Curriculum Vitae

He Wang

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❖ Research Interests

My research areas are in Algebraic Topology and Group Theory, and their applications to Data Science, Machine Learning, and Deep Learning. I also develop undergraduate and graduate courses to support the theoretical foundation of the growing fields of Data Science and Artificial Intelligence.

❖ Education/Employment History

❑ Employment History

- 2024 – current. **Program Director for the new University Interdisciplinary Program: MS Statistics and MS Statistics-Connect,** Northeastern University.
- 2021 – current. **Program Director, MS in Applied Mathematics and MS in Operations Research,** Northeastern University. (**Interim** director 2021 July – 2021 Dec.)
- 2024 – current. **Associate Teaching Professor**, Department of Mathematics, Northeastern University, Boston, USA.
- 2019 – 2024. **Assistant Teaching Professor**, Department of Mathematics, Northeastern University, Boston, USA.
- 2016 – 2019. **Postdoctoral Researcher**, University of Nevada, Reno, USA. Mentor: Christopher Rogers
- 2010 – 2016. **Teaching Assistant**, Northeastern University, Boston, USA.

❑ Education

- 2010 – 2016. **Ph.D. in Mathematics**, Northeastern University, Boston, USA.

Advisor: Alexandru Suciu
Research Field: Algebraic Topology and Group Theory
Thesis: Resonance varieties, Chen ranks and formality properties of finitely generated groups.

- 2007 – 2010. **M.S. in Mathematics**, Nankai University, Tianjin, China.
  Advisors: Xiugui Liu and Xiangjun Wang
  Research Field: Algebraic Topology
  Thesis: Spectral sequences and their applications in stable homotopy groups of spheres and twisted cohomology.
- 2003 – 2007. **B.S. in Mathematics and Applied Mathematics,** Hebei Normal University, China.

❖ Scholarship/Creative Activity

❑ Publications (The authors in the publication are listed **alphabetically** by last name, with each author having made an **equal contribution**.)

Google Scholar : https://scholar.google.com/citations?user=woYNpf8AAAAJ&hl=en

1. Refereed articles

- Taylor expansions of groups and filtered-formality, (with Alex Suciu), submitted. arXiv:1905.10355. European Journal of Mathematics 6 (2020), nr. 3, 1073-1096. MR 4151729.
- Chen ranks and resonance varieties of the upper McCool groups, (with Alex Suciu), Advances in Applied Mathematics, Volume 110, (2019), 197-234. MR3983125.
- Formality properties of finitely generated groups and Lie algebras, (with Alex Suciu), Forum Mathematicum. 31 (2019), no. 4, 867–905. MR3975666.
- Cup products, lower central series, and holonomy Lie algebras, (with Alex Suciu), Journal of Pure and Applied Algebra Volume 223, Issue 8, (2019), 3359–3385. MR3926216.
- Pure virtual braids, resonance, and formality, (with Alex Suciu), Mathematische Zeitschrift 286 (2017), no. 3-4, 1495–1524. MR3671586.
- On a spectral sequence for twisted cohomologies, (with Weiping Li and Xiugui Liu), Chinese Annals of Mathematics, Series B 35 (2014), no. 4, 633–658. MR3227750.
- Some products involving the fourth Greek letter family element ˜δ s in the Adams spectral sequence, (with Xiugui Liu), Turkish Journal of Mathematics 35 (2011), no. 2, 311–321. MR2839725

- The cohomology of the mod p Steenrod algebra, (with Xiugui Liu), Proceedings of the Japan Academy, Ser. A, Mathematical Sciences 85, (2009), no.9 143–148. MR2573964

2. Books chapters

- Pure braid groups and their relatives, (with Alex Suciu), Perspectives in Lie Theory, 403–426, Springer INdAM Series, vol. 19, Springer, 2017. MR3227750.

❑ Creative Activity

1. Exhibition Projects (Conference Posters**)**

- 2015 July Computational Geometric Topology in Arrangement Theory, ICERM, Brown University.
  Poster title: "Formality properties of finitely generated groups".
- MathWorks Day at Northeastern University (March 1, 2023)
  Poster Title: Machine Learning in Applied Math Curriculum using MATLAB.
- Poster at Conference for Advancing Evidence-Based Learning (CAEBL) on April 30th, 2024 (CATLR)
  Poster Title: Undergraduate and Graduate Mathematics Education in the Era of AI
- AI Gallery https://learning.northeastern.edu/leveraging-chatgpt-to-support-coding-in-applied-math/

2. Conference/Workshop/Seminar Presentations

- Conference for Evidence-Based Learning on April 30th, 2026 (CATLR, Northeastern University)
  Title: Mathematical Foundations for AI: Experiential and Human-centered Learning
- 2019 July The 8-th International Conference on Matrix Analysis and Applications (ICMAA 2019) **University of Nevada, Reno**, Nevada.
  Title: "Matrix methods in algebraic topology".
- 2018 Oct. Algebra seminar at **Temple University**, Philadelphia, PA.
  Title: "Moduli spaces in rational homotopy theory".
- 2017 Nov. AMS 2017 Fall Western Sectional Meeting: Special Session on Homotopy Theory, **University of California, Riverside**, Riverside, CA.

Title: “Formality properties: generalizations and applications”.

- 2017 Apr. Two lectures in the pure math seminar at **University of Nevada, Reno.**
  Title: “Massey products, formality properties and A∞-algebras”.
- 2016 Oct. The Department of Mathematics & Statistics Colloquium at **University of Nevada, Reno.**
  Title: “Formality properties in topology and group theory”.
- 2016 Apr. PhD thesis defense at **Northeastern University,** Boston.
  Title: “Resonance varieties, Chen ranks and formality properties of finitely generated groups”.
- 2016 Mar. AMS 2016 Spring Eastern Sectional Meeting: Special Session on Topology and Combinatorics of Arrangements (in honor of Mike Falk), **State University of New York at Stony Brook,** NY.
  Title: “Towards a new resonance-Chen ranks formula: the case of welded braids”.
- 2016 Mar. Graduate Student Seminar at **Northeastern University**, Boston.
  Title: “Algebraic and geometric invariants of finitely generated groups”.
- 2015 Nov. Geometry, Algebra, Singularities, Combinatorics (GASC), **Northeastern University**, Boston.
  Title: “Algebraic invariants of pure braid-like groups”.
- 2015 Aug. Combinatorial Constructions in Topology, **University of Regina,** Regina, Canada.
  Title: “Resonance varieties and Chen ranks of braid-like groups”.
- 2015 July Computational Geometric Topology in Arrangement Theory, **ICERM**, **Brown University**.
  Title: “Formality properties, resonance varieties, and Chen ranks”.
- 2015 Apr. Maurice Auslander Distinguished Lectures and International Conference, **Woods Hole**, MA.
  Title: “Resonance varieties, Hilbert series and Chen ranks”.
- 2015 Mar. AMS 2015 Spring Eastern Sectional Meeting: Special Session on Algebraic Structures Motivated by and Applied to Knot Theory. **Georgetown University**, Washington, DC.
  Title: “Cohomology jump loci of configuration spaces”.

- 2014 May Maurice Auslander Distinguished Lectures and International Conference, **Woods Hole**, MA

  Title: "Lie algebras of finitely generated groups and their formality properties".
- 2012 Dec. Algebraic Topology Seminar at **Nankai University**, Tianjin, China.

  Title:"Cohomology jump loci and algebraic invariants".
- Graduate Student Seminar at **Northeastern University**, Boston.

  Title: "Massey products and its applications". (2012 Oct.)

  Title: "A new application of Toda brackets". (2013 Apr.)

  Title: "The computation of the holonomy Lie algebra of a discrete group". (2013 Oct.)

  Title: "Some functors from topological spaces to Lie algebras and varieties". (2014 Feb.)

❖ Grants

❑ External grants (2019-current)

- Awarded '**MathWorks Mini-Grant'** for **Curriculum Development using MATLAB** from **MathWorks for 2022 -2023. ($ 25,000. PI**)
  Title of proposal: Mathematical Perspectives on Machine Learning and Deep Learning

❑ Internal grants (2019-current)

- Awarded Full-Time Faculty Professional Development Fund (FFPDF) from Northeastern University Office of the Provost for **2021-2022**. ($ 2,000. PI)

❑ Grants before 2019

- 2017 Oct. & 2018 Sept. Postdoctoral Awards for **Professional Development** at University of Nevada, Reno.
- 2015 Dec. External AMS Graduate Student Travel Grant from **American Mathematical Society**.
- 2015 July Travel funding from Graduate Student Government at Northeastern University.
- 2015 Feb. & 2016 Feb. Travel grants from College of Science at Northeastern University.
- 2008 Nov. – 2009 Nov. Second Prize Scholarship at Nankai University.
- 2004 Dec. – 2006 Dec. First Prize Scholarship at Hebei Normal University.

❖ Teaching and Advising

❑ Courses (2019-current at Northeastern)

(Course number >5000 is graduate course.)

2026 Spring

- Math6241- Stochastic Processes (New Course)
- Math5010- Foundations of Statistical Theory and Probability
- Math7243- Machine Learning and Statistical Learning Theory 1
- Math7339- Machine Learning and Statistical Learning Theory 2

2025 Fall

- Math5010- Foundations of Statistical Theory and Probability (New Course)
- Math7243- Machine Learning and Statistical Learning Theory 1
- Math7339- Machine Learning and Statistical Learning Theory 2

2025 Spring

- Math7243- Machine Learning and Statistical Learning Theory 1
- Math7339- Machine Learning and Statistical Learning Theory 2
- Math 8984: Research

2025 Summer 1

Math5110- Applied Linear Algebra and Matrix Analysis.

2024 Fall

- Math7243- Machine Learning and Statistical Learning Theory 1
- Math7339- Machine Learning and Statistical Learning Theory 2

2024 Summer 2

- Math5110- Applied Linear Algebra and Matrix Analysis.

2024 Spring

- Math7243- Machine Learning and Statistical Learning Theory 1
- Math7339- Machine Learning and Statistical Learning Theory 2

2023 Fall

- Math7243- Machine Learning and Statistical Learning Theory 1 (15 students)
- Math5110- Applied Linear Algebra and Matrix Analysis. (11 students)
- Math7339- Machine Learning and Statistical Learning Theory 2 (overload) (11 students)

2023 Summer 2

- Math5110- Applied Linear Algebra and Matrix Analysis. (11 students) (overload)

2023 Summer 1

- Math7741 Readings in Probability and Statistics (1 student) (overload)

2023 Spring

- Math7339- Machine Learning and Statistical Learning Theory 2 (**New course**) (16 students)
- Math7243- Machine Learning and Statistical Learning Theory 1 (overload) (31 students)
- Math4570- Matrix methods for data analysis and machine learning (29 students)
- Math7978: Independent Study on Machine Learning topics (4students) (overload)

2022 Fall

- Math7243- Machine Learning and Statistical Learning Theory (overload) (14 students)
- Math5110- Applied Linear Algebra and Matrix Analysis (18 students)
- Math4570- Matrix methods for data analysis and machine learning (33 students)

2022 Spring

- Math7243- Machine Learning and Statistical Learning Theory (9 students)
- Math7243- Machine Learning and Statistical Learning Theory (overload) (20 students)
- Math4570- Matrix methods for data analysis and machine learning (37 students)
- Math7978: Independent Study on Machine Learning and Statistical Learning (1 graduate student independent study) (overload)

2021 Fall

- Math7243- Machine Learning and Statistical Learning Theory (18 students) (overload)
- Math5110- Applied Linear Algebra and Matrix Analysis. (29 students)
- Math4570- Matrix methods for data analysis and machine learning (**New course**, 37 students)

2021 Summer

- Math7978: Independent Study on Deep Learning–GANs and Style Transfers. (1 graduate student independent study) (overload)

2021 Summer I

- Math3081- Probability and Statistics. (46 students) (overload)
- Math2331- Linear Algebra (44 students) (Course Coordinator) (overload)

2021 Spring

- Math2331- Linear Algebra (27 students)
- Math2331- Linear Algebra (24 students) (Course Coordinator)
- Math7243- Machine Learning and Statistical Learning Theory (17 students) (**Major revision**)

2020 Fall

- Math3081- Probability and Statistics. (59 students)
- Math5110- Applied Linear Algebra and Matrix Analysis. (20 students) (**Major revision**)
- Math2331- Linear Algebra. (39 students) (Course Coordinator)

2020 Summer I

- Math3081- Probability and Statistics. (47 students)
- Math2331- Linear Algebra (32 students) (Course Coordinator)

2020 Spring

- Math3081-Probability and Statistics. (45 students) (Course Coordinator)
- Math2321- Calculus 3 (35 students)
- Math2321- Calculus 3 (35 students)

2019 Fall

- Math3081- Probability and Statistics (71 students)
- Math2331- Linear Algebra (48 students)
- Math2331- Linear Algebra (29 students)

❑ **Courses Before 2019**

Instructor at University of Nevada, Reno (Postdoctoral Researcher)

- 2019 Summer A mini-course for graduate students on Rational Homotopy Theory.
- 2019 Spring Calculus 2
- 2019 Spring Linear Algebra
- 2018 Fall Calculus 3
- 2018 Fall Linear Algebra
- 2018 Spring Linear Algebra. (Two sections.)
- 2017 Fall Linear Algebra. (Two sections.)
- 2017 Spring Linear Algebra. (Two sections.)
- 2016 Fall Linear Algebra. (Two sections.)

Instructor at Northeastern University (PhD student)

- 2015 Fall Calculus for Business and Economics.
- 2014 Fall Calculus for Business and Economics.

Teaching Assistant at Northeastern University (PhD student)

- 2016 Spring Differential Equations and Linear Algebra.
- 2015 Summer Number Theory.
- 2015 Spring Calculus 1.
- 2014 Spring Calculus for Business and Economics.
- 2013 Fall Calculus for Business and Economics.
- 2013 Spring Calculus for Business and Economics.
- 2012 Fall Calculus for Business and Economics.
- 2012 Spring Differential Equations and Linear Algebra.
- 2011 Fall Calculus 1.
- 2011 Spring Real Analysis.
- 2010 Fall Differential Equations and Linear Algebra.

❑ Advising Activities

1. Undergraduate thesis/capstone:

- Fall 2020, advise Xiaoying He for senior thesis on braid groups (Now PhD student at Brandies University).

- Fall 2021, advise Zhengxun Liu for undergraduate research capstone for "Knots, Braids, and Configuration Space". (Now MS student at Mathematical Physics at the University of Edinburgh, Scotland.)

- Spring 2024, advise Mark Larson for Senior project "Applying Machine Learning Techniques to Particle Physics Data Analysis". (Now, PhD student in Physics at University of Chicago)

- Spring 2025, advise Erica Chen for MATH 4025 Applied Math Capstone project: "Analysis of Transit Routing Algorithms: Optimizing Path Selection on the MBTA Network".

- Fall 2025, advise Quella Wang for MATH 4970: Jr/Sr Honors Project 1: "*Math & Music: A Topological Data Analysis of Harmonic Structure in Beethoven's Ninth (Iv)*." This project

will be presented in The 28th Annual Nebraska Conference for Undergraduate Wisdom in Mathematics NCUWM 2026 . Quella has been awarded PEAK Summit Fellowship from Northeastern University for this project.

2. Mentor and recommendations:

- Mentor for Ke Zhang Spring 2022-Spring 2023. (Now PhD student at the University of California, Riverside.)

- Since 2020, I have written recommendations letters for **more than 70 students** for applying to graduate school/job/scholarship. Some of them already enroll in MS or PhD programs in prestigious universities including Columbia University, Iowa University, Clemson University, or work in Harvard Medical School, etc.

3. Advising MS/PhD students

- Organize the weekly Data Camp/Data Workshop for graduate students.
- Advising MS Applied Math graduate students on academic research and industry research.
- Advising MS/PhD graduate students on teaching and professional development.

❖ Service and Professional Development (2019-current at Northeastern)

1. Service to the Institution

(1). Department service (Department of Mathematics**)**

- **Program Director** for MS Applied Math and MS Operations Research (2021- current.) As the program director, I have several department, college, and university services. I also work as the director for MS Math.
- Graduate programs committee (2021- current)
- Diversity and Inclusion Committee (2021- current)
- Teaching committee (2019 - current)
- TA training committee (2019 - current)
- Math Awards committee (2023 - current)
- Assistant Teaching Professor hiring search committee (2022 spring, 2023 spring)
- Part-time lecturer hiring search committee. (2020 summer, 2021 summer)
- Mentors for graduate students (2022-current)

- Advising and admitting students for MS Math (2021- current)
- Course Coordinator (2020, 2021)
- Academic job panel for graduate students (2021)
- Calculus Field Day–Problems Preparation (2020).

(2). College service

- College of Science- Graduate Curriculum committee. (2021 - current)
- College of Science- Co-op advisor hiring search committee (2022 summer)
- College of Science- Fall Teaching Focus Group for supporting fall 2020 remote teaching under Covid pandemic (2020 summer)
- College of Science Partnership-2023 UNCF Ernest E. Just Life Sciences Initiative

(3). University service

- **Program Director for MS Statistics and MS Statistics-Connect since July 2024**
- Help developing the new University Interdisciplinary Program: MS in Statistics 2023 (Help working on the proposal for Northeastern Leadership review.)
- New MS in Applied Math- Miami Campus 2023 (Help working on the proposal for Northeastern Leadership review.)

2. Service to the Discipline/Profession (2016-current)

- Referee for peer-reviewed mathematics research journals, including Forum Mathematicum (FORUM), Algebraic & Geometric Topology, Journal of Homotopy and Related Structure, European Journal of Mathematics, Linear and Multilinear Algebra. (10 manuscripts)
- Textbook Review (4 textbooks)
- Reviewer for MathSciNet. (18 articles)
- Reviewer for Zentralblatt MATH. (4 articles)

3. Professional Development (2019-current)

(1) Experiential Learning

Work with the Northeastern University- The Experiential Network (XN) and several external industry companies in pharmaceutical research, digital surgery and artificial indigence to

develop **XN industry experiential projects** for experiential learning in my Math 4570, Math 7243, Math 7339 courses:

- 3D images data analysis using deep learning (with Zeta Surgical company) (2020)
- Brain Hemorrhage Segmentation using machine learning and deep learning (with Zeta Surgical company) (2021-current)
- Find Novel Intrinsic Oncology Targets and Biology using machine learning and deep learning (With Merck Research Laboratories) (2022-current)
- Develop Chatbot Model to Fine-Tune Company Specific Questions and Chat Sequences with Gigturbo Company (Semester XN project starting in Fall 2023)
- SKEPSIS: Voice Command Function (Semester XN project starting in Spring 2024)
- Develop a new XN project with on AI Research on Property Tax Effects for Spring 2026.

In addition, students also choose projects from other resources, like Kaggle, UCI, government, labs, etc. In the last three years, there are **more than 50 teams** in my courses complete final projects using methods in linear algebra, in machine learning and deep learning.

(2) Curriculum Development

- Supported by FFPDF from Northeastern University Office of Provost and 'MathWorks Mini-Grant' for Mathematical Perspectives on Machine Learning and Deep Learning Curriculum Development using MATLAB.
- Revised two current graduate courses MATH 5110 and MATH 7243.
- Developed one new undergraduate course MATH 4570, and three graduate courses, MATH 5010, 6231, 7339.
- Update current curriculum for MS Applied Math, MS Math, MS Operations Research.
- Proposed new curriculum for MS Applied Math program with two concentrations and new curriculum for graduate certificate.

(3) Attending conferences/seminars/workshop

- Non-Tenure Track Hiring STRIDE Workshop.
- Inclusive Teaching Workshop (Led by COS Facilitators from the Northeastern University Skills and Capacity for Inclusion (NU-SCI))
- CATLR Workshops

- Regularly attend meetings, talks, conferences relating math, applied math, machine learning, deep learning, artificial intelligence, data science at Northeastern University.