Subhadip Chowdhury

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Education

2012 - 2018 **Ph.D. in Mathematics**, *The University of Chicago* Chicago, IL
- **Advisor** - Danny Calegari
- **Dissertation Title** - Self-similarity of Ziggurat Fringes and Rigidity of Extremal Free Group Actions on the Circle

2014 **M.S. in Mathematics**, *The University of Chicago* Chicago, IL
- **Topic Proposal** - Stable Commutator Length and Quasimorphisms

2009 - 2012 **Bachelor of Mathematics with Honours**, *Indian Statistical Institute, Bangalore Centre* Bengaluru, KA, India
- First Division with Distinction

Academic Appointments

2023 - Present **Assistant Instructional Professor**, *University of Chicago* Chicago, IL
- Elem Functions and Calculus I-II-III, Math 130's sequence (2023-24)

2020 - 2023 **Visiting Assistant Professor**, *The College of Wooster* Wooster, OH
- Introduction to Topology, Math 330 (Fall 2021)
- Numerical Analysis, Math 327 (Spring 2022)
- Chaotic Dynamical Systems, Math 299 (Spring 2023)
- Teaching Apprenticeship, IDPT 398 (Spring 2022)
- Putnam Seminar, Math 27901 (Fall 2021, Fall 2022)
- Differential Equations, Math 221 (Fall 2020*)
- Transition to Advanced Mathematics, Math 215 (Spring 2021*, Fall 2021, Fall 2022)
- Multivariate Calculus, Math 212 (Spring 2022, Fall 2022)
- Mathematical Foundations of Computing, Math 130 (Spring 2022, Spring 2023)
- Theory of Integral Calculus, Math 125 (Fall 2022, half-semester)

- Theory of Differential Calculus, Math 115 (Fall 2021, half-semester)
- Applied Differential Calculus, Math 110 (Spring 2023, half-semester)
- Calculus and Analytic Geometry II, Math 112 (Spring 2021*)
- Calculus and Analytic Geometry I, Math 111 (Fall 2020*)

* online and hybrid versions

2018 - 2020 **Visiting Assistant Professor**, *Bowdoin College* Brunswick, ME

- Ordinary Differential Equations, Math 2208 (Fall 2019, Spring 2020)
- Linear Algebra, Math 2000 (Spring 2019)
- Multivariable Calculus, Math 1800 (Fall 2018, Spring 2019, Fall 2019, Spring 2020),
- Differential Calculus, Math 1600 (Fall 2018)

Summer 2018 **Mathematics Instructor, Chicago Academic Achievement Program**, *The University of Chicago College* Chicago, IL

- Proof-Based Methods in Mathematics

2014 - 2018 **Graduate Instructor**, *The University of Chicago College* Chicago, IL

- Mathematical Methods for Social Sciences, Math 195 (Winter 2018, Fall 2017)
- Linear Algebra, Math 196 (Summer 2017),
- Calculus III, Math 153, (Winter 2017, Winter 2016, Spring 2015)
- Calculus II, Math 152 (Fall 2016, Fall 2015, Winter 2015),
- Calculus I, Math 151 (Fall 2014)
- Elementary Functions and Calculus III, Math 133 (Spring 2016)

Teaching Professional Development

Sep 2023 **September Symposium on Teaching at UChicago**, *University of Chicago*

- Six-hour workshop on Interactive Lecturing, Pedagogical Reflections on Generative AI, Inclusive Pedagogy, and Feedback for Student Learning

2023 - Present **Exploratory Teaching Group on Collaborative Learning**, *University of Chicago*

- Ongoing committee discussions on the implementation of collaborative learning in the Physical Science Division and Biological Sciences Division undergraduate courses
- Attend and provide weekly pedagogy training to graduate and undergraduate TAs and Tutors

2023 - 2024 **Mathematics Department Pedagogy Seminar**, *University of Chicago*
- Weekly one-hour meeting. Topics include Mathematics specific teaching practices, including reading and discussion of *Mathematical Association of America* books and articles
- Presented a talk titled *Collaborative Learning in Undergraduate Mathematics*

2023 - 2024 **Chicago Center for Teaching and Learning Reading Group**, *University of Chicago*
- Biweekly group discussion on the implementation of alternate grading in STEM courses using ideas from *Grading for Growth* by Clark and Talbert.

2020 - 2023 **Inclusive Teaching Workshops**, *College of Wooster*
- Three-hour workshops every August run by STEM Success Initiative.
- Workshops include: inclusive practices for teaching, grading, and assessment; supporting diverse students.

2021 **Assessment Workshop**, *College of Wooster*
- One-hour workshop run by Dr. Missy Schen, Assessment Director.
- Workshop includes setting goals for course, writing clear and fair assessment items, and pros/cons of different assessment types.

2021 - 2023 **The Grading Conference**
- Online two-day conference every June supported by NSF
- Topics include: Alternate grading practices (e.g. standards-based, specifications-based, etc.) to best support student learning, promote diversity, equity, and inclusion in the classroom

2013 - 2014 **College Fellow**, *University of Chicago*
- Teaching Assistant for Honors Calculus I-III, Math 161-163 taught by Eugenia Cheng

2013 - 2017 **Grader for First year graduate courses**, *University of Chicago*
- Riemannian Geometry taught by André Neves (Spring 2017)
- Differential Topology taught by Danny Calegari (Winter 2016)
- Differential Geometry taught by Sidney Webster (Winter 2015)
- Algebraic Topology taught by Danny Calegari (Fall 2013)

Curriculum Development

Autumn 2023 — **Weekly Tutorials and Quizzes** for Calculus I-II (Math 131-132) courses, *University of Chicago*

- Developed new content for students attending tutorial sessions led by peer tutors with a focus on collaborative learning and enhancement of conceptual understanding outside the classroom.
- Gave content and pedagogy training to the undergraduate tutors.

Spring 2023 — Created **Chaotic Dynamical Systems** (M29904) course, *College of Wooster*

- Developed new content including syllabus, course notes, exams, and `OCTAVE` projects.

Spring 2021 — **Calculus Review and Restructure**, *College of Wooster*

- Helped subdivide gateway courses to fine-tune student placement and increase accessibility
- created new MCQ question bank for placement tests

Thesis and Project Advising

2021 - 2023 — **Advisor for Senior Independent Study** (Bachelor's Thesis), *College of Wooster*

- Lucy Wickham, 2022-2023
  "Tile Invariants and an Exploration of Tilings with Ribbon Pentominoes and L-Pentominoes".
- Michael Curran, 2022-2023
  "Isometric Immersion: Hilbert's Theorem and the Case of the Hyperbolic Plane"
- Ussama Mustafa, 2022-2023 (jointly with the CS department)
  "Exploring the Power of Generative Architectures such as GANs, Transformers, and VQGAN+CLIP through the Construction of an Illustrated Storybook Generator"
- Sabrina Helck, 2021-2022
  "The Infinity Conundrum: Understanding Topics in Set Theory and the Continuum Hypothesis".
- Molly Hutter, 2021-2022
  "In Hot Water! Using Numerical Analysis to show the Effects of Climate Change on the Great Lakes".

2021 - 2022 **Supervisor for Applied Methods and Research Experience**, *College of Wooster*

- **Summer '22**: Funded by Goodyear Tire and Rubber Company - Innovation Technology division, students were tasked with creating a comprehensive analysis application for their non-pneumatic tires using Python, converting multi-program routines involving complex data structures and cutting-edge numerical methods, into one standardized workflow.
  Supervisees: Ussama Mustafa, Praneel Panchigar, Kevin Yuan
- **Summer '21**: A client-funded research project, where students were tasked with understanding trends in customer behavior at a regional grocery store chain, analyzing halo effects, and coming up with creative targeted programs to increase sales using customer segmentation techniques.
  Supervisees: Abigail Breitenbucher, Luke Pritchard, Maya Vasta, Kweku Yamoah

Spring 2019 **Advisor for Intermediate Independent Study**, *Bowdoin College*

- Theo de Quillacq, 2020 - *Machine Learning*
- Arav Agarwal, 2020 - *Group Theory*

2020 - 2021 **Second Reader for senior I.S. Project**, *College of Wooster*

Independent studies where I have been a committee member and reader -

- Joaquin Abos Amo, 2021,
  "A Game Theoretical Analysis of War Situations and International Conflict"
- Rephael Berkooz, 2021
  "Musical Feature Engineering with Wavelet Analysis for Music Recommendation"
- Molly Hutter, 2020
  An Investigation into Finite Difference Methods in Solving a Reaction-Diffusion System to Model the Spread of Wildfires
- Alayt Issak, 2020
  "Visualizing Concepts: Generative Adversarial Network (GAN) visuals synthesized from semantic vectors"

2019 **Second Reader for Honors Project**, *Bowdoin College*

- Rosa Rossi-Goldthorpe, 2019
  "Modeling the Mechanism of Lithium in the Treatment of Bipolar Disorder"

2014, 2016 **Advisor for Summer Research Experience for Undergraduates**, *University of Chicago*
- M. C. Welsh, 2016 - *Scissors congruence*
- S. Park, 2016 - *Rationality of zeta functions over finite fields*
- E. Hsiao, 2016 - *Canonical energy and black hole stability*
- L. Linov, 2014 - *An introduction to knot theory and the knot group*
- J. H. Yoo, 2014 - *The Jordan-Chevalley decomposition*

2014 - 2016 **Directed Reading Program Mentor**, *University of Chicago*
- Dan Su, Winter 2016 - *Topology*
- Wenyu Chen, Fall 2015 - *The Dynamics of Circle Homeomorphisms*
- Weston Ungemach, Spring 2014 - *Discrete Group actions on Topological Spaces*

2014 - 2016 **WOMP Mentor**, *University of Chicago*
- Warm-up program organized and run by advanced graduate students for incoming grads in the math department

2010 - 2011 **Instructor in Regional Mathematical Olympiad and National Mathematical Olympiad Training Camp**
- in Kolkata, West Bengal and Bangalore, Karnataka, India

Administrative Experience

2023 - Present **Phoenix STEM program Coordinator for Mathematics department**, *University of Chicago*

Duties include -
- Collaborating with the Phoenix STEM director and other STEM departmental coordinators to create programs that increase student performance, retention, confidence, and sense of belonging; specifically among low-income and first-generation college students
- Implementing and training Graduate Teaching Assistants and Undergraduate Team Leaders on Collaborative Learning Pedagogy
- Designing and training the above groups on mathematical content for CL tutorials
- Conducting weekly office hours for the Phoenix STEM scholars
- Creating SMART goals to assess the performance of Graduate TAs and Undergrad Team Leaders and provide appropriate feedback
- Creating and maintaining communication channels between the directors and the Phoenix STEM students

2023 - 2024 **Co-coordinator of Math 130's (Calculus) program**, *University of Chicago*
Duties include -
- Designing problems and worksheets for Calculus tutorials outside lectures
- Visiting classes and tutorials to assess the performance of Junior Tutors and provide appropriate feedback
- Creating and maintaining communication channels between the Directors, Section Leaders, and the Junior Tutors
- Administering weekly Quizzes (writing, collecting, scanning, assigning grading, data cleaning, and publishing)
- Collaborating with Educational Technology officers to automate the process for over 300 students simultaneously

2023 - 2024 **Member of AIP Subcommittee to decide Online Homework Platform**, *University of Chicago*
Duties include -
- Scheduling and meeting with representatives from different vendors,
- Researching University and administrative regulations for the decision process
- comparing and contrasting the various pros and cons and preparing report for the Senior Faculty

2015-2018 Administration of the **University of Chicago College Calculus Accreditation Exam**, under the supervision of Jitka Stehnova and John Boller
Duties included -
- Creating a MCQ question bank (2018)
- Grading subjective answers
- Designing sorting criteria and algorithm
- Processing large data sets using Excel and Python

Other Professional Service

2021-2023 **Primary Faculty Advisor, The Student Mathematical Association of America Club**, *College of Wooster*
- Student organization promoting opportunities for community development within the mathematics department and for increasing mathematics awareness on and around campus

Summer 2021 | **Creating Guides for incoming international students in STEM**, *College of Wooster*
- Supported by Great Lakes Colleges Association Internationalization grant

2018-2020 | **Co-organizer, Problem Solving Session**, *Bowdoin College*
- Training undergraduates in problem solving strategies for *Putnam Competition*

2019-2020 | **Co-organizer, Student of Color Study Group**, *Bowdoin College*
- Weekly study group for underrepresented students in Math, CS and Physics

2019 | **Judge, MAA Undergraduate Poster Session**, *JMM 2019*, Baltimore, MD

2015 | **Judge, QED Young Math Symposium**, *Math Circles of Chicago*
- Chicago's only youth math symposium

2014 | **Organizer & Moderator, AWM Postdoc Panel**, *University of Chicago*
- Regarding application process, job market etc.

2014-2018 | Webmaster and active member of the UChicago chapter of *Association for Women in Mathematics*

2014-2019 | Member of the American Mathematical Society

Research Interests

Low-dimensional topological dynamics, especially the theory of nonabelian group actions on the circle. Theory of formal languages, with an aim to solve combinatorial group theory problems using topological methods. Broadly interested in geometric group theory, complex dynamics, and big mapping class group related topics as well.

Publications and Preprints

- **Ziggurat fringes are self-similar.** *Ergodic Theory and Dynamical Systems*, doi:10.1017/etds.2015.75

  In this paper, we give explicit formulae for fringe lengths of the Calegari-Walker Ziggurats – i.e. graphs of extremal rotation numbers associated to positive words in free groups. These formulae reveal (partial) integral projective self-similarity in ziggurat fringes, which are low-dimensional projections of characteristic polyhedra on the bounded cohomology of free groups. This explains phenomena observed experimentally by Gordenko and Calegari-Walker.

- **A Topological proof that O_2 is 2-MCFL.**
  arxiv.org/abs/1710.04597
  In this paper, we give a new proof of Salvati's theorem that the group language O_2 is 2 multiple context free using homology theory. Unlike Salvati's proof, our arguments do not use any idea specific to two-dimensions. This raises the possibility that the argument might generalize to O_n.

Invited Talks

Oct 2023	*American Mathematical Society Fall Southeastern Sectional Meeting - Special Session on Ergodic Theory and Dynamical Systems*, Mobile, AL, USA
March 2022	*Joint Mathematical Meetings - Project NExT session on Re-Imagining Grading: The Whys and Hows*, virtual, USA
Jan 2022	*Ohio Speaker's Circuit*, Kenyon College, OH, USA
Jan 2021	*Joint Mathematical Meetings - AMS Special Session on Quantization for Probability Distributions and Dynamical Systems*, Virtual, USA
Mar 2019	*Bowdoin College Department Seminar*, Bowdoin College, Brunswick, ME, USA
Apr 2018	*American Mathematical Society Spring Southeastern Sectional Meeting* , Vanderbilt University, Nashville, TN, USA
Jan 2018	*Joint Mathematical Meetings - AMS Special Session on Dynamical Systems: Smooth, Symbolic, and Measurable*, San Diego, CA, USA
Sep 2017	*American Mathematical Society Fall Eastern Sectional Meeting - Special Session on Geometric Group Theory*, SUNY, Buffalo, NY, USA
Dec 2016	*Canadian Mathematical Society Winter Meeting - Session on Geometric Group Theory and Topology in Low Dimensions*, ON, Canada

Expository Talks in Student Seminars

Feb 2020	*Rotation Number and Dynamics on the Circle*, College of Wooster
Oct 2019	*Scissor's Congruence and Hilbert's 3rd Problem*, Bowdoin College
Nov 2018	*The Illumination Problem and Rational Billiards*, Bowdoin College
Apr 2018	*Rotation Number and Dynamics on the Circle*, Bowdoin College
Apr 2018	*Explorations in Circle Packings*, University of Chicago
Apr 2017	*Hilberts 3rd Problem and the Dehn Invariant*, University of Chicago
Dec 2015	*Combinatorics of chessboard puzzles about domination, independence and tours*, University of Chicago
Nov 2013	*Cut-Copy-Paste - Algebra and Tiling*, University of Chicago
Feb 2013	*Stable Commutator Length*, University of Chicago

Awards and Scholarships

2012-2013	**McCormick Fellowship**, University of Chicago Awarded by the Admissions Committee to a small number of highly rated applicants to the Ph.D. program of the Department of Mathematics, for an amount of $9000 over two years.
2012	**S.H. Aravind Gold Medal**, Indian Statistical Institute Awarded for outstanding performance in B. Math, to the student with highest CGPA in the program.
2011	**Summer Reaserch Fellowship**, Indian Academy of Science
2009	**Bronze medal, 50th International Mathematical Olympiad**, Germany
2009	**National Board of Higher Mathematics scholarship**, Department of Atomic Energy, Government of India
2008	**Kishore Vaigyanik Protsahan Yojana fellowship**, Department of Science and Technology, Government of India
2007	**National Talent Search Examination scholarship**, National Council of Education Research and Training, India

Research Conferences and Workshops Attended

May 2017	*2017 Georgia International Topology Conference*, University of Georgia, Athens
April 2016	*Bloomington Geometry Workshop*, Indiana University, Bloomington
June 2015	*Summer School in Geometry and Topology*, University of Chicago
June 2015	*Diffeomorphism Groups Summer school*, UC Berkeley
May 2015	*Midwest Topology Seminar*, University of Chicago
June 2014	*Thurston Legacy Conference*, Cornell University

Skills and Languages

Technical	C, Python, Haskell, Mathematica, Octave, PHP, HTML, CSS, LaTeX, MS Office
Language	English, Bengali, Hindi - fully proficient in speaking, reading, and writing