

# Xujiang Tang

Undergraduate in Mathematics | Algebraic Topology, Finite Groups, Equivariant Homotopy Theory  
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## Research Profile

Early-stage researcher in pure mathematics, with current work centered on Quillen-type  $p$ -subgroup complexes, finite group topology, subgroup-complex homology, and equivariant homotopy-theoretic methods. I am especially interested in the interface between atom/crosscut models, centralizer and orbit-carrier geometry, group cohomology, classifying-space methods, and stable or proper equivariant homotopy theory.

## Research Interests

- Algebraic topology and equivariant homotopy theory; subgroup complexes, classifying spaces, stable homotopy-theoretic structures, and geometric fixed point methods.
- Finite group theory; Quillen's  $p$ -subgroup conjecture, elementary abelian  $p$ -subgroups, centralizer structures, group cohomology, and FRUL-WOS sphere methods.
- Formalized mathematics; Lean, Mathlib, proof engineering, and long-term formalization of algebraic and topological arguments.
- Additional interests: machine learning theory, optimization, stochastic processes, and operator-theoretic methods.

## Education

**Yangtze University College of Arts and Sciences**, Jingzhou, China (B.Sc. in Mathematics and Applied Mathematics, expected June 2027)

- Selected coursework: mathematical analysis, linear algebra, probability and statistics, differential equations, computational modeling, optimization theory, numerical computation, data structures, Python, R, and MATLAB.
- Selected marks: Optimization Theory 97/100; Numerical Computation Methods 96/100.

**Great Bay University**, China (Visiting Student, 2025-present)

- Research in theoretical mathematics and machine learning theory.

## Publications and Manuscripts

### Submitted manuscripts and preprints

- **X. Tang**. Centralizer Energy, FRUL-WOS Spheres, and Quillen's  $p$ -Subgroup Conjecture. Submitted to *Annals of Mathematics*. Develops an atom/crosscut-complex approach to Quillen-type  $p$ -subgroup complexes using centralizer-energy descent, orbit-carrier Mayer-Vietoris methods, controlled-flat certificates, class-2 commutator-polar data, and protected cross-polytope obstructions.
- **X. Tang**. Geometric Fixed Point Tomography and Spoke Bokstedt Periodicity. Submitted to *Algebraic & Geometric Topology*.
- **X. Tang and C. Fan**. Out-of-Distribution Generalization Error Bounds for Successful Prediction of Deep Autoregressive Algorithms. Submitted to NeurIPS 2026.
- **X. Tang**. Quartic Difficulty: Assessing the Learnability of Unsupervised Learning Algorithms. Submitted to COLT.

### Published and accepted papers

- **Q. Li and X. Tang**. HKGEduRec: A Knowledge Graph-Enhanced Dynamic Hybrid Framework for Educational Recommendation with Cold-Start Mitigation. IEEE ICMEIM 2025, EI-indexed.
- **X. Tang and Q. Li**. Logical Gene Encoding: A Bio-Inspired Approach for Energy-Efficient Automated Reasoning. IEIT 2025, EI-indexed. DOI: 10.2991/978-94-6463-803-5\_81.
- **Q. Li and X. Tang**. Robust Optimal Reinsurance and Investment with Inflation Risk: A Game-Theoretic Approach and Explicit Solutions. *AIMS Mathematics*, accepted, 2025.

## Selected Research Experience

**Finite Group Theory and Quillen's  $p$ -Subgroup Conjecture** - Independent research, 2025-present

- Developed a subgroup-complex approach involving atom complexes, centralizer energy, FRUL-WOS spheres, orbit carriers, and controlled fillings.
- Current focus: homological and equivariant-topological methods for Quillen-type problems and related subgroup-complex obstructions.

**Algebraic Topology and Equivariant Homotopy Theory** - Independent research, 2025-present

- Research on geometric fixed point tomography, spoke Bokstedt periodicity, and stable homotopy-theoretic structures.

**Formal Proof and Lean** - Formalized mathematics, 2026-present

- Study of Lean, Mathlib, proof engineering, and long-term formalization of advanced arguments in algebra and topology.

## Selected Research Experience continued

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### **Theoretical Machine Learning and Optimization** - Research projects, 2024-present

- Work on learnability, generalization guarantees, out-of-distribution prediction, and optimization-theoretic aspects of learning algorithms.

### **Additional Applied Research** - Mathematical modeling, spatial omics, long-sequence data, and quantitative finance, 2023-present

- Epidemic prevention and population-mobility modeling in Jingzhou; spatial omics data processing; epilepsy-related long-sequence modeling using Koopman/operator-theoretic methods; stochastic-process models and robust financial decision problems.

## Visiting Position and Training

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- Zhejiang University Lean Formalization Summer School, 2026. Formal proof, Lean, Mathlib, and computer-assisted theorem proving.

- Neural Networks and Python Implementation, short winter training with Prof. Mark Vogelsberger. Grade: A.

## Honors, Competitions, and Activities

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- Kaggle Silver Medal, Jigsaw Toxic Comment Classification Challenge.

- Regional Gold Medal, WorldQuant International Quant Championship.

- Third Prize, UCAS Graduate AI Forum.

- Mathematical Modeling Competition, Hua Zhong Cup; National College Students Statistical Modeling Competition; multiple national second prizes in mathematical modeling competitions.

- Reviewer, ICLR 2026 Workshop.

## Professional Experience

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- **Peking University Open-Source LLM Group**, Jun.-Aug. 2024. Contributed to LLM deployment and retrieval-augmented generation systems.

- **Deloitte**, Jul.-Sep. 2024. Consulting workflows, teamwork, and communication.

- **Guolian Securities**, Jul.-Sep. 2024. Statistical methods in securities research and quantitative workflows.

## Selected Academic Contacts and Collaborations

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- William Redman, Johns Hopkins University.

- Ziyue Qiao, Great Bay University.

## Skills

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**Mathematics:** algebraic topology, finite group theory, homotopy theory, representation theory, optimization, numerical analysis, stochastic processes, differential equations, causal inference, and statistical modeling.

**Formal proof and programming:** Lean, Mathlib, Python, PyTorch, NumPy, Pandas, MATLAB, R, C++, LaTeX, Git/GitHub, and Linux.

**Languages:** Mandarin Chinese; English.