\[framework\]](#)
  - Expected to submit to NeurIPS 2024 Conference in May 2024.

- Junwen Qiu, **Yilin Gu**, Andre Milzarek (2023). Convergence of A Revised Forward-Backward-Forward Method for Nonsmooth Nonconvex-Nonconcave Minmax Problem. [\[page\]](#) [\[slides\]](#)

### B. DRO and Contextual Optimization

- **Yilin Gu** (2023). A Nonparametric Kernel-based Integrated Estimation-Optimization Framework for Convex Optimization. [\[slides\]](#)
  - Expected to submit to NeurIPS 2024 Conference in May 2024.
- **Yilin Gu** (2023). A Stochastic Distributionally Robust Fairness Framework for Constrained Data-driven Systems. [\[slides\]](#)

### C. Machine Learning Theory

- **Yilin Gu**, Andre Milzarek, Yichen Yu, Xin Jin, and Ruiyun Xu (2023). Stepwise Prototype Optimization: Adaptive Multiple Vector Quantization Classification. [\[page\]](#) [\[codes\]](#)
  - Expected to submit to NeurIPS 2024 Conference in May 2024.

## ACADEMIC EXPERIENCE

**Shenzhen Research Institute of Big Data**, Shenzhen, China  
Research Associate, Institute of Fundamental Research

Nov. 2021 - present

- Engaged in the fundamental mathematical optimization research project “*Higher Order-Type Methods for Structured and Stochastic Variational Inequalities*” supported by Shenzhen Research Institute of Big Data (SRIBD) Startup Fund JCYJ-AM20190601.
- Responsible for studying stochastic algorithm for nonsmooth nonconvex-nonconcave minmax problem under fewer assumptions. Through introducing weak Minty Variational Inequality and two-sided Polyak-Lojasiewicz condition, modified traditional minmax methods (eg. PPA, OGDA, EG, etc.) for finding stronger solutions under better complexity bound and convergence rate.
- Introduced normal mapping, converted the expectation of natural residual into an equivalent and better-solved nonlinear equation, and solved the equation with modified minmax methods to measure the convergence of these methods in nonconvex-nonconcave setting.

**Shenzhen Finance Institute**, Shenzhen, China

June 2021 - Sept. 2022

System Engineer Intern, Center on Blockchain and Intelligent Technology

- Engaged in the supply chain finance project of China Association of Small and Medium Enterprises (CASME), in which solved financial difficulties for startup manufacturing companies.
- Designed a specific financing approach called “Forage Finance” for YunQin Technology Company, a startup poultry company with financial difficulties in production resources.
- With blockchain technology, developed a supply chain finance and risk management information system for YunQin and related upstream and downstream companies in the poultry supply chain, from which successfully solved YunQin’s financial problem in a low risk way and increased its total profit by 65%, compared with the first 2 quarters of last year.
- The YunQin project was scored as 5.00/5.00 by the advisor Mr. Shen Zhenyuan from CASME.

## SEMINAR AND TALKS

- **Convex-Concave Minmax Optimization: Applications and Methods**, Shenzhen Research Institute of Big Data (SRIBD) Forum, August 2022.
  - In this seminar, I first introduced the smooth convex-concave saddle point problem and its intuitions. To solve such problem, I intuitively showed an algorithm called gradient descent-ascent (GDA) that theoretically feasible but practically diverged, and further showing its converged variant, proximal point algorithm (PPA). Given the intractability of PPA’s future step gradient  $\nabla f(x_{k+1}, y_{k+1})$ , I provided the optimistic gradient descent-ascent algorithm (OGDA) and the extragradient (EG) algorithm, and highlighted how gradients used in OGDA and EG approximate the gradient of the PPA. Then, I exploit this interpretation to show that the primal-dual gap of the averaged iterates generated by both algorithms converge with a rate of  $O(1/k)$ . Ultimately, I analyzed the last iterate convergence properties of both algorithms, and showed that the last iterate of both algorithms converge at a rate of  $O(1/\sqrt{k})$ , which is slower than the averaged iterate in smooth convex-concave saddle point problem.
- **SAGA: Introduction to Variance Reduction**, Shenzhen Research Institute of Big Data (SRIBD) Forum, Feb 2022.
  - This seminar is about a recursive framework for improving convergence performance in expectation on convex stochastic optimization. By replacing the gradient of the reference point with the last iterate, the stochastic average gradient algorithm (SAGA) saves more computational resource with linear convergence, and supports for composite objectives where a proximal operator is used on the regularizer, compared with stochastic variance reduced gradients (SVRG).
- **Global Management Challenge Workshop**, Macau University of Science and Technology
  - The Global Management Challenge (GMC) is a global strategic operation management competition that runs with a complex computer simulation system, in which each team runs different virtual company in the same market environment, and competes by developing and producing products that can better meet customer needs to maximize their investment performance.
  - In this workshop, I mainly taught the basic rules and insights of this competition, concepts and theory of operation management, strategic data-driven decision making, decision model building, the application of basic machine learning tools on data mining, etc.

- As the workshop instructor, I held the workshop for 2 years (once a week), and successfully educated and trained over 600 students. Among all the students, one group of students won the world champion title, 12 groups participated the national final and won the first prize, and 46 groups won the second prize.

## TEACHING EXPERIENCE

School of Data Science, The Chinese University of Hong Kong, Shenzhen

- MAT-3007: Optimization (Undergraduate)
  - Teaching Assistant, 2022 Fall

Faculty of Innovation Engineering, Macau University of Science and Technology

- MATH-200: Numerical Computation (Undergraduate)
  - Teaching Assistant, 2021 Spring, Eval 5.76/6.00
- CS-482: Data Science (Undergraduate)
  - Teaching Assistant, 2020 Fall, Eval 5.88/6.00

School of Business, Macau University of Science and Technology

- BBAZ-16014: Operations Management (Undergraduate)
  - Teaching Assistant, 2021 Spring, Eval 5.95/6.00
- BBAZ-16011: Business Statistics (Undergraduate)
  - Teaching Assistant, 2020 Fall, Eval 6.00/6.00
- BBAZ-16001: Introduction to Management (Undergraduate)
  - Teaching Assistant, 2020 Spring, Eval 5.64/6.00
- Global Management Challenge Workshop (Graduate & Undergraduate)
  - Instructor, 2020 Fall, Eval 6.00/6.00
- Global Management Challenge Workshop (Graduate & Undergraduate)
  - Instructor, 2019 Fall, Eval 6.00/6.00

## INDUSTRY EXPERIENCE

**Guo Sheng Securities**, Nanchang, China

June 2019 - Sept. 2019

Financial Analyst, Securities Business Department

- Collated and analyzed user-related information, engaged in programming security data warehouse with MySQL, and updated and configured daily and weekly reports to databases for some core financial data such as stock price, yield, yield trend, etc.
- Engaged in the development of a basic intelligent investment decision-making model with investor counselors, applying neural network algorithms, such as RNN and LSTM, to predict daily yield, in order to use DQN algorithm to find the best investment solution for customers.

**Ascending Powers Co., Ltd.**, Shenzhen, China

June 2018 - May 2019

Deep Learning Intern, Big Data Department

- Worked in the Big Data Research & Development Team of Ascending Powers, which corporates with the Tsinghua University and Tsinghua-Berkeley Shenzhen Institute (TBSI), and is committed to instantiating the world's top research achievements and applying them to business.
- Designed a series of supply chain financing risk management (FRM) approaches, including inventory financing, receivables financing, etc. Correspondingly, estimated risk probabilities for each approach and provided intelligent interest rate model, applying multiple machine learning algorithms under co-training platform provided by TBSI multimedia big data laboratory.
- Engaged in the FRM project of the world largest P2P company LendingClub, which has been implemented with our AI-driven inventory financing approach and successfully decreased the bad loan rate by 48%, compared with last year.

<b>HONORS AND AWARDS</b>	Dean's List of CUHK Business School (Top 5% + cGPA $\geq$ 3.50)	2023
	AY21-22 Third Class Academic Excellence Scholarship	2022
	Degree of B.S. in Business Analytics with First Class Honor (Top 5% + cGPA $\geq$ 3.50)	2021
	1st Prize (2nd Place) in the 40th Global Management Challenge (GMC), Macau Division	2020
	AY19-20 2nd Prize of MUST Business School Undergraduate Research Award	2020
	AY18-19 ICBC Macau Scholarship	2019
	AY18-19 Dean's Honor List of MUST Business School (Top 5% + cGPA $\geq$ 3.70)	2019
	AY18-19 3rd Prize of MUST Business School Undergraduate Research Award	2019
	2nd Prize in the 39th Global Management Challenge (GMC), Mainland China Division	2019
	AY17-18 Henry Fok Foundation Scholarship	2018
	AY17-18 Dean's Honor List of MUST Business School (Top 5% + cGPA $\geq$ 3.70)	2018
	3rd Prize in the Guangdong-Hong Kong-Macau Innovation and Entrepreneurship Competition	2018
	2nd Prize in the 5th 'Creative Youth' Innovation and Entrepreneurship Competition	2018

## SKILLS

**Programming:** Python, R, Matlab, MySQL, HTML, CSS, JavaScript,  $\text{\LaTeX}$ .

**Machine Learning:** Linear & Logistic Regression, Clustering, SVM, Neural Network, Decision Tree, Ensemble Methods, Numerical Methods, Information Theory, Prototype Learning, Adversarial Learning, Reinforcement Learning, etc.

**Deep Learning:** Scikit-learn, Keras, Tensorflow, Pytorch.

**Optimization Theory:** Convexity and convex analysis, Convergence analysis, Gradient method, Newton's method and Gaussian/inexact/quasi-Newton methods, Acceleration and momentum techniques, Stochastic optimization, KKT conditions and optimality conditions, Projected and proximal methods, Alternating direction method of multipliers, Cubic Regularization, etc.

**Business Intelligence:** Spreadsheet, Tableau, BigQuery, Power BI.