Patrick Chan
Curriculum Vitae

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EDUCATION

Indiana University Bloomington - Bloomington, IN — August 2022-Present
PhD Student in Mathematics (Advisor: Jim Davis) – PhD Minor in Voice

Loyola University Chicago - Chicago, IL — August 2021-May 2022
Masters of Science in Mathematics

Loyola University Chicago - Chicago, IL — August 2018-May 2021
Bachelor of Science in Mathematics

RESEARCH EXPERIENCE

Graduate Research Fellow — Summer 2023 - Present
Department of Engineering Sciences, Loyola University Chicago
Supervised by Dr. Vincent Chen

- Model and simulate
- Design and fabricate solutions for specialized animal testing
- Mentor Undergraduate and High School Students

Research Assistant, Mathematics — Fall 2019 - Spring 2022
Department of Mathematics, Loyola University Chicago
Supervised by Dr. Peter Tingley

- Solved for the restrictions on Dyck paths necessary to qualify as a root multiplicity.
- Created a program that finds root multiplicities in rank three using a quiver variety approach. [Code]

Research Fellow (Carbon Fellowship) — Fall 2019 - Spring 2022
Department of Engineering Sciences, Loyola University Chicago
Supervised by Dr. Vincent Chen
EEG to EMG System Identification

- Processed stroke patient data.
- Created a Parametric Model which predicts EMG given a EEG input

EEG Brain Mapping Project

- Administered electrical stimulation while collecting EEG data.
- Wrote a program that tests correlation between the collected EEG data and the pseudo-random stimulation. (Signal Processing)
- Writing a program that can test correlation in real-time.
- Gained CITI Certification for Human Subject Research

REU participant — Summer 2020
Department of Mathematics, Texas A&M University
Supervised by Dr. Anne Shiu
Algebraic Methods for Computational Biology

- Researched the relation between the closed and open embedding dimension of convex neural codes, introducing the classification of the non-degenerate convex embedding dimension.
- Researched the geometric criteria for non-closed convexity of neural codes.

- Researched the identifiability of Linear Compartment Models with a focus on the impact of leaks using the singular locus, SL, method and focusing on dividing edges of a model's SL.
- Report: Relations Between Open and Closed Embedding Dimensions of Neural Codes

FYRE Participant (Sponsered by HHMI) Fall 2018 - Summer 2019
Department of Engineering Sciences, Loyola University Chicago
Supervised by Dr. Vincent Chen
Mouse's Auditory Reflex Project

- Worked with load cells and myDaq to design enclosure for mice.
- Collected test data from load cell.
- Guided the programming team on mathematics and statistics.
- Led UNIV 102 Lecture on the unique structures of Aplysia's Nervous Systems using I. Kupfermann's, H. Pinsker's, V. Castellucci's, and E. R. Kandel's paper, *Central and Peripheral Control of Gill Movement in Aplysia.*

PAPERS & PRE-PRINTS

- P. Chan, Katherine Johnston, Joesph Lent, Alexander Duys De Perez, and Anne Shiu. *Non-degenerate Neural Codes and Obstructions to Closed Convexity.* SIAM Journal on Discrete Mathematics, 37(1):114–145, 2023. Available at arXiv:2011.04565
- P. Chan, Katherine Johnston, Anne Shiu, Aleksandra Sobieska, and Claire Spinner. *Identifiability of Linear Compartment Models: The Impacts of Removing Leaks and Edges.* Available at arXiv:2102.04417
- P. Chan, and Peter Tingley. *Quiver Varieties and Root Multiplicities in Rank 3*

POSTERS & TALKS

- Topologists and Friends Organized Graduate Seminar "TopFrOGS"
  - *A Wall to Wall Introductions: A storybook view of CTC Wall's construction of an h-cobordism from two of his papers.* August 3rd and 10th, 2025. Bloomington, IN.
  - *Dancing with spheres: a portrait of* $S^2 \tilde{\times} S^2$. January 30, 2025. Bloomington, IN.
- *The last leg of "On the question of genericity of hyperbolic knots" roadmapped.* Hyperbolic Knots Seminar. March 25, 2025. Bloomington, IN.
- TQFT Learning Seminar. Bloomington, IN
  - *An introduction to* $(2,1)$ *TQFTs and Frobenius Algebras.* February 19th, 2025
  - *An introduction to Modular Tensor Categories.* April 16th, 2025
- *Broadening Participation in the Classroom.* Indiana University's Advocates & Allies for Equity: Graduate Student Professional Development Seminar. April 18, 2024. Bloomington, IN.
- *Embedding Dimensions and Geometric Preclusion of Closed Convexity of Neural Codes.* Loyola's Math & Stats Club: Rambler Mathematics Symposiums. April 29, 2021. Online.
- *Degenerate and Non-degenerate Embedding Dimensions of Neural Codes.* Texas A&M Mathematics REU Miniconference. July 21, 2020. Online. [Slides]
- *Relation Between Auditory Stimulation and Reflex.* First Year Research Experience Capstone Conference. June 30, 2019. Chicago, IL. (w/ Dr. V. Chen)

EXPERIENCE

Indiana University Bloomington, Department of Mathematics:

- Teaching Assistant: Fall 2022 - Present

  MATH-M106: Math of Decision and Beauty Fall 2022 - Spring 2025

  Class covering Perspective Geometry, Game Theory, Graph Theory, Voting Theory, and Symmetry (frieze patterns, D_n, and C_n)

  - Facilitated a flipped classroom.
  - Two hours of pre-scheduled office per week.

  MATH-M125: Pre-Calculus Mathematics Fall 2022 - Spring 2024

  - Created groupworks to flip the classroom.

Loyola University Chicago, Engineering Department:

- Graduate Lab Assistant (see Research Experience)

Loyola University Chicago, Maths and Stats Department:

- Online Course Assistant: Spring 2021

  MATH 266: Differential Equations and Linear Algebra

  Course lead by Dr. Peter Tingley

  - Ran an hour and a half of office hours per week.
  - Help facilitate group work in class.

- Teaching Assistant: Fall 2021 - Spring 2022

  MATH 161: Calculus I (All Sections) Fall 2021

  Sections lead by Dr. Eric Chang, Dr. John Del Greco, Dr. Antony Giaquinto, Dr. Aaron Lauve, and Dr. Darius Wheeler.

  - Run four hours of standard office hours
  - Pioneered "Enrichment", an hour long inquiry based learning activity which runs four times a week designed to let students better class material and expose them to higher level math concepts. (Students are getting to explore Vector Calculus, Delta-Epsilon Proofs, and Parameterization and Reparameterization of a Curve among other fun topics!)

  MATH 201: Discrete Math & Number Theory Spring 2022

  Course lead by Dr. Carmen Rovi

  - Run one and a half hours of office hours.
  - Assisted in grading homework, tests, and quizes.
  - Assisted in teaching LaTeX.
  - Helped assign and facilitate student projects.

MathILy "serious Mathematics infused with Levity":
A five-week intensive summer program for gifted high schoolers to learn undergraduate and graduate level mathematics through inquiry-based learning.

- PRiME (Protector and Responder in the MathILy Environment): Summer 2021
  - Handled paperwork, monitored student well-being, ran social activities, and helped critique student write-ups.
  - assist in facilitating group work.
  - Co-taught a week-long course on Complex Analysis, and another on Game Theory.

Loyola University Chicago, Writing Center:

- *Undergraduate Tutor* Fall 2019 - Spring 2021

- *Member of The Research and Development Subcommittee* Fall 2019 - Spring 2021
- *STEM Outreach* Spring 2020 - Spring 2021

OTHER

Graduate Director of Lab of Experimental Mathematics and Math Applications "LEMMA"
(Formerly Lab of Geometry at IU "LOG(IU)") Fall 2025-Present

Lab of Geometry at IU "LOG(IU)": Fall 2023 - Spring 2025
Mentoring a reading course for undergraduates with a focus on geometry based projects with mid- and end- of-semester student presentations.

- Ran Inquiry-Based Classes
- (Fall 2023 Project): Fundamental Group, Covering Spaces, and the Galois Correspondence.
- (Spring 2024 Project): Visualizing D^n and S^n, Charts and Atlases, Handlebody Decomposition, and Surgery Theory.
- (Fall 2024 Project): Knot Theory focusing on knots that arise from crocheting.
- (Spring 2025 Project): Quilting covering spaces. Basic group theory, homology, and covering spaces.

Sprouts' Bloomington Math Circle: Fall 2025 - Present
Co-pioneered and Co-lead with Julia Plavnik Fall 2025-Present
Once a month math activity targeted towards pre-K through 2nd grade students, to help them develope mathematical thinking!

Bloomington Math Circle: Fall 2024 - Present
Co-lead with Samantha Duckworth Fall 2025-Present
Assisted (Program lead by Ayelet Lindenstrauss & Michael Larsen) Fall 2024 - Spring 2025
Weekly meetings with elemetry school students (3rd through 6th grade) teaching higher level math concepts through activities. (e.g. modular arithmetic, similar triangles, proof by induction, etc.)

Paper Referee for IEEE EMBS Conference on Neural Engineering (NER) 2025

Graduate Student Topology and Geometry Conference Organizer 2025

- FIScal Handler Topologically Allied Conference Organizer (FISH TACO)
- HOspiTality CORrespeNdent Topologically Allied Conference Organizer (HOT CORN TACO)

Math Quests Program Summer 2025
Gail Borden Public Library
I created and taught a program at my local library to provide active learning classes for $3^{rd}-6^{th}$ grade students covering game theory (introduction to combinatorial and matrix games) and vectors (arithmetic and projections).

Seminar organizer of Visualizing Mathematics at Indiana University Fall 2022