

ROBIN TRUAX  
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RESEARCH INTERESTS

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Algebra, combinatorics, and their application to other fields in pure and applied math, especially political methodology and complexity theory.

EDUCATION

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**Stanford University** 2020 - 2024

*BS in Mathematics, BA in Political Science, MS in Computer Science (expected).*

Overall GPA: 4.11. Math GPA: 4.13. Key graduate classes: algebra, algebraic geometry, topology and geometry, analysis, probability theory. Other key classes: real, complex, and functional analysis, elementary, algebraic, and analytic number theory, discrete math, complexity theory, etc.

**University of Washington** 2019 - 2020

Audited multiple graduate classes in abstract algebra using Dummit and Foote, Aluffi, Awodey.

**North Seattle College** 2019 - 2020

Dual enrollment simultaneous with high school. Overall GPA: 3.96. Math GPA: 4.0. Took classes in multivariable calculus, vector calculus, linear algebra, differential equations, symbolic logic, etc.

RESEARCH EXPERIENCE

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**Computational Correlation for Boolean Decision Trees** 2022 -

Studied various notions of multitask efficiency for Boolean decision trees using the metrics of size and depth. Used combinatorics and graph theory to develop a notion of "computational correlation" and prove properties about the model. Individual project with Li-Yang Tan at Stanford.

**Repetitions in Pak-Stanley Labels of Graphs** 2022

Discovered and proved novel results on repetitions in the Pak-Stanley labels for graphs using tools from combinatorics, algebra, and chip-firing. Created computational tools for analyzing the  $G$ -Shi arrangement. Group project guided by Gordon Kirby and Susanna Fishel at ICERM.

**The Game Theory of Ranked-Choice Voting** 2022 -

Studied voting systems using tools from social choice theory. Mathematically formalized and studied the properties of ranked-choice voting. Independent project with Avi Acharya at Stanford.

**New Proofs and Analogues of Tokuyama's Formula** 2021

Created novel proofs at the intersection of representation theory and combinatorics. Made progress towards developing analogues of Tokuyama's Formula for other reductive groups, such as symplectic groups. Group project guided by Slava Naprienko and Daniel Bump at Stanford.

**Split Petal Projections and the Knot Determinant** 2019 - 2021

Investigated "split petal projections", a symmetric representation of knots derived from petal projections. Developed algorithms to compute knot determinants of split petal projections directly from petal permutations. Independent project with Allison Henrich from Seattle University.

## PRESENTATIONS AND TALKS

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- Counting Pak-Stanley Labels in the  $G$ -Shi Arrangement** *January 2023*  
Joint Mathematics Meetings
- Repetitions of Pak-Stanley Labels in the  $G$ -Shi Arrangement** *January 2023*  
Joint Mathematics Meetings
- The Three Rows Game: Repetitions in Pak-Stanley Labels** *October 2022*  
National Diversity in STEM Conference
- The  $G$ -Shi Arrangement: Games on Paths, Trees, and More** *August 2022*  
Summer at the Institute for Computational and Experimental Research in Mathematics
- The  $G$ -Shi Arrangement and the Three Rows Game** *July 2022*  
Summer at the Institute for Computational and Experimental Research in Mathematics
- $G$ -Shi Arrangements and Parking Functions** *June 2022*  
Summer at the Institute for Computational and Experimental Research in Mathematics
- The Lindström-Gessel-Viennot Lemma: Tiling, Paths, and Determinants** *March 2022*  
Stanford Undergraduate Mathematics Organization Symposium
- Locks and Learning: A Demonstration of Mathematical Storytelling** *October 2021*  
Seattle Public Schools Teacher Mathematics Conference
- Towards a Tokuyama's Formula for Symplectic Groups** *August 2021*  
Stanford Undergraduate Research Institute in Mathematics
- Novel Proofs of Tokuyama's Formula** *July 2021*  
Stanford Undergraduate Research Institute in Mathematics
- Chip-Firing: From Algebra to Sandpiles** *June 2021*  
Stanford University Directed Reading Program
- The Probabilistic Method and Sum-Free Subsets of Abelian Groups** *May 2021*  
Stanford University
- How to Drive Students Away From Math: A Tutorial** *October 2020*  
Seattle Public Schools Teacher Mathematics Conference
- Knot So Hard: An Introduction to Petal Projections** *February 2020*  
Western Washington Community College Student Mathematics Conference
- Split Petal Projections, Knot Colorings and Determinants** *August 2019*  
Summer Institute of Mathematics at the University of Washington

## TEACHING AND WORK EXPERIENCE

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- Research in Stanford's Department of Political Science** *2022 -*  
Studied voting systems using computational and formal tools. Developed tools for empirically testing theories. Wrote a paper being submitted for publication.
- Grader in Stanford's Department of Mathematics** *2021 -*  
Evaluated students in Stanford's honors math sequence on discrete math and probability theory, as

well as upper-division courses in graph theory and algebraic geometry.

**Community Tutor at North Seattle College** 2019 - 2020  
Tutored students in subjects ranging from basic algebra to multivariable calculus, linear algebra, differential equations, as well as computer science in both one-on-one and group settings.

**Individual Tutor** 2018 - 2020  
Privately tutored students studying calculus, preparing them to pass Advanced Placement exams. Also individually tutored college students in group theory and abstract algebra.

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#### AWARDS AND GRANTS

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**SACNAS 2022 Travel Scholarship** 2022

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#### WORKSHOPS AND CONFERENCES

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**Joint Mathematics Meetings** 2023  
The American Mathematical Society

**National Diversity in STEM Conference** 2022  
Society for the Advancement of Chicanos/Hispanics and Native Americans in Science

**Summer@ICERM Institute for Computational Combinatorics** 2022  
The Institute for Computational and Experimental Research in Mathematics

**Seattle Public Schools Teacher Mathematics Conference** 2021  
Seattle Public Schools, Virtual

**Stanford Undergraduate Research Institute in Mathematics** 2021  
Stanford University

**Stanford Directed Reading Program** 2021  
Stanford University

**Seattle Public Schools Teacher Mathematics Conference** 2020  
Seattle Public Schools, Virtual

**Mathematics Online Reading Program at Harvard University** 2020  
Harvard University, Virtual

**Western Washington Community College Student Mathematics Conference** 2020  
Edmonds College

**Summer Institute for Mathematics at the University of Washington** 2019  
The University of Washington

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#### OUTREACH AND SERVICE

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**Mentoring with the PMP** (*Helping incarcerated people progress in math by mail.*)

**Animating Mathematics** (*Programmatically generating animations using manim*)  
Created [The Tale of Three Triangles](#). Recognized by math educator Grant Sanderson for

narrative structure and storytelling. Translated into Mandarin. Also created animated proofs of other results in discrete math, such as  $R(3, 3) = 6$  and  $C_n = \frac{1}{n+1} \binom{2n}{n}$ .

**Guest Speaking to Future Mathematicians** (*Visting classes and clubs*)

Visited advanced high school math classes such as precalculus, IB Math SL/HL, AP Calculus AB/BC to discuss problem-solving and geometric reasoning. Also visited high school and middle school math clubs to provide insight into the beauty and art of mathematics.

**Leading Reading Courses** (*Teaching the art of problem-solving*)

Led a quarter-long course on The Art and Craft of Problem Solving by Paul Zeitz.

**Reviewing for zbMATH** (*Helping index papers in knot theory and combinatorics*)

PUBLICATIONS

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- [1] A. Henrich, R. Truax. "Petal Projections, Knot Colorings and Determinants". *Involve, a Journal of Mathematics*. Vol. 15 (2022), No. 2, 207–232.  
<https://msp.org/involve/2022/15-2/p02.xhtml>
- [2] C. Bennett, L. Martinez, A. Mock, G. Rojas Kirby, R. Truax. "Repetitions of Pak-Stanley Labels in  $G$ -Shi Arrangements". *Preprint*. <https://arxiv.org/abs/2210.13613>