Zhiyuan Liu

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Research Interests

Combinatorics, with an emphasis on algebraic and geometric methods, including polytopes, tropical geometry, matroid theory and discrete geometry.

Education

Southern University of Science and Technology (SUSTech) — Shenzhen, China
B.Sc. in Mathematics (SUSTech) — *Fall 2023 – Present*
Advisor: Prof. Ziqing Xiang | Overall average: **92.51/100**

KTH Royal Institute of Technology — Stockholm, Sweden
Exchange Program — *Spring 2026*

Publications and Preprints

Counting Lattice Points in Minkowski Sums of Cross Polytopes — 2026
We investigate lattice points in Minkowski sums of cross polytopes and provide a proof of a conjecture by Athanasiadis and Chapoton concerning the h-polynomials of preorders. — *Mentor: Warut Thawinrak*
With Ziyi Dai, Qilin Hou, Warut Thawinrak, and Hongyu Wang.
Research article; under review. **[arXiv:2608.16037]**

Incidence Geometry with Polarity and Tiled Surfaces — 2026
We extend Fomin and Pylyavskyy's master theorem for incidence geometry to allow nonorientable surfaces by incorporating polarity, and characterize which incidence presentations admit proofs by tiling. — *Mentor: Yuchong Zhang*
With Peixuan Liu and Yuanqi Jiang.
Research article; under review. **[arXiv:2611.16862]**

Cîrtoaje-Leng Inequality — 2025
We make a generalization of one inequality of normalized elementary symmetric polynomials provided by Cîrtoaje and give a new proof. — *Mentor: Gangsong Leng*
With Chunji Wang and Yuchi Wu.
Research article; under review.
Chinese version. **[nsmath:1053371]**

Optimum Coefficients of Two Inequalities — 2023
Expository article (in Chinese). **[nsmath:782702]**

Academic Experience

PKU Algebra and Combinatorics Experience (PACE) 2026 — Summer 2026
Peking University
Participated in two research projects:

- **Polytopes.** Studied cross-polytopes and investigated their Minkowski sums. — *Mentor: Warut Thawinrak*
- **Incidence geometry.** Studied the work of Sergey Fomin and Pavlo Pylyavskyy on incidence geometry and proposed generalizations of their results. — *Mentor: Yuchong Zhang*

3rd Conference-School on Tensor Methods in Mathematics and Artificial Intelligence Computing — Fall 2026
Shenzhen MSU-BIT University

2025 Sino-French Summer School — Summer 2025
University of Chinese Academy of Sciences

Selected Coursework

SUSTech

- Topics in Combinatorics
- Commutative Algebra
- Advanced Probability
- Topology
- Topics in Algebra and Number Theory
- Differential Manifolds
- Abstract Algebra (H)
- Partial Differential Equations (H)

KTH

- Computational Methods for Stochastic Differential Equations and Machine Learning
- Game Theory

UCAS

- Algebraic Topology
- Probability Theory
- Differential Geometry

Selected Presentations

Summer 2026 — **Incidence Geometry with Polarity and Tiled Surfaces**
Speaker, PACE 2026, BICMR. Advisor: Yuchong Zhang. [slides]

Spring 2026 — **Weak Convergence and Long-Time Accuracy in Brownian Dynamics**
SF2525 seminar, KTH Royal Institute of Technology. [poster]

Spring 2025 — **Polynomial Methods and Incidence Theory**
Seminar speaker, SUSTech. Advisor: Prof. Ferdinand Ihringer.

Spring 2024 — **Special Solutions to Two Inequalities from AMM and a Discrete Analogue of a Gronwall-Type Inequality**
Seminar speaker, SUSTech.

Teaching Experience and Activities

Fall 2025 — **Teaching Assistant, Linear Algebra**
Southern University of Science and Technology.

2023 – Present — **Part-time Assistant Coach, High School Mathematics Competitions**
The First High School of Changsha.

2025 – Present — **Problem Setter, High School Mathematics Competitions**
New Star Mathematical Olympiad.

Awards and Honors

2026 — **First Prize**, Chinese Mathematics Competitions for College Students (CMC), Final Competition
2023–2025 — **First Prize**, CMC, Guangdong Province
2023–2025 — **Outstanding Student**, SUSTech
2023 — **First-Class Scholarship**, SUSTech
2022 — **First Prize (Gold Medal)**, Chinese Mathematics Olympiad (CMO)
2021 — **Second Prize (Silver Medal)**, Chinese Mathematics Olympiad (CMO)

Skills and Languages

Programming and tools Python, LaTeX, C++.
Languages Mandarin (native); English (proficient).