Nico Courts

Graduate Student
University of Washington Department of Mathematics
nico@nicocourts.com ncourts@uw.edu github.com/NicoCourts

MATH RESEARCH INTERESTS

I am a student of Prof. Julia Pevtsova studying the representation theory of Hopf (and other) algebras including Schur algebras and q-deformations of objects from algebraic geometry. I rely on techniques from geometry and homological algebra as well as support theory to understand the representation categories of these algebras.

DATA SCIENCE RESEARCH INTERESTS

I am also an intern with Pacific Northwest National Labs under the instruction of Dr. Henry Kvinge. I am particularly interested in using my familiarity with concepts from algebra, category theory, and geometry to enhance the current understanding of deep learning models with a focus towards providing more robust interpretability.

EDUCATION

Ph.D., Mathematics — June 2022 (expected)
University of Washington, Seattle, WA

Master of Science, Mathematics — March 2020
University of Washington, Seattle, WA
Thesis Topic: Schur Duality and Strict Polynomial Functors

Bachelor of Science, Mathematics — May 2016
Magna Cum Laude, Phi Beta Kappa, Dean's List, Departmental Honors
University of Southern California, Los Angeles, CA

Budapest Semesters in Mathematics — Fall 2015
Algebraic Topology, Conjecture & Proof, Cryptography, Differential Geometry
Budapest, Hungary

Associate of Science, Mathematics — June 2013
Key of Knowledge, Dean's list, Honors Program
Citrus College, Glendora, CA

RESEARCH EXPERIENCE

Current Focus

In the recent past, my studies have been focusing on understanding the rational representations of GL_n as established by Schur in his thesis and later work (and later translated and elucidated by Green). More recently, Friedlander, Suslin, Krause, and others have found equivalent categories that more readily afford monoidal structure in the interest of establishing the monoidicity of the Schur-Weyl functor and examining the interactions between different forms of duality. My goal is to use this to try to say something about the bounded derived category of the Schur algebra $S(p,p)$ in positive characteristic.

On the data science side, my primary focus so far has been on few-shot learning using pre-trained encoders and leveraging the topology and geometry of encoded space to try to make better inferences on unseen datasets (transfer learning).

Graduate Reading Courses

University of Washington, Seattle, WA

- Group Schemes and Algebraic Groups – Prof. Julia Pevtsova – *Autumn 2018*

- Abelian Categories – Prof. James Zhang – *Spring 2018*
- Representation Theory – Prof. Julia Pevtsova – *Winter/Spring 2017*
- (Simplicial) Cohomology – Prof. Steve Mitchell – *Autumn 2016*

INTERNSHIPS

NSIP PhD Intern June 2020 – Present
Pacific Northwest National Labs, Seattle, WA

A full-time summer internship resulting in the below publication. After completion I was asked to continue on part-time while I complete my graduate work. I contributed the majority of the coding and tests in our published work as well as (under the instruction of Dr. Kvinge), coming up with the idea of a fuzzy simplicial complex and the subsequent model we used.

PUBLICATIONS

Kvinge, H., New, Z., Courts, N., Lee, J.H., Phillips, L.A., Corley, C., Tuor, A., Avila, A., & Hodas, N.O. *Fuzzy Simplicial Networks: A Topology-Inspired Model to Improve Task Generalization in Few-shot Learning.* (2020). https://arxiv.org/abs/2009.11253 (to appear)

TEACHING EXPERIENCE

Graduate Teaching Assistant Autumn 2016 – Present
University of Washington, Seattle, WA

- **As an instructor:**
  - Math 124 – Calculus I (Su 2018)
  - Math 308 – Matrix Algebra (Sp 2019)
- **As a teaching assistant:**
  - Math 120 – Precalculus (Au 2017)
  - Math 124 – Calculus I (Wi 2017, Wi 2019, Sp 2020)
  - Math 125 – Calculus II (Au 2016, Sp 2017, Wi 2021)
  - Math 126 – Calculus III (Su 2017, Wi 2018, Sp 2018, Au 2020)
  - Math 327 – Introductory Real Analysis (Su 2019)
  - Math 381 – Discrete Mathematical Modeling (Au 2018)
  - Math 403 – Group Theory (Wi 2020)

Lead Teaching Assistant and Instructor Summer 2016
SCS Noonan Scholars (previously South Central Scholars), Los Angeles, CA

- Independently developed and delivered approximately 50 hours of instruction and five exams to gifted university-bound students in calculus 2 and 3.
- Total of 100 contact hours, including daily supevised worksheet sessions.
- Took the initiative to deliver weekly lectures in higher mathematics (number theory, knot theory, differential equations, etc.) along with entry-level problems that allowed students to get a sense of the "flavor" of these fields.

Various Teaching and Mentorship Positions Spring 2012 – Summer 2013
Citrus College, Glendora, CA

- **PAGE Program Tutor** Assisted a licensed teacher in the education of a class of middle school children intended to reinforce the previous year's learning and to prevent "backsliding". Personally instructed a small group of students who were prepared to learn more advanced topics in intermediate algebra.

- **SIGMA Mentor** Took on a small group of students each semester utilizing a holistic approach to education – supplementing standard tutoring with more in-depth educational guidance and planning.
- **Math Tutor** Instructed students in the fast-paced Math Success Center where I provided homework help in all math classes through linear algebra and differential equations.

LEADERSHIP & SERVICE

Graduate Student Representative
University of Washington, Seattle
Summer 2019 - Spring 2020

- Planned and organized a variety of events and lectures for the graduate students as well as the department at large.
- Served as an advocate for the graduate students in several capacities.
- Worked on promoting better communication between the students and faculty.
- Empowered students to make changes to the department while promoting respect for the wishes of the faculty and administration.

Washington Directed Reading Program
Co-organizer and mentor

- Ran the program along with other graduate students in the 2019/2020 year, focusing on procuring funds and encouraging participation of under-represented groups.
- Supervised an undergraduate student in a reading course based around Rebecca Weber's book *Computability Theory* (Autumn 2018).

Math Hour Olympiad
Volunteer Judge
University of Washington, Seattle
Spring 2018

Math Day
Volunteer
University of Washington, Seattle
2017 and 2018

TALKS GIVEN

Schur Algebras & Duality
November 20, 2020
Special Colloquium Series for Mathematical Sciences
Georgia Southern University (online)

EVENTS ATTENDED

Conference on Lie and Jordan Algebras and their Representations
Sichuan University
Chengdu, Sichuan Province, P.R. China
January 2020

Triangulated Categories in Representation Theory and Geometry
University of Sydney
Sydney, NSW, Australia
June 2019

MSRI Summer School
The Mathematics of Machine Learning

University of Washington, Seattle
July 29 - August 9, 2019

ABC Workshop
Geometric and Cohomological Methods in Algebra
University of Washington, Seattle
November 11, 2018

Joint Mathematical Meetings
Seattle, WA
January 2016

SKILLS & HOBBIES

Languages:

- *English* – This is my native language.
- *German* – Ich kann ziemlich gut Deutsch sprechen, lesen, und verstehen! (proficient)
- *Russian* – Я немного понимаю по-русски. (beginner)
- *Programming* – **Go**, **Haskell**, Java, **LaTeX**, PHP, **Python**, Typescript.

Computer Skills: Web/Application Development, Server Administration, Sage, Windows, Linux, FreeBSD.

Life Skills: Critical Thinking, Abstract Reasoning, Communication, Objectivity, Empathy.

Hobbies: Hiking, Jogging, Rollerskating, Appreciating the Wonders of the PNW.