

Tony Xiaochen Xiao

Northeastern University
Department of Mathematics
360 Huntington Ave
Boston, MA 02215

xiao.xiaoc@northeastern.edu

Phone: +1 (408)508-9689

Website: <https://tonyxiaochenxiao.github.io/>

EDUCATION **Northeastern University**, Department of Mathematics
Ph.D. in Mathematics, 2021 - 2026 (Expected). GPA: 4.00
Advisor: Jose A. Perea

Northeastern University, Department of Mathematics
M.S. in Mathematics, 2019 - 2021. GPA: 3.95

Beijing University of Technology, College of Metropolitan Transportation
B.S. in Transportation Equipment and Control Engineering, 2015 - 2019. GPA: 3.67

INTERESTS *My research is in applied/computational topology and the mathematical foundations of data science. I am particularly interested in the interplay between algebraic/geometric topology, algorithms, and applications in science and engineering.*

GRANTS **Outstanding Students 'Qihang' Plan**
Scholarship granted by the university, 04/2018

Scholarship for Excellent Academic Records
Scholarship granted by the university, 10/2017

Scholarship for Excellent Academic Records
Scholarship granted by the university, 10/2016

AWARDS **Beijing Competition of Transportation Science and Technology of Undergrads**
Second Prize, Beijing, 11/2018

National College Students Mathematical Contest in Modeling
Second Prize in Beijing venue, 04/2018

'Dingxin Cup' Students' Extracurricular Academic Science and Technology Works Competition
Third Prize at the university, Beijing, 10/2017

The 14th Awarding Program for Future Scientists
National Third Prize, Beijing, 11/2014
Thesis: *Research on traffic problems and solutions in Wudaokou section*
Advisor: Zhenxiang Ye, Tsinghua University

The 34th Beijing Adolescents Science and Technology Innovation Contest
Second Prize in Beijing venue, 10/2014

TEACHING **Instructor:** Introduction to Math Reasoning (MATH 1365), Spring 2022

Teaching Assistant:

- Analysis 1 (MATH 5101), Fall 2025, with Xuwen Zhu
- Calculus 1 (MATH 1341), Summer 2025, with George Prasanth
- Optimization and Complexity (MATH 7234), Spring 2025, with Oana Veliche
- Calculus 3 (MATH 2321), Summer I 2024, with John Lindhe
- Number Theory 1 (MATH 3527), Spring 2024, with Evan Dummit
- Matrix Methods and Data Analysis (MATH 4570), Fall 2023, with Leepeng Lee
- Calculus and Differential Equations in Biology (MATH 1251), Fall 2022, with Carlos Curley
- Applied Linear Algebra (MATH 5110), Fall 2021
- Machine Learning and Statistical Learning Theory (MATH 7243), Fall 2021 with He Wang
- Introduction to Math Reasoning (MATH 1365), Fall 2020, with Peter Crooks
- Introduction to Math Reasoning (MATH 1365), Spring 2020, with Lee-peng Lee

Mentoring: Directed Reading Program (DRP)

- Fall 2024 with Emma Malabanan, Fu Chai, MingRui Jiang, Azhar Abdulla, Aidan Tillman
- Fall 2023 with Zhiyuan Li, Angela Barrett, Henry Barthelemy
- Spring 2023 with Anna Xia, Yiyang Liu, Anubhab Das

RESEARCH *Extracting Sparse Eilenberg-MacLane Coordinates via Principal Bundles*, 01/2023-Now
Advisor: Jose Perea

Abstract: We present in this paper an application of the sheaf theory to the problem of nonlinear dimensionality reduction in data analysis. Specifically, we construct Eilenberg-MacLane coordinates — functions from data to Eilenberg-MacLane spaces $K(G, n)$ — that encode nontrivial persistent cohomology classes in arbitrary dimensions n and coefficients G . Using soft sheaf theory, we establish a pipeline from persistent cohomology classes to the homotopy classes of such coordinate functions, extending previous results on circular, projective, and lens coordinates to all dimensions and arbitrary discrete Abelian groups. Crucially, our proof is constructive: we derive explicit formulas via inverses of Čech coboundary operators, yielding a recursive algorithm with polynomial complexity based on matrix computations. We validate our approach through experiments on synthetic datasets, and present novel examples of $K(\mathbb{Z}/2, 2)$ -coordinates not addressed in prior work.

Survey of Homology and Cohomology Theory, 05/2020-08/2020

Advisor: Ben Knudsen

During Summer 2020, despite logistic restrictions due to COVID-19, I reviewed Hatcher's *Algebraic Topology* under the supervision of Dr. Knudsen. We had weekly meetings and it helped me with my study of Homology/Cohomology theory.

Vehicle Detection of Aerial Images based on Sparse Representation, 10/2016-10/2018

Advisor: Shaofan Wang

I spent two years with Dr. Wang in researching the vehicle recognition in images photographed by UAV. Based on the sparse representation model, we constructed a Matlab program that can be used to identify vehicles in a given aerial image.

TALKS &
PRESENTATIONS

Young Topologists Meeting 2025

KTH Royal Institute of Technology, Stockholm, Sweden, 06/2025.

Topology of Arrangements with an eye to Applications

University of Pisa, Pisa, Italy, 09/2025.

The Geometric Realization of AATRN

IMSI, Chicago, USA, 08/2025.

Spires 2024 - 4th Annual Centre for Topological Data Analysis Conference

University of Oxford, Oxford, UK, 08/2024.

Montreal Summer School - Applications of Representation Theory in TDA & GIT

Université du Québec à Montréal (UQAM), Montreal, Canada, 06/2024.

Mid-Atlantic Topology Conference 2024

Northeastern University, Boston, USA, 03/2024.

Graduate Student Seminar at Northeastern

Northeastern University, Boston, USA, 01/2024.

Brandeis Graduate Student Seminar

Brandeis University, Boston, USA, 10/2023.

EXPERIENCES

AMS Graduate Student Chapter at Northeastern University

Vice President

01/2024 - Now

Graduate courses I have taken and am taking at Northeastern:

Courses	Instructors	Grade/GPA	Term
MATH 5111 - Algebra I	Ben Knudsen	A/4.0	Fall 2019
MATH 5101 - Analysis I	Petar Topalov	A/4.0	Fall 2019
MATH 7233 - Graph Theory	Gabor Lippner	A/Audited	Fall 2019
MATH 8450 - Research Seminars in Mathematics	Jonathan Weitsman	A/4.0	Fall 2019
MATH 7301 - Functional Analysis	Petar Topalov	A-/3.67	Spring 2020
MATH 5121 - Topology I	Ben Knudsen	A/4.0	Spring 2020
MATH 7221 - Topology II	Ben Knudsen	A/4.0	Fall 2020
MATH 7303 - Complex Manifold	Alina Marian	Audited	Fall 2020
MATH 5102 - Analysis II	Hsiang Chang	A/4.0	Spring 2021
MATH 5112 - Algebra II	Milen Yakimov	A/4.0	Spring 2021
MATH 7320 - Modern Algebraic Geometry	Peter Crooks	Audited	Spring 2021
MATH 7241 - Probability I	Christopher King	A/4.0	Fall 2021
MATH 7243 - Machine Learning and Statistical Learning Theory	He Wang	A/4.0	Fall 2021
CS 7430 - Formal Specification, Verification and Synthesis	Stavros Tripakis	A/4.0	Fall 2021
MATH 7243 - Modern Representation Theory (Tensor Categories)	Milen Yakimov	A/4.0	Spring 2022
MATH 7234 - Optimization and Complexity	Oana Veliche	A/4.0	Spring 2022
MATH 7721 - Readings in Topology (K-theory)	Ben Knudsen	A/4.0	Spring 2022
MATH 7721 - Readings in Topology (Homotopy Theory)	Ben Knudsen	A/4.0	Fall 2022
MATH 7721 - Readings in Topology (Persistence Homology)	Jose Perea	A/4.0	Fall 2022
MATH 7721 - Readings in Probability and Statistics	Paul Hand	A/4.0	Fall 2022
MATH 7375 - Topics in Topology (Topological Data Analysis)	Jose Perea	A/4.0	Spring 2023
MATH 7223 - Riemannian Optimization	David Rosen	A/4.0	Spring 2023
MATH 5122 - Geometry I	Xuwen Zhu	Audited	Spring 2023
MATH 7359 - Elliptic Curves and Modular Forms	Evan Dummit	A/4.0	Fall 2023
MATH 7362 - Topics in Algebra (Homological Algebra)	Oana Veliche	A/4.0	Fall 2023
PhD Candidacy Achieved			Fall 2023