Luocheng Liang

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https://notdesigned.github.io

Education

The Chinese University of Hong Kong, Shenzhen **Guangdong, China**
B.S. major in Computer Science, *minor in* Mathematics *expected May 2026* *Sep.2022 – Present*

Cumulative GPA of **3.817**/4.0. I am selected for **Bachelor-Ph.D. Class** with **Scholarship** (**top ∼3%** students on basis of outstanding performance) and **Dean's List** of the School of Data Science in both AY2022-23 and AY2023-24

University of California, Berkeley **United States**
Visiting student in GLOBE program *Aug.2024 – Dec.2024*
GPA: **4.0**/4.0, for **A** in Computer Security; Programming Language and Compiler; $\mathbf{A}^+$ in Differential Topology
Core Courses in CS:
Data Structures; Machine Learning; Operating System; Computer Architecture; Design and Analysis of Algorithms
Core Courses in Math:
Ordinary Differential Equation; Optimization; Probability; Complex Variables; Stochastic Processes; Abstract Algebra; Differential Topology. (All A in these classes)

Research Interests

My research focuses on the theoretical foundations of artificial intelligence, bridging my background in algorithm design and optimization with deep mathematical principles. My work on graph algorithms provided expertise in computational complexity, while my training in differential topology, abstract algebra, and optimization drives my interest in the geometric and mathematical structures underlying intelligent systems.
Currently, my research focuses mainly on the following directions:

- **Machine Learning Theory**: Building on my experience in optimization and algorithm analysis, I aim to investigate the mathematical structure and theoretical limits of learning algorithms, with a focus on generalization, convergence, and complexity.
- **Mathematical and Geometric Foundations of Generative Models**: I am particularly interested in employing tools from optimal transport theory, differential geometry, and statistical physics (e.g., renormalization group methods) to study the dynamical mechanisms of generative models such as diffusion models, flow matching, continuous normalizing flows (CNFs), and Schrödinger bridges.

I view AI not merely as an engineering discipline but as a nascent scientific field that will ultimately develop a rigorous theoretical framework akin to physics or mathematics. My ultimate goal is to advance this mathematical and physical understanding of AI, uncovering its fundamental principles to enhance the reliability and interpretability of intelligent systems.

Research

- **A Gradient Projecting-based Approach for Efficient Densest Subgraph Discovery**
  Yingli Zhou, Luocheng Liang and Yixiang Fang

Accepted on SIGMOD 2026
Applying the FISTA algorithm to existing approaches and introducing key algorithmic improvements to gives better time complexity guarantee

- **Accelerated Coordinate Descent for Directed Densest Subgraph Discovery**
  Luocheng Liang, Yingli Zhou and Yixiang Fang
  Excepted to submit on SIGKDD 2026
  Designed randomized coordinate descent algorithms leveraging optimization theory (Lovász extension and submodular optimization) with a novel linear programming formulation. Achieved the first SOTA algorithm with runtime complexity proportional to $\log(1/\epsilon)$ for the densest subgraph approximation problem

Experience

The Chinese University of Hong Kong, Shenzhen **Guangdong, China**
Research Assistant, advised by Prof. Yixiang Fang *May 2024 – July 2025*
I developed novel approaches with strong theoretical guarantees to solve the **Densest Subgraph Problem** approximately and exactly. I implemented them as open-source practical tools in C++. We accelerate the finding of an approximate solution to the densest subgraph by a factor of **100x∼1000x** faster. (for example, the former SOTA runs in 277 seconds, and ours method solves in 0.3 seconds on a knowledge graph with $n = 4 \times 10^5, m = 3 \times 10^6, \epsilon = 10^{-4}$).

The Chinese University of Hong Kong, Shenzhen **Guangdong, China**
Research Assistant, advised by Prof. Hongyuan Zha and Prof. Jie Wang *Present*
Conducting theoretical research on generative modeling, with a focus on diffusion models, score-based generative models (SGMs), and Schrödinger bridge formulations. Exploring connections between these frameworks and optimal transport theory, aiming to develop rigorous mathematical foundations and novel algorithmic insights for generative modeling.

Contest Awards

The 48th ICPC Asia Hefei Regional Bronze Medalist **Hefei, China**
Trio-teamed programming contest *2023*

2024 GDCPC Silver Medalist **Guangdong, China**
Trio-teamed programming contest *2024*

Technical Skills

- **Programming Languages**: Python, C++, with extensive experience in algorithm implementation and optimization
- **Machine Learning**: PyTorch, NumPy, Pandas, MATLAB
- **Mathematical Tools**: Optimization algorithms, graph theory, statistical analysis
- **Development Tools**: Git, Linux, data preprocessing and visualization

Languages

- **English**: Fluent (IELTS 7.5)
- **Japanese**: Reading and daily dialogues level
- **Chinese**: Native